Rev. Biol. Trop., 16(1): 129-143, 1969

# Anomalous Specimens of Philoscia pruinosa (Richardson, 1913) from Costa Rica

by

George A. Schultz*

(Received por publication September 20, 1967)

RICHARDSON (1) described a new species of terrestrial isopod crustacean from Costa Rica that she called *Pentoniscus pruinosus* placing it in a new genus *Pentoniscus* because, according to her, there were five articles in the flagellum of the second antenna. According to a review of the genus by SCHULTZ (2), *Pentoniscus* is a synonym of *Philoscia* because there are three, not five, flagellar articles, thus, the correct name of the especies is *Philoscia pruinosa* (Richardson, 1913). The specimens described here were taken at several locations in Costa Rica. A more complete account of Costa Rican isopods is now nearing completion. This is a partial account of anomalous specimens found in several populations of *P. pruinosa.*

It is the object in this paper to describe some of the specimens that were found, especially those that were most distinct from the normal specimens which constituted the majority of animals in most *Philoscia pruinosa* populations in Costa Rica. Two major anomalous types of *P. pruinosa* specimens were found. The first and most widespread anomaly involved morphological and pigmentation differences in both sexes. The second anomaly was confined to females (no males were found) and included body width-length ratio differences and total (except eyes) lack of pigmentation.

An individual abnormality was also discovered —it was a modification of the merus of the seventh walking leg of a normal male isopod. It would probably have been overlooked if the specimens were not so thoroughly examined to find specimens with the other anomalies described here. Other than the fact that the abnormality consisted of at least four scaly growths involving the integument of the merus (fig. 4 K), nothing more will be said of it.

---

* 15 Smith St., Hampton, New Jersey 08827, U.S.A.

This study was done under support of the Organization for Tropical Studies, Inc., University of Costa Rica. The author wishes to thank the members of the Organization for Tropical Studies and especially Dr. Alvaro Wille, Faculty of Agronomy, Department of Entomology, for their assistance in the project.

## OBSERVATIONS

The first group of morphologically modified isopods has three anomalies, all of which are directly correlated to the other two according to the degree of their modification. The most extremely modified forms of isopods (both males and females) have elongate bodies, white non-pigmented integuments and very elongate pleopods. Each population of the species was characterized by a different percentage of anomalous specimens. Collections accurately reflecting the percentage of anomalous specimens were not made because it was not immediately apparent upon collecting the isopods in the field that there were different morphological types in the populations. Another difficulty of establishing the exact percentages of anomalous specimens was that there was a gradient of morphologically modified and pigmented specimens in the populations. Specimens ranged from normal animals to animals that were highly morphologically modified and pigmentless. Since there is a gradient of morphological differences in the specimens from extremely modified to normal, they do not represent a distinct variety or new species.

The three principal differences found between the normal and anomalous *P. pruinosa* specimens will now be examined in more detail. The first difference is color. Normal pigmentation consists of a wine-red base color with a pattern of unpigmented spots or white patches arranged in a bilaterally symetrical pattern, not differing much from other *Philoscia* species. There is a normal, but not wide, range of pigmentation differences in specimens from populations of normal animals. Pigmentation in highly anomalous specimens is absent except for eye pigmentation. There is a range of pigmentation in anomalous specimens all the way from the normally pigmented to the completely pigmentless forms, hence, the range in degree of pigmentation is much wider in the anomalous forms than in the normal animals. There seems to be a positive correlation between the lack of pigment and the degree of morphological difference in the anomalous animals, although some apparently highly morphologically different forms do have some pigmentation.

The second difference, elongation of the body (both the thorax and abdomen) of the animals, is seen in both sexes. If the proportion of the body width-length in a normal specimen is taken as the basis for comparison, it is found that for an average of five males and five females it is a ratio of 1:2.8. When the same measurements are taken on the specimens represented in the drawings presented here of a male and female that are extremely anomalous, they are 1:3.6 for the male and 1:3.5 for the female. No complete analysis of a series of normal or anomalous specimens has yet been made, but the preliminary observations show that the more elongate the animal the less pigmented it is.

