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Geographic Range and Habitat Characteristics of the Caddisfly *Cryptochia neosa*

Abstract

Cryptochia neosa males were collected in sweepnet samples and from laboratory-reared pupae from six streams widely separated in the Blue Mountains of Oregon and Washington. *C. neosa* seems to be the only species of *Cryptochia* in the Blue Mountains and its range may extend further westward and eastward. *Cryptochia* larvae were collected or observed in 117 low-order, high-gradient streams containing sediment-free woody debris. Larvae attach primarily to submerged wood and bark during the summer, but they also move into mats of damp, decaying leaves in the fall. Most of the 11 habitat characteristics that differed significantly between streams with and without *Cryptochia* can be related to their effect on the sedimentation of attachment sites. The streams inhabited by *Cryptochia* are receiving increased protection in current forest management plans. We suggest that this species should be downgraded from Category 2 to Category 3C of the Federal Rare and Endangered Species List.

Introduction

Cryptochia is a small genus in the Family Limnephilidae (Order Trichoptera). There are seven species confined to montane streams of western North America. *C. pilosa* is widely distributed in the maritime areas of the Pacific Northwest (Wisseman and Anderson 1987), and *C. furcata* has been reported from the interior mountains of Washington, Montana, and British Columbia (Denning 1964). There are very few records for the other five species, which include *C. neosa* from northeastern Oregon and southeastern Washington and four species known only from California (Denning 1975).

As with many caddisflies, species of *Cryptochia* are differentiated on the basis of male genitalia (see Denning 1975 for a key). Females and larvae of the genus cannot, as yet, be separated to the species level. However, the distinctive larva and its case provide easy identification of the genus. There is a dense fringe of long hairs on the anterior edge of the larval pronotum and there are two curved bands of dense scale hairs appearing to form a crown on the flattened head (Wiggins 1977). The case is tapered lengthwise, is rectangular in cross-section, and is made of transversely arranged bits of wood and bark.

The only published record of *C. neosa* is the holotype male collected June 21, 1952 at 1550 m on Lunch Creek near Prairie City, Grant Co., OR (Denning 1954). Unpublished records of *C. neosa* include one male from Whiskey Creek south of La Grande, Oregon (Stamford Smith, Cent. Wash. Univ., pers. comm.) and several males collected in 1974-77 from Goose Creek in the Wallowa Range of the Blue Mountains incidental to a research project conducted by the U. S. Forest Service's Pacific Southwest Forest and Range Experiment Station (Patrick J. Shea, pers. comm.; Butcher 1979). Denning's holotype male is deposited at the California Academy of Sciences. The Whiskey Creek specimen, identified by Stamford Smith at Central Washington University, is deposited in the entomology collection there. The Goose Creek specimens were also identified by Stamford Smith, but their fate and the number of males and females collected are unknown (P. Shea, pers. comm., S. Smith, pers. comm).

The lack of knowledge about *C. neosa* and its potential rarity led to its classification in 1984 as a Category 2 candidate invertebrate for the Federal Rare and Endangered Species List (Federal Register 1984). A Category 2 species is one for which current information indicates that listing it as threatened or endangered might be appropriate, but for which conclusive data on its biological vulnerability are insufficient to support such a listing (Federal Register 1984). The purpose of this study was to determine the status of this species, including its current geographic range and habitat characteristics.

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Methods and Results

Geographic Range

Adults were field-collected and laboratory-reared from streams in several areas of the Blue Mountains. From mid-June to mid-August, 1990 and 1991 we used a muslin butterfly net to sweep streamside vegetation, logs, and moist undercut banks. In May and June, 1992 we collected pupae for rearing. Some pupae, attached to pieces of wood, were placed in screen wire cages that were partially submerged in Tie Creek near La Grande such that the pupae were near, but above water level. Other pupae were placed on moist filter paper in covered Petri dishes and held in a dark environmental chamber at 20°C. Not all pupae eclosed, but some dead pupae were identifiable.

