

# THE PREVALENCE OF SOME HELMINTH PARASITES IN CANADA GEESE WINTERING IN SOUTHERN ILLINOIS

HAROLD C. HANSON and JAMES H. GILFORD<sup>1</sup>

*Illinois Natural History Survey, Urbana and  
University of Illinois, Urbana*

The concentration of large numbers of animals in restricted areas poses the possibility of serious epizootics. Concern has been felt particularly in the case of the Canada geese (*Branta canadensis interior*) of the Mississippi Flyway, where over 90 per cent of the population concentrates in winter on three refuges in southern Illinois. With this concern in mind, the present survey of helminth parasites of Canada geese wintering at the Horse-shoe Lake Refuge in Alexander County in Illinois was undertaken during the autumns of 1951-1953. The coccidia of these geese, as well as those of other flyways, have been studied previously (Levine 1952; Hanson, Levine and Ivens 1957). Blood protozoa were surveyed by Levine and Hanson (1953); the microfilaria by Hanson, Levine and Kantor (1956), and Hanson (1956). Further studies of the blood parasites are in progress.

The present report is not a complete catalogue of the helminth fauna of the Canada geese of the Mississippi Flyway as it is based chiefly on a study of the forms inhabiting the viscera, particularly those found in the digestive tract.

The senior author is responsible for age and sex determinations, collection of the viscera, and preparation of the manuscript; the junior

author is responsible for the examination of the viscera and the identification of parasites found.

## ACKNOWLEDGMENTS

We are indebted to Dr. Norman D. Levine, Dr. Thomas G. Scott and Dr. Ralph E. Yeatter for a critical review of the paper. We are also grateful to Mr. James M. Stubblefield of Cairo, Illinois, for providing cold storage for viscera collections.

## MATERIALS AND METHODS

The great majority of the samples of viscera examined were obtained from geese shot by hunters. As hunters returned from the shooting fields, permission was sought to eviscerate the bagged geese. Consent was usually given, but in some instances with the request that the hunters be permitted to retain the heart, liver, and occasionally the gizzard. The viscera were removed through a cut in the abdominal wall, after first cutting the esophagus near the proventriculus by means of a long-handled surgical scissors. The kidneys were not included in the visceral mass thus obtained. The removed viscera were then placed in a quart cardboard container and held in a local ice house until examination. Viscera collected in 1953 had to be frozen in dry ice prior to examination. The viscera of a considerable number of geese

<sup>1</sup> Present address of second author: Frederick, Maryland.

were saved by professional pickers for a nominal fee. In most cases the geese were first aged and sexed by methods described by Hanson (1949) prior to evisceration. In some instances, the age and sex of the goose involved were later determined by examination of the cloaca and bursa.

A total of 639 geese was examined during this study; 22 during 1950-51, 428 during 1951-52, and 189 during 1952-53. Of these, 179 were immature males; 202 were immature females; 153 were yearling and adult males; and 105 were yearling and adult females.

## RESULTS

### TREMATODA

*Notocotylus attenuatus* (Rudolphi). Trematodes belonging to the family Notocotylidae occur quite commonly in the caeca of waterfowl. They are usually considered quite harmless to the host (Augustine in Hegner *et al.*, 1938). Approximately 8 per cent of the Canada geese wintering at Horseshoe Lake in the years of the study were infected with the above species. Infection rates in the four age-sex classes probably did not vary significantly (Table 1), but the number of worms per infected individual was notably higher in the adults, especially the females, than in the immature geese (Table 2).

*Notocotylus sp.* Unidentified species of *Notocotylus* were found in 1.3 per cent of the geese of all ages examined, but inspection of the data will show that the infections were confined almost entirely to adult females (Table 1) and that the number of worms per infected individ-

ual was highest in this age-sex class (Table 2.).

*Prosthogonimus macrorchis* Macy. This trematode genus is world-wide in distribution, but *P. macrorchis* is confined to North America, chiefly in the lake region of the upper Midwest where it is the most important trematode parasite of chickens (Macy, 1934). When it infects the oviduct of laying hens, a sharp drop in egg production may ensue. The life cycle involves two intermediate hosts, the snail *Amnicola limosa* and dragonflies of the genera *Leucorhina*, *Tetragoneuria*, *Epicordulia* and *Mesothemis* (Macy, 1934).

