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HELMINTH PARASITES OF NORTHERN SPOTTED OWLS (*STRIX OCCIDENTALIS CAURINA*) FROM OREGON

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ABSTRACT: Helminth parasites are reported for the first time from northern spotted owls. Seventy-one percent of a sample of *Strix occidentalis caurina* from western Oregon was infected. Nematodes (*Porrocaecum depressum*, *Capillaria falconis*, *Microtetrameres* sp. and *Synhimantus hamatus*) were the most prevalent parasites although cestodes (*Paruterina rauschi*) and acanthocephalans (*Centrorhynchus conspectus*) were also represented. There was an association between components of this helminth fauna and the diet of spotted owls which is dominated by small rodents. The occurrence of *P. rauschi* rather than *P. candelabraria* in this geographic region and host-species may provide additional support for recognition of a parapatric distribution in the ranges of *Paruterina* spp. among strigiforms in the Nearctic.

Key words: *Strix occidentalis*, northern spotted owl, helminths, survey.

INTRODUCTION

Spotted owls, *Strix occidentalis* are characteristic birds of forested habitats in North America extending from British Columbia to northern Mexico (Bent, 1938). In the Pacific Northwest a subspecies, the northern spotted owl (*S. occidentalis caurina*), is typically associated with old-growth coniferous forests for roosting and nesting (Forsman et al., 1984). The status of this species (whether threatened or endangered) has been poorly understood, and, until recently, relatively little biological information has been available (Gould, 1977; Solis, 1983; Forsman et al., 1984; Gutiérrez and Carey, 1985).

Basic ecological data including habitat use, foraging behavior and food habitats of northern spotted owls have been presented (Barrows, 1980, 1981; Forsman et al., 1984), but there has been little information about their parasites. Haematozoan parasites including *Leucocytozoon zeimanni*, *Haemoproteus* sp., *Trypanosoma* sp. and microfilaria were collected from a single host, *S. occidentalis occidentalis*, in the Liebre Mountains of southern California (Wood and Herman, 1943). Haematophagus ectoparasites, such as hippoboscids and other arthropods, could influence mortality in nestling owls but definitive data are not available (Forsman et al., 1984). There are no previous reports of adult helminth parasites from spotted owls. In the current study new records for helminths in *S. occidentalis* from western Oregon are presented along with preliminary comments on parasite-host ecology.

MATERIALS AND METHODS

Fourteen birds (8 juveniles, 6 adults) from localities along the western flank of the Cascade Mountains and from the Coast Ranges of western Oregon (Fig. 1) were collected and submitted to the Veterinary Diagnostic Laboratory (VDL, College of Veterinary Medicine, Oregon State University, Corvallis, Oregon 97331, USA) between September 1985 and July 1988. Juvenile birds were acquired during a study of dispersal of juvenile spotted owls in western Oregon that was conducted between 1982 and 1985 (see Miller and Meslow, 1985). Adults were made available by J. Reid and A. B. Carey during a study of predator-prey relationships of spotted owls (Old-growth Forest Wildlife Habitat Project, USDA Forest Service, PNW Forestry Science Laboratory, Olympia, Washington 98502, USA).

Complete necropsies were conducted; all internal organs of each owl were examined for the presence of helminth parasites and an attempt was made to determine the cause of death. Tissue specimens from each owl were fixed in 10% formalin and evaluated histologically. Helminths were fixed in buffered 10% formalin and examined, either entire, or in histological sections. Cestodes were stained in Semichon's acetic carmine; rostellar hooks were examined by squashes of the rostellum. Nematodes were either

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cleared in glycerine, by evaporation of an ethanol-glycerine solution, or in lactophenol. Representative specimens of helminths were deposited in the collections of the U.S. National Parasite Collection (USDA, ARS, Beltsville, Maryland 20705, USA; accession numbers 80154–80158; 80511). In the text data for occurrence of individual helminths are presented in the format (range in intensity, mean, standard deviation).

