PREVALENCE OF TRICHINELLA NATIVA IN LYNX (FELIS LYNX) FROM ALASKA, 1988–1993

Authors: Zarnke, Randall L., Gajadhar, Alvin A., Tiffin, Gregory B., and Hoef, Jay M. Ver

Source: Journal of Wildlife Diseases, 31(3) : 314-318

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-31.3.314

Journal of Wildlife Diseases, 31(3), 1995, pp. 314–318

PREVALENCE OF *TRICHINELLA NATIVA* IN LYNX (*FELIS LYNX*) FROM ALASKA, 1988–1993

Randall L. Zarnke,[1] Alvin A. Gajadhar,[2] Gregory B. Tiffin,[3] and Jay M. Ver Hoef[1]

[1] Alaska Department of Fish and Game, 1300 College Road, Fairbanks, Alaska 99701, USA
[2] Agriculture and Agri-Food Canada, Health of Animals Laboratory, 116 Veterinary Road, Saskatoon, Saskatchewan, Canada S7N 2R3
[3] Agriculture and Agri-Food Canada, Animal Diseases Research Institute, P.O. Box 640, Lethbridge, Alberta, Canada T1J 3Z4

ABSTRACT: Lynx (*Felis lynx*) carcasses were collected during the 1989 to 1990 through 1992 to 1993 trapping seasons in Alaska (USA). Seven areas were represented. Tongue samples were removed from 1,065 carcasses. Specimens were examined for the presence of *Trichinella nativa* larvae by means of enzymatic digestion. Overall prevalence was 21%. Both prevalence and number of larvae per gram of host tissue were directly related to age of the host. Age-specific prevalence ranged from 4% for kittens up to 59% for lynx 5 yr of age and older. For infected lynx, intensity ranged from 0.27 larvae per gram of host tissue for kittens up to 2.35 larvae per gram for lynx 3 yr of age and older. Location-specific prevalence ranged from 19% to 27%. Year-specific prevalence ranged from 13% to 26%. Prevalence in both males and females was 21%.

Key words: Alaska, lynx, *Felis lynx*, trichinellosis, *Trichinella nativa*.

INTRODUCTION

Trichinella nativa is a common parasite of free-ranging carnivores and omnivores, including lynx (*Felis lynx*) (Zimmerman, 1971). Transmission occurs by ingestion of infected meat.

Prevalence of trichinellosis in lynx ranged from 29% to 50% in Europe and the former Soviet Union (Churina et al., 1979; Horning, 1983; Brglez, 1989; A. Oksanen, pers. comm.). Prevalence in three widely separated areas of Canada was 3% (Smith and Snowdon, 1988). Prevalence in lynx from Alaska during the 1950's was 23% (Rausch et al., 1956). Most previous studies have been based on small sample sizes. A survey in Finland (A. Oksanen, pers. comm.) was an exception.

Humans in many areas of Alaska (USA) commonly eat lynx meat (Charnley, 1984). A case of human trichinellosis in Europe has been attributed to consumption of infected lynx meat (Horning, 1983). Therefore, a survey of *T. nativa* in lynx from Alaska was initiated in order to provide current data regarding the potential for human exposure from eating lynx meat.

Our objective was to determine the relationship of *T. nativa* prevalence to geographic location, age, sex, and year of collection. In addition, intensity of infection (number of *T. nativa* larvae per gram of host tissue) was determined.

MATERIALS AND METHODS

Seven areas of Alaska were represented: Central Arctic (150° to 156°W; 67° to 68°30'N), Eastern Arctic (144° to 146°W; 66°30' to 67°30'N), Central Interior (145° to 149°W; 64° to 66°N), Eastern Interior (141° to 143°W; 63° to 65°N), Eastern Border (141° to 143°W; 62° to 63°N), Southeast Mainland (143° to 145°W; 61° to 62°30'N), and Southcentral (145° to 146°W; 62° to 63°N) (Fig. 1).

Carcasses were obtained from trappers. Lynx trapping seasons in Alaska normally begin in November or December and end in January or February of the following year. Therefore, collection periods are reported as 2 yr periods. For example, the current study began with the 1989 to 1990 season and ended with the 1992 to 1993 season. Sex was determined by examination of internal sex organs. Age was determined by counting cementum annuli of a canine tooth (Crowe, 1972). Most animals were represented by entire carcasses. However, only heads were available for 107 animals collected during the 1989 to 1990 and 1990 to 1991 seasons from the Eastern Arctic study area.