The prevalence of this fluke in the wintering population of Canada geese appears to be low (Table 1); none of the adults and only 1 per cent of the young geese were infected. This finding is consonant with earlier studies (see Macy, 1934, p. 33) that the bursa of Fabricius of young waterfowl serves as the main reservoir of these flukes. In adult waterfowl, it is a parasite only in the active oviduct of the female (the bursa of Fabricius being absorbed in adult geese); hence, its absence in adult wintering Canada geese.

Determination of the importance of this parasite in Canada geese will be largely dependent upon studies made on the breeding grounds. With certain exceptions, we are in agreement with Rausch (1951) that helminth infections of birds that breed in Arctic or sub-Arctic regions and winter in the southern areas are contracted in the North, for it is there that the requisite intermediate hosts are found. In this regard, it is of interest to note that a wide

variety of snails has been collected from northern Ontario by early surveyors. Evidently the first intermediate host, *Amnicola limosa*, occurs throughout the region, as it has been collected from the Albany and Attawapiskat Rivers in Ontario which drain a major portion of the breeding range (J. F. Whiteaves in McInnes, 1905). *Physa* sp. was found by Hanson to be the most abundant snail in small pools on Akimiski Island, N.W.T., also an important part of the breeding range of the Canada geese of the Mississippi Flyway, and in ponds found in the marsh at the mouth of the Attawapiskat River. Dragonflies, the requisite secondary hosts, are abundant in the region. The senior author has collected *Leucorrhinia hudsonica* in the "pothole muskeg" country adjacent to the Albany River, one of the preferred nesting areas of Canada geese.

Wehr and Herman (1954) examined several hundred immature and adult Canada geese collected in winter from the Pea Island National Wildlife Refuge, North Carolina. They found only one specimen of *Prosthogonimus*.

*Echinostomum revolutum* (Froelich). This species is cosmopolitan in distribution but largely limited to the temperate regions of the world. Pulmonate snails and, to a lesser extent, tadpoles, are its intermediate hosts. Infections in the final host result from ingesting the intermediate hosts (Beaver, 1937). Infection rates in Canada geese at Horseshoe Lake, Illinois, varied from 9 to 23 per cent (Table 1). The data suggest that this trematode has a slightly higher incidence in imma-

ture geese. However, the average number of worms per infected individual showed no correlation with any one sex-age class (Table 2). In view of the wide distribution of this species, it is not surprising that it is the most prevalent trematode parasite infecting Canada geese in Illinois. Its pathological effect on these geese is not known. Infections are probably most commonly contracted on the breeding grounds. This species has also been recorded from Canada geese in eastern Washington (Hansen, McNeil, and Priebe, 1957).

*Zygodontycole lunatum* (Diesing). This species has been reported from a wide variety of ducks, domestic geese, and the Canada goose. Infective stages have been found in the snails, *Helisoma trivolvis* and *H. antrosom* (Gower, 1938). Waterfowl become infected by ingesting metacercariae which have encysted on aquatic vegetation. The adult trematode is found in the intestinal caeca. According to Gower (1938), no pathogenicity has been attributed to the genus *Zygodontycole*.

Four and one-half per cent of the 639 geese studied were infected with this trematode. Infection rates appear to be significantly higher in adult geese (Table 1), but the average number of worms per infected individual did not vary significantly with either age or sex (Table 2). It is of interest that Whiteaves (in McInnes, 1904, 1905) has recorded four species of snails of the genus *Helisoma* including *Helisoma trivolvis*, from the Albany, Attawapiskat, and Winisk Rivers in Ontario, the major river systems draining the muskeg breeding grounds of the

TABLE 1.—Prevalence of Some Trematodes in Canada Geese Wintering in the Horseshoe Lake Game Refuge, Alexander County, Illinois, 1950-51 to 1952-53.

