

Ecomorphosis in *Proisotoma vesiculata* Folsom

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Introduction

A number of species in the Order Collembola, particularly in the family Isotomidae, exhibit a phenomenon known as ecomorphosis. During late spring, apparently in response to environmental factors such as rising temperatures and lowered soil moisture, individuals undergo morphological and physiological changes. The most spectacular change in many species is the appearance of four to six stout spines (usually papillate) dorsally on the rear of the abdomen. Stach (1966) erected a genus, *Spinisotoma*, to accommodate Isotomidae bearing such spines. For a review of ecomorphosis in Collembola, including a list of species assigned to the genus *Spinisotoma*, see Cassagnau (1956, 1971), Cassagnau and Fabres (1968), and Wonio and Pedigo (1974).

Folsom (1937) described *Proisotoma vesiculata* and commented in his description, "At the extremity of the dens is a large lateral transparent bladderlike dilation extending beyond the mucro."

This study reports an ecomorphic form of *Proisotoma vesiculata* and presents life history data which suggests that the vesicle (Fig. 1C) observed by Folsom is only present during a very short part of the life cycle (possibly during only one instar).

Results and Discussion

During 1974 and 1975 four individuals of a species of *Proisotoma* subgenus *Appendisotoma* were collected. They were considered to be ecomorphic because of six distinctive papillate spines borne dorsally on the last abdominal segment (Fig. 1A). The specimens closely resembled *Proisotoma (Appendisotoma) vesiculata*, a species not known to occur in Indiana, but differed in possessing abdominal spines and lacking dental vesicles (Fig. 1B).

In 1976, collections were made on 13 occasions—June through December. From June until late October only ecomorphic forms were taken, but on October 24 two slides were made in which ecomorphic individuals were in the process of molting from the ecomorphic form (with six large abdominal spines and no vesicle) to the normal form of *Proisotoma vesiculata* (without spines and with a vesicle).

During the period of study, 1974-1978, 56 collections were made and 665 slides were examined. Table I summarizes life cycle data. First instar young could not be identified with certainty, but considering that spermatheca were observed in the genital tract of males March 13, and first instar *Proisotoma* were present in the collections about April 1, it was reasonable to conclude that eggs were deposited about the last week in March. The molt from normal young to ecomorphic young took place for the most part in May and early June. By the

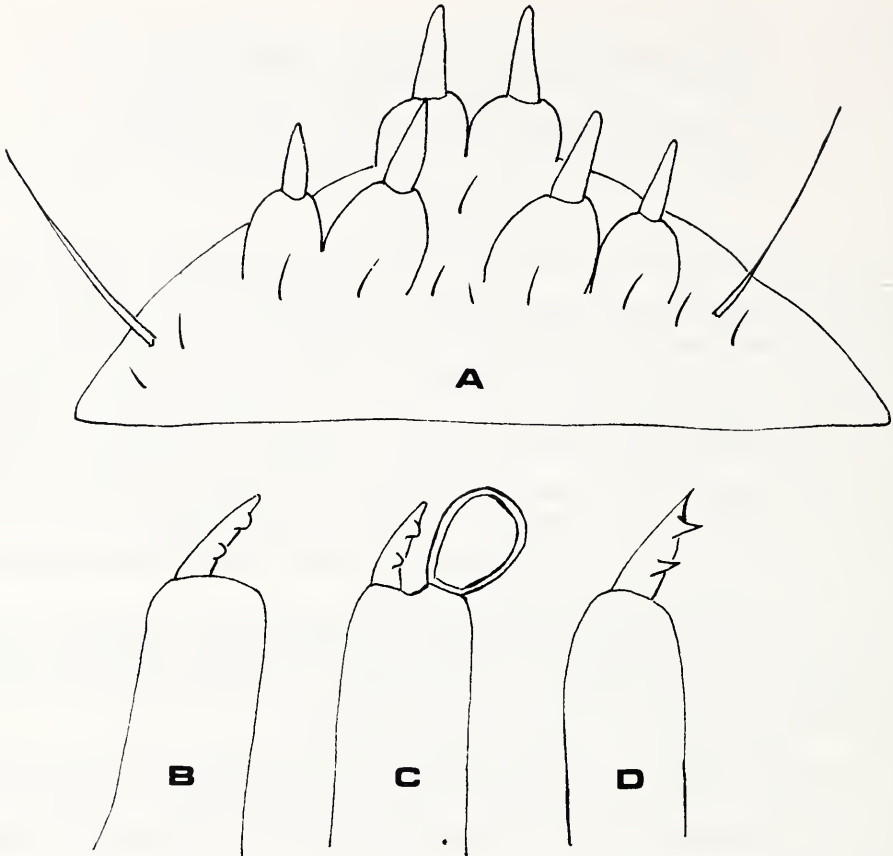


FIGURE 1. *Proisotoma vesiculata*. (A) Dorsal abdominal spines of an ecomorph. (B) Tip of dens and mucro of an ecomorph. (C) Tip of dens showing vesicle and mucro. (D) Tips of dens and mucro of adult.

first of July only ecomorphic forms were taken. Starting in late October, the ecomorphic forms molted to normal forms, and at this stage the vesicle first appeared. No hypothesis was formed as to its function, but it was only observed during October, November, and December. All mature adults collected in March were without the vesicle.

TABLE I Seasonal distribution of normal and ecomorphic young and adult *Proisotoma vesiculata*.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Eggs				—								
Young (normal, w/o vesicle)				—	—							
Young (normal, w/vesicle)											—	—
Young ecomorphic)					—	—	—	—	—	—	—	—
Adults (w/vesicle) ¹											—	—
Adults (w/o vesicle)			?	—	—	—	—	—	—	—	—	—

¹Type specimens were collected December 7, 8.

In a separate study (Gary Bannon, unpublished) the electron microscope was used to investigate the ultrastructure of the digestive tracts of normal and ecomorphic individuals of *Proisotoma vesiculata*. Bannon's conclusions agreed

with those of Cassagnau and Fabres (1968) who found that the mesenteron of ecomorphic forms was highly abnormal. It is probable that ecomorphic forms do not feed but depend on fatty deposits in the body as sources of energy, and in sections of ecomorphs examined by Bannon, numerous fat bodies were present. If ecomorphs do not eat and hence do not grow, they probably do not molt during ecomorphosis, and indeed, no instance was found in this study of an ecomorph to ecomorph molt.

It is difficult to determine the arrival of sexual maturity in Collembola, for the presence of a genital opening may be noted a number of weeks in advance of egg laying or sperm deposition. It should be noted also that sexually mature individuals continue to molt (Christiansen, 1964). With the exception of three large ecomorphic individuals which showed evidence of genital openings (one female, two males), all ecomorphs were juveniles. Even after the molt from ecomorphic to normal form, most individuals remained in the juvenile stage. It is unfortunate that severe winter weather in Indiana during 1976 and 1977 precluded sampling during January and February, for it is during this period that the vesicle is lost and sexual maturity arrives.

This study is the first to report ecomorphosis in the genus *Proisotoma*, but two additional undescribed species of *Proisotoma* (*Appendisotoma*) which exhibit this phenomenon are under study, and it is possible (if not probable) that all of the members of this subgenus exhibit ecomorphosis.

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