We collected five adult and two pupal male *Cryptochia neosa* and two adult and one pupal female *Cryptochia* from sweepnet samples, captivity-reared pupae, and dead pupae. All specimens have been deposited in the Systematic Entomology Laboratory Collection at Oregon State University. The males were collected from six streams, bringing to nine the number of streams from which this species has been positively identified (Fig. 1). These nine streams are widespread in the Blue Mountains and no other species of *Cryptochia* has been reported from this area. We conclude that *C. neosa* is the only species of *Cryptochia* present in the Blue Mountains, and we assume that all the larvae we found in the Blue Mountains are this species. Because of this assumption, we henceforth use "*Cryptochia*" to represent "*Cryptochia* probably *neosa*" and we use "*Cryptochia* sp" to refer to the genus as a whole.

Cryptochia larvae were more easily found than were adults. Larvae were simply picked from or observed on wood and bark in small streams. We selected most streams on the basis of their accessibility and size. Initial collecting revealed that large, fast streams did not contain *Cryptochia*. Initial collecting also was concentrated in the Wallowa-Whitman National Forest, and we visited fewer streams in outlying areas as we expanded the search for the geographic range limits. Data on locations of *Cryptochia* larvae were also provided by U. S. Forest Service workers in the Umatilla and Malheur National Forests.

We found *Cryptochia* larvae in 117 streams throughout the Blue Mountains (Fig. 1). Because of their wide distribution, no attempt was made to locate all streams in which they were present. Many of these larvae have also been deposited in the Systematic Entomology Laboratory Collection at Oregon State University; site locations for all specimens collected in this study are available from the first author.

Although the Blue Mountains are isolated from other mountain ranges to the north and south, they are not far from the Ochoco Mountains to the west or from several ranges in Idaho east of Hell's Canyon National Recreation Area. We collected *Cryptochia* larvae in both areas (Fig. 1). Although we suspect these Ochoco and Idaho individuals are *C. neosa*, they might also be *C. pilosa* and/or *C. furcata*. *C. pilosa* has been recorded from the east slopes of the Cascade Mountains (Anderson 1976) about 60 km west of the Ochocos and the Deschutes River system lies between and drains both mountain areas. References to Idaho specimens of *C. pilosa* date back to Ross (1950), but we could not locate the actual record(s) to which he referred. There is an unpublished record of a *C. pilosa* collected in 1974 near Priest River (O. S. Flint, Smithsonian Inst., Washington, D.C., pers. comm.), but this location is in the panhandle area of Idaho well north of our collection sites. *C. furcata* has not been reported south of Washington and Montana (Denning 1964). We have not attempted to capture the adult males necessary to determine the areas of sympatry, parapatry, or possible gap between the ranges of *C. neosa, C. pilosa, and C. furcata.*

Habitat Characteristics

We characterized the substrates to which larvae cling during the summer by carefully searching for larvae in five streams during July and August, 1992. Substrates were classified as to type, texture, and size. In addition we recorded the location of the larvae on the substrate and the location of the larvae in relation to water line. Lastly, we recorded whether the substrate was located in a riffle, glide, pool, or a debris jam at a pool outlet.

Since *C. pilosa* larvae are known to move into damp leaves during the fall (Wisseman and Anderson 1987), we collected leaves in November, 1993 from three streams known to contain *Cryptochia* larvae. We restricted our collection along the bank to damp leaves, which were usually within 1 m of the water edge and less than 30 cm above the water line. We also collected leaves from the

