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Freshwater Triclad (Turbellaria) of Washington

Abstract

During a survey of freshwater habitats in Washington state, three genera of triclad flatworms (*Polycelis*, *Dugesia*, and *Phagocata*) were observed in such diverse environments as springs, streams, lakes, caves, and temporary ponds. Field data which included the temperature, pH and elevation of collection sites indicated that 1) *Polycelis* was restricted to relatively cold habitats such as springs and small montane streams; 2) *Dugesia* was common in lowland lakes and larger streams with more variable temperatures; and 3) *Phagocata* was found at a single locality, a temporary pond which was present for only three months of the year. The relationship between these ecological differences and the different life history strategies exhibited by these genera is discussed.

Introduction

Systematic statewide studies of freshwater flatworms in North America have added much to the understanding of this rather widespread and ecologically diverse group of aquatic organisms. In particular the work in Virginia (Kenk, 1935), Michigan (Kenk, 1944), Alaska (Kenk, 1953), Tennessee (Darlington and Chandler, 1972), and New Mexico (Chandler and Darlington, 1975) has increased our knowledge of the distribution and natural history of triclad greatly. No such systematic study has been undertaken in any of the states of the Pacific Northwest, and this report is an attempt to provide information of this nature from Washington and present comparative data from a wide range of freshwater habitats.

Methods and Materials

This survey was conducted throughout Washington state during 1973 and 1974, and as many types of freshwater environments as possible were examined. Thirty-three collection sites from fourteen Washington counties were included in the study, and the temperature and pH of the habitats were recorded at most sites. Flatworm collections were carried out for 30 minutes at each site and the number of individuals collected can be used to approximate relative population sizes. When utilizing these measures of relative frequency in comparisons between populations of different species, considerable error may be introduced because of differences in substrate preference. However, this type of behavioral variation is probably minimal within species except in cases of extreme environmental dichotomy such as between cave and epigeal streams (see Nixon, 1974).

Following species identification of the collected specimens, microscopic observations were made in order to ascertain the frequency of sexual maturity in the populations. The term "mature" for each species listed below includes all individuals possessing reproductive organs, regardless of the degree of development. Use of this term should not imply that all individuals in this category were involved in sexual reproduction nor

that sexual reproduction occurs necessarily in populations containing mature individuals, for as Kenk (1973a) has pointed out in the case of *Polycelis*, although sexually mature individuals have been observed from many localities at different seasons, no egg capsules or cocoons have ever been observed in the North American species.

Results

Polycelis coronata (Girard)

This species was first described fully by Hyman (1931) from South Dakota, and subsequently has been reported from Colorado (Kenk, 1952), Alaska (Kenk, 1953; Holmquist, 1967), Utah (Beck, 1954; Braithwaite, 1962; Carpenter, 1969), Oregon (Hyman, 1963; Kenk, 1973a), Alberta (Ball and Fernando, 1968), New Mexico (Kenk, 1973a; Chandler and Darlington, 1975), and Montana, Wyoming, and Idaho (Kenk, 1973a). In 1937, D. M. Pike collected specimens of *Polycelis* from Mt. Rainier National Park, Washington, and Hyman deposited them in the National Museum of Natural History, Smithsonian Institution, under the name *P. coronata* (Kenk, 1973a).

Throughout its range, this species has been shown to be restricted to springs and streams of relatively low temperatures, and this finding was also characteristic of the species in this study. Specimens collected in Washington were observed in habitats ranging from 5 to 14 C which were at elevations of 76 to 1920 meters (250-6300 ft). The localities where pH was measured yielded values between 5.0 and 7.4. Five populations contained sexually mature individuals, and those localities exhibited considerably more narrow ranges in these aspects: temperature 10-11 C, pH 6.5-6.8, elevation 91-488 meters (300-1600 ft). Although mature individuals were collected from June through September, no conclusions can be made involving seasonal variation in this regard because many locations were inaccessible during winter months. The collection sites and field data from each site are listed below.

WHATCOM COUNTY

—spring in Bellingham, 51 individuals collected, 3 mature, 6/11/74, pH 6.5, temperature 11.0C, elevation 91 meters (300 ft).

—small stream near Sehome Hill, Bellingham, 3 collected, none mature, 5/21/74, 12.0C, 76 meters (250 ft).

—small stream on Lake Louise Road near Lake Whatcom, 4 collected, none mature, 5/23/74, 10.0C, 107 meters (350 ft).

—small stream near Lake Whatcom in Bellingham, 2 collected, none mature, 5/14/74, 13.0C, 91 meters (300 ft).

—small stream near Mt. Baker, 24 km (15 miles) east of Glacier, 43 collected, none mature, 9/21/74, pH 6.3, 5.0C, 1402 meters (4600 ft).

—small stream near Glacier Creek on Road 3409, 57 collected, 2 mature, 9/21/74, pH 6.8, 10.0C, 488 meters (1600 ft).