The third difference is in the pleopod or abdominal appendage shape. The antennae, the walking legs and the mouth parts appear to be similar in proportion to the respective appendages of normal animals. Only the pleopod shape then appears to be anomalous, and all five pleopods are more elongate than their normal counterpart. The anomalous shape mostly is confined to the exopod portion of the pleopod, but on the second pleopod which is important for sexual function of the male, the endopod is extremely elongate, being about twice the length of the normal endopod and quite distinctly seen projecting out from behind the isopod (dark structures, fig. 2 A). In some marine isopods the endopod of the second male pleopod is known to project out from behind the body, but in terrestrial isopods, it has never been recorded that way except as an anomaly. The other four endopods of the pleopods are only slightly elongate, but even for a population of normal animals, there is very little recorded about the normal variation of the endopods.

The five exopods differ in degree from normal to highly anomalous, elongate pleopods, and apparently a series of exopods, each minutely differing from the next and forming a long series of exopods, from normal to highly anomalous, can be made. A comparison of the male fifth pleopods (figs. 1 F, 4 K and 2 G and H) at once reveals the extreme differences of shape and structure in the exopods of the pleopods. The degree of difference from normal of female pleopods is seen to be less (compare fig. 4 F, the normal, with fig. 3 F and K). A more detailed discussion of the exopodal differences will now be made. How significant the differences are will only be known when the individual variation of the characters is studied in more detail.

The male first exopod is the least elongated of the exopods, but inspection and comparison of figures 1 and 2 B show that in the anomalous male the exopod is longer than wide, whereas, in the normal specimen, it is wider than long. There is also a difference in the length of the genital apophysis associated with the first pleopod. That of the anomalous male is proportionately longer in relation to the total length of the pleopod than that of the normal male. The apex of the endopods is also different. There are apparently scales near the end of the narrower apex in the elongate specimens (compare figs. 1 B and 2 D), but none are present in the normal male. The exopod of the second pleopod of the anomalous male is more elongate than that of the normal male and it ends in a sharper point. The exopods of the third and fourth pleopods are also more elongate and pointed than those of the normal pleopods. The most dramatic difference in exopod length is found on pleopod five. In the normal male, the fifth exopod is slightly longer than wide; in the anomalous male the exopod is four times longer than wide. The tips of the exopods are extremely produced, and project posteriorly from beneath the whole animal as seen in the dorsal view (fig. 2 A, white structures near endopods of uropods).

The anomalous females have pleopods that do not differ greatly from the pleopods of the normal females. Exopods of pleopods of normal females are very similar to those of non-pigmented females (see fig. 4 B-F), so illustations of normal female pleopods are not included here.' The pleopods of two anomalous females from the same population from which the males were obtained are shown in figure 3. Those of the first female (fig. 3 B-F) are less elongate than those of the second female (fig. 3 G-K). The body of the first female was slightly pigmented and that of the second female (fig. 3 A) was pigmentless. The pigmentless second female specimen was morphologically most different from the normal females. In the set of pleopods from the first female, only the fourth (fig. 3 D) and the fifth (fig. 3 F) are elongate. The third, fourth and fifth pleopods each have extra spines on the posterolateral edge when compared to the number of spines in the normal female. Each exopod from the set of anomalous female pleopods from the second female is elongate. All except the first exopods are longer than broad, but the first is still proportionately longer than that of a normal female.

