Seasonal Fluctuations of Tricholipeurus parallelus (Osborn, 1896) (Mallophaga: Trichodectidae) on White-tailed Deer Odocoileus virginianus (Zimmerman, 1780) from South Texas

W. M. SAMUEL
and
D. O. TRAINER

Reprinted from
THE AMERICAN MIDLAND NATURALIST
Vol. 85, No. 2, April, 1971, pp. 507-513
University of Notre Dame Press
Notre Dame, Indiana

Seasonal Fluctuations of Tricholipeurus parallelus (Osborn, 1896) (Mallophaga: Trichodectidae) on White-tailed Deer Odocoileus virginianus (Zimmermann, 1780) from South Texas[1]

W. M. SAMUEL[2] and D. O. TRAINER
Department of Veterinary Science, University of Wisconsin, Madison 53706

ABSTRACT: From 1966 to 1969, a total of 434 white-tailed deer from the Welder Refuge were examined for lice. *Tricholipeurus parallelus*, the only chewing louse found, was prevalent and relatively numerous on deer examined in winter and spring and rare or absent on deer during the summer and autumn. Fawns did not become infested until they entered their first winter. Seasonal fluctuations were characterized by the abundance of adult male and nymphal stages of lice during winter. The results for this louse are compared with those for related lice from livestock.

INTRODUCTION

Seasonal fluctuations in numbers of chewing lice of the genus *Tricholipeurus* Bedford, 1929, on white-tailed deer and other cervids have been mentioned briefly by Bennett (*in* Anderson, 1962) and Cowan (1964). Lice were reported to be common on deer during the winter and rare during the summer. Similar seasonal patterns have been reported for other lice of this genus on livestock: *Bovicola bovis* (L.) on cattle (Craufurd-Benson, 1941; Matthysse, 1944), *Damalinia equi* (Denny) on horses (Murray, 1963a), and *Damalinia ovis* (Schrank) on sheep (Scott, 1952).

The authors prefer to follow Scanlon (1960) rather than Hopkins and Clay (1952) and place *parallelus* in the genus *Tricholipeurus*, instead of *Damalinia*. Other synonyms used frequently are *Bovicola* and *Trichodectes*.

An ecological investigation of diseases and parasites of white-tailed deer has been under way at the Welder Refuge in southern Texas since 1962 (Cook *et al.*, 1965, 1967; Samuel, 1969; Samuel and Trainer, 1970 a, b). This part of the investigation was initiated in 1966 to establish seasonal and other environmental patterns of *Tricholipeurus parallelus* on white-tailed deer.

METHODS

The study area comprised approximately 20.2 km^2 of the 31.6 km^2 Refuge and has been described in detail previously (Samuel,

[1] This study was supported jointly by the Welder Wildlife Foundation, Sinton, Texas (Contribution No. 137), and the Department of Veterinary Science, University of Wisconsin (Paper No. 655).

[2] Present address: Department of Zoology, University of Alberta, Edmonton, Canada.

1969; Samuel and Trainer, 1970a). The most common habitat of deer in the Refuge consists of brushy savannas and chaparral with grassy sandhills and stands of live oak (*Quercus virginiana* Mill.) and hackberry (*Celtis laevigata* Willd.).

During the study period, 1966-1969, summers were hot and humid; winters, short and mild. Rainfall was variable in distribution and quantity (84 cm in 1966, 132 cm in 1967).

From January 1966 through January 1969, 291 deer were collected by shooting. Our aim was to collect 30 deer each season (winter = December-February; spring = March-May; summer = June-August; autumn = September-November). Ages of deer were determined according to tooth eruption and wear of the lower jaw molars (Severinghaus, 1949).

Deer were collected from three geographic areas: 26% were taken on sandy and sandy loam soils (Kovar, 1963) in plant communities (mainly the Live oak-chaparral of Box and Chamrad, 1966), with vegetation described as "dense" (Samuel and Trainer, 1970a); 40% were from sandy and sandy loam soils in areas of "sparse" vegetation, mainly Huisache-bunchgrass and Bunchgrass-annual forb communities; and 34% were on upland clay soils from the "moderately dense" Mesquite-buffalo grass and Chaparral-bristle grass communities.

