PRODUCTION ECOLOGY OF HAUSTORIUS CANADENSIS (AMPHIPODA: HAUSTORIIDAE) IN SOUTHERN MAINE[1,2]

T.E. DONN, JR and R.A. CROKER (Department of Zoology and Jackson Estuarine Laboratory, University of New Hampshire, Durham, NH 03824 U.S.A.)

1. INTRODUCTION

Several studies (Croker, 1977; Dexter, 1969; Samaeoto, 1969; Shelton, Robertson, 1981) have shown that the sandy beach communities of the east coast of North America are dominated by haustoriid amphipods. The sandy beach communities in northern New England consist of approximately 11 species, predominantly peracarid crustaceans, and are dominated by the haustoriid amphipods Haustorius canadensis and Acanthohaustorius millsi and Amphiporeia virginiana (Croker, 1977). Although much work has been done on these communities, to date no attempt has been made to describe the patterns of energy flow or secondary production occurring in these systems.

The purpose of this study was to examine the seasonal dynamics of production in the amphipod Haustorius canadensis on a sandy beach in southern Maine, U.S.A. In New Hampshire and Maine H. canadensis remains within the intertidal throughout the year; however, seasonal migrations are evident, with the amphipod moving upward on the beach during the summer and toward MLW during winter (Croker, 1977; Donn, pers. obs.).

[1]Contribution number 147 of the Jackson Estuarine Laboratory Contribution Series.

[2]This paper represents a portion of a dissertation submitted to the University of New Hampshire by T. Donn in partial fulfillment of the requirements for the Ph.D. in Zoology.

2. METHODS

Long Sands, located in southern Maine, U.S.A. (43°07′46" N, 70°37′12" W) is an exposed, 13 on McLachlan′s (1980) exposure scale, fine sand beach. The beach is approximately 160m wide from the base of the seawall to MLW, with a mean tidal amplitude of 2.6m. Long-term studies (Croker, 1977) have shown the macroinfaunal community to be relatively stable over time.

A population of Haustorius canadensis was sampled along a permanent transect using $0.04m^2$ quadrats in a stratified random design (5 levels, 3 replicates) at monthly intervals from November, 1978 until August, 1981. During the reproductive seasons of 1979 and 1980 the sampling frequency was increased to biweekly to obtain a better understanding of the reproductive patterns of H. canadensis. The amphipods in the samples were sorted, counted and the H. canadensis were retained. Densities were corrected for the changing width of the distribution, and population size is expressed as abundance (number per metre of beach front). Sex and length, base of rostrum to end of pleosome, of all H. canadensis in the samples was subsequently determined. The length-frequency histograms obtained were separated into individual cohorts (Harding, 1949; Hasselblad 1966).

Determination of the length-weight relationship and caloric content was made on animals brought back live from the field. Within 24 hours the animals were anaesthetized by placing them in

A. McLachlan et al. (eds.), *Sandy Beaches as Ecosystems*

70% ethanol for approximately 15 minutes, and then diluting the solution by a factor of about 5. Length-weight determinations were made on 30 animals per month from August 1980 to July 1982. Animals were measured, sexed and then dried for 24 hours at 60° C, weighed, ashed for 4 hours at 450° C and reweighed. Individual functional regressions (Ricker, 1973) of log weight on log length were determined for each month, and the slopes were tested for equality using the method of Clarke (1980). Of the 24 months for which the length-weight relationship was determined only 2 showed significant differences from the rest, therefore all data were pooled and the functional regression;

$$\log(AFDW) = -5.01 + 3.15 \log(length)$$

$$n = 614 \quad r = .89$$

was used in subsequent calculations. Caloric content was determined on Haustorius canadensis collected between June 1981 and July 1982. The amphipods were grouped by sex and 1mm size classes, dried 24 hours at 60° C, ground in a mortar and pestle, formed into pellets, redried and weighed. Between 1 and 5 pellets from each group were combusted in a Parr Semi-micro Bomb Calorimeter depending on the amount of material available. Mean caloric content was determined for each size class and these values used for the calculation of a mean monthly caloric content.

Four methods of calculating production were compared, the Removal Summation, Increment Summation , and Instantaneous Growth methods (Crisp, 1971; Gillespie, Benke, 1979), and the Size Frequency method (Hamilton, 1969). The first three methods, along with the Allen Curve method, have been shown to be equivalent (Gillespie, Benke, 1979). The Removal Summation, Increment Summation and Instantaneous Growth methods require that individual cohorts be distinguished. However, they allow the seasonal patterns of production to be observed. The size frequency method does not require individual cohorts to be distinguished, using instead an "average" cohort, but will only yield estimates of total production by the cohort, which must be corrected for the lifespan of the cohort (Cushman et al., 1978; Waters, 1979).

3. RESULTS

In southern Maine, Haustorius canadensis has a 2 year life span, with a reproductive period extending from mid-May through August. Juveniles hatch and are released from the brood pouch at a length of 1.8mm to 2.0mm, and grow to a maximum adult length of 8mm to 9mm.

The separation of the length-frequency histograms into their component cohorts allowed individual cohort abundances (Fig. 1) and, using the above equation, mean ash-free weight of each cohort (Fig. 2) to be determined. The variability in cohort abundances is most probably due to the spatial dynamics of the population on the beach as well as to sampling error.

The mean caloric content ($\pm$ 95% confidence interval) of Haustorius canadensis is 4400 $\pm$ 77 $cal \cdot gm^{-1}$ dry weight. H. canadensis has a mean ash content of 22.8%, resulting in an ash-free caloric value of 5700 $\pm$ 100 $cal \cdot gm^{-1}$. When mean monthly caloric content (dry weight) is plotted against time (Fig. 3) a distinct seasonal pattern emerges; a minimum value during winter and a peak caloric content at the end of the reproductive season in late August.

Annual production was calculated using the four methods described above. A comparison of the results from these methods (Table 1) indicates that the removal summation, increment summation, and instantaneous growth methods yielded very similar results. The size-frequency method overestimated the others by 60%. This result is similar to that obtained by Waters (1981, Table 1) and is greater than