SKAGIT COUNTY

—small stream near Rt. 20, 29 km (18 miles) northeast of Marblemount, 76 collected, none mature, 9/28/74, pH 7.0, 12.0C, 305 meters (1000 ft).

—small stream near Old Cascade Highway, 4.8 km (3 miles) southeast of Marblemount, 62 collected, 2 mature, 9/28/74, pH 6.7, 10.0C, 183 meters (600 ft).

SNOHOMISH COUNTY

—small stream on Mt. Pilchuk, 5 collected, none mature, 8/29/74, pH 6.5, 7.0C, 1463 meters (4800 ft).

—small stream 4.8 km (3 miles) west of Monte Cristo, 211 collected, none mature, 8/29/74, pH 6.8, 9.0C, 732 meters (2400 ft).

—small stream 25.7 km (16 miles) southeast of Darlington, just east of Road 322, 108 collected, 6 mature, 8/29/74, pH 6.8, 10.0C, 427 meters (1400 ft).

—small stream near Big Four Ice Caves, 42 collected, none mature, 8/29/74, pH 6.5, 6.0C, 488 meters (1600 ft).

KING COUNTY

—small stream just east of SR 410, 12.8 km (8 miles) southeast of Enumclaw, 39 collected, none mature, 8/9/74, pH 7.0, 11.0C, 457 meters (1500 ft).

—creek just east of U.S. 2, 8 km (5 miles) west of Stevens Pass, 44 collected, none mature, 8/24/74, pH 6.2, 8.0C, 732 meters (2400 ft).

PIERCE COUNTY

—small stream 4.8 km (3 miles) northeast of Mt. Rainier, 25 collected, none mature, 8/9/74, pH 6.6, 9.0C, 1920 meters (6300 ft).

LEWIS COUNTY

—small stream 17.7 km (11 miles) northeast of Packwood, just east of SR 123, 64 collected, none mature, 8/9/74, pH 7.1, 11.0C, 640 meters (2100 ft).

SKAMANIA COUNTY

—small stream near Pimlico Creek, just north of SR 1302, 71 collected, none mature, 8/10/74, pH 6.4, 9.0C, 823 meters (2700 ft).

—small pool of water near spring in Deadhorse Cave, 21 collected, none mature, 8/10/74, pH 5.0, 6.0C, 884 meters (2900 ft).

—small stream near Swift Creek Reservoir, just south of Mt. St. Helens, 32 collected, none mature, 7/7/74, pH 6.9, 10.0C, 488 meters (1600 ft).

KLICKITAT COUNTY

—small stream just west of Road N84, 4.8 km (3 miles) north of Troutlake, 41 collected, none mature, 8/10/74, pH 6.8, 11.0C, 732 meters (2400 ft).

—small stream just west of Road N88, 3.2 km (2 miles) northwest of Troutlake, 6 collected, none mature, 7/7/74, 8.0C, 579 meters (1900 ft).

YAKIMA COUNTY

—small stream near Bird Creek, just east of Road N80, 14.5 km (9 miles) northeast of Troutlake, 45 collected, none mature, 7/6/74, pH 7.0, 10.0C, 1372 meters (4500 ft).

CHELAN COUNTY

—Bridge Creek, 14.5 km (9 miles) southwest of Leavenworth, 54 collected, none mature, 8/25/74, pH 7.4, 14.0C, 610 meters (2000 ft).

—small stream 16 km (10 miles) southwest of Leavenworth, 3 collected, none mature, 8/25/74, pH 7.1, 9.0 C, 671 meters (2200 ft).

SPOKANE COUNTY

—Big Springs on Mt. Spokane, 48 collected, none mature, 8/24/74, pH 6.5, 6.0C, 1250 meters (4100 ft).

CLALLAM COUNTY

—small stream 25.7 km (16 miles) south of Pt. Angeles, 46 collected, none mature, 8/16/74, pH 6.4, 8.0C, 1554 meters (5100 ft).

JEFFERSON COUNTY

—small stream near Hoh River Visitor Center, 51.5 km (32 miles) southeast of Forks, 86 collected, 4 mature, 8/16/74, pH 6.6, 11.0C, 183 meters (600 ft).

—small stream near Dosewallups Falls, 40.2 km (25 miles) southwest of Quilicene, 53 collected, none mature, 8/17/74, pH 6.8, 9.0C, 457 meters (1500 ft).

Dugesia tigrina (Girard)

This species along with *D. dorotocephala* is the most common and widespread triclad found in North America (Kenk, 1972) and has been reported from many types of freshwater habitats. Hyman (1963) noted the occurrence of both *Dugesia* species in Oregon, but failed to point out if they were found in the same streams and also made no mention of relative abundance. While being common in North America generally (occurring from coast to coast), this species is not nearly as common in Washington, having been found at only four localities. These habitats are considerably warmer than those of *Polycelis* and were all at relatively low elevations. The collection sites of *Dugesia* were:

WHATCOM COUNTY

- Lake Whatcom, 16 collected, none mature, 9/17/74, 17C, 91 meters (300 ft).
- Whatcom Creek (flowing from Lake Whatcom), 23 collected, none mature, 9/17/74, 18C, 91 meters (300 ft).
- Lake Fazon, 48 collected, 6 mature, 9/18/74, 15C, 76 meters (250 ft).