RESULTS AND DISCUSSION

The majority of owls was collected during the winter and the predominant cause of death was emaciation and starvation (six birds) or suspected predation by great horned owls, *Bubo virginianus* (four birds) (Table 1). Although helminths were associated with all birds that had died of starvation, parasitism is not considered to be a contributing factor as infections were typically of low intensity.

Helminths were recovered from 10 of 14 birds (71%), multiple infections (>1 species/host) occurred in five birds (range one to three helminth species/host) and intensity of infection was low (Table 1). Nematodes were the most commonly occurring helminths (four species) while only single species of cestodes and acanthocephalans were found (Table 1). Hosts were distributed across the entire sampling area in western Oregon, and were found in both the western hemlock (*Tsuga heterophylla*) and mixed conifer vegetation zones (see Franklin and Dyrness, 1973); both juvenile and adult spotted owls were infected (Table 1, Fig. 1).

Gravid specimens of *Paruterina rauschi* were found in the small intestine of three hosts (3–10; 7.7; 4.0) (Table 1). Two species of *Paruterina* are typical parasites of strigiform birds in North America (Freeman, 1957; Schmidt, 1986). *Paruterina rauschi* is considered to have a relatively narrow host distribution in barred owls (*Strix varia*) principally in the south temperate zone of North America, although it is also known from great horned owls and saw-whet owls (*Aegolius acadicus*) (Freeman, 1957). In contrast *P. candelabraria* has a broad host

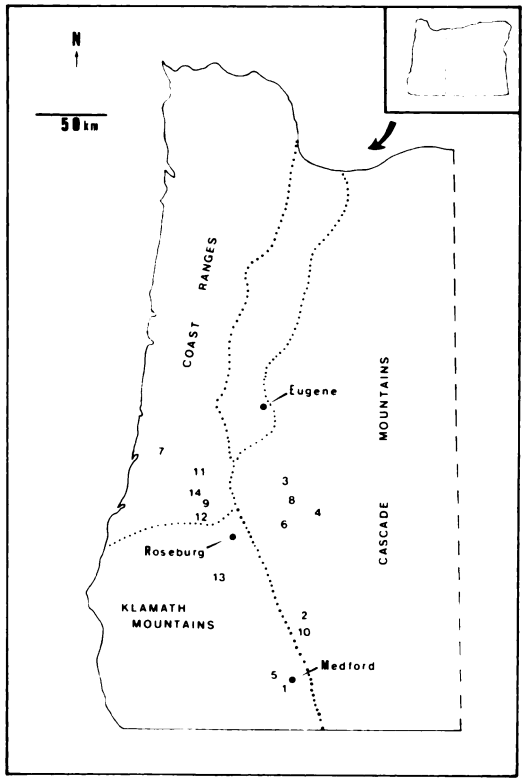


FIGURE 1. Localities of collection for *Strix occidentalis caurina* in southwestern Oregon. Numbers indicate locality of collection. Refer to Table 1 for data on age, sex, and presence of parasites in individual birds. Major population centers are included for reference.

range at high latitudes in North America and the Holarctic predominantly coinciding with the distribution of *Nyctea scandiaca* (Rausch, 1948; Freeman, 1957; Ramalingam and Samuel, 1978; Schmidt, 1986). The occurrence of *P. rauschi* rather than *P. candelabraria* in *S. occidentalis caurina* from western Oregon provides further support for recognition of largely parapatric geographic ranges for *Paruterina* spp. from owls in the Nearctic (Freeman, 1957; Ramalingam and Samuel, 1978). Life cycles known for *Paruterina* spp. indicate the importance of a variety of rodents as intermediate hosts (Freeman, 1957; Zenchak and Hall, 1971; Rausch, 1983).

Mature males of *Centrorhynchus con-*

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TABLE 1. Collection data for *Strix occidentalis caurina* from western Oregon: age, sex, cause of death and presence of helminths among individual birds.

