

## FURTHER OBSERVATIONS ON THE SEX-RATIOS OF TERRESTRIAL ISOPODS<sup>1</sup>

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Vandel<sup>2</sup> contends that in terrestrial isopods the females are more numerous than males in collections. He gives tables showing the sex-ratios of collections of ten species.

This condition he ascribes to the operation of a differential death-rate of the sexes, as shown by Geiser<sup>3</sup>. The males he considers the less viable sex, as would be expected on the basis of the genetic type of constitution to which they presumably belong.

There is also confirmatory evidence in support of his view (especially in respect of certain species) from the work and findings of other students. Certain species, now known to reproduce on occasion parthenogenetically, have the males very rare of occurrence.

His numbers collected, however, are too small to be statistically reliable, and no indication is given as to the manner in which they were collected, nor the character of the habitat, nor regarding the percentage of the colony that escaped during collection, etc.,—all factors of the greatest importance.

Although Vandel finds that the sex-ratios of adult collections are one-sided in favor of the female sex, he nevertheless finds that in cultures of the species which he made, the sexes were about equally represented at birth, and in

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<sup>1</sup>In extension of a paper, "Observations on the Numerical Proportions of the Sexes in Terrestrial Isopods, with especial Reference to *Porcellio (Proporcellio) laevis*," in *Amer. Midl. Nat.* [in press.]

<sup>2</sup>Vandel, A. "Recherches sur la sexualité des Isopodes," *Bull. biol. de France et de la Belgique* 59:318-71, 1925.

<sup>3</sup>Geiser, S. W., "The Differential Death-rate of the Sexes among Animals, with a suggested Explanation," *Washington Univ. Studies, Sci. Ser.*, 12:73-96, 1924.

young populations. This accords with the findings of the present writer, who found the sexes approximately equal in very young populations of *Armadillidium vulgare* and *Porcellio laevis*.

If there is a later preponderance of one sex over the other in older populations, one will be justified in inferring such a differential death-rate as Vandel infers. Collections, however, must include all sizes of individuals, and the sexes must be determined for the smallest individuals as well as the largest. The method of capture must conserve all of the population. The sex of the smallest individuals can be determined by study of the last thoracic segment, to determine the presence or absence of the external male genital pores, which appear after the first ecdysis (which occurs a very few days after birth). The collecting ought, also, to continue for some time, until the locality is "fished out." This can be done with potato traps for the capture of the isopods.

Collections statistically ample, also, should be taken. The larger the number of individuals taken, the more reliable the figures. When a smaller number is taken, chance plays a larger part. When these precautions are taken, results and ratios quite divergent from Vandel's results are obtained. Thus, of a collection of 381 individuals of *Tracheoniscus rathkei* (*Porcellio rathkei* of authors) made at Okoboji, Iowa, in 1926<sup>4</sup>, the sex ratio was almost exactly 100, (*i. e.*, 100 males to every 100 females). A collection of 1739 individuals made in the fall of the same year at Mount Pleasant, Iowa<sup>5</sup>, gave 862 males and 877 females. Other collections of *Tr. rathkei* showed variations from this. Okoboji material in smaller populations (of five or six hundred individuals) gave very low sex-ratios. In the species *Porcellio laevis*, 2892 individuals collected at Dallas showed 1379 males and 1537 females—a sex-ratio of 89.7. A collection of *Armadillidium vulgare* taken also at Dallas, and including 1527 individuals, showed 884 males and 643

<sup>4</sup>Made by the present writer.

<sup>5</sup>Made by Professor H. E. Jaques, of Iowa Wesleyan College, and students.

females—a sex-ratio of 137. Vandel in his most valuable contribution found in 76 individuals of *Arm. nasatum* (a species closely allied to *Armadillidium vulgare*) a sex-ratio of 85, and in a collection of 92 *Tracheoniscus rathkei* a sex-ratio of 56. In *Philoscia muscorum*, a collection of 48 individuals gave Vandel a sex-ratio of 9 (there being only 4 males in the population), while with *Proporcellio quadriseriatus* Verh<sup>6</sup>. taken at Dallas, a collection of 311 individuals gave a sex-ratio of 57.

