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NOTES ON THE ECOLOGY AND GROWTH OF *IDOTEA PHOSPHOREA* HARGER (CRUSTACEA: ISOPODA)

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A small population of *Idotea phosphorea* Harger was monitored at irregular intervals from 1976 to 1978. The general biology was similar to other idoteids investigated, and measurements of head width, body length, and wet and dry weight allow the conversion into energy equivalents of remains found in gut analyses.

Introduction

In recent years there has been a great deal of research on the flora and fauna of the Bay of Fundy and its estuaries. Particular attention has been given (Strong 1978; 1979) to the life cycle and energy relations of *Idotea baltica* (Pallas), an inhabitant of intertidal *Ascophyllum nodosum* (L.) LeJolis. Several other isopod species occur in lesser numbers within these seaweed mats, among them a poorly described congener. This isopod, *Idotea phosphorea* Harger, has apparently hitherto never been examined in sufficient detail to warrant a published description of its ecology, although it has been listed in faunal studies (Richardson 1901; 1905; Bousfield & Leim 1959; Gosner 1971). It is eaten by black ducks *(Anas rubripes* Brewster), several species of groundfish including *Cottunculus thompsoni* (Günther), *Anguilla rostrata* (LeSueur), *Urophycis tenuis* (Mitchell), and *Raja erinacea* (Mitchell) and probably other vertebrates. This report provides some preliminary biological observations, together with selected measurements that allow easy conversion to energy units (calories).

Materials and Methods

In total 330 *Idotea phosphorea* were collected on 12 occasions between May 1976 and June 1978 at Cape Blomidon, N.S. (45°12′N, 64°20′W). All were returned alive to the laboratory and were killed by freezing at -15°C.

Isopods were subsequently thawed and the length from cephalon to telson measured to the nearest 0.1 mm with handheld calipers. Width of the cephalon was also determined to the nearest 0.05 mm by a stage micrometer fitted to a compound microscope. Each isopod was sexed, any embryos in the female brood pouches were counted and removed, and the fresh weight was determined to the nearest mg after blotting on paper towel for 1 minute. Finally, the dry weight was determined to the nearest 0.01 mg on an electrobalance after drying for 24 hours at 70°C in a vacuum oven.

Calorific equivalents were obtained with a microbomb calorimeter following techniques outlined elsewhere for *Idotea baltica* (Strong & Daborn 1978). Ash contents were determined on separate pellets according to Reiners and Reiners (1972).

Each animal collected in 1976 (total = 93) was assigned a color score of 1 to 4 where 1 represented totally light (white) individuals, 4 included isopods that were completely dark (absence of any white), and 2 and 3 indicated intermediate conditions. The distribution of these scores within the population was then compared to the microhabitat from which the isopods were collected.

Results and Discussion

Life Cycle

As with other species of *Idotea,* the developing embryos pass through 4 embryonic stages after extrusion into the brood pouch, the fourth of which corresponds to the first free living instar. These stages are similar to those described for *Idotea baltica* (Strong 1978). All embryos in a single brood were at the same stage of development and were of a similar size.

Fecundity of crustaceans has been described by a variety of equations, including linear (Jones & Naylor 1971), semi-logarithmic (Daborn 1977), and logarithmic (Sheader 1977) formulae. The linear relationship, which had the greatest coefficient of correlation ($r=0.685$), was accordingly chosen, although it accounts for only 46.9% of the variation (Fig 1). The smallest length of any female with a brood collected in the field was 10 mm.

Although collections of *I. phosphorea* were obtained at somewhat irregular intervals, sufficient data were available to identify the major period of breeding activity (Fig 2). In 1977, deposition of ova into the brood pouches presumably occurred before April, and by June all females carried broods. Release of juveniles was maximal in July and August, and in September no females carried young. In 1978, however, reproduction presumably occurred somewhat earlier. The duration of embryonic development is probably within the range of 1 to 2 months reported for other members of the genus (Kjennerud 1950; Naylor 1955; Sheader 1977; Strong 1978).

