MORPHOLOGICAL ADAPTATION IN THE DEEP-SEA BENTHIC HARPACTICOID COPEPOD FAMILY CERVINIIDAE

BY

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INTRODUCTION

Por (1964) suggested that deep-sea harpacticoids were adapted to an "epipelic way of life", by means of a "gradual elongation of limbs". To test this hypothesis I examined four closely related Arctic species to determine if such a predicted gradient of morphological characteristics exists with increasing depth.

The deep-sea macrobenthos is highly diverse (Sanders & Hessler, 1969), and harpacticoid copepod assemblages follow this trend (Coull, 1972). Species and genera from the family Cerviniidae are often dominant members of deep-sea benthic copepod communities (Brodskaya, 1963; Por, 1964; Por, 1969; Coull, 1972; Dinet, 1977; Montagna & Carey, 1978). Thus, members of the Cerviniidae are especially good for testing hypotheses about the deep-sea.

In general, deep-sea harpacticoids are found patchily distributed at cm and m scales (Thistle, 1978), in agreement with Jumar's (1975) "grainmatching model". Disturbance/predation is probably also important in structuring these communities since harpacticoids are negatively correlated with the presence of sessile surface-deposit feeding polychaetes (Thistle, 1979). In this study I provide information about the nature of speciation in deep-sea harpacticoids.

MATERIALS AND METHODS

The specimens described herein were collected between 5 to 3576 m over a period of seven years (eight cruises) from the Beaufort Sea (Arctic Ocean). The study area, sampling techniques, and the associated harpacticoid fauna are described in Montagna & Carey (1978).

Cerviniids did not occur at depths shallower than 25 m (Montagna, 1979), and usually dominated at depths greater than 100 m. Four species of the subfamily Cerviniinae overwhelmingly dominated: Cervinia magna Smirnov, 1946

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(synonymous with *Pseudocervinia* Brodskaya, 1963), *Cervinia langi* Montagna, 1979, *Cervinia unisetosa* Montagna, 1980 and *Expansicervinia glacieria* Montagna, 1980. The species were distributed by increasing depth in the order presented above, the former two being shelf species, the third bathyal and the latter abyssal. *Expansicervinia* is more nearly related to *Cervinia* than any other genus of the subfamily; I have discussed the taxonomic relationships of the Beaufort Sea *Cerviniidae* in a previous paper (Montagna, 1980). The taxonomy and distribution of the four species provide an opportunity to compare morphological changes in a species suite associated along a depth gradient.

Only mature females have been used for body measurements. Drawings were made with a camera-lucida, and measurements taken directly from mounted specimens and camera-lucida drawings. When possible, multiple measurements were taken to insure that trends observed would not be artifacts of an aberrant individual, and to account for population variability. Unfortunately only one individual of *Expansicervinia glacieria* was available for detailed measurements.

Length to width ratios (L/W) were calculated to measure elongation of appendages. Structures were treated as quadrilaterals, and measurements taken from the centers of the opposite sides. Since the structures were not perfectly square or rectangular, slightly different measures were obtained depending on the exact placement of the micrometer. By taking repeated measures of the same structure, I have estimated these measurement inaccuracies to be about 10% for each L/W.

**RESULTS**

Variability due to differences in the size of mature females of a population are very small (table I). Generally the standard error of the mean body size deviated by less than 3%.

Six morphological characters exhibited linear relationships with increasing depth: (1) The ratio of the antennule relative to the antennae increases from 0.88 to 1.5 (table I) with depth. Thus, the antennule increases in size while the antennae become reduced (fig. 1). The antennae in the two shallower species possessed many broad spines, whereas only setae were present in the two deeper species. (2) The cephalothorax becomes longer and narrower (fig. 1), the L/W increases from 0.78 to 1.3 (table I). (3) The caudal rami increase in length from 0.19 to 0.36 mm. (4) The length of the caudal rami in percentage of total body length increases from 12 to 24% (table I). This suggests that a decrease in somite body length is compensated for by an increase in length of the caudal rami. (5) Fusion of swimming leg segmentation decreases with depth. The most common (and probably ancestral) condition in Harpaticoida are 3-segmented biramous swimming legs (Lang, 1948), which is true for the two deeper occurring species. However, in the shallowest form (*Cervinia magna*) the endopod (innermost branch) segments of all four legs (P₁-P₄) are fused, and