There are apparently almost always a larger number of spines on the posterolateral edges of the exopods in anomalous isopods when compared to the number on those structures in normal animals. In the normal animals there is apparently no fixed number of spines per exopod, since observations have shown that spine numbers of one more or one less than that recorded here are occasionally found. However, the most probable number of spines for normal animals per exopod is that recorded here in the illustrations. For the normal and anomalous animals illustrated here, the first exopod on the male and female has no spines. On the second exopod the normal male, female and the anomalous female each have only one spine on the exopod, but the anomalous male has three spines. On the third exopod there are three spines on the normal male and female. On the third exopod of the second set of exopods (fig. 3 I) from an anomalous female, there are also three spines; but there are four spines on the exopod from the anomalous female represented by the first set (fig. 3 E), and four spines are on the exopod of the anomalous male.

On the fourth pleopods there are three spines on exopods of the normal male and female; but there are five spines on the fourth of the first set of anomalous female exopods, and four spines on the exopod of the second set of an anomalous female. The anomalous male has five spines on the exopod. The fifth exopod has two spines on the normal male, female and second anomalous female; but the first anomalous female has three spines and the male has none (fig. 4 K), or three on one and four on the other of the bilateral pair of exopods from one animal (fig. 2 G and K). On exopod five one anomalous set of exopodal spines has what are apparently sensory elements projecting from near the tips of the spines (fig. 2 G). The exopods pictured in figure 2 G and H are from the same animal. It thus can be seen that an anomalous male exopod can differ not only from other exopods, but also from its bilateral partner, hence, there is some difference in exopod structure depending upon whether the exopod is from the right or left part of the animal. This is probably true for the other four pleopodal exopods as examination of a series of animals undoubtedly would reveal.

The pleopods of the anomalous isopods have been shown to differ in width-length ratio just as the bodies of the anomalous animals differ in width-length ratio. They also differ in number of posterolateral spines on the exopods of the pleopods. Animals that have an elongate body are almost always lighter in color than normal in addition to having the elongate pleopods, hence, the differences in body color, proportions and pleopodal structure are related.

So far, there have been no investigations of the population structure biology of the anomalous specimens, so that it cannot be compared to that of the normal specimens. However, anomalous females are found to be gravid and have eggs and embryos in their marsupia. They appear to be similar to the normal animals in male-female ratio, body lengths, percentage of gravid females, brood number, etc., but actual statistical comparisons have not been made. Since the anomalous isopods differ from the normal by degrees of differences, there is at present no reliable criterion whereby slightly anomalous animals can be readily differentiated from normal animals. Hence, their population structure biology cannot be studied independently of the normal isopods. It would be interesting to discover if the morphologically anomalous animals were different from the normal animals in population structure, but more collections must be made to provide statistically reliable samples for a detailed analysis.

In addition to the morphologically anomalous specimens, a second anomalous population of *P. pruinosa* was found. The population was composed of pigmentless (except for the eyes), proportionately elongate, but shorter females (fig. 4 A). No normal, or morpohologically anomalous animals, nor males were among the 175 specimens collected at the one site where the female population was found. There was no range of color difference between the white female specimens and specimens of the normal wine-red color found at other sites, although some normal males and females can be lightly pigmented. The specimens from the population composed exclusively of females then differed in kind, not degree, from the normal specimens. There were no striking morphological diffrerences in the pleopods of the white females when compared to the pleopods of the normal specimens (fig. 4 B F). However, the body width-length proportion (1:3.3) was closer to that of the anomalous females (1:3.5) than to that of the normal females (1:2.8). Not only were the pleopods of normal shape, but the appendages from other parts of the body appeared to be of the same proportions as those of normal animals.

The average length of the 175 white females was 2.58 mm, and that of a population of 86 normal males and 129 normal females was 2.52 mm. The 129 normal females averaged 2.84 mm long, a difference of only 0.26 mm longer than the white, but proportionately more elongate females. The white females carried both eggs and embryos so the eggs were viable. The number of eggs in the marsupia of the white females averaged 6 per female, and the number in the normal females averaged 6.04 per female. Of the white females, 23.8 %, and, of the normal females, 41,8 % were carrying offspring in their marsupia. The population structure data are not much different in the two populations. However, really definitive biological studies have not been made and, enough collecting has yet to be done to determine if the females represented a monogenic or a parthenogenetic breeding type. The population definitely is different from a normal breeding population of *P. pruinosa* that also differs from the normal animals in body width-length ratio and lack of pigmentation. The name *alba* is hereby proposed as the subspecies name.