Immediately after shooting, a standard area on the medial surface of the left hind leg and groin of each deer was examined for lice. This area, called the "index area" has been described previously (Samuel and Trainer, 1970a). Ears of all deer were also examined. The index area was chosen because of time limitations, ease of examination, and the higher numbers of lice recovered (Samuel, 1969). Lice were stored in 70% ethyl alcohol, identified according to Scanlon (1960), counted, aged and sexed.

TABLE 1.—Comparison of the prevalence and numbers of *Tricholipeurus parallelus* to the age of deer from the Welder Refuge (1966-1968)

Host age	No. deer examined	No. deer infested	Per cent deer infested	Level of infestation		
				mean	median	range
⩽ 1 day	21	0	0	0	0	-
2-3 days	32	0	0	0	0	-
4-7 days	53	0	0	0	0	-
8-13 days	26	1	4	1.0	1.0	-
14-30 days	11	0	0	0	0	-
2-6 months	14	2	14	1.0	1.0	-
7-11 months	18	12	67	10.9	2.0	(1-39)
1 year	73	39	53	11.9	6.0	(1-70)
2 years	48	15	31	10.8	3.0	(1-50)
3-4 years	53	22	42	4.2	3.0	(1-22)
⩾ 5 years	55	22	40	25.1	4.0	(1-87)

In addition, 143 fawns less than 30 days of age were captured live during the summers of 1966 and 1967, and scanned in their entirety for lice.

RESULTS

Tricholipeurus parallelus, the only chewing louse detected, was found on 138 of 434 (32%) deer. Thirty deer collected in January 1969 were not aged. Prevalence of lice on the remaining 404 deer was 28% (Table 1). Only one of 143 neonatal fawns was infested with lice. The overall prevalence on fawns, yearlings and adults, respectively, was 9, 53 and 38%. Chi-square values comparing fawns with yearlings and adults were 60.8 and 40.6 ($P<0.001$). Numbers of lice per index area were variable, but median values revealed that most deer had few lice.

The high prevalence of *T. parallelus* on fawns 7 to 11 months old coincided with a marked increase in prevalence on deer of all ages collected during the winters from 1966 to 1969 and the springs of 1967 and 1968 (Fig. 1). Average numbers of lice, though variable by season, were similar to prevalence results. During the summer and autumn numbers of chewing lice were low. No lice were found on the index area of 29 deer examined in the summer of 1968. In attempting to find remnant populations, the entire surface of two deer and the heads and tails of several deer killed in the summer of 1968 were examined thoroughly; no lice were found.

Seasonal changes in the relative abundance of adult and nymphal lice were examined. The numbers of female lice were lowest and the

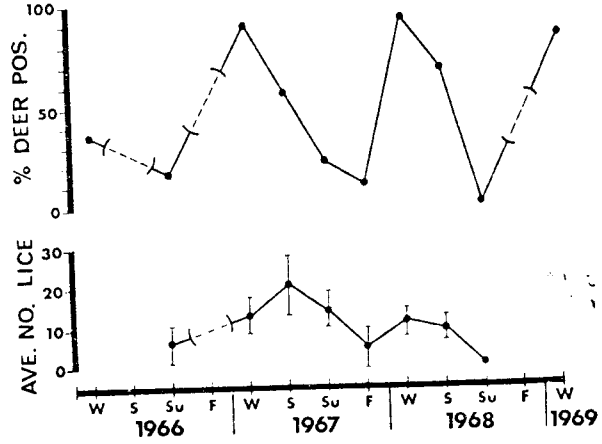

Fig. 1.—Comparison of prevalence (% positive) and numbers (per index area) of *Tricholipeurus parallelus* on deer from the Refuge to the season of the year (1966-1969). Vertical bars represent one standard error ± the mean. No deer were examined for lice during the spring of 1966, or the autumns of 1966 and 1968

numbers of nymphal lice were highest during the winter (Table 2).