Trichinella nativa larvae encyst in muscle tissue. Common diagnostic specimens include tongue, masseter, and diaphragm. In a preliminary study, we found that tongue and masseter provided nearly identical results and were equally suitable. For this study, tongue was selected due to amount of tissue available and ease of collection.

Frozen tongues were shipped to the Animal Diseases Research Institute in Lethbridge, Alberta, Canada for analysis. Ten-gram portions of each tongue were chopped into small pieces and subjected to enzymatic digestion (Schad et al., 1984). Resulting digested material was cleaned and examined microscopically for the presence of *T. nativa* larvae. Specimens and animals which harbored *T. nativa* larvae will be referred to as positive. Specimens and animals with no *T. nativa* larvae will be referred to as negative. For ease of evaluation, results were grouped by year of collection.

Selected isolates were identified to the species level based on species-specific regions within the excised expansion segment of the large subunit ribosomal DNA. The DNA was amplified by specific polymerase chain reaction primers. Products were identified by agarose gel electrophoresis (Zarlenga and Dame, 1992).

Data were analyzed by a logit generalized linear model (Agresti, 1990) to test for relationship of both prevalence and intensity to the following independent variables: age, sex, geographic location, and year of collection. All four independent variables were categorical. All main and pairwise interaction effects were considered in the model. Effects which were not significant ($\alpha > 0.05$) were removed until the most parsimonious model was obtained. The final model contains only those effects, and possible interactions, which are significant with a log-likelihood ratio statistic at $\alpha \leq 0.05$.

RESULTS

Samples were collected from 1,065 lynx. Prevalence was not significantly affected by interactions of independent variables. Prevalence was 21% in both males (110 positive of 512 tested) and females (89 positive of 428 tested). Age was the only independent variable which was significantly ($P < 0.0001$) related to prevalence (Table 1). The number of *T. nativa* larvae per gram of lynx tissue (LPG) was weakly related ($P = 0.072$) to age of lynx (Table 1). Only positive animals were included in this analysis. There were no statistically significant differences in prevalence between study areas (Table 2).

Year-specific prevalence of trichinellosis in lynx was as follows: 17 (13%) positive of 129 tested for the 1989 to 1990 season, 41 (20%) positive of 210 tested for the 1990 to 1991 season, 84 (20%) positive of 419 tested for the 1991 to 1992 season, and 75 (26%) positive of 285 tested for the 1992 to 1993 season. There were no significant differences in year-specific prevalences.

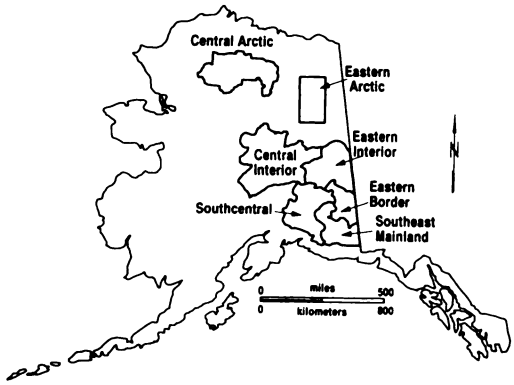

FIGURE 1. Location of areas where lynx (*Felis lynx*) samples were collected for *Trichinella nativa* survey.

DISCUSSION

Prevalence was essentially identical in male and female segments of the populations. Transmission of *T. nativa* occurs by means of ingesting infected meat. Therefore, we inferred that these two cohorts had similar feeding habits.

Based on the logit model, age was significantly correlated to prevalence (Table 1). Presumably, opportunities for exposure to *T. nativa* are available throughout the life of a lynx. Apparently, exposure is cumulative with each additional year of life.

The LPG increased in each age cohort (Table 1). *Trichinella nativa* larvae do not reproduce in situ. Thus, LPG can increase only if additional larvae are ingested. Based on these data, it appears that lynx are subjected to repeated exposure throughout their lives.

Transmission of trichinellosis from lynx to other potential hosts may be at least partially dependent on these repeated exposures. Viability of *T. nativa* larvae in situ declines as time passes (Marquardt and Demaree, 1985). In the absence of repeated exposure, infectivity of lynx meat might decline to a negligible level.

TABLE 1. Age-specific prevalence and intensity of *Trichinella spiralis* infection in lynx (*Felis lynx*) from Alaska, 1988 to 1993.

