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ABSTRACT

Six species of terrestrial isopods were found in a preliminary survey of appropriate habitats at the UWM Field Station. Each species is characterized briefly with distinctive features of its morphology and life cycle.

INTRODUCTION

Terrestrial isopods are among the most commonly observed and familiar of all crustaceans. They frequently are found in habitats near our homes and have the unusual distinction (for crustaceans) of numerous common names, among them pill bug, sow bug, potato bug, woodlouse and slater. They have drawn the attention of ecologists and play a major role in some of the classic studies of the dynamics of the forest floor fauna (LaMont Cole's 1946 study of the cryptozoa of an Illinois woodland for example).

What part do these isopods play in the ecosystems where they are present? They are generally regarded as primary decomposers, feeding on dead plant material and breaking it down into soil-sized pieces. However, investigations into the feeding and digestive processes of isopods have shown that the primary decomposers of the foods they ingest may actually have been microorganisms "softening up" the leaf litter and other organic debris before it is ever ingested by isopods (Neuhauser and Hartenstein, 1978). This evidence would place isopods more in the role of secondary decomposers. Another aspect of the digestive physiology of terrestrial isopods is that they are capable of concentrating heavy metals within their bodies, and there is some evidence that they might thus be useful as environmental indicators of the presence of these materials in contaminated soils (Weiser, et al., 1976).

Another aspect of the role of isopods in ecosystems is their predators. Potential isopod predators include centipedes, spiders, beetles and small vertebrates such as shrews. Because of the difficulty of conducting field studies of such predation, laboratory tests have been used to show that at least under certain conditions, such as when the predators are sufficiently hungry and when the prey animals are young, isopods will serve as food for carabid beetles, lycosid spiders, centipedes, toads and other predators. We have observed that these organisms share the microhabitats of isopods at the Field Station. Sutton (1970) devised a chemical way of testing the gut contents of predators removed from the field to detect whether or not they had been feeding on isopods. This method provides a more accurate picture of the true isopod predators within a particular ecosystem. Estimates of the contribution of isopods as prey to the bioenergetics of such ecosystems have been few; one of them (White, 1968) concluded that isopods probably make a greater contribution to the energy flow of ecosystems by their role in the breakdown of leaf litter than by their role as prey.

Our goal in this note is to give an introduction to the isopod species we have found at the Field Station and some sketch of their habits and habitats.

METHODS

Table 1 shows the collecting localities for the six species we collected at the Station for June through October. These localities represent the range of habitats potentially occupied by terrestrial isopods. In each of these we searched the leaf litter layer and dead wood (logs, stumps, etc.) for the presence of isopods. Isopods were collected by hand, using featherweight forceps or an aspirator to pick up individual specimens, which were subsequently preserved and stored in 70% ethanol. Measurements were made using a wild M5 stereomicroscope fitted with 20X widefield eyepieces and an eyepiece graticule. Graticule units were converted to the nearest tenth of a millimeter.

RESULTS and DISCUSSION

Six species of isopods were found in four habitats at the Field Station (Table 1). Within these habitats, the isopods showed a very uneven pattern of distribution, being aggregated in those areas providing the best combination of the required physical (humidity, temperature, etc.) and biological (nutritional sources, etc.) factors, such as decaying logs on the floor of the Upland Woods. Boards (area approximately $1m^2$), which have been placed on the ground in grassy areas at the Station to shelter snakes, provide excellent niches within the field habitat. We typically collected 50 or more isopods by flipping over one of these boards.

Table 1. Habitats in which six species of isopods were found at the Field Station.

	Upland Woods	Field	Buildings and Immediate Vicinity	Along Bog Boardwalk
Cylisticus convexus			X	
Hyloniscus riparius	X			X
Porcellio spinicornis			X	
Porcellionides pruinosus			X	
Trachelipus rathkei	X	X	X	X
Trichoniscus pusillus				X

The species we have collected to date at the Station are all thought to have been introduced to North America from Europe. The state isopod lists for Iowa (Longnecker, 1923), Michigan (Hatchett, 1947) and Minnesota (Sargent, 1973) contain several other species, but only one (Ligidium elrodii) is thought to be native to North America. The evolutionary history of terrestrial isopods suggests they became land animals directly by emergence from the marine near shore habitat, rather than via a freshwater route. Of all crustaceans, terrestrial isopods are unique in the degree to which they have adapted to life on land. One of the prominent morphological adaptations which facilitates their uniquely nonaquatic existence are the pseudotracheae, a mass of tiny air channels connected to the outside through a small pore. The small pore cuts down water loss associated with oxygen uptake. Pairs of pseudotracheae are located on the underside of the abdomen in most terrestrial isopod species. A few species lack them completely and show far less tolerance to conditions of low humidity. Hyloniscus riparius and Trichoniscus pusillus lack pseudotracheae but Porcellio spinicornis and Porcellionides pruinosus have two pairs and Cylisticus convexus and Trachelipus rathkei have five pair each.

