SOME ASPECTS OF FEEDING MECHANISMS OF EUPHAUSIID CRUSTACEANS

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INTRODUCTION

Comprehensive studies of the feeding appendages of euphausiids have been provided by Mauchline (1967) and by Nemoto (1967). Euphausiids are considered to be "maxillary feeders but the other appendages also play an important part" (Mauchline & Fisher, 1969).

Feeding experiments and stomach content studies have provided some evidence that those euphausiid species with thoracic legs of nearly uniform length, presumably suited morphologically for filter-feeding, eat mainly detritus and phytoplankton; the others, with one or more pairs of elongated anterior thoracic legs, eat mainly animal matter. But the data suggest that most if not all species are omnivorous (see Mauchline & Fisher, 1969).

In species investigated thus far, food is drawn into the "food basket", a structure enclosed on all sides, formed by the six limbs of the cephalothorax (Jorgensen, 1966; Mauchline & Fisher, 1969). "Limb" or "leg" as used here and elsewhere, refers to the endopodite of the crustacean appendage.

There are conflicting views on how the food basket functions. According to Barkley (1940, cited in Jorgensen, 1966), the feeding current entering the food basket probably results from the forward swimming motion in Euphausia superba Dana. Water enters the feeding apparatus through the coarse filter of the distal segments of the legs, and leaves through the much finer sieve of the proximal segments. Ponomareva (1963), however, working on Euphausia pacifica Hansen, Thysanoessa raschii (M. Sars) and T. inermis (Kröyer), suggested that pleopods create the feeding current "from the caudal towards the cephalic end of the body", an explanation similar to Lebour's (1924). Mauchline's work on Meganyctiphanes norvegica (M. Sars) and on T. raschii (M. Sars), corroborating Cannon & Manton (1927), indicated, however, that the thoracic exopodites are responsible for the feeding current which "runs upwards to the base of the exopodite and passes into the food groove between the limbs" (Mauchline & Fisher, 1969).

Since the feeding apparatus is morphologically similar in all of the species studied by these investigators, it would seem unlikely that all of their explanations are correct at the same time. The present study was undertaken with the objective
of re-examining these mechanisms experimentally, taking advantage of the fact that some aspects of the mechanisms proposed by the different investigators were mutually exclusive.

MATERIALS AND METHODS

The study was carried out at the Biological Field Station, Norris Point, western Newfoundland. The station is located about two km from the edge of a deep basin (maximum depth, 225 m) where all four euphausiid species in the Gulf of St. Lawrence are represented. Animals were caught and maintained essentially as described in Lasker & Theilacker (1965). All animals were kept in the dark; feeding behaviour was observed under red safety bulbs to which euphausiid eyes are relatively insensitive (Kampa et al., 1959). Carmine was used to trace the direction of water currents created by the animals and the path of their food. Observations were based on a total of more than 100 individuals, but among these only 19 Meganymphanes norvegica (M. Sars), 15 Thysanoessa raschii (M. Sars), 13 T. inermis (Kröyer), six T. inermis forma neglecta (Kröyer), and two T. longicaudata (Kröyer) survived for more than one day; two M. norvegica, five T. raschii, six T. inermis, and one T. longicaudata lived for more than ten days. There were no previous records of the successful maintenance of T. longicaudata and T. inermis f. neglecta in the laboratory.

RESULTS AND DISCUSSION

The following observations apply to all three filter-feeding species, M. norvegica, T. raschii and T. inermis:

— The exopodites were in constant motion, but the direction of the current created by their activity could not be determined with certainty.
— The pleopods were also in constant motion, and the current created by them, labelled with carmine dye, was never observed to enter the food basket.
— Euphausiids were seen to accumulate carmine particles in the food basket while just maintaining position by the slow beating of the pleopods.
— Nothing was retained in the food basket after periods of rapid swimming.
— In live euphausiids, there was no space for large-sized food material to enter either at the posterior end of the food basket or between adjacent thoracic legs. If water did enter, food material would be filtered on the outside of the basket.

These observations provide evidence against suggestions that the feeding current results from the forward swimming motion of the animal or from the action of the pleopods. The current cannot enter at the base of the thoracic appendages between adjacent limbs since there is no space. One previous explanation is consistent with these observations: The feeding current is created by the exopodites (Cannon & Manton, 1927; Mauchline & Fisher, 1969), and it enters the basket through the coarse filter of the distal segments of the thoracic legs, exiting through the fine sieve formed by the proximal segments (Barkley, 1940; Jørgensen, 1966).