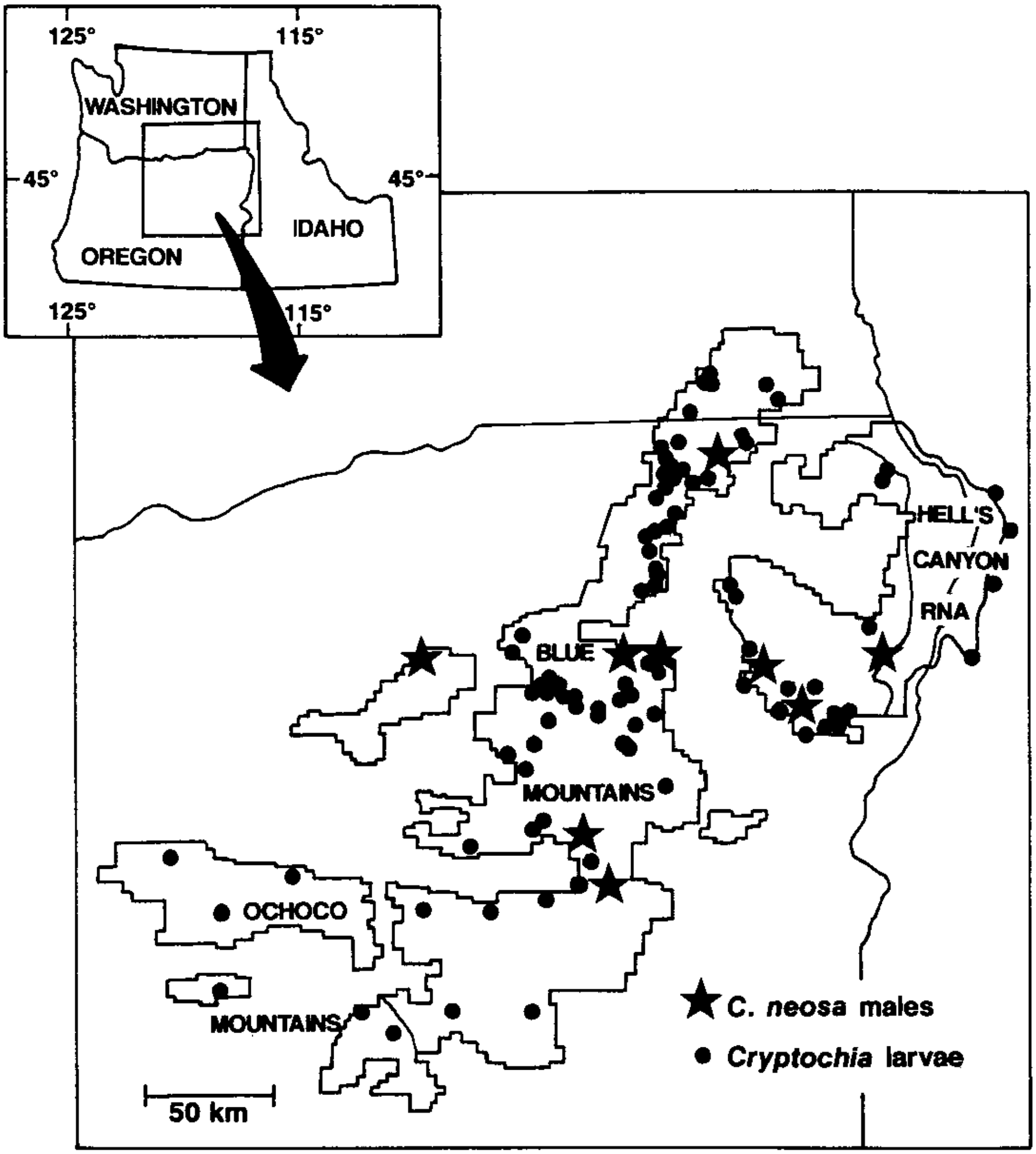

Figure 1. Capture sites for *Cryptochia* larvae and *C. neosa* males in eastern Oregon, southeastern Washington, and western Idaho.

water surface and from behind rocks and debris jams below the water line.

We found *Cryptochia* larvae clinging only to pieces of wood and bark during the summer, although we also found them among the damp, decaying leaves both above and below water line in November. *Cryptochia* larvae found in debris jams at pool outlets during the summer were always clinging to small pieces of wood. In the five streams searched to characterize substrate types, we found larvae using 212 (90.6%) pieces of wood and 22 (9.4%) pieces of bark. The pieces of wood ranged from small twigs to long limbs. Many streams also contained logs too large to turn over; it is possible that these also provided appropriate sites for larval attachment. The pieces of bark used by *Cryptochia* were mostly large and heavy. Most (210; 89.7%) of the substrate pieces had rough texture and the wood was partly decayed. The other 24 (10.3%) pieces were smooth.