Both the mean length of each sex (Fig 3) and the sex ratio (Fig 4) on each collecting date of 1977 indicate that males have a shorter life span than females. Both sexes die after reproducing. Males apparently return to the intertidal zone earlier in the

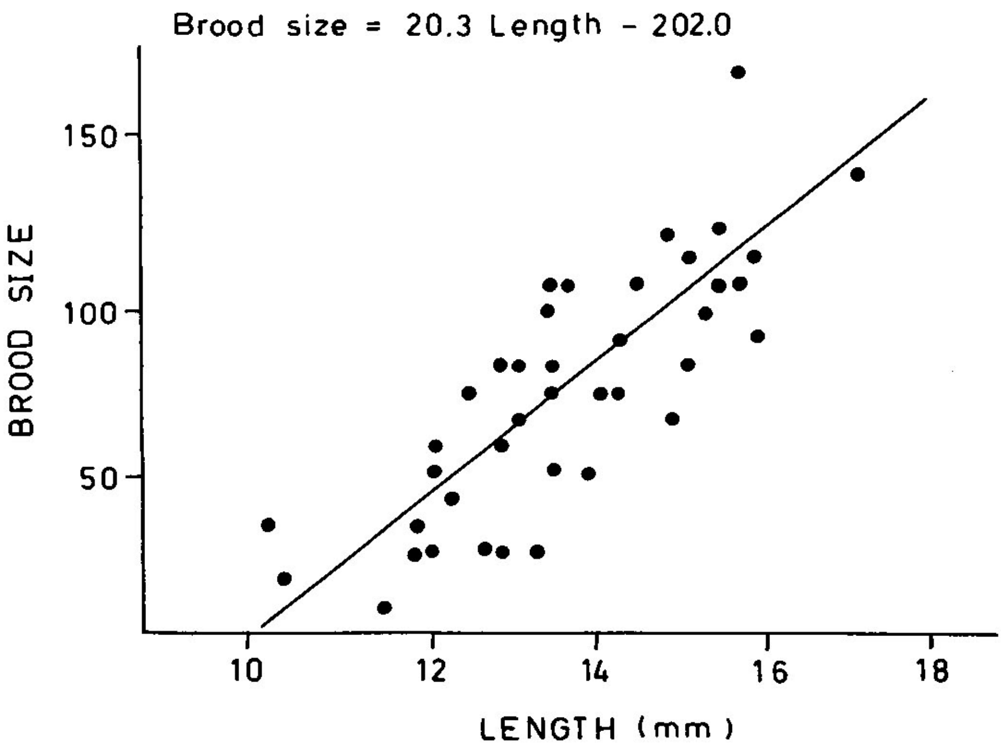

Fig 1. Relationship between length of female *I. phosphorea* and number of embryos in brood pouch (stages I-III).

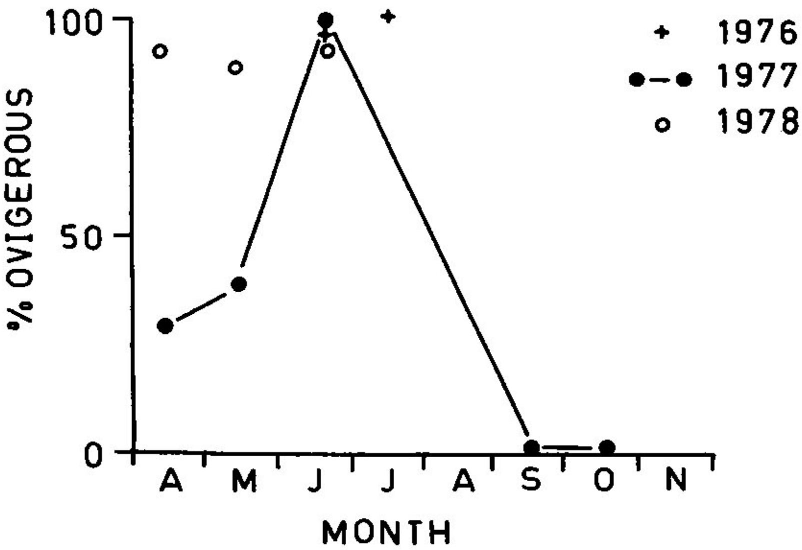

Fig 2. Percent of females ovigerous (embryos in brood pouches) on each collecting date.