KITSAP COUNTY

- Long Lake, 46 collected, none mature, 8/30/74.

Unlike *Polycelis*, the *Dugesia* populations were observed in habitats with relatively slow water movement. Individuals of *Dugesia* were usually found on the aquatic vegetation in the lakes and were rarely observed on or under stones, whereas in Whatcom Creek most individuals were collected from the undersides of the larger rocks present. This behavior contrasted with that of *Polycelis* individuals which were found exclusively on the undersides of stones, possibly reflecting differences in rates of water flow.

Phagocata sp.

This triclad was found at a single locality in Bellingham, Whatcom County, a temporary pond which was present for only three months of the year. This pond was formed by heavy rainfall and melting snow during April of 1974 and 1975 and became dry by June of each year. Individuals of various sizes (3 to 10 mm) and colors (white, pink, tan) appeared soon after formation of the pond and were very abundant (hundreds of individuals observed) but extremely variable. Reproduction by fragmentation was observed as the pond began to warm and dry, similar to the processes reported in *Phagocata velata* (Stringer, 1909; Castle, 1928; Castle and Hyman, 1934; Kenk, 1944, 1972) and *P. vernalis* (Kenk, 1944, 1972). Further details of this process and illustrations of the Washington forms have been presented elsewhere (Nixon, 1977).

Sphalloplana sp.

A collection of specimens probably belonging to this genus has been made by C. M. Senger in a pool in Deadhorse Cave, Skamania County, during 1975 and 1976 (R. Kenk, pers. comm.). This is the same locality where partially cave-adapted specimens of *Polycelis* have been collected (Nixon, 1975, and this report). Like many cave-adapted forms, the *Sphalloplana* are white, eyeless planarians (Senger, pers. comm.), probably having lost pigmentation through regressive evolutionary processes.

Dendrocoelopsis vaginata Hyman

While not collected by the author in this study, this species has been recorded by Kenk (1973b) from Nigger Creek, Whitman County. Although Kenk does not mention the co-occurrence of this species with other triclads at this locality, B. Z. Lang observed (pers. comm.) that *Dendrocoelopsis*, *Polycelis*, *Phagocata* and *Dugesia* co-exist in many springs and streams in seven eastern Washington counties. Specifically, Lang has recorded *Polycelis coronata*, *Phagocata oregonensis* and *Dendrocoelopsis vaginata* at the following localities:

WHITMAN COUNTY

- numerous springs at north end of Rock Lake.

SPOKANE COUNTY

- spring in city of Cheney.
- spring and brook below Pine Lake.

ADAMS COUNTY

- spring and brook 8 km (5 miles) north of Washtucna.

In addition, Lang noted that *Dendrocoelopsis vaginata* and *Dugesia* sp. were found in a creek in Spokane County, 8.8 km (5.5 miles) north of Reardan. He also collected *Dendrocoelopsis vaginata* and *Polycelis coronata* together at a spring west of Spring Lakes in Lincoln County. Although I recorded virtually no instances of coexistence of freshwater triclads in western Washington, such coexistence is common in eastern Washington. The causes of this difference are extremely puzzling, and elucidation of environmental factors involved in the dichotomy would be a worthy topic for future ecological research.

Discussion

The question of sexuality in natural populations of triclad flatworms is extremely complex, and the factors involved in inducing sexual maturity are probably different in each species. Indeed, differences among populations of a single species may vary in this regard. Kenk (1972:22) indicated that in *Dugesia dorotocephala* some populations may rely completely upon asexual reproduction but in others sexual reproduction may prevail. This may be the case in the Washington populations of *D. tigrina* as well, seeing that in one Whatcom County population sexually mature individuals were observed while in another none were observed.

In Washington populations of *Polycelis*, sexually mature individuals were relatively rare in most cases, and no egg capsules or cocoons were observed. Kenk (1973a) noted that no capsules or cocoons have ever been observed in any of the North American species of *Polycelis* and that the factors involved in inducing sexuality are unknown. The effect of temperature on sexual maturity and other aspects of the life cycle in European triclads has been shown by various workers (Reynoldson, 1960; Reynoldson *et al.*, 1965; Taylor and Reynoldson, 1962) and may also be important in North American species. Indirect evidence regarding temperature may be seen in the Washington populations of *Polycelis* which were observed in habitats between 5 and 14C. However, in the 28 populations studied, sexually mature individuals were observed only in those habitats between 10 and 11C, a relatively narrow temperature range.

In the *Phagocata* population studied in Whatcom County, sexually mature individuals were never observed; reliance upon the asexual process of fragmentation may be caused by the short time period available during the year.

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