Specimen number[a]	Collection date[b]	Age[c]	Sex[d]	Death[e]	Species and number of helminths[f]	
1	November 1985	J	F	S	*Porrocaecum depressum*	2
					Synhimantus hamatus	9
					Paruterina rauschi	10
2	September 1985	J	F	S	*Synhimantus hamatus*	—[g]
3	December 1985	J	M	P	*Porrocaecum depressum*	1
4	December 1985	A	M	T	Negative[h]	
5	December 1985	J	F	P	Negative[h]	
6	December 1985	J	M	P	*Centrorhynchus conspectus*	1
7	February 1986	J	M	S	*Porrocaecum depressum*	4
					Paruterina rauschi	3
8	March 1986	J	M	S	Negative[h]	
9	June 1986	A	F	P	Negative[h]	
10	October 1986	J	M	U	*Synhimantus hamatus*	—[g]
11	March 1987	A	M	S	*Capillaria falconis*	1
					Centrorhynchus conspectus	1
					Paruterina rauschi	10
12	December 1987	A	F	U	*Porrocaecum depressum*	1
					Synhimantus hamatus	—[g]
					Centrorhynchus conspectus	1
13	April 1988	A	M	S	*Porrocaecum depressum*	1
					Microtetrameres sp.	32
14	July 1988	A	M	U	*Porrocaecum depressum*	1
					Centrorhynchus conspectus	2

[a] Numbers refer to geographic localities (Fig. 1).
[b] Month and year.
[c] Juvenile (J), adult (A).
[d] Female (F), male (M).
[e] Cause of death: starvation (S), predation (P), trauma (T), undetermined (U).
[f] Number of specimens/host.
[g] Data for intensity not available.
[h] Helminths not found.

spectus occurred in four owls (1–2; 1.25; 0.50) (Table 1). This acanthocephalan is a typical but uncommon parasite of owls and some falconiforms in North America (Van Cleave and Pratt, 1940; Nickol, 1983; Rausch, 1983). Intermediate hosts include insectivores, mustelids, various rodents, snakes and caudate amphibians (Collins, 1969; Nickol, 1969; Anderson and McDaniel, 1975; Rausch, 1983).

One male *Capillaria falconis* was found in the small intestine of an adult male owl (Table 1). This capillariid has a broad host range among falconiforms and strigiforms in the Holarctic (Read, 1949; Skriabin et al., 1957; Ramalingam and Samuel, 1978).

Mature specimens of *Porrocaecum depressum* were found in the upper small intestine of six hosts (1–4; 1.7; 1.2) (Table 1). *Porrocaecum depressum* is a common parasite of strigiform birds in the Holarctic (Morgan and Schiller, 1950; Ramalingam and Samuel, 1978; Rausch, 1983). Intermediate hosts are known to include shrews (*Sorex* spp.) and other insectivores (Rausch, 1983).

Adults and larvae of a spirurid nematode tentatively referred to *Synhimantus hamatus* were found in the proventriculus of four owls (Table 1). Accurate data for intensity of infection (see Table 1) are unavailable because complete specimens were not recovered from all hosts. *Synhimantus hamatus* has apparently not been reported previously from an avian host in the Nearctic. However, a related species, *S.*

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laticeps is known from strigiform and falconiform hosts in the Holarctic (Cram 1927; Yamaguti, 1961; Skriabin et al., 1965; Ryzhikov et al., 1978).

Although mature *S. hamatus* were found penetrating the mucosa and proventricular glands and larvae were found histologically at varying depths in the mucosa, substantial pathology was not associated with these infections. In two birds a thick layer of mucus, desquamated epithelial cells, cellular debris, numerous spirurid eggs, larvae, and mature nematodes was observed on an intact mucosal surface. The proventricular glands and muscularis were histologically normal.