TABLE 2.—Comparison of the seasonal abundance, sex ratio and age structure of *Tricholipeurus parallelus* on deer from the Welder Refuge (1966-1968)

Season	Total number lice			
	Adult			Nymphs
	Male	Female	Total	
Winter	171	90	261	198
Spring	27	425	452	64
Summer	11	91	102	0
Autumn	2	11	13	2

TABLE 2.—(continued)

Season	Ratio	
	Male/female	Nymph/adult
Winter	1/0.5	1/1.3
Spring	1/15.7	1/7.1
Summer	1/8.3	0/102
Autumn	1/5.5	1/6.5

Fifty-seven per cent of the 37 deer collected during winter-spring in plant communities with vegetation classed as "dense" were infested with *T. parallelus*. This prevalence was significantly less than the 84% of 68 and 85% of 47 deer found where vegetation was classified "moderate" ($X^2=9.19$; $P=<0.005$) and "sparse" ($X^2=8.37$; $P=<0.005$). Median numbers (with ranges) of lice per infestation were: "dense," 3.0(1-87); "moderate," 3.0(1-39); and "sparse," 4.0(1-72). During the summer-autumn seasons, prevalence of infestations was 6% (2 of 36) in "dense," 14% (6 of 43) in "moderate," and 16% (8 of 49) in "sparse" vegetations ($P>0.05$).

Whether deer lived on sandy or sandy loam (42%) or on clay or clay loam (52%) soils did not influence the prevalence of *T. parallelus* ($P>0.05$). Likewise, there was no difference in the prevalence of lice on male (46%) and female (48%) deer ($P>0.05$).

DISCUSSION

Although two related species of chewing lice, *Tricholipeurus lipeuroides* (Mégnin, 1884) and *T. parallelus*, have been reported on white-tailed deer from Texas (Peters, 1930; Van Volkenberg and Nicholson, 1943; Werneck, 1950; Hightower *et al.*, 1953), only *T. parallelus* was detected on deer from Welder. The finding of a single species is in agreement with Scanlon (1960) who found no concurrent infestations by *T. parallelus* and *T. lipeuroides* on the same deer.

The dramatic seasonal fluctuations of the percentage infestation of *T. parallelus* on deer verified a phenomenon mentioned only briefly by Bennett (Anderson, 1962). Chewing lice were prevalent during the winters of 1966 to 1969 (% = 36, 90, 93, 83) and the springs

of 1967-1968 (% = 56, 67) and relatively abundant during the winters and springs of 1967-1968 (mean no. per index area = 13, 11, 20, 9). Each summer, 1966 to 1968, and during the fall of 1967, the occurrence of lice was low (% = 16, 22, 0, 10; mean no. = 6, 15, 0, 5). The age and sex composition of the louse populations in winter was characterized by relatively high numbers of adult male and nymphal lice. Thus, *T. parallelus* adhered to the general rule that females of the family Trichodectidae exceed the number of males in natural populations (Hopkins, 1949) only in spring, summer, and autumn. Matthysse (1944) maintained the cattle louse *Bovicola bovis* through two generations, never introducing males, and recovered only females. Whether *T. parallelus* is also parthenogenetic is not known, but we, like Matthysse, found more males only during periods of increasing infestations.

The reason(s) for the summer-autumn decline of *T. parallelus* on deer from Welder is unknown. However, several mortality studies of *Damalinia ovis* on sheep and *D. equi* on horses from Australia (Murray, 1963 a and b, 1968) can be summarized for comparison. Murray reported three known causes of louse mortality: shearing, solar radiation, and rainstorms. Similar, as well as other, factors may be involved in annual fluctuations of *T. parallelus* on deer. The shearing of sheep each spring may be compared indirectly to the loss of the deer's winter hair coat which must, like shearing, alter the microclimate surrounding the louse.