## DISCUSSION

There seems to be no obvious relationship between the two major *P. pruinosa* anomalies. The morphologically anomalous specimens do not appear to be part of a separate population, but the anomalous characters intergrade with the normal characters and together they form some kind of poles between which a balanced polymorphism is present. What the actual genetic difference, or differences, may be remains to be discovered.

The pigmentless female population, while of approximately the same body width-length ratio and with the same lack of pigment as the extremely anomalous females of the morphologically anomalous group, are not morphologically different from the normal *P. pruinosa* specimens in any major way. The population of pigmentless females could have reproduced by monogeny, a preponderance of females giving rise to only female offspring (VANDEL 4, p. 495) or by parthenogenesis, an asexual reproduction of unfertilized eggs to produce only females. Parthenogenetic races are known in the trichoniscid isopods, and they are in some instances known to have a different chromosome number from the parent or normal race (VANDEL, 3, p. 318). Unfortunately the different anomalous subgroups of *P. pruinosa* species were not anticipated when the collections were made, so a histological fixative was not used to preserve the chromosomes of the specimens. Populations of normal *P. pruinosa* are found throughout Costa Rica, and the species undoubtedly is one of the principal leaf litter inhabiting isopod species of Central America. They were found in a wide variety of other types of habitats, and were frequently taken with other species. More effort should be made to collect significantly large collections of the species for statistical analysis of the anomalous part of the populations. Since the isopods are very important reducer organisms, reducing the leaf litter to soil, they deserve further study.

## SUMMARY

Specimens of populations of the terrestrial isopod crustacean species *Philoscia pruinosa* (Richardson, 1913) from Costa Rica were found to contain two anomalous morphotypes in addition to normal animals. In the first morphotype, the anomaly consisted of an elongation of the body and pleopods, of both males and females, with a general loss of body pigmentation. A range of differences in morphology occurred between the extremely anomalous isopods and the normal specimens. In general, specimens with the most elongate bodies and pleopods had no pigment, and the differences were positively correlated in degree with each other. It was thus impossible to establish exact criteria of classification of the morphologically anomalous animals from the small collections made. Gravid

females with eggs and embryos in their marsupia were regularly found among the morphologically anomalous females.

The second group of anomalous isopods consisted of pigmentless females. No males were found and it is probable that the specimens represented a mono- genic or a parthenogenetic race of the species. The pigmentless females had bo- dies that were more elongate than normal females and the females formed a group that was quite distinct from, without intergrading with, the normal animals. Gravid females with eggs and embryos were found, and the population structure biology of the pigmentless females was very similar to that of the normal group. Since the difference was one of kind, rather than degree, the population is given the subspecies name *alba.*

An abnormality of the merus of the seventh walking leg of an otherwise normal male is briefly described and illustrated.

## RESUMEN

Se encontraron dos morfotipos anómalos en especímenes de la especie de isópodo crustáceo terrestre *Philoscia pruinosa* (Richardson, 1913) de Costa Rica. En el primer morfotipo la anomalía consistió en la elongación del cuerpo y los pleópodos en animales de ambos sexos, con pérdida general de pigmentación corporal. También aparecieron varias diferencias entre la morfología de los isópodos altamente anómalos y la de los especímenes normales. Generalmente los especímenes con cuerpos y pleópodos alargados carecían de pigmentación y las diferencias se relacionaron cuantitativamente entre sí. Debido a los escasos números de la colección no fue posible establecer criterios exactos de clasificación de los animales morfológicamente anómalos. Generalmente se encontraron hembras grávidas con huevos y embriones en sus marsupios entre las morfológicamente anómalas.

