Field Behavior and Adaptive Strategies of Appendicularians (Chordata: Tunicata)

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Abstract

The behavior of 7 species of appendicularians from the family Oikopleuridae was observed using SCUBA in the Gulf of California and the Florida Current. The frequency and orientation of feeding and the pattern of swimming while within the house varied considerably among species. Appendicularians expanded new houses in 189 to 5 min. House-expansion behavior was complex and variable among species. Appendicularians rarely abandoned the house in response to predation. Predators included the sergeant major (Abudefduf sp.), medusae, chaetognaths and ctenophores. The abandonment of the house was based on a cost-benefit behavior strategy which maximized time spent inside the house while minimizing predation and energy investment in house secretion. Strategies of predator avoidance are discussed.

Introduction

The behavior of large, gelatinous zooplankton has been studied only with difficulty in the laboratory, and until recently direct observations of plankton in nature have been limited primarily to descriptions from bathyscaphes (Seebe, 1934; Tregouboff, 1955; Bernard, 1958; Barham, 1966). The few direct observations of zooplankton behavior by divers (Bainbridge, 1952; Emery, 1968; Hamner et al., 1975) indicate that the complex behavior patterns of many planktonic organisms are a significant component of their ecology.

The Appendicularia, a class of abundant pelagic tunicates, exhibit one of the most complex and unusual behavior patterns of any planktonic animal. Appendicularians feed using the house (Fig. 1), an external, mucus structure secreted around the animal by glandular epithelium on the trunk. Sinusoidal beating of the tail drives water through the house, past complex filters where phytoplankton becomes concentrated for transport to the mouth. While the appendicularian feeds within one house, it secretes the rudiment of the next, carrying it in collapsed form against the trunk. Every 4 to 6 h, when the house becomes clogged with particles, the animal discards or jettisons it and expands a new, previously secreted house (Fol, 1872; Galt, 1972). The house may also be abandoned in response to disturbance or predation (Lohmann, 1909). Although house expansion has been described (Fenaux and Hirel, 1972; Galt, 1972), other aspects of appendicularian behavior in nature are unknown. The following field study examines the significance of feeding, jettisoning, and house-expansion behavior to the adaptive strategies of 7 species of appendicularians from the Gulf of California and the Florida Current.

Materials and Methods

Field behavior of 7 species of appendicularians, Megalocercus huxleyi Ritter, Stegosaoma magnun Langerhans, Oikopleura intermedia Lohmann, O. rufescens Fol, O. cornutogastra Aida, O. longicauda Vogt, and O. fusiformis Fol, were observed at depths of 5 to 30 m while SCUBA diving in the Gulf of California, 2 to 5 km east of Puerto Escondido, and in the Florida Current, 8 to 10 km west of Bimini, the Bahamas (Hamner, 1975). Although some appendicularian species are minute, the 7 species observed here were large with total lengths often exceeding 1 cm. Appendicularians were easily located by searching for their particle-covered, spherical houses which ranged from 0.6 to 4 cm in diam-
Movement of the tail and blue, yellow or red pigmentation of the trunk also aided in locating and observing these animals. Once an occupied house had been located, the researcher oriented it a few centimeters in front of his face plate for observation. Accuracy in observing detail at close range underwater improved with experience. Objects observed underwater are magnified by approximately 1/3 their actual size. This also aided in observation. The following categories of information were recorded on an underwater cassette tape recorder:

Orientation. The feeding orientation of appendicularians within their houses with respect to the surface was observed.

Tail Beating. The presence of tail beating was noted when the appendicularian was first located.

Predation. Individual acts of predation on appendicularians by both planktonic and fish predators were observed. Planktonic predators were captured by hand for later identification.

Swimming Rates. Swimming patterns of appendicularians within their houses were described. Swimming rates were measured by placing a spot of uranine dye behind the house. Another spot of dye was placed behind the house after it had moved several centimeters and the distance between spots measured with a ruler. Dye was dispensed with a syringe. The time required for the appendicularian to swim between spots was determined by speaking a sharp sound into the tape recorder at the beginning and end of the swimming period. This interval was later measured with a stop watch. Slow, deliberate movements by the diver produced little turbulence, insuring accurate measurements.

Jettisoning Behavior. Appendicularians were forced to abandon their houses by prodding the house gently with a finger. Different areas of the house were prodded to determine relative sensitivity. Jettisoning was also noted when water turbulence disturbed the appendicularian. The appendicularians were shaded with a hand or flat plate to determine the presence of a shadow response.