Age	Prevalence: Number with *Trichinella nativa* larvae	Prevalence: Number sampled	Prevalence: Percent positive	Mean intensity of samples with *Trichinella nativa* larvae
Kitten[a]	4	90	4	0.27[b]
1	58	341	17	1.84
2	91	338	27	2.11
3	19	74	26	2.34[c]
4	7	17	41	
≥5	17	29	59	

[a] Age determined by counting cementum annuli of tooth.
[b] Number of *Trichinella nativa* larvae per gram of lynx tissue.
[c] Mean value for all lynx ≥3 yr.

TABLE 2. Location-specific prevalence of *Trichinella nativa* infection of lynx (*Felis lynx*) from Alaska, 1988 to 1993.

Location	Prevalence: Number of samples with *Trichinella nativa* larvae	Prevalence: Number sampled	Prevalence: Percent positive
Central Arctic	28	103	27
Southcentral	38	157	24
Eastern Interior	23	105	22
Eastern Border	37	171	22
Southeast Mainland	14	68	21
Central Interior	63	328	19
Eastern Arctic	25	133	19

Although there were no statistically significant differences in prevalences between study areas, prevalence was highest in lynx from the Central Arctic study area (Table 2). The mean age of lynx collected in the Central Arctic region was noticeably higher compared with other areas. For example, the mean (±SE) age of lynx collected during the 1990 to 1991 season in the Central Arctic study area was 5.8 yr ± 1.2 yr (n = 10). By contrast, the mean (±SE) age of animals collected from the Eastern Border study area during the 1990 to 1991 season was 1.6 yr ± 0.2 yr (n = 38). As stated earlier, age was the factor most highly correlated to prevalence (Table 1). Therefore, it was not surprising that prevalence was highest in the region where mean age also was highest.

Chronology of initial exposure to *T. nativa* cannot be determined by means of enzymatic digestion. Therefore, there was no way of knowing the precise year when the adult lynx represented in this study were initially exposed. Year-of-exposure was obvious for kittens. Therefore, year-specific prevalence for the kitten cohort could be readily calculated. Unfortunately, the number of kittens included in each yearly collection was inadequate to allow a meaningful statistical evaluation.

Populations of both lynx and snowshoe hares (*Lepus americanus*) experience a predictable 10-yr cycle of abundance (Brand et al., 1976). This similarity in population dynamics is due to the strong dependence of lynx upon hares as a food source (Keith, 1963). In years of hare abundance, lynx subsist primarily on a diet of hares (Brand and Keith, 1979). Hares are primarily herbivorous. Therefore, trichinellosis is rare in hares (Rausch et al., 1956). Thus, exposure of lynx to *T. nativa* would theoretically be low in years of hare abundance.

Conversely, in years when hares are scarce lynx presumably use other animals as food sources. Alternate prey species might include red fox (*Vulpes vulpes*), marten (*Martes americana*) or even other lynx. Prevalence of trichinellosis is higher in these omnivorous and carnivorous species (Rausch et al., 1956). Thus, there is a greater opportunity for transmission of trichinellosis to lynx.

Hare and lynx populations peaked in 1990 to 1991 in many areas of Alaska (Abbott, 1993). Both were declining in the last 2 yr of this study. Based on the data presented earlier, there was evidence for a minor increase in prevalence of trichinellosis in lynx during this time frame. However, there were no statistically significant differences in year-specific prevalences. The current survey did not cover an ad-

equate time period to clearly elucidate a chronologic pattern, if any exists. Year-specific patterns of prevalence may have been evident if the survey covered 15 to 20 yr.

In addition, there was no apparent year-specific pattern of prevalence for any of the individual study areas. Lynx and hare population cycles are grossly synchronous throughout Alaska (Stephenson and Karczmarczyk, 1989). However, there may be minor differences where lynx population density in one area peaks 1 to 2 yr prior to the population in another region (Stephenson and Karczmarczyk, 1989). Therefore, combining test results from all study areas may effectively mask differences in year-specific prevalence which might occur at individual areas. Using the logit model, we can detect complex interactions of multiple causative factors, including location, age, and year of collection. No such relationships were evident.

Management implications

Trichinellosis poses no apparent threat to the long-term viability of lynx or other wildlife populations. However, there is potential for transmission of *T. nativa* from lynx to humans (Horning, 1983). Therefore, results of this study and cooking recommendations for lynx meat will be shared with trappers and other consumers.