El segundo grupo de isópodos anómalos consistió de hembras sin pigmentación. No se encontraron machos y es probable que los especímenes representan una raza monogénica o partenogenética de la especie. El cuerpo de estas hembras era más alargado que el de las normales y formaban un grupo diferente, aunque sin presentarse ejemplares intermedios. Se encontraron hembras grávidas con huevos y embriones y la biología de la estructura de población de las hembras sin pigmentación era similar a la del grupo normal. Por ser la diferencia cualitativa y no cuantitativa se le dio el nombre *alba* a la subespecie.

Se describe brevemente e ilustra una única anormalidad en el mero de la sétima pata ambulatoria de un macho.

# LITERATURE CITED

1. RICHARDSON, HARRIET
1913. Terrestrial isopods collected in Costa Rica by Mr. Picado, with the description of a new genus and species. *Proc. U. S. Nat. Mus.*, 44: 337-340.

2. SCHULTZ, G. A.
1968. The reduction of *Pentoniscus* Richardson (1913) to a synonym of *Philoscia* Latreille (1804) with notes on disposition of the species (Isopoda: Oniscoidea). *Crustaceana*, 15 (1): 15-18.

3. VANDEL, A.
1960. Isopodes terrestres. Première Partie. *Faune de France*, 64: 1-416.

4. VANDEL, A.
1962. Isopodes terrestres. Deuxième Partie. *Faune de France*, 66: 417-931.

Fig. 1. Normal male pleopods. A. First pleopod. B. Detail of endopod of first pleopod. C. Second pleopod D. Third pleopod. E. Fourth pleopod. F. Fifth pleopod.