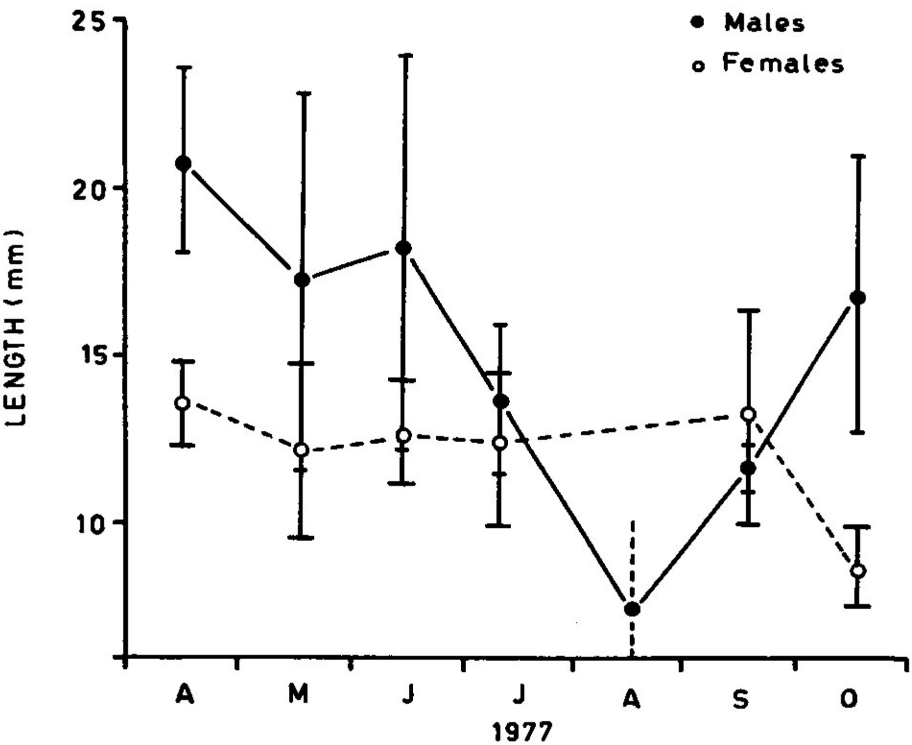

Fig 3. Mean lengths of males and females on each collecting date of 1977. Only 2 males and no females were collected in August. Vertical lines represent ± s.d.

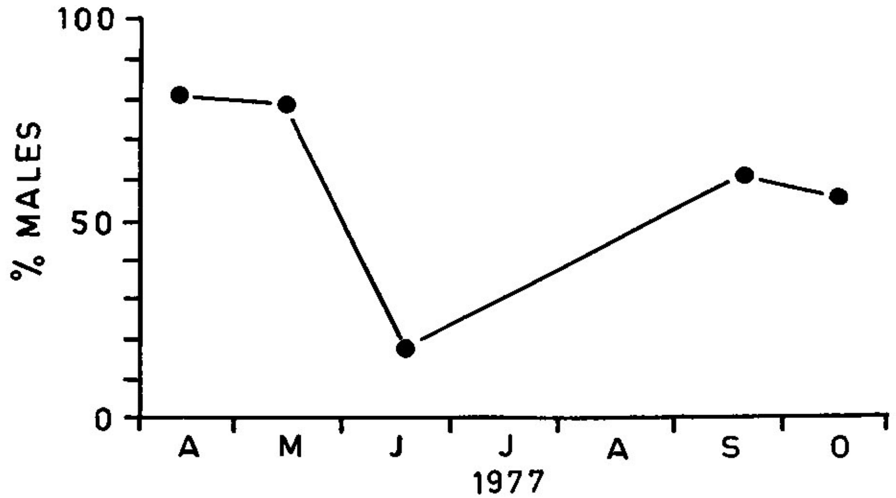

Fig 4. Percent males on each collecting date.