As stated above, the sex-ratios of several hundreds of juvenile *Armadillidium vulgare* and *Porcellio laevis*, were practically 100. Thus, a sample of 101 juveniles taken at random, and having a geometric-mean-length of 4.88 mm. gave 54 males and 47 females; while in a similar random sample of *Porcellio laevis*, the proportions were 48 males and 52 females. This suggests cogently that the proportions of the sexes in early life, and presumably at birth, are practically equal.

As appears elsewhere<sup>7</sup>, we would expect, (assuming a differential death-rate of the sexes) that the older populations would have a higher sex-ratio in favor of the more viable sex. I have made the same observation for *Porcellio laevis*. In this species, I found that the sex-ratio was relatively lower in the younger populations, and became higher in the older populations. Thus, in *Porcellio laevis* only the males attain great age (four or five years is the maximum in this species). The high sex-ratio of the June 11/July 8 collection of 1527 *Armadillidium vulgare* (sex-ratio, 137) is to be similarly explained, since the sex-ratio of young populations is practically a 1:1 ratio.

It would appear that the ratios of the sexes reported for sow-bugs are often erroneous, because either (1) the numbers of individuals are too small; (2) because no account is taken of aggregations of one sex that may take place from time to time; (3) because differences of sex-behavior may cause the individuals of one sex to avoid certain habitats; (4) the collections may not cover a time-period long

<sup>6</sup>See Geiser, *Field & Laboratory* 2:29-30. 1933.

<sup>7</sup>See footnote 1, *ut supra*.

enough to secure *all* the individuals in a given locality. Unless the latter is done one cannot be sure that his data on the proportions of the sexes properly represent the true situation in the field.

The writer found in his study of material of *Tracheoniscus rathkei* from Okoboji, Iowa (1381 individuals) and from Mt. Pleasant, Iowa (1739 individuals) that in this species the males are more rare than the females in the older populations. This, then, is in accord with the situation which has been found to be true for certain crustacea, notably Mysidaceae (Blegvad<sup>8</sup>) and Brachyura (Punnett<sup>9</sup>). On what basis can one explain the fact that *Porcellio laevis* and *Armadillidium* show a greater longevity of the male sex? Perhaps on the basis of Schöbl's<sup>10</sup> findings regarding the very high mortality among the reproducing females of *Porcellio scaber*. It is probable that in the highly weakening ecdyses immediately preceding egg-laying the females succumb in large numbers and thus reduce greatly the number of surviving females. The males thus gain a majority over the females.

It is interesting to note that in this group of animals (which includes only a few over a thousand species) we have such a variety of methods of reproduction and survival. Parthenogenesis occurs in *Spiloniscus*; the females have a higher survival value in *Porcellio rathkei*, while in *Porcellio laevis* and *Armadillidium vulgare* a greater survival value is to be noted among the males.

Unless the Isopods are collected in such a way that the whole population is caught, and unless the population is accurately "sexed" after capture, the data obtained and published are of little value. These blemishes invalidate the sex-ratio data set forth in the otherwise admirable papers of Vandell, to whose careful observation and scientific acumen students of the isopods are deeply indebted.

<sup>8</sup>Blegvad, H. "On the Biology of some Danish Gammarids and Mysids." *Rept. Danish Biol. Sta. to Board of Agric.* 28:102, 1922.

<sup>9</sup>Punnett, R. C. "Note on the Proportions of the Sexes in 'Carcinus moenas'." *Proc. Cambr. Phil. Soc.* 12:293-96, 1904.

<sup>10</sup>Schöbel, J. "Die Fortpflanzung Isopoder Crustaceen." *Arch. f. mikr. Anat.* 17:125-40, 1880.