Year, Age and Sex Classes	Number Examined	<i>Notocotylus</i> sp.		<i>Notocotylus attenuatus</i>		<i>Prosthogonimus macrorchis</i>		<i>Echinostomum revolutum</i>		<i>Zygocotyle lunatum</i>	
		Number Infected	%	Number Infected	%	Number Infected	%	Number Infected	%	Number Infected	%
1950-51											
Immature males.....	3									0	0.0
Immature females.....	3									1	33.3
Total or Average.....	6									1	16.7
Adult males.....	10									0	0.0
Adult females.....	6									0	0.0
Total or Average.....	16									0	0.0
1951-52											
Immature males.....	135	1	0.7	18	13.3	1	0.7	14	10.4	3	2.2
Immature females.....	144	0	0.0	13	9.0	3	2.1	12	8.3	5	3.5
Total or Average.....	279	1	0.1	31	11.1	4	1.4	26	9.3	8	2.9
Adult males.....	96	0	0.0	10	10.4	0	0.0	10	10.4	10	10.4
Adult females.....	53	2	3.8	9	17.0	0	0.0	4	7.5	7	13.2
Total or Average.....	149	2	1.3	19	12.8	0	0.0	14	9.4	17	11.4

TABLE 1.—Continued

Year, Age and Sex Classes	Number Examined	<i>Notocotylus</i> sp.		<i>Notocotylus attenuatus</i>		<i>Prosthogonimus macrororchis</i>		<i>Echinostomum revolutum</i>		<i>Zygoctyle lunicatum</i>	
		Number Infected	%	Number Infected	%	Number Infected	%	Number Infected	%	Number Infected	%
1952-53											
Immature males.....	41	0	0.0	0	0.0	0	0.0	12	29.3	0	0.0
Immature females.....	55	0	0.0	0	0.0	0	0.0	10	18.2	3	5.5
Total or Average.....	96	0	0.0	0	0.0	0	0.0	22	22.9	3	3.1
Adult males.....	47	0	0.0	0	0.0	0	0.0	4	8.5	1	2.1
Adult females.....	46	5	10.9	0	0.0	0	0.0	7	15.2	0	0.0
Total or Average.....	93	5	5.4	0	0.0	0	0.0	11	11.8	1	1.1
All Years											
Immature males.....	179	1	0.6	18	10.1	1	0.6	26	14.5	3	1.7
Immature females.....	202	0	0.0	13	6.4	3	1.5	22	10.9	9	4.5
Total or Average.....	381	1	0.3	31	8.1	4	1.0	48	12.6	12	2.9
Adult males.....	153	0	0.0	10	6.5	0	0.0	14	9.2	11	7.2
Adult females.....	105	7	6.7	9	8.6	0	0.0	11	10.5	7	6.7
Total or Average.....	258	7	2.7	19	7.4	0	0.0	25	9.7	18	7.0
All Ages and Sexes.....	639	8	1.3	50	7.8	4	0.6	73	11.4	30	4.5

TABLE 2.—Average Number of Trematodes Per Infected Individual of Canada Geese Wintering at the Horseshoe Lake Game Refuge, Alexander County, Illinois, 1950-51 to 1952-53.

Year and Age-Sex Class	<i>Notocotylus</i> <i>sp.</i>	<i>Notocotylus</i> <i>attenuatus</i>	<i>Prosthogonimus</i> <i>macrorchis</i>	<i>Echinostomum</i> <i>revolutum</i>	<i>Zygocotyle</i> <i>banatum</i>
1950-51					
Immature males.....					1.0
Immature females.....					0.0
Total or Average.....					1.0
Adult males.....					0.0
Adult females.....					0.0
Total or Average.....					0.0
1951-52					
Immature males.....	7.0	10.5	2.0	9.1	3.0
Immature females.....	0.0	21.6	3.0	4.8	2.0
Total or Average.....	7.0	16.1	2.5	7.0	2.5
Adult males.....	0.0	30.3	0.0	5.0	4.7
Adult females.....	12.0	53.0	0.0	6.3	3.1
Total or Average.....	12.0	41.7	0.0	5.7	3.6
1952-53					
Immature males.....	0.0			2.7	0.0
Immature females.....	0.0			1.5	4.0
Total or Average.....	0.0			2.1	4.0
Adult males.....	0.0			3.3	3.2
Adult females.....	16.3			2.0	0.0
Total or Average.....	16.3			2.7	3.2

Canada geese of the Mississippi Flyway.

This species has also been recorded from migrant Canada geese in eastern Washington (Hansen, McNeil, and Priebe, 1957).

#### CESTODA

*Hymenolepis lanceolata* (Block). This tapeworm has been recorded from ducks, geese, and swans in Europe, Asia, and North America (Gower, 1939; Wehr and Herman, 1954; Schiller, 1951). Infective rates in the Canada geese of the Mississippi Flyway are relatively high, approximately 16 per cent of the population being parasitized (Table 3). The average number of worms per infected individual did not appear to vary significantly with either age or sex class (Table 4).