Summers in south Texas are characteristically hot and sunny. Temperatures and humidities at the Welder Refuge frequently exceed 32 C and 90%, respectively. (The average maximum figures from several plant communities at the Welder Refuge in July 1968 were 31 C and 91%.) The influence of solar radiation on the temperature within the hair coat of deer was not measured. However, exposure of the hair of deer to these conditions possibly results in killing the lice or inhibiting their reproduction. In fact, Murray (1963a) stated, "It seems likely that solar radiation is a factor which can prevent increases of the number of lice in the summer on those species of large animals which live exposed to the weather, particularly where solar radiation is intense."

Tropical storms occur from May to November in south Texas. Three major tropical storms occurred at Welder during the study period (May 1967, September 1967, June 1968), all bringing large amounts of rain within a few days. Similar phenomena in Australia killed *D. ovis* on sheep (Murray, 1963b). At the Welder Refuge, 1 month after each storm, the prevalence of *T. parallelus* on deer was low.

Direct comparisons between results of this study and Murray's studies (1963 a and b, 1968; Murray and Gordon, 1968) must be treated cautiously because of differences in the host, lice and environment. In our study relatively few males of *T. parallelus* were recovered while the sex ratio of *D. ovis* is 1:1 (Scott, 1952). Also,

the increase in louse numbers during the mild and short winters at Welder (ca. 3 months) may be inadequate for the population of *T. parallelus* to survive summer losses according to the mathematical model for increase in populations of *D. ovis* (Murray and Gordon, 1968). Finally, the finding that *T. parallelus* was least successful on deer from plant communities with vegetation described as "dense" differs, at least in part, from the solar-radiation and rainstorm-exposure ideas of Murray. The complete explanation of the effect of these and other factors in determining the ultimate numbers of *T. parallelus* remains unknown.

That a louse population crash occurred each summer—and not a mass regional movement of lice on the host—was suggested by the facts that: (1) most fawns did not become infested with lice until they were approximately 7 months of age (*i.e.*, entering their first winter), indicating little vertical transmission from the dam to fawns, and (2) no lice were found on several deer examined completely during the summer of 1968. Remnant populations of lice must have been present, however, since louse prevalence in the winter of 1969 was typically high.

Transmission of the rapidly increasing louse populations during the late autumn and winter via direct contact of hosts is probably an easy matter due to mating behavior during the autumn and increased grouping of deer from autumn through winter (Michael, 1966).

Acknowledgments.—We thank Mr. W. C. Glazener, assistant director of the Welder Wildlife Refuge, Sinton, Texas, Drs. M. White, University of California, Berkeley, and F. F. Knowlton, Fish and Wildlife Service, San Antonio, Texas, and other Welder Refuge and University of Wisconsin staff for assistance in collecting deer. Drs. White and Knowlton also aged all deer older than 1 month of age. Dr. N. A. Wilson, University of Northern Iowa, Cedar Falls, confirmed the identification of the lice. Dr. J. C. Holmes, University of Alberta, Edmonton, reviewed the manuscript and contributed valuable suggestions.

REFERENCES

ANDERSON, R. C. 1962. The helminth and arthropod parasites of the white-tailed deer (*Odocoileus virginianus*): a general review. *Trans. Roy. Can. Inst.*, **34**:57-92.

BOX, T. W. AND A. D. CHAMRAD. 1966. Plant communities of the Welder Wildlife Refuge. *Contrib. No. 5, Series B, Welder Wildlife Found.*, Sinton, Texas. 28 p.

COOK, R. S., D. O. TRAINER, W. C. GLAZENER AND B. D. NASSIF. 1965. A serological study of infectious diseases of wild populations in South Texas. *Trans. N. Amer. Wildlife Conf.*, **30**:142-155.

———, M. WHITE, D. O. TRAINER AND W. C. GLAZENER. 1967. Radiotelemetry for fawn mortality studies. *Wildlife Dis. Ass. Bull.*, **3**:160-165.

