

SOME PARASITES OF EUROPEAN WILD HOGS IN THE SOUTHERN APPALACHIANS¹

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Abstract: Two ectoparasites, the American dog tick (*Dermacentor variabilis*) and the hog louse (*Haematopinus suis*) have been found on European wild hogs (*Sus scrofa*) in the southern Appalachians. Of 205 hogs examined, 35.6 and 13.7 percent harbored ticks and lice, respectively. Ticks were more prevalent in the spring and summer and lice more prevalent in the winter. Tick and louse parasitism varied considerably from year to year. Seven endoparasites have been found in European wild hogs. These nematodes are gullet worms (*Gongylonema* sp.), lungworms (*Choerstrongylus pudendotectus* and *Metastrongylus elongatus*), kidney worms (*Stephanurus dentatus*), stomach worms (*Physicocephalus sexalatus*), ascarids (*Ascaris lumbricoides*), and whipworms (*Trichuris suis*). *Gongylonema* sp., *C. pudendotectus*, and *S. dentatus* were most prevalent. The presence of *T. suis* in the kidneys of swine is a new discovery, because it is usually found in the caecum and colon. The importance of parasites in wild hog populations is discussed.

The purposes of this study were to determine: (1) the species and kinds of parasites involved and (2) the prevalence of parasitism of the European wild hog. This is believed to be the first published account concerning parasites of the European wild hog in North America.

The European wild hog was introduced into the southern Appalachians in 1912 (Jones 1959). The hog dispersed from the release site and became established as a big game species. Today, it provides recreation annually for thousands of hunters. It is imperative that information be obtained on the life history and management of the species to facilitate management of areas inhabited by hogs. This study is part of the search for information on the species in a new habitat. Estimates of the hog population on the 80,000-acre study area during the time of this study varied from 253 hogs in 1961 to 797 hogs in 1968.

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Gerrish, and W. W. Becklund of the U. S. Department of Agriculture for identification of parasites. G. H. Matschke, former project leader, collected some of the data used and reviewed the manuscript. B. H. Erickson, U.T.-A.E.C. Agricultural Research Laboratory, Oak Ridge, Tennessee, also reviewed the manuscript and offered suggestions. L. A. Hunt, J. C. Lewis, and J. D. Morris assisted in collection of parasites.

METHODS AND MATERIALS

The study was conducted on the Tellico Wildlife Management Area, located in the Appalachian Mountains of southeastern Tennessee. Hogs killed during the annual fall hunts (October-December) were macroscopically checked when possible for ecto- and endoparasites. Examinations for helminths were limited to a few organs because of time limitations. The organs examined, when present, were lungs, kidneys, livers, and esophagi. Particular attention was given these organs because complete necropsies of pen-reared hogs had revealed parasites in these tissues. Examinations of the digestive tract were not conducted until the last year of the study.

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Table 1. Prevalence of ectoparasites of European wild hogs trapped in the Tellico Wildlife Management Area, Tennessee, by seasons, 1960-1968.

SEASON	EASTERN DOG TICKS		HOG LICE	
	No. Examined	Percent Infested	No. Examined	Percent Infested
Winter	8	0.0	8	87.5
Spring	86	26.7	86	1.2
Summer	131	40.5	131	12.2
Fall	41	9.8	41	9.8
Totals	266	30.5	266	10.5
Totals ^a	205	35.6	205	13.7

^a Animals counted only once since some hogs were examined in more than 1 month and in some cases were examined as juveniles and again as adults.

Stomach contents of hogs killed on the annual hunts were collected for a food-habits study and were also examined macroscopically for helminths when separating food items.

Helminths were fixed in a 10 percent formalin solution and identified by the Beltsville Parasitological Laboratory of the U. S. Department of Agriculture.

Trapping of wild hogs (Matschke 1962) was conducted throughout the year except during the annual hunts. Hogs trapped were checked for ectoparasites by examining the entire hog macroscopically, paying close attention to the portions of the anatomy normally harboring ectoparasites (in and around the ears, stomach, and flanks).

Taxonomy on helminths is based on the work by Yamaguti (1961).

RESULTS

Two ectoparasites have been found on the European wild hog. These are the American dog tick and the hog louse. Ticks were found in and around the ears, on the stomach and flanks, while lice were found mostly on the stomach and flanks. Individual hogs harbored few ticks, with six being the maximum number per animal.

Table 2. Prevalence of ectoparasitism of European wild hogs trapped in the Tellico Wildlife Management Area, Tennessee, by years, 1960-1968.