Features such as the number of pair of pseudotracheae are not always easy to observe in the field and it is often assumed that all isopods collected together belong to the same species. Superficially they do resemble each other, with a principal difference being their adult size. Hyloniscus riparius and Trichoniscus pusillus are both quite small with maximum lengths of 5 to 6 mm. The other species range from 12 to 16 mm in body length as adults. This difference allows at least the separation of those species that are distinctively small from those that are larger. Sutton (1980) reports that head width measurements are relative to overall size and, because other morphological features influence apparent body length, actually give the better comparison for preserved specimens. From a single sample containing three of the larger species from one collecting site, we obtained the figures in Table 2 which still indicate significant size overlap.

Table 2. Head width measurements of three of the larger species of isopods.

	N	MEAN + SD
Cyclisticus convexus	33	1.4 + 0.47 mm
Porcellio spinicornis	16	1.3 + 0.38 mm
Trachelipus rathkei	8	1.6 + 0.19 mm

An additional complication associated with using isopod morphology for identification is that immatures are not merely tiny replicas of adults, but differ from them in such key features as the relative lengths of antennal segments, a factor which can be used to help separate species as adults. The young develop from eggs and are kept in the brood-pouch (marsupium) on the ventral surface of the thorax of the female. Temperate climate terrestrial isopods may have one or two broods per year and we looked for a seasonal pattern in the percent of gravid females (those with eggs or young in the brood-pouch).

There are a few distinctive characteristics which may allow the identification of species in the field without the aid of a microscope. Cylisticus convexus is the only one of the six species collected capable of rolling itself up into a ball. Its posteriorly projecting uropods prevent its forming a completely closed sphere (unlike members of the genus Armadillidium, the true "pill bugs"). Females of this species ranged from a high of 32% gravid in July to a low of 0% in October.

A unique feature of the species Hyloniscus riparius is that it has only one eye on each side of the head. This is a feature one might be able to see in the field with a good hand lens. All other Field Station species have either three simple eyes or a compound eye with many ommatidia. Of the females of this species examined from our Field Station collecting, 14% were gravid in September but none were in October.

Porcellio spinicornis has a distinctive color pattern; dorsally, the head and abdomen are black (the abdomen is dark ventrally also), contrasting with the lighter thorax. Some individuals also have a double row of yellow patches down the back. Sutton (1980) emphasized the distinctiveness of the habitat preference of this species, saying that the close correlation between its presence and limestone shows a limiting factor which determines the localities in which it can survive. We found this species only in the limestone gravel at the greenhouse entrance and near the concrete portions of other Field Station buildings. Our preliminary data show this species to be the most strongly seasonal in its life cycle pattern; while 83% of the females were gravid in July, none of those collected in other months were.

Porcellionides pruinosus is a species which also has distinctive coloring. When alive, individuals appear to have a frosty "bloom" over their light gray surface. The gray antennae have distinct white bands at the joints, a feature seen in preserved specimens as well. We discovered this species at the Station only recently, in October, 1987 and therefore have no indication of what its life cycle might be. None of the females we collected were gravid.

Trachelipus rathkei is the least distinctive morphologically, having a color pattern that is quite variable. However, it is the most widespread, being found in every major habitat (see Table 1) and also the most numerous. It is the least seasonal in its life cycle pattern, with roughly a third of the females being gravid in June, July and August, although the percentages for September and October were both zero.

Trichoniscus pusillus has three simple eyes on each side of the head, although because of its small body size (5 mm) this distinctive feature may be difficult to see, even when comparing this species to the superficially similar Hyloniscus riparius under high magnification. We have data for females from

September only, when 64% of them were gravid.

Other species commonly found in southeastern Wisconsin which we still have not found at the Field Station are Armadillidium vulgare and Porcellio scaber. The relatively simple observation of the presence or absence of certain species in a particular locality, such as the Field Station, only serves to trigger one's curiosity as to the ecological factors underlying those observations. Why Trichoniscus pusillus, for example, is found in only one habitat while Trachelipus rathkei is everywhere is the kind of question whose answer would require a detailed knowledge of the species-specific limiting factors for each of these isopods and the ability to accurately measure these parameters in the field. Do the islands in the Bog function as true zoogeographic islands, harboring an isolated population of terrestrial isopods? What are the factors governing the degree of niche separation which allows as many as four different isopod species to live together under the bark of one tree stump? This paper is a preliminary report on a project that will be continued at the Station.

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