*Hymenolepis* sp. At least four species of hymenolepid tapeworms are included in this category, but detailed identification could not be made as the scoleces were usually missing from worms obtained from viscera that had been frozen during storage. Unidentified hymenolepid tapeworms were found nearly twice as frequently in immature geese as in adults (Table 3). Their prevalence in the two age classes varied little from year to year (immatures, 10.4-12.5 per cent; adults, 6.2-6.7 per cent). However, the number of worms per infected individual dropped markedly in 1952-53 as compared with the previous year (Table 4).

#### NEMATODA

*Tetrameres fisispina* (Diesing). This nematode is cosmopolitan in distribution. It has been reported from ducks, swans, turkeys, gal-

linules, and grebes (Gower, 1939). It normally occurs in the proventriculus, and one species (*T. americana*) is pathogenic in chickens and quail. Wehr and Herman (1954) recovered an unidentified species of *Tetrameres* from the proventriculus of two goslings captured at the Seney National Wildlife Refuge in Michigan.

Since *T. fisispina* is relatively rare in Canada geese wintering in southern Illinois; with less than 1 per cent being infected (Table 3), it does not appear to be of serious concern.

*Amidostemum anseris* (Zeder). The gizzard worm of waterfowl is apparently world-wide in its distribution (Gower, 1939). It is one of the few helminth parasites of waterfowl which may have pathogenic effects on the host. Wehr and Herman (1954) believe it to be the most common parasite of Canada geese.

Approximately 32 per cent of the geese wintering at Horseshoe Lake during the years of the study were infected with this parasite (Table 3). Infection rates were somewhat higher in immature geese and the average number of worms per infected bird was notably higher in immatures than in adult geese in two out of the three years of the survey (Table 4).

In an investigation of losses among Canada geese wintering on the Pea Island National Wildlife Refuge, North Carolina, Herman *et al.* (1955) found that 100 per cent of the sick geese and 90 per cent of the healthy ones were infected with gizzard worms. In heavy infections the gizzards were almost denuded of their lining. The high incidence of

TABLE 3.—Prevalence of Some Cestodes and Nematodes in Canada Geese Wintering at the Horseshoe Lake Game Refuge, Alexander County, Illinois, 1950-51 to 1952-53.

Year and Age and Sex Classes	Number Examined	<i>Hymenolepis</i> sp.		<i>Hymenolepis lanceolata</i>		<i>Tetrameres fissispina</i>		<i>Amidostemum anseris</i>		<i>Sarconema eurycerca</i>		<i>Trichostrongylus tenuis</i>	
		Number Infected	%	Number Infected	%	Number Infected	%	Number Infected	%	Number Infected	%	Number Infected	%
1950-51													
Immature Males	3			2	66.7			3	100.0	0	0.0		
Immature Females	3			0	0.0			3	100.0	0	0.0		
Total or Average	6			2	33.3			6	100.0	0	0.0		
Adult Males	10			1	10.0			4	40.0	0	0.0		
Adult Females	6			1	16.7			3	50.0	2	33.3		
Total or Average	16			2	12.5			7	43.8	2	12.5		
1951-52													
Immature Males	135	14	10.4	26	19.3	0	0.0	41	30.4	0	0.0	0	0.0
Immature Females	144	21	14.6	10	6.9	0	0.0	53	36.8	0	0.0	1	0.7
Total or Average	279	35	12.5	36	12.9	0	0.0	94	33.7	0	0.0	1	0.1
Adult Males	96	3	3.1	12	12.5	0	0.0	20	20.8	7	7.3	2	2.1
Adult Females	53	7	13.2	14	26.4	2	3.8	17	32.1	5	9.4	3	5.7
Total or Average	149	10	6.7	26	17.4	2	1.3	37	24.8	12	8.1	5	3.6

TABLE 3.—Continued.