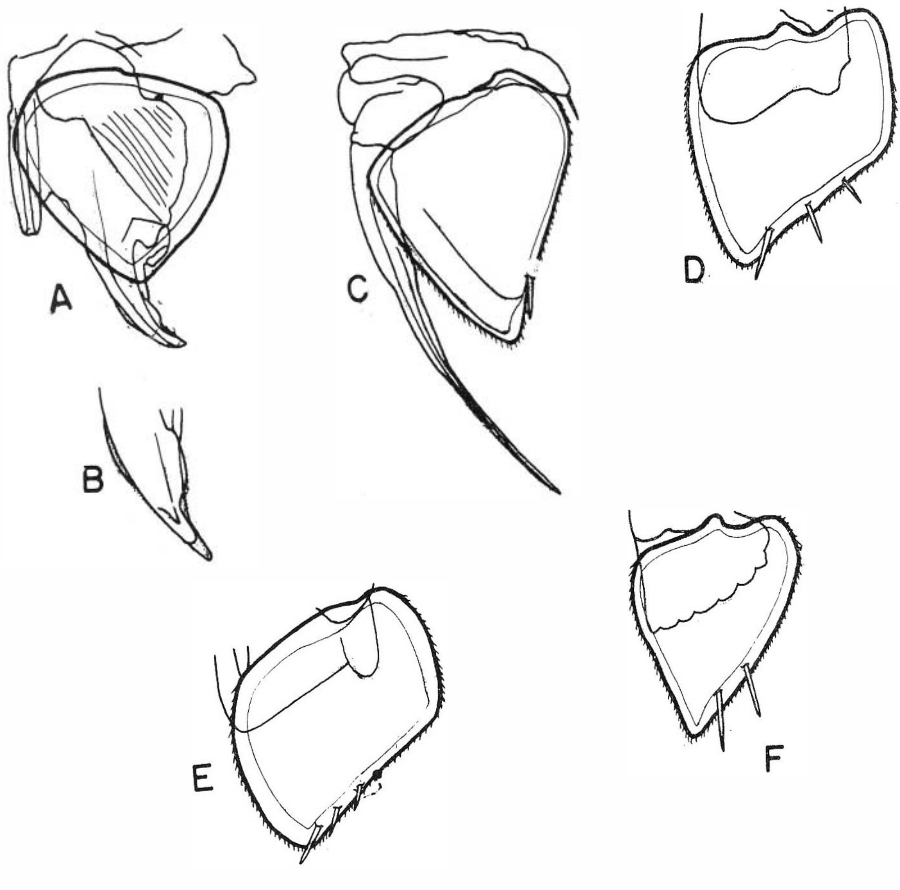


Fig. 2. An anomalous male. A. Dorsal view. B. First pleopod. C. Second pleopod. D. Detail of endopod of first pleopod. E. Third pleopod. F. Fourth pleopod. G.-H. Fifth pleopods. I. First walking leg. J. Dactylus and propodus of second walking leg. K. Dactylus and propodus of seventh walking leg.

