MORPHOLOGICAL CORRELATES OF MALE CLAW ASYMMETRY IN THE FIDDLER CRAB UCA PUGNAX (SMITH) (DECAPODA, BRACHYURA)

BY

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RÉSUMÉ
Chez les crabes ocypodiens du genre Uca, le mode d’alimentation diffère d’un sexe à l’autre en raison d’un dimorphisme dans la taille et la fonction des pinces. Les mâles ont un taux de prise de nourriture inférieur à celui des femelles et sont moins efficaces dans l’extraction de cette nourriture du substrat, ce qui correspond à un dimorphisme sexuel dans la structure des pièces buccales. Les soies sont importantes dans le processus d’extraction et leur morphologie est apparue comme sexuellement différente. Les femelles ont davantage de soies: elle possèdent 10-50% de soies de plus des mâles par unité de surface, ou suivant la largeur de carapace. Les soies sur le premier et le second maxillipède ont montré cette disposition, et le nombre de soies à extrémité en cuiller était spécialement en corrélation avec le sexe. Les sexes n’ont pas montré de différence dans la relation de la largeur de la carapace avec la surface des maxillipèdes. D’après les connaissances courantes sur le comportement de fourragement et sur la morphologie des Ocypodidae, la différence sexuelle dans la morphologie des pièces buccales indiquerait que le dimorphisme pourrait résulter d’une divergence de niche entre mâles et femelles.

INTRODUCTION
Fiddler crabs (genus Uca) may be best known for the impressive dimorphism in male claw size. Male fiddler crabs sport an hypertrophied (master) claw used in ritualized aggressive interactions and in mate attraction (Crane, 1975; Christy & Salmon, 1984). Because only the minor claw is used in feeding, males can feed only with one appendage while females may utilize both. This sexual dimorphism results in a variety of gender specific differences in feeding behavior, including differences in feeding rate (Weissburg, in prep.; Valiela et al., 1974; Murai et al., 1983; Caravello & Cameron, 1987), and patterns of resource defense (Caravello & Cameron, 1987).

Weissburg (in prep.) showed the influence of this dimorphism on the relationship between intake rate and resource abundance, and documented a complicated sex specific relationship among these two variables, where increased resource levels are not automatically translated into increased harvesting rates. Using patches of 50, 100, and 200 µg.g⁻¹ chlorophyll a, Weissburg found no increase in intake rate for females. Males, on the other hand, experienced increased intake rate, but the gains were less than expected based on food
abundance differences among patches. In all cases female intake rate was higher than male intake rate.

A principal agent of the sex specific intake rate patterns is the differential food extraction rate of males and females (Weissburg, in prep.). Fiddler crabs process sediment in the buccal cavity, where specialized mouthparts separate food material from inorganic mineral grains. The inorganic material is compacted into a ‘foodball’ which is then removed and redeposited on the substrate. The interval between foodball deposition events dictates the processing time, which defines as scoop rate (claw motions sec−1) increases. Extraction is an asymptotically increasing function of time, and these extraction rate curves are sex specific. Females feed more quickly than males although there is substantial overlap in the range of scoop rates. At equivalent scoop rates the female extraction rate curve is shifted so that females extract more food than males. Males feeding at the higher female rates would remove virtually no food material from the sediment (Weissburg, in prep.).

Females must therefore possess characteristics which confer higher extraction efficiency at elevated scoop rates. Fiddlers use the 1st and 2nd maxillipeds, which are equipped with a variety of specialized setae, to extract sediment-bound organic material from the substrate (Miller, 1961). The focus of this study is the investigation of possible sex specific differences in setae number in the fiddler crab Uca pugnax (Smith, 1870).

METHODS

Male and female fiddler crabs were collected from Flax Pond, Long Island, New York, U.S.A., killed by freezing at 0°C and fixed in 3% formalin. After preservation, one 1st and 2nd maxilliped each were removed, and mounted on a slide using light corn syrup. Both maxillipeds came from the same side of the animal, and both sides were equally represented. The slide was examined under a compound microscope at 125 ×, and setae were counted using an ocular grid.

Figs. 1 and 2 show the regions within which setae were counted. In the 2nd maxilliped (fig. 1) counts on regions I-V used a 10 × 20 μm grid; region VI was a roughly rectangular tuft of long setae which were counted with a 10 × 40 μm grid oriented parallel to the tuft’s long axis, and region VII setae were counted using a 20 × 20 μm grid. All grids were randomly placed within each region, except for region VI where the grid was placed roughly in the middle of the tuft.

Regions for the 1st maxilliped are shown in fig. 2. Regions I and II were counted within a 15 × 15 μm grid, and region III counts used a 10 × 20 μm grid. In addition to the areal counts, modified, or “spoon-tipped” setae (Miller, 1961) on each maxilliped were counted, as these structures appear to be a critical element of the food extraction apparatus. Maximum carapace