Year and Age and Sex Classes	Number Examined	<i>Hymenolepis</i> sp.		<i>Hymenolepis lanceolata</i>		<i>Tetrameres fissispina</i>		<i>Amidostemum anseris</i>		<i>Sarconema eurycerca</i>		<i>Trichostrongylus tenuis</i>	
		Number Infected	%	Number Infected	%	Number Infected	%	Number Infected	%	Number Infected	%	Number Infected	%
1952-53													
Immature Males.....	41	3	7.3	17	41.5	2	4.9	20	48.8	0	0.0	0	0.0
Immature Females.....	55	7	12.7	8	14.5	0	0.0	23	41.8	0	0.0	0	0.0
Total or Average.....	96	10	10.4	25	26.0	2	2.1	43	44.8	0	0.0	0	0.0
Adult Males.....	47	3	6.4	5	10.6	0	0.0	8	17.0	1	2.1	0	0.0
Adult Females.....	46	3	6.5	9	19.6	0	0.0	10	21.7	2	4.3	0	0.0
Total or Average.....	93	6	6.5	14	15.1	0	0.0	18	19.4	3	3.2	0	0.0
All Years													
Immature Males.....	179	17	9.5	45	25.1	2	1.1	64	35.8	0	0.0	0	0.0
Immature Females.....	202	28	13.9	18	8.9	0	0.0	79	39.1	0	0.0	1	0.5
Total or Average.....	381	45	11.8	63	16.5	2	0.5	143	37.5	0	0.0	1	0.3
Adult Males.....	153	6	3.9	18	11.8	0	0.0	32	20.9	8	5.2	2	1.3
Adult Females.....	105	10	9.5	24	22.9	2	1.9	30	28.6	9	8.6	3	2.9
Total or Average.....	258	16	6.2	42	16.3	2	0.8	62	24.0	17	6.6	5	1.9
All ages and sexes.....	639	61	9.5	105	16.4	4	0.6	205	32.1	17	2.6	6	0.9

TABLE 4.—Average Number of Cestodes and Nematodes Per Infected Individual of Canada Geese Wintering at the Horseshoe Lake Game Refuge, Alexander County, Illinois, 1950-51 to 1952-53.

Year and Age-sex Class	<i>Hymenolepis sp.</i>	<i>Hymenolepis lanceolata</i>	<i>Tetrameres fissispina</i>	<i>Amidostemum anseris</i>	<i>Sarconema eu. ycerca</i>	<i>Trichostrongylus tenuis</i>
1950-51						
Immature males.....		0.0		10.4	0.0	
Immature females.....		0.0		12.5	0.0	
Total or Average.....		0.0		11.5	0.0	
Adult males.....		2.0		3.1	0.0	
Adult females.....		3.0		7.3	5.0	
Total or Average.....		2.5		5.2	5.0	
1951-52						
Immature males.....	2.3	4.3	0.0	18.5	0.0	0.0
Immature females.....	12.0	12.5	3.0	20.0	0.0	3.0
Total or Average.....	7.2	8.4	3.0	19.3	0.0	3.0
Adult males.....	9.7	2.7	0.0	8.9	4.2	6.0
Adult females.....	4.3	4.0	0.0	6.3	2.0	4.2
Total or Average.....	7.0	3.4	0.0	7.6	3.1	5.1
1952-53						
Immature males.....	4.5	5.8	5.0	5.5	0.0	
Immature females.....	4.0	3.1	0.0	3.0	0.0	
Total or Average.....	4.3	4.5	5.0	4.3	0.0	
Adult males.....	3.5	5.0	0.0	7.1	2.0	
Adult females.....	2.3	4.2	0.0	4.3	3.5	
Total or Average.....	2.9	4.6	0.0	5.7	2.8	

infection may have been due in part to ecological factors that fostered transmission. However, it is clear from the report that a low protein diet and protein malnutrition of the host played an important part in the severity of the pathogenic effect of the worms and the extent of the losses. Gizzard worms were also believed to be at least contributory to a die-off of Canada geese in eastern Washington (Hansen, McNeil, and Priebe, 1957).

*Sarconema eurycerca* Wehr. The description of the adults of this species was based on individuals found in the whistling swan (Wehr, 1939). Its occurrence in Canada geese constitutes a new host record. The adult worms have been found in Canada geese only in the muscle of the heart. Only yearling and adult geese (17 or more months of age) were found to be infected. In our earlier study, (Hanson, Levine and Kantor, 1956) microfilaria of this species were found in 9.5 per cent of yearling geese (17-20 months old) and 4.5 per cent of the older adults (29 months and older). These figures are in good agreement with the over-all 6.6 per cent infection rate found in the combined yearling and adult class in the present study (Table 3). Infection rates, however, appear to be somewhat higher in adult females than in males, but the average number of worms per infected individual did not vary significantly with sex (Table 4). This nematode may be one of the more pathogenic helminths infecting Canada geese, but we have no data as to its importance in this regard.