The location of the larvae on the attachment substrate was determined for 198 larvae. Most (187; 94.4%) were in a position (bottom, downstream side, end crevice) somewhat protected from the current while 11 (5.6%) were on the top or upstream side of the substrate in the direct current. Unlike *C. pilosa* larvae which Wisseman and Anderson (1987) nearly always found in damp organic matter above the water line, we only found one of the 234 larvae above water level during the summer. However, several of the larvae found by Umatilla National Forest workers were reportedly above water line. Finally, we found larvae only in riffle areas (62; 59.0%) and in the debris jams (43; 41.0%) at pool outlets. In both areas water velocity was greater than in pools and glides.

We selected 33 sites for comparing 21 habitat characteristics between streams with and without *Cryptochia*. All eight streams in which extensive searching failed to produce any *Cryptochia* were compared to 25 randomly chosen sites containing *Cryptochia*. At each site we sampled a 100 m section divided into ten equal segments. In each segment we: 1) measured the percent of riffle, pool, and glide and recorded the maximum depth, percent embeddedness, and dominant bottom substrate in each of these flow types; 2) estimated average stream width; 3) measured gradient with a clinometer; 4) counted pieces of wood and bark; 5) measured total canopy cover at mid-segment with a densiometer; 6) estimated percent bank stability on the basis of the amount likely to contribute to sedimentation during spring run-off; and 7) estimated the percent of the bank providing sites where adults might hide during the daytime including cover from trees, shrubs, herbaceous vegetation, undercut bank, and logs.

Bottom substrate differed between streams with and without *Cryptochia* only in riffle areas (riffle: $p=0.007$; pool: $p=0.82$; glide: $p=0.71$; Fisher exact probability test, Siegel 1956). Gravel or larger substrates predominated in the riffles in 24 of the 25 streams containing *Cryptochia*, but sand and silt substrates were present in the riffles in four of the eight streams lacking *Cryptochia*. Streams containing *Cryptochia* larvae also had significantly less substrate embeddedness in all three flow types (riffle, pool, glide) than streams without *Cryptochia* (Table 1).

Streams with *Cryptochia* had significantly more riffle, less glide, shallower glide, steeper gradient, greater total bank stability, more canopy cover, and greater percent tree cover than did streams lacking *Cryptochia* (Table 1). Wood and bark, the predominant summer attachment substrates for *Cryptochia* larvae, also were significantly more common in streams containing *Cryptochia* (Table 1).

Discussion

Cryptochia larvae were widespread in the Blue Mountains. It was typical to find at least one individual within 10 min in any low-order, high-gradient stream containing sediment-free woody debris or bark. However, extensive searching in large streams or in low-gradient streams rarely produced any individuals. We believe this distribution of *Cryptochia* can be related to the availability of appropriate habitat and food.

Cryptochia sp. larvae are primarily grazers (Wiggins and Mackay 1978), but may be partially shredders (Pereira *et al.* 1982). Larval gut contents include fungal hyphae and spores, algae, vascular plant tissue including leaf and wood cells, and other fine particulate organic matter (Wiggins 1977, Pereira *et al.* 1982, Wisseman and Anderson 1987).

Low gradient streams are characterized by siltation which inhibits the growth of fungi and algae and excludes many grazing invertebrates (Dudley and Anderson 1982) including, apparently, *Cryptochia*. Most of the habitat characteristics that differed significantly between streams with and without *Cryptochia* could be related to their effect on the siltation of the woody debris and bark to which *Cryptochia* larvae cling. More riffle and steeper gradients keep sediment moving in streams containing *Cryptochia*, while more glide and deeper glide would allow sediment to settle in streams without *Cryptochia*. These differences, along with lower bank stability, would contribute to the greater substrate embeddedness throughout streams lacking *Cryptochia*.

The greater total canopy cover and percent tree cover in streams with *Cryptochia* may contribute directly to the presence of *Cryptochia* by providing locations for adults to hide. Alternatively, tree and canopy cover may be inversely correlated with such human disturbances as logging and road building that can increase siltation and embeddedness and thus reduce the likelihood of *Cryptochia*

TABLE 1. Comparison of 18 habitat characteristics between streams containing *Cryptochia* larvae and streams where *Cryptochia* larvae were not found.