spring than do females, which is also true for *I. baltica* (Strong 1978). Once the broods are deposited into the brood pouches, the largest males die, and the sex ratio declines sharply in favor of females. Following release of the young, the large females also die, and the sex ratio again approaches unity.

Microhabitat

I. phosphorea were collected from two different areas of the same beach in each of the 3 summers it was visited. In addition to those isopods collected from *A. nodosum* mats, many were found clinging either to the red alga *Gigartina stellata* (Stakh. in With.) Batt. or to the undersides of larger stones in the area. A distinct color polymorphism was evident between the two microhabitats (Fig 5). Considering that these microhabitats are not separated by either a physical barrier or excessive distance, movement of isopods between the 2 areas is likely. Although complete color change is probably not possible, lightening or darkening of the existing color patterns can be achieved by chromatophore activity. Presumably chromatophore expansion and contraction occurs in response to background color. In this way, isopods moving from one area to the other can rapidly match whatever substrate they contact. Similar color and pattern polymorphism has been reported elsewhere for *I. baltica* (Matzdorff 1883; Pieron 1913; 1914; Peabody 1959; Suneson 1947; Strong 1977) and *I. neglecta* (Kjennerud 1950).

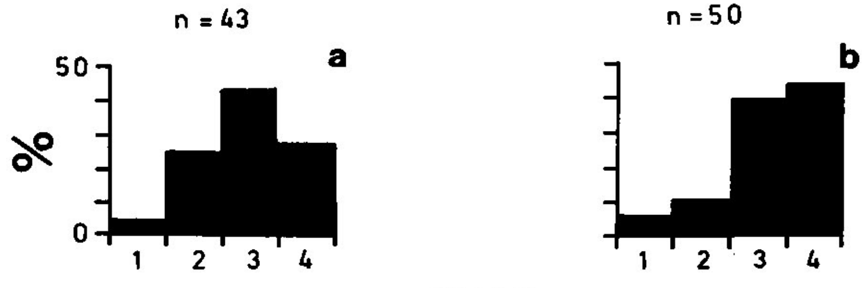

Fig 5. Percent of total *I. phosphorea* collected from each microhabitat in 1976 as a function of body color. 1 - white, 2 - mostly white, 3 - mostly dark, 4 - dark. a - amongst *A. nodosum*, b - under stones or amongst *G. stellata*.