*Ornithofilaria* sp. Microfilaria, believed to be *O. fallisensis* Ander-

son (1954) were found in the course of studies of the blood parasites of the Canada geese wintering at Horseshoe Lake (Levine, and Hanson, 1953; Hanson, Levine and Kantor, 1956; and Hanson, 1956). A three-year study of infection rates in 369 immature geese revealed that about 24 per cent of the birds of the year were infected with this parasite during the winter period (Hanson, 1956). Older geese are less heavily infected (Hanson, Levine and Kantor, 1956). Despite detailed examination of several infected geese, including a very heavily infected one, the adult form was not found.

*Trichostrongylus tenuis* (Mehlis). This widely distributed nematode parasitizes the caeca of geese, ducks, and gallinaceous birds. Wehr and Herman (1954) previously recorded it in a gosling Canada goose from Michigan. It is of relatively rare occurrence in the Mississippi Flyway population of Canada geese, the present study indicates only about 1 per cent of the population is infected. However, infection rates appear to be significantly higher in adult geese than in immatures (Table 3), and the average number of worms in the infected individual was higher in the adult age groups (Table 4).

*Cyathostoma* sp. In January 1955, a Canada goose was trapped at Horseshoe Lake that exhibited respiratory difficulties suggestive of laryngeotracheitis. Subsequent study of this goose by the College of Veterinary Medicine, University of Illinois, revealed that the trachea contained a mass of worms of this genus and that these had caused an in-

flammation of the tracheal mucosa.

*Acanthocephala* sp. Two specimens of an unidentified species of *Acanthocephala* were collected from an adult male Canada goose shot at Horseshoe Lake.

#### DISCUSSION

Canada geese of various subspecies range almost the entire continent of North America north of Mexico. Their breeding grounds include, or did include, much of the land lying in the northern half of the continent, aside from most mountainous, heavily forested, and desert regions. The subspecies vary greatly in size, and the ecological conditions under which they breed also vary enormously. It should therefore be apparent from the wide diversity of ranges and habitats that unusual rewards in research are to be gained from studies of the parasites of this group of birds.

Our findings show that the Canada geese of the Mississippi Flyway are much less heavily infected with the gizzard worm *Amidostemum* than the Canada geese wintering on Pea Island, North Carolina. Other relationships of this kind should be sought. In an earlier study (Hanson, Levine and Ivens, 1957) it was shown that the different subspecies and sub-populations (flyway populations) of subspecies of Canada geese, as well as other species of geese, tend to have different coccidia. Investigations of the blood protozoa of the Canada geese of the Mississippi Flyway revealed heavy infections of *Leucocytozoon* and *Haemoproteus* and the presence of *Plasmodium*. In contrast to these

findings, a survey of the blood parasites of waterfowl in the mixed prairie and fescue grasslands of Saskatchewan and southwestern Manitoba revealed extremely low infection rates. Only 4 of 433 ducks and none of 232 Canada geese examined (Burgess, 1957) were infected. Yet, black flies (*Simulium*) requisite for the transmission of *Leucocytozoon* were apparently present. As Burgess (1957) points out, little is known of the complexities of host-parasite-vector-environment relationships. A recent study has revealed that black flies are now spreading into the western Canadian prairies via irrigation ditches (Fredeen and Shemanchuk, 1960). This extension of possible vectors of *Leucocytozoon* more generally into the Canadian prairies raises the question as to whether the blood parasites characteristic of more eastern populations of waterfowl will also be spread westward.

Host-parasite relationships are usually subtle ones, but the finding of Herman, Steenis, and Wehr (1955) that protein malnutrition apparently paves the way for serious losses on the wintering grounds is a most provocative one. On the basis of past history and ecological considerations, concentrations of Canada geese wintering in the Mississippi Flyway do not appear to be ordinarily vulnerable to serious losses from parasites. Excellent food supplies, the feeding habits of the geese in winter, freezing weather, and the absence of intermediate hosts during much of the wintering period reduce the chance of losses from helminth parasites.