ACKNOWLEDGMENTS

The following individuals generously contributed their time by collecting and submitting specimens: Toby Boudreau, Terry Doyle, Steve DuBois, Robin Eagan, Craig Gardner, Howard Golden, Danny Grangaard, Thomas Lowy, Karen Ogden, Craig Perham, Chris Scranton, and Shelli Swanson. Dr. David Worley of Montana State University provided invaluable advice and assistance during the early stages of this project. The authors thank the Alaska Trappers Association for publicizing and facilitating the carcass collection program. This project was supported by U.S. Federal Aid in Wildlife Restoration Projects.

LITERATURE CITED

ABBOT, S. M. (editor). 1993. Furbearers. Project W-23-3 and W-23-4, Federal Aid in Wildlife Restoration Survey and Inventory Management Report, Alaska Department of Fish and Game, Juneau, Alaska, 303 pp.

AGRESTI, A. 1990. Categorical data analysis. John Wiley and Sons. New York, New York, 558 pp.

BRAND, C. J., AND L. B. KEITH. 1979. Lynx demography during a snowshoe hare decline in Alberta. The Journal of Wildlife Management 43: 827–849.

———, ———, AND C. A. FISCHER. 1976. Lynx responses to changing snowshoe hare densities in central Alberta. The Journal of Wildlife Management 40: 416–428.

BRGLEZ, J. 1989. The incidence of trichinellosis in some wild animals in Yugoslavia. *In* Proceedings of the Seventh International Conference on Trichinellosis, C. E. Tanner, A. R. Martinez-Fernandez, and F. Bolas-Fernandez (eds.). Consejo Superior de Investigaciones Cientificas Press, Madrid, Spain, pp. 412–415.

CHARNLEY, S. 1984. Human ecology of two central Kuskokwim communities: Chuathbaluk and Sleetmute. Subsistence Division Technical Paper Number 81, Alaska Department of Fish and Game, Juneau, Alaska, 391 pp.

CHURINA, N. V., Y. M. MALAFEEV, AND A. I. RUSSKOVA. 1979. Trichinelliasis in lynx in the Central Urals and Trans-Ural region. Ekologicheskie issledovaniya v lesnykh i lugovykh biogeotsenosakh ravnin Zaural'ya. Informatsionnye materialy Talitskogo Statsionara, 1979. Sverdlovsk, Russia, pp. 51–53.

CROWE, D. M. 1972. The presence of annuli in bobcat tooth cementum layers. The Journal of Wildlife Management 36: 1330–1332.

HORNING, B. 1983. Short report concerning *Trichinella* research in Switzerland (1979–1982). Wiadomosci Parazytologiczne 29: 638–640.

KEITH, L. B. 1963. Wildlife's ten year cycle. University of Wisconsin Press, Madison, Wisconsin, 201 pp.

MARQUARDT, W. C., AND R. S. DEMAREE, JR. 1985. Parasitology. MacMillan Publishing Company, New York, New York, 446 pp.

RAUSCH, R., B. B. BABERO, R. V. RAUSCH, AND E. L. SCHILLER. 1956. Studies on the helminth fauna of Alaska. XXVII. The occurrence of larvae of *Trichinella spiralis* in Alaskan mammals. The Journal of Parasitology 42: 259–271.

SCHAD, G. A., D. A. LEIBY, AND K. D. MURRELL. 1984. Distribution, prevalence and intensity of *Trichinella spiralis* in furbearing animals of Pennsylvania. The Journal of Parasitology 70: 372–377.

SMITH, H. J., AND K. E. SNOWDON. 1988. Sylvatic trichinosis in Canada. Canadian Journal of Veterinary Research 52: 488–489.

STEPHENSON, R. O., AND P. KARCZMARCZYK. 1989. Development of techniques for evaluating lynx population status in Alaska. Project W-23-1, Study

7.13, Federal Aid in Wildlife Restoration Research Final Report, Alaska Department of Fish and Game, Juneau, Alaska, 95 pp.

ZARLENGA, D. T., AND J. B. DAME. 1992. The identification and characterization of a break within the large subunit ribosomal DNA of *Trichinella spiralis*: Comparison of gap sequences within the genus. Molecular and Biochemical Parasitology 51: 281–290.

ZIMMERMAN, W. J. 1971. Trichinosis. *In* Parasitic diseases of wild animals, J. W. Davis and R. C. Anderson (eds.). Iowa State University Press, Ames, Iowa, pp. 127–139.

Received for publication 3 October 1994.