YEAR	NO. EXAMINED	PERCENT INFESTED	
		Eastern Dog Ticks	Hog Lice
1960	3	100.0	0.0
1961	1	100.0	0.0
1962	8	87.5	0.0
1963	6	33.0	0.0
1964	73	17.8	8.2
1965	30	26.7	0.0
1966	58	6.9	37.9
1967	79	50.6	0.0
1968	22	9.1	0.0
Totals	266	30.1	10.5

However, hundreds of lice have been found on individual hogs. Hanson and Karstad (1959:70) reported *D. variabilis* and *H. suis* on feral hogs in Georgia. In addition, they recovered two species of ticks (*Amblyomma maculatum* and *A. americanum*) and screw-worm fly larvae (*Callitroga americana*).

Prevalence of ectoparasitism of trapped European wild hogs is presented in Tables 1 and 2, by seasons and year, respectively. The *t*-test was used to determine significant differences in parasitism.

Significant differences in parasitism by ticks and lice were found between the different seasons ($P < 0.05$), with two exceptions. No significant difference in tick parasitism in winter versus fall could be demonstrated. There was also no difference for louse parasitism in summer versus fall.

The percentage of hogs parasitized was 35.6 for ticks and 13.7 for lice. Significant differences were found between tick and louse parasitism in the different seasons, with the exception of fall. Tick parasitism was higher in the spring and summer and louse parasitism was higher in the fall.

Parasitism of hogs by ticks is more common in the warmer months (spring and

summer) and by lice, more prevalent in winter.

Prevalence of ticks and lice on European wild hogs varies from year to year (Table 2). A pattern of higher tick parasitism in alternate years is suggested by the data, and significant differences were found between parasitism in adjacent years. Louse parasitism occurred only in 1964 and 1966.

Parasitism by ticks was significantly higher than parasitism by lice in all years except 1966 ($P < 0.10$) and for the total figures ($P < 0.01$). In 1966, louse parasitism was significantly higher than tick parasitism ($P < 0.01$).

Fifteen percent of the juvenile hogs and 3.8 percent of the adults examined harbored lice. This is a significant difference ($P < 0.01$). Thirty-four and 27.5 percent of the adult and juvenile hogs examined, respectively, were infested with ticks ($P > 0.05$). Lice parasitism is higher among juveniles and tick parasitism is higher among adults.

The following seven endoparasites have been found in European wild hogs: gullet worms, lungworms, kidney worms, stomach worms, ascarids, and whipworms. It is of considerable significance that *T. suis* was found in the kidneys of 2 of 33 examined wild hogs.

Gongylonema sp. were found in the lining of the esophagus and were recognizable as a whitish, thread-like undulating line. Lungworms were found in the bronchioles and smaller bronchi of the lungs and looked like dark threads of hair. *C. pudendotectus* was the most common occurring species of lungworm (Table 3). *S. dentatus* was collected from the ureters and cortex of the kidneys and exhibited a black and white mottled body which was rather thick. Larvae of *S. dentatus* were found in unhealed lesions or abscesses on the liver in two juvenile hogs and one adult. No adult

Table 3. Prevalence of endoparasitism of European wild hogs killed on the annual hunts, Tellico Wildlife Management Area, Tennessee, 1962-1968.

PARASITES	PREVALENCE	
	No. Examined	Percent Positive
<i>Gongylonema</i> sp.	35	62.8
<i>Choerstrongylus pudendotectus</i>	32	56.2
and <i>Metastrongylus elongatus</i>		
<i>Stephanurus dentatus</i>	37	51.3
<i>Physocephalus sexalatus</i>	66	34.8
<i>Ascaris lumbricoides</i>	4	25.0
<i>Trichuris suis</i> ^a	37	5.4

^a Kidneys examined, parasitism by this species is probably more prevalent than indicated because they are normally found in the digestive tract.

worms were present in the kidneys of these animals. *P. sexalatus* was found in the stomach contents and resembled small, white rootlets. *A. lumbricoides*, a large, whitish parasite was collected from the small intestine. *T. suis* was found impacted in the hilus and medulla of two kidneys where they resembled masses of dark threads or hairs.

Finding *T. suis* in the kidneys is a most startling discovery since the primary site for infection is the caecum and colon according to Soulsby (1965:238) and Morgan and Hawkins (1949:186). W. R. Eskew, Jr., a pathologist with the U. S. Department of Agriculture, was present when this parasite was removed from a kidney and he subsequently had it identified by R. R. Gerish. Eskew (Personal communication) stated that "finding the whipworm in the kidney was very unusual—they are usually found in the caecum and colon."