COWAN, I. MC. 1946. Parasites, diseases, injuries, and anomalies of the Columbia black-tailed deer (*Odocoileus hemionus columbianus* (Richardson)) in British Columbia. *Can. J. Res.* (D), **24**:71-103.

CRAUFURD-BENSON, H. J. 1941. The cattle lice of Great Britain. *Parasitology*, **33**:331-358.

HIGHTOWER, B. G., V. W. LEHMAN AND R. B. EADS. 1953. Ectoparasites from mammals and birds on a quail preserve. *J. Mammal.*, **34**:268-271.

HOPKINS, G. H. E. 1949. The host associations of lice of mammals. *J. Zool. Proc. Zool. Soc. London*, **119**:387-604.

——— AND T. CLAY. 1952. A check list of the genera and species of mallophaga. Brit. Mus. Publ., London. 362 p.

KOVAR, J. A. 1963. Physical, chemical, mineralogical properties of some soils of the Welder Wildlife Foundation. M.S. Thesis. The Agr. and Mech. College of Texas, College Station, Texas. 88 p.

MATTHYSSE, J. G. 1944. Biology of the cattle biting louse and notes on cattle sucking lice. *J. Econ. Entomol.*, **37**:436-442.

MICHAEL, E. D. 1966. Daily and seasonal activity patterns of white-tailed deer on the Welder Wildlife Refuge. Ph.D. Thesis. Texas A. & M. University, College Station, Texas. 216 p.

MURRAY, M. D. 1963a. Influence of temperature on the reproduction of *Damalinia equi* (Denny). *Aust. J. Zool.*, **11**:183-189.

———. 1963b. The ecology of lice on sheep. V. Influence of heavy rain on populations of *Damalinia ovis* (L.). *Ibid.*, **11**:173-182.

———. 1968. Ecology of lice on sheep. VI. The influence of shearing and solar radiation on populations and transmission of *Damalinia ovis*. *Ibid.*, **16**:725-738.

——— AND G. GORDON. 1968. Ecology of lice on sheep. VII. Population dynamics of *Damalinia ovis* (Schrank). *Ibid.*, **16**:179-186.

PETERS, H. S. 1930. A new biting louse (Mallophaga) from the white-tailed deer. *Proc. Entomol. Soc. Wash.*, **32**:76-79.

SAMUEL, W. M. 1969. Parasites of the white-tailed deer in south Texas. Ph.D. Thesis. The University of Wisconsin, Madison. 196 p.

——— AND D. O. TRAINER. 1970a. *Amblyomma* (Acarina:Ixodidae) on white-tailed deer *Odocoileus virginianus* (Zimmermann) from south Texas with implications for theileriasis. *J. Med. Entomol.*, **7**:567-574.

——— AND ———. 1970b. *Pulex porcinus* Jordan and Rothschild, 1923 (Siphonaptera:Pulicidae), an occasional parasite of white-tailed deer from the Welder Refuge in southern Texas. *J. Wildlife Dis.*, **6**:182-183.

SCANLON, J. E. 1960. The Anoplura and Mallophaga of the mammals of New York. *Wildlife Dis.*, No. 5, May. 121 p.

SCOTT, M. T. 1952. Observations on the bionomics of the sheep body louse (*Damalinia ovis*). *Aust. J. Agr. Res.*, **3**:60-67.

SEVERINGHAUS, C. W. 1949. Tooth development and wear as criteria of age in white-tailed deer. *J. Wildlife Manage.*, **13**:195-216.

VAN VOLKENBERG, H. L. AND A. J. NICHOLSON. 1943. Parasitism and malnutrition of deer in Texas. *Ibid.*, **7**:220-223.

WERNECK, F. L. 1950. Os Malofagos de Mamiferos. Pt. 11. Edica do Instituteo Oswaldo Cruz, Rio de Janeiro. 207 p.

SUBMITTED 6 APRIL 1970 ACCEPTED 15 APRIL 1970