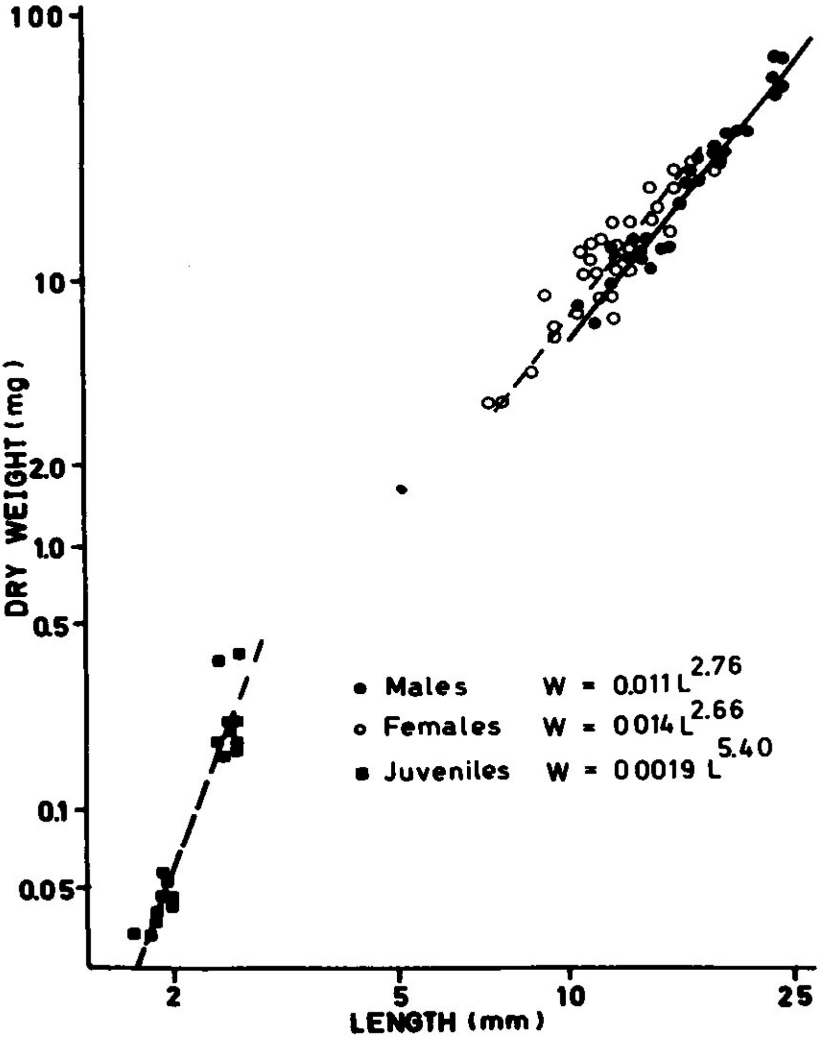

Fig 6. Relationships between length and dry weight of *I. phosphorea*.

Energy Content

Although the length of an animal is convenient for measurement, weight is biologically more meaningful. Accordingly, length-weight relationships were derived for *I. phosphorea* (Fig 6).

The regression coefficients for males and females are within the range of values reported for other *Idotea* (Howes 1939; Khmeleva 1971; Romanova 1974; Strel'nikova 1970), but the value for juveniles is most certainly not. In fact, an exponent greater than 3 is rather surprising, considering that the addition of length at such a small size (ca. 2.0 mm when released from the brood pouch) would seem more advantageous than the accumulation of biomass. Extensive morphological differentiation does not occur within this length range, and because only a few measurements were available, the reason for such a high exponent is unknown.

In addition, the relationship between fresh weight and dry weight was determined for both sexes together (Fig 7). Individual relationships for each sex did not seem justified because of the errors involved in measurement of fresh weight.