Table 3 shows the level of parasitism in hogs killed on the annual hunts. Parasitism by *P. sexalatus*, *A. lumbricoides*, and *T. suis* may be more common than indicated because examination of the digestive tract, where these parasites are normally found, was not conducted until the last year of the study.

DISCUSSION

Lice are easily transferred from mother to young, especially when the young are suckling or resting against the mother's body. This probably accounts for the higher infestation of juveniles with lice. If a sow harbors lice, every juvenile in her litter also harbors lice. In comparison, ticks attach themselves to their host and do not transfer from mother to young as commonly. Because adults do more traveling and thus expose themselves more often to possible contact with ticks, parasitism by ticks is higher among adults.

Judging from macroscopic, external examinations, the presence of these ectoparasites does not seem to affect the health of the host, even when heavy infestations occur. The possibility that these parasites carry diseases to which hogs are susceptible has not been explored.

Although only a few helminths have been collected from European wild hogs to date on the Tellico area, in the future, with more refined techniques and complete necropsies, other parasites may be found. Spindler (1934:40) listed 16 helminths collected from domestic hogs in Georgia and Florida. Hanson and Karstad (1959:69-70) reported six helminths infecting feral hogs in Georgia, and Babero et al. (1959:95) listed 10 helminths infecting feral hogs also in Georgia.

In comparing the published works mentioned with this study, it is interesting that one parasite collected by the former authors was intestinal and the other muscular in infecting hogs; six parasites found by the latter authors were all intestinal. Possibly, more emphasis should be placed on the digestive and muscular systems in future surveys on endoparasites from European wild hogs. *M. elongatus*, *A. lumbricoides*, and *T. suis* were collected in all three studies.

coides, and *T. suis* were collected in all three studies.

The effect of endoparasites on hog populations is unknown, but they are probably directly or indirectly responsible for some mortality. *S. dentatus* has caused death in domestic hogs and paralysis caused by migratory forms in the central nervous system has been recorded in domestic hogs and was observed in this study in pen-reared European wild hogs. Babero et al. (1959:103) stated *S. dentatus* was the most common parasite collected in feral hogs and the pathology produced by this nematode appeared to be more serious than that caused by any other helminth. *A. lumbricoides* has caused colic, convulsions, and death in domestic hogs. During migration of numerous ascarids through the lungs, domestic pigs have difficulty in breathing and may die of pneumonia. Lungworms and *T. suis* have also caused death in domestic hogs and heavy infections of lungworms commonly result in localized pneumonia.

Infections of endoparasites may be fatal; however, they probably contribute to mortality by affecting the general health of hogs, thus making them vulnerable to environmental factors. Severinghaus and Cheatum (1956:174) reported malnutrition to be the basic factor in predisposing deer (*Odocoileus virginianus*) to death, but the parasite load reduced the chances of deer surviving severe winters.

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ATTEMPTS TO IDENTIFY MEAT OF GAME ANIMALS BY STARCH-GEL ELECTROPHORESIS

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Abstract: Total protein, esterase, and lactic dehydrogenase patterns of muscle extracts from domestic cow (*Bos taurus*), pig (*Sus scrofa*), and sheep (*Ovis aries*), and from moose (*Alces alces*), deer (*Odocoileus virginianus*), and caribou (*Rangifer tarandus*) were compared. The electrophoretic patterns were genera specific. Electrophoretic analysis shows promise as a method for identification of meat for game law enforcement.

An enforcement problem of wildlife agencies is the positive identification of game species which may have been taken illegally. Jackson (1962) described a method for identifying muscle tissue of game animals using paper chromatography. He stated that electrophoresis probably could be used for identification of tissue samples, but that the paper chromatography method was simpler. This method has proven unreliable in Atlantic Canada, and the precipitin reaction is now used to identify meat samples of game and domestic animals (J. Berkan, personal communication). Unfortunately, the precipitin reaction is not genera specific, the taxonomic level required for game law enforcement.

The comparison of the composition of skeletal muscle has been the subject of many studies. Hamoir (1955) found that

skeletal muscle proteins varied biochemically both qualitatively and quantitatively even between closely related fish species. Starch-gel electrophoresis has been demonstrated to be suited for such comparative work (Giles 1962, Tsuyuki et al. 1965, Baker 1966, Scopes 1968, Jacobson et al. 1969). Wilson et al. (1967) found that some commercial samples of frozen fish fillets which were labeled "haddock" contained cod (*Gadus morrhua*) lactate dehydrogenase (LDH) when subjected to starch-gel electrophoresis and the gel stained for LDH. They suggested that many enzymes, besides LDH, exhibit species specificity and that mislabeling of meat products should easily be detectable using similar analysis.

The purpose of this study was to develop a positive method of differentiation be-