Another spirurid, *Microtetrameres* sp. was found in a single host (Table 1). Female specimens were located within the proventricular gland cells while males were found on the surface of the mucosa. These specimens appeared distinct from *M. bubo*, the only species of *Microtetrameres* known from strigiforms in Oregon (Schell, 1953).

The occurrence of *Paruterina rauschi*, *Centrorhynchus conspectus* and *Porrocaecum depressum* reflects the importance of small mammals as intermediate hosts for helminths in spotted owls (Rausch, 1949; Freeman, 1957; Rausch, 1983). Small mammals, primarily rodents, constituted 90% of the biomass consumed by owls in Oregon, although seasonal and geographic variation in prey selection was noted (Forsman et al., 1984). In contrast acquisition of *Synhimantus hamatus* and *Microtetrameres* sp. may be restricted to the summer, a period of maximum exploitation of arthropod prey by owls (see Skriabin et al., 1965; Forsman et al., 1984).

A similarity in the parasite faunas of *S. occidentalis* and *S. varia* might be expected based on the possible superspecies status for these owls (see A.O.U., 1983). Thus, *P. rauschi* appears to be primarily a parasite of *Strix* spp. in the south temperate zone (Freeman, 1957). The highly sedentary habits and limited vagility of *S. occidentalis* (see Forsman et al., 1984) may additionally influence the distribution of *P. rauschi* with the geographic range of this cestode being determined by that of the definitive host (see Freeman, 1957). However, other species including *Porrocaecum depressum*, *Capillaria falconis*, *Synhimantus hamatus*, *Microtetrameres* sp., and *Centrorhynchus conspectus* may constitute a group of parasites widely shared with other species of owls (Morgan and Schiller, 1950; Skriabin et al., 1957; Yamaguti, 1961; Rausch, 1983) and may reflect the broad ecological associations among strigiforms in the Pacific Northwest.

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ADDENDUM

Subsequent to the acceptance of this paper, six adult spotted owls (five males, one female) that had died during late October and November 1988 were submitted to the VDL for examination. Causes of mortality for this group of birds were undetermined. Helminths were recovered from all owls and multiple infections occurred in three hosts (range one to four helminth species/host). Single male and female birds collected in the Cascade Mountains in the proximity of H. J. Andrews Experimental Forest (45 miles northwest of Eugene, Fig. 1) were infected with *Microtetrameres* sp. and *Tetrameres strigiphila* (three males, one female; one male, five females) and *Paruterina* sp. and *Capillaria* sp. (cf. *C. falconis*) (one destrobilate specimen, two females), respectively. Three male birds from the Coast Ranges (proximate to 11–12 on Fig. 1) were infected per individual host as follows: *T. strigiphila* (one female); *Capillaria* sp. (cf. *C. falconis*), *Porrocaecum depressum*, *Synhimantus* sp. (cf. *S. hamatus*), and *Cyrnea* sp. (cf. *C. americanum*) (one, one, four, and two females, respectively); and *T. strigiphila* (four males, 11 gravid females). An additional male from the Klamath Mountains (about 16 km south of Roseburg, Fig. 1) was infected with *Centrorhynchus conspectus* (one gravid female).

Specimens of *C. americanum* and *T. strigiphila* (USNM Helm. Coll. Nos. 80545, 80544) had not been found in earlier collections of spotted owls. Females of *C. americanum* occurred along the anterior margin of the koilon whereas males and females of *T. strigiphila* were localized in common cysts within the tunica muscularis of the proventriculus. Cysts were evident on the serosal surface of the proventriculus and measured 4.3 to 6.0 mm in diameter. Contrary to the original report of *T. strigiphila* from *Strix varia*, gravid females were not always found encysted with accompanying males (see Pence et al., 1975, The Journal of Parasitology 61: 494–498). As with other spirurids reported from spotted owls, life cycles for species in the genus *Tetrameres* and *Cyrnea* may involve arthropod intermediate hosts, thus transmission is probably limited to the summer.

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