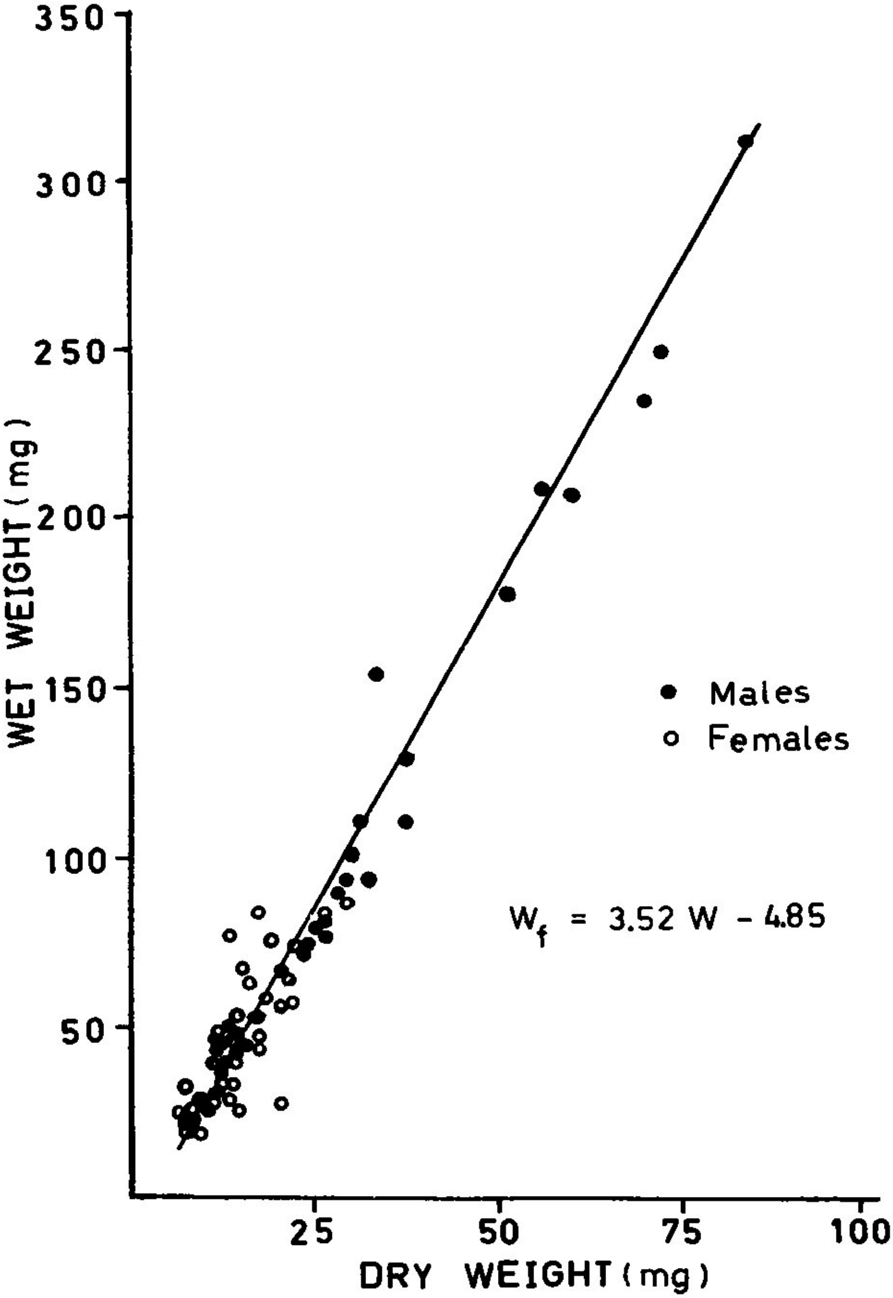

Fig 7. Relationship between wet and dry weight of *I. phosphorea*.

Examination of gut contents of benthic carnivores frequently reveals many fragments of crustacean integument that are difficult to identify. The cephalon, however, is relatively easy to identify in *I. phosphorea*. Therefore, the relationship between its width and the length of the animal was derived to permit conversion of head fragments in gut analyses into units of length. Since sex cannot be determined from the cephalon only, males and females were combined.

Using equations of Figures 7 and 8, it is possible to convert either measurements of length into fresh or dry weight, whichever is required.

In terms of energy to be gained by a predator, the energy content of the prey is of greater importance than weight (Table 1). Ovigerous females (those with ova in the brood pouches) contain 36% more energy per unit weight than those with no embryos. On the whole, values in Table 1 are similar to those reported for *I. baltica* (Shapunov 1969; Strong & Daborn 1978).