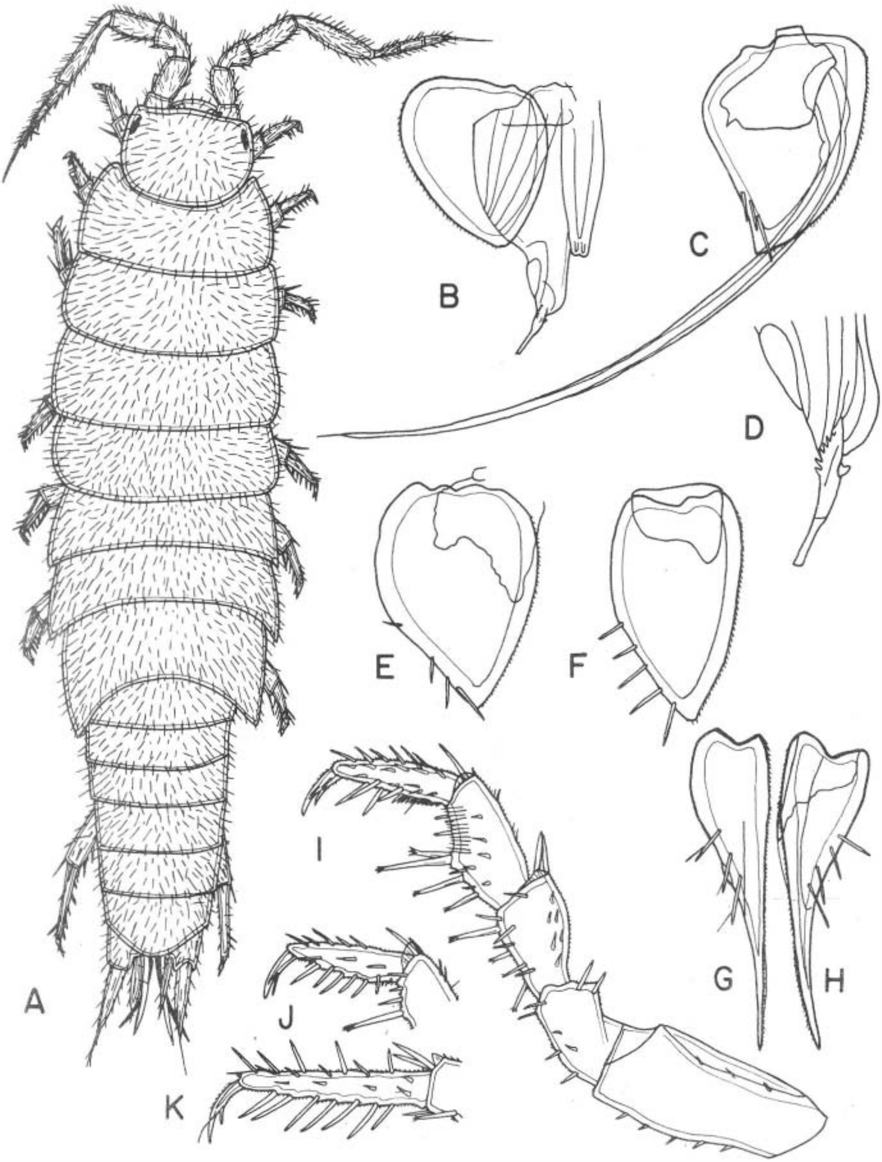

A
B
C
D
E
F
G
H
I
J
K

Fig. 3. An anomalous female. A. Dorsal view. B. First pleopod. C. Second pleopod. D. Fourth pleopod. E. Third pleopod. F. Fifth pleopod. G. First pleopod. H. Second pleopod. I. Third pleopod. J. Fourth pleopod. K. Fifth pleopod. L-M. Dactylus and propodus of seventh walking legs. N. First walking leg.