## LITERATURE CITED

- ANDERSON, R. C. 1954. *Ornithofilaria fallisensis* n. sp. (Nematoda: Filarioidea) from the domestic duck with descriptions of microfilariae in waterfowl. *Can. J. Zool.*, 32(2):125-37.
- AUGUSTINE, D. L. 1938. Helminthology. In Hegner, R., F. M. Root, D. L. Augustine, and C. G. Huff. Parasitology, with special reference to man and domesticated animals. D. Appleton-Century Co., N. Y., pp. 211-489.
- BEAVER, P. C. 1937. Experimental studies on *Echinostomum revolutum* (Froelich) a fluke from birds and mammals. III. *Biol. Monog.* 15(491), 96 pp.
- BURGESS, G. D. 1957. Occurrence of *Leucocytozoon simondi* M. and L. in wild waterfowl in Saskatchewan and Manitoba. *J. Wildl. Mgt.*, 21(1):99-100.
- FREDEEN, F. J. H. and J. A. SHEMAN-CHUK. 1960. Black flies (Diptera: Simuliidae) of irrigation systems in Saskatchewan and Alberta. *Can. J. Zool.*, 38(4):723-735.
- GOWER, W. C. 1938. Studies on the trematode parasites of ducks in Michigan with special reference to the mallard. *Mich. State Coll. Agr. Expt. Sta. Mem.* 3, 94 pp.
- GOWER, W. C. 1939. Host-parasite catalogue of the helminthes of ducks. *Amer. Midl. Nat.*, 22(3):580-628.
- HANSEN, H. A., C. W. McNEIL and M. PRIEBE. 1957. Mortality of Canada geese with impacted gullets in eastern Washington, 1949-1954. *J. Wildl. Mgt.*, 21(1):96-98.
- HANSON, H. C. 1949. Methods of determining age in Canada geese and other waterfowl. *J. Wildl. Mgt.*, 13(2):177-83.
- \_\_\_\_\_. 1956. A three-year survey of *Ornithofilaria* sp. Microfilariae in Canada geese. *J. Parasitol.*, 42(5):543.
- \_\_\_\_\_, N. D. LEVINE and S. KANTOR. 1956. Filariae in a wintering flock of Canada geese. *J. Wildl. Mgt.*, 20(1):89-92.
- \_\_\_\_\_, J. H. STEENIS and E. E. WEHR. 1955. Causes of winter losses among Canada geese. *Trans. 20th N. A. Wildl. Conf.*, pp. 161-165.
- LEVINE, N. D. 1952. *Eimeria magnalabia* and *Tyzzeria* sp. (Protozoa: Eimeriidae) from the Canada goose. *Cornell Vet.*, 42(2):247-52.
- \_\_\_\_\_, and H. C. HANSON. 1953. Blood parasites of the Canada goose, *Branta canadensis interior*. *J. Wildl. Mgt.*, 17(2):185-196.
- MACY, R. W. 1934. Studies on the taxonomy, morphology, and biology of *Prosthogonimus machrorchis* Macy, a common oviduct fluke of domestic fowls in North America. *Univ. Minn. Agr. Expt. Sta. Tech. Bull.* 98, 71 pp.
- McINNES, W. 1904. The Winisk River, Keewatin District. Summary Reports of the Operations of the Geological Survey of Canada for the year 1903. (new series), 15(886A):101-108.
- \_\_\_\_\_. 1905. The upper parts of the Winisk and Attawapiskat Rivers. Summary Reports of the Operations of the Geological Survey of Canada for the year (1904). (new series), 16(952A):153-164.
- RAUSCH, R. 1951. Biotic interrelationships of helminth parasitism. In *Public Health Problems in Alaska*. *Public Hlth. Repts.*, 66(29):911-944.
- SCHILLER, E. L. 1951. The cestoda of Anseriformes of the north central states. *Amer. Midl. Nat.*, 46(2):444-461.
- WEHR, E. E. 1939. New general and species of Filarioidea. III. *Sarcocnema eurycerca* n. gen., n. sp. *Proc. Helminthol. Soc. Wash.*, 6(2):95-97.
- \_\_\_\_\_, and C. M. HERMAN. 1954. Age as a factor in acquisition of parasites by Canada geese. *J. Wildl. Mgt.*, 18(2):239-47.

Manuscript received March 24, 1961.