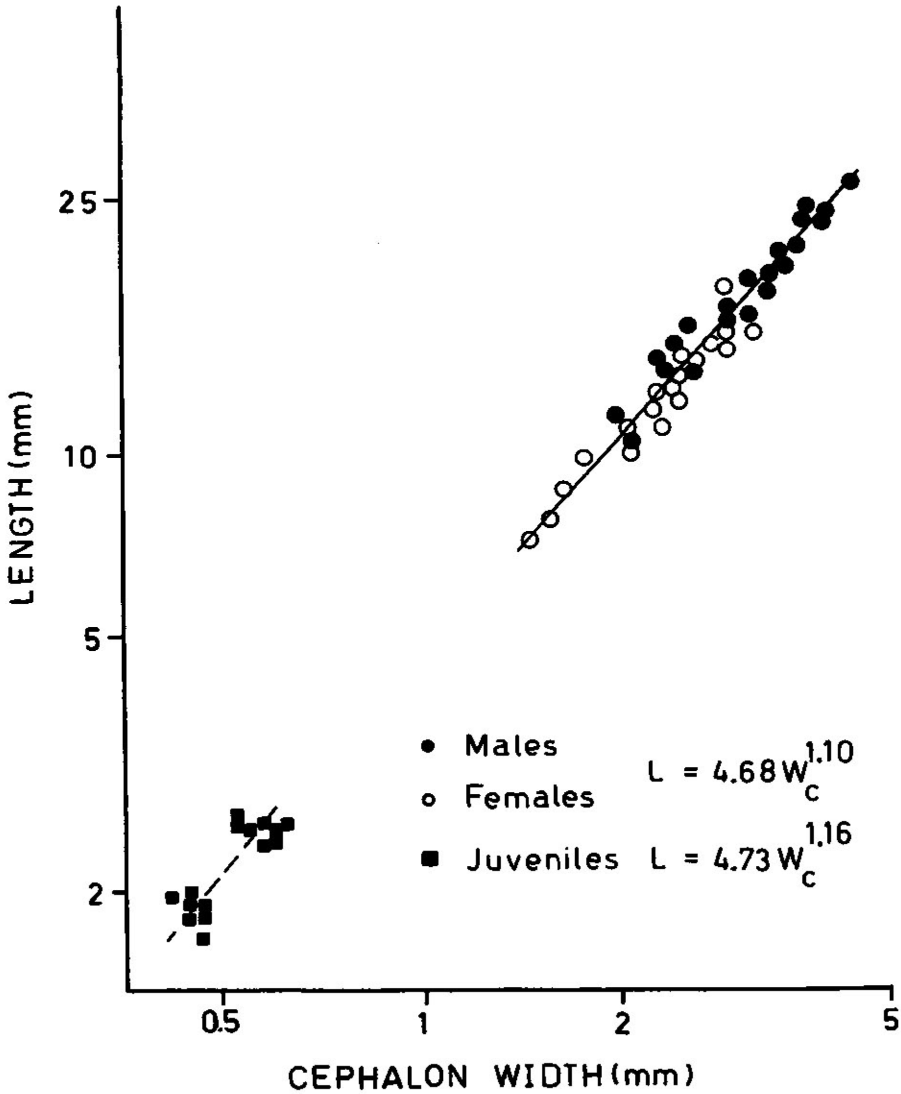

Fig 8. Relationships between cephalon width and body length of *I. phosphorea*.

Table I. Ash and calorific contents of *Idotea phosphorea*.

Class	Cal/mg dry weight (± 1 s.d.)		% ash (± 1 s.d.)	
Juveniles	2.33	(1)**	n/a*	
Males	2.57 ± 0.12	(12)	40.08 ± 2.48	(9)
Females (ovigerous)	2.92 ± 0.16	(6)	36.27 ± 4.02	(4)
Females (post-ovigerous)	2.14 ± 0.05	(4)	40.10 ± 0.86	(2)
Adult mean	2.59 ± 0.29	(22)	39.07 ± 3.32	(15)

* not available
** number of determinations

It must be re-emphasized that our knowledge of this species is still fragmentary. The collection of data in this report is admittedly incomplete, but it is useful in that one can convert measurements of cephalon width, which might be available from gut analyses, into units of length, weight, or energy, whichever is most appropriate.

Acknowledgments

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