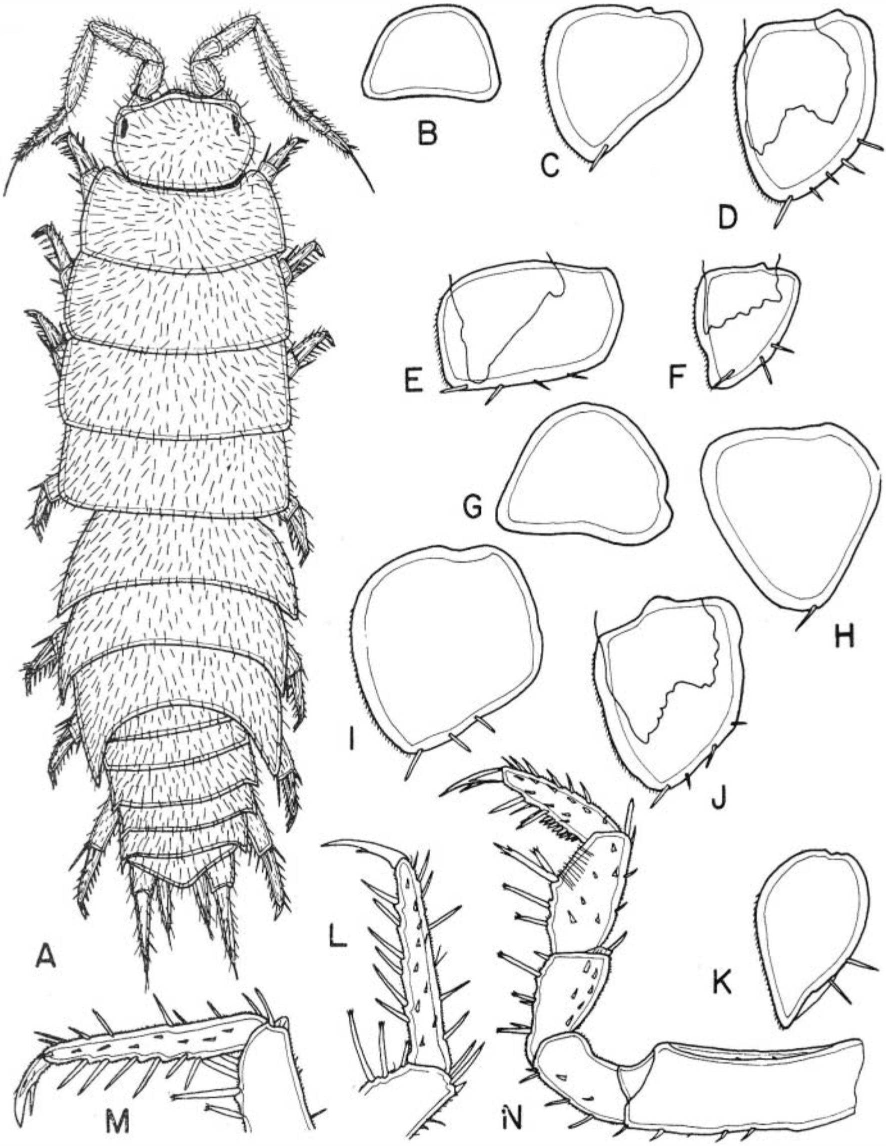
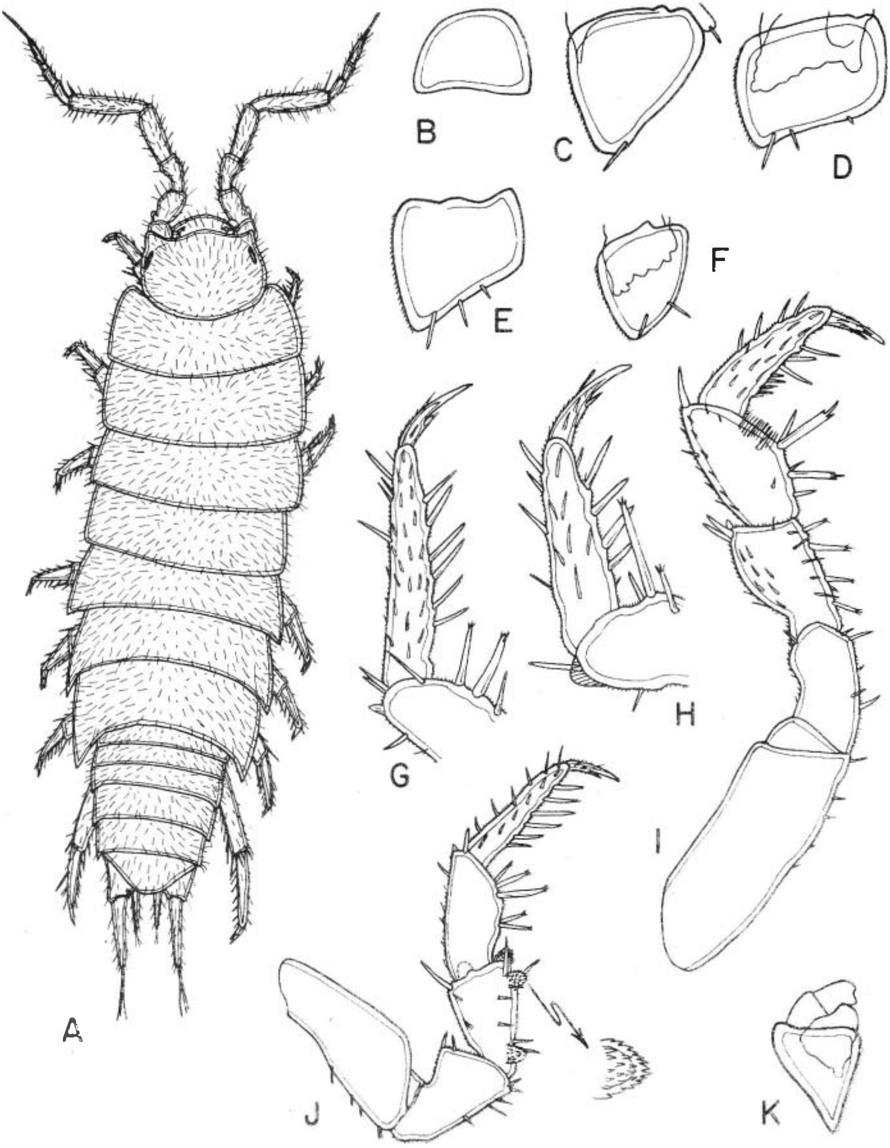

A
B
C
D
E
F
G
H
I
J
K
L
M
N

Fig. 4. A-I. An anomalous non-pigmented female. A. Dorsal view. B. First pleopod. C. Second pleopod. D. Third pleopod. E. Fourth pleopod. F. Fifth pleopod. G. Dactylus and propodus of seventh walking leg. H. Dactylus and propodus of second walking leg. I. First walking leg. J. Abnormal male seventh walking leg with detail of abnormality. K. Fifth pleopod from an anomalous male.


A
B
C
D
E
F
G
H
I
J
K