Habitat characteristic	Streams with *Cryptochia* larvae N	Mean ± SD	Range	Streams without *Cryptochia* larvae N	Mean ± SD	Range	P[a]
riffle length/100 m (%)	25	88.4 ± 10.3	59.5 – 100.0	8	73.7 ± 26.3	15.0 – 96.0	0.049
pool length/100 m (%)	25	5.7 ± 5.0	0.0 – 17.5	8	7.2 ± 8.8	0.0 – 25.0	NS
glide length/100 m (%)	25	5.8 ± 8.8	0.0 – 39.0	8	19.1 ± 21.7	4.0 – 70.5	0.007
max riffle depth (cm)	25	14.0 ± 5.0	7.0 – 29.0	8	15.0 ± 8.0	9.0 – 34.0	NS
max pool depth (cm)	21	22.0 ± 6.0	12.0 – 38.0	7	25.0 ± 18.0	9.0 – 63.0	NS
max glide depth (cm)	14	15.0 ± 6.0	7.0 – 26.0	8	21.0 ± 9.0	10.0 – 40.0	0.022
riffle embeddedness (%)	25	4.8 ± 2.7	0.0 – 11.0	8	35.7 ± 24.7	16.5 – 83.0	<0.001
pool embeddedness (%)	21	36.3 ± 25.8	2.0 – 85.0	7	83.0 ± 10.7	65.8 – 100.0	<0.001
glide embeddedness (%)	14	38.3 ± 30.0	5.0 – 82.5	8	76.6 ± 15.4	55.0 – 100.0	0.009
stream width (m)	15	1.3 ± 0.5	0.5 – 2.8	8	1.3 ± 0.5	0.8 – 2.0	NS
gradient (%)	25	11.7 ± 8.1	3.8 – 35.8	8	4.0 ± 1.6	1.4 – 6.3	<0.001
wood and bark (#/100 m)	25	79.0 ± 34.0	26.0 – 133.0	8	38.0 ± 17.0	10.0 – 65.0	0.003
shade cover (%)	25	69.6 ± 11.8	31.5 – 86.4	8	36.5 ± 25.3	0.4 – 65.2	<0.001
bank stability (%)	25	90.3 ± 5.8	74.5 – 99.0	8	81.6 ± 13.6	57.5 – 97.5	0.048
tree bank cover (%)	25	24.0 ± 11.0	2.0 – 48.0	8	7.5 ± 6.4	0.0 – 18.0	<0.001
shrub bank cover (%)	25	37.8 ± 27.3	3.0 – 87.0	8	22.4 ± 21.0	0.0 – 47.0	NS
herbaceous bank cover (%)	25	63.9 ± 18.5	9.0 – 89.0	8	77.1 ± 19.8	51.0 – 100.0	NS
cutbank, log bank cover (%)	25	22.3 ± 21.5	2.0 – 99.0	8	13.3 ± 5.7	5.0 – 20.0	NS

[a]Mann-Whitney U-test; one-tailed.

being present. Perhaps lower tree and canopy cover in streams without *Cryptochia* may be only incidental to these streams often meandering through open meadows.

Wood provides the major input of organic matter into the headwaters of streams in the coniferous forests of western North America (Dudley and Anderson 1982). The wood standing crop decreases as stream order increases and streams acquire the power to flush out most debris annually (Anderson *et al.* 1978, Dudley and Anderson 1982). What remains in large streams is subject to abrasion, which removes the softer surface layers of the wood that could otherwise be inhabited by various organisms (Dudley and Anderson 1982). *Cryptochia* larvae were uncommon on smooth wood, and the lack of *Cryptochia* in larger streams is most likely related to this paucity of soft, decomposing wood colonized by fungi and algae. The turbulent water in large streams may also be unsuitable for *Cryptochia* larvae, which usually assume a position out of direct current even in smaller streams.

If we are correct in concluding that *C. neosa* is the only species of *Cryptochia* present in the Blue Mountains, then it is widely distributed. Most of the small order streams that it inhabits are located on national forest land. Concerns about the effects of logging, grazing, and road-building on these streams and their fisheries has led to increased protection in current Forest Service management plans. Thus, we believe that the status of *C. neosa* should be changed from Category 2 to Category 3C. The latter category is for taxa "proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat" (Federal Register 1984).

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