

LIFE HISTORIES AND GROWTH OF THE GASTROPODS *BITTIUM RETICULATUM* AND *BARLEEIA UNIFASCIATA* INHABITING THE SEAWEED *GELIDIUM LATIFOLIUM*

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ABSTRACT

Bittium reticulatum and *Barleeia unifasciata* are two of the most abundant microgastropods inhabiting the alga *Gelidium latifolium* in the North of Spain. *Bittium reticulatum* produces one cohort annually, born in August, and living over two years. *Barleeia unifasciata* shows two population groups, each one formed by two cohorts. There are important differences in density and growth rate between the two groups. The two species are separated spatially on *Gelidium*. *Bittium reticulatum* prefers to live at the base of the plant and *Barleeia unifasciata* prefers the upper part. There are different demographic patterns in each population. This fact supports the concept of distribution in compartments relative to intertidal systems. Each compartment favours different demographic patterns.

INTRODUCTION

Along the littoral zone of the Asturian coast (N of Spain) *Bittium reticulatum* (da Costa) and *Barleeia unifasciata* (Adams) show a gradient of distribution with maximum densities at the upper levels of the eulittoral zone, which is dominated by a belt of the alga *Bifurcaria bufurcata* Ros. (Anadón, 1980).

B. reticulatum and *B. unifasciata* are the most abundant molluscs within the *Gelidium latifolium* (Grev.) Thur. et Born, belt, which is at the mid-level of the eulittoral zone in the Cabo Pañas region (Asturias, N of Spain) (Fernández & Niell, 1982; Anadón, 1983).

Three subsystems can be defined in this *Gelidium* community: Subsystem I, vegetal community; Subsystem II, zoobenthos related to macrophytes, and Subsystem III, zoobenthos associated with trapped sediments (Fernández *et al.*, 1987). *B. reticulatum* mainly inhabits subsystem III whereas *B. unifasciata* belongs in subsystem II.

Subsystem III seems to be a more stable habitat than subsystem II (Fernández *et al.*, 1987)

and different strategies are expected for species inhabiting both subsystems. In the present study, life history and growth of *B. unifasciata* and *B. reticulatum* are examined to determine differences due to their adaptation to the subsystems II and III.

MATERIAL AND METHODS

Two samples of 2025 cm² area were taken monthly for one year (July 1984-June 1985) from *Gelidium latifolium* at Bañugues, Asturias (UTM coordinates, 30T UP 9624). All the molluscs from each sample were isolated and sieved through a 0.5 mm mesh, and dried (110°C, 24 h.).

For size frequency analysis, one hundred individuals were chosen at random from the samples and measured with the aid of a micrometer eyepiece. The measurements were grouped in shell height intervals of 0.5 mm. The size cohorts within each population were established using the method described by Crisp (1971).

Those individuals below 2 mm for *Bittium reticulatum* and 1 mm for *Barleeia unifasciata* were considered as new recruits.

To determine biomass, 50 individuals of each size group were chosen and dried (Round & Hickman, 1971). Ash-free dry weight was obtained after incineration following the method of Crisp (1971).

The height-weight relationship was calculated for each species (Fig. 1).

Fitted growth curves were calculated for each species following the least square linear regression technique.

RESULTS

Bittium reticulatum

Density (Fig. 2) was high in August, November and March, with a maximum of 5340 individuals m⁻². The minimum value occurred in February (141 individuals m⁻²). The annual biomass fluctuated in parallel to the density both in terms of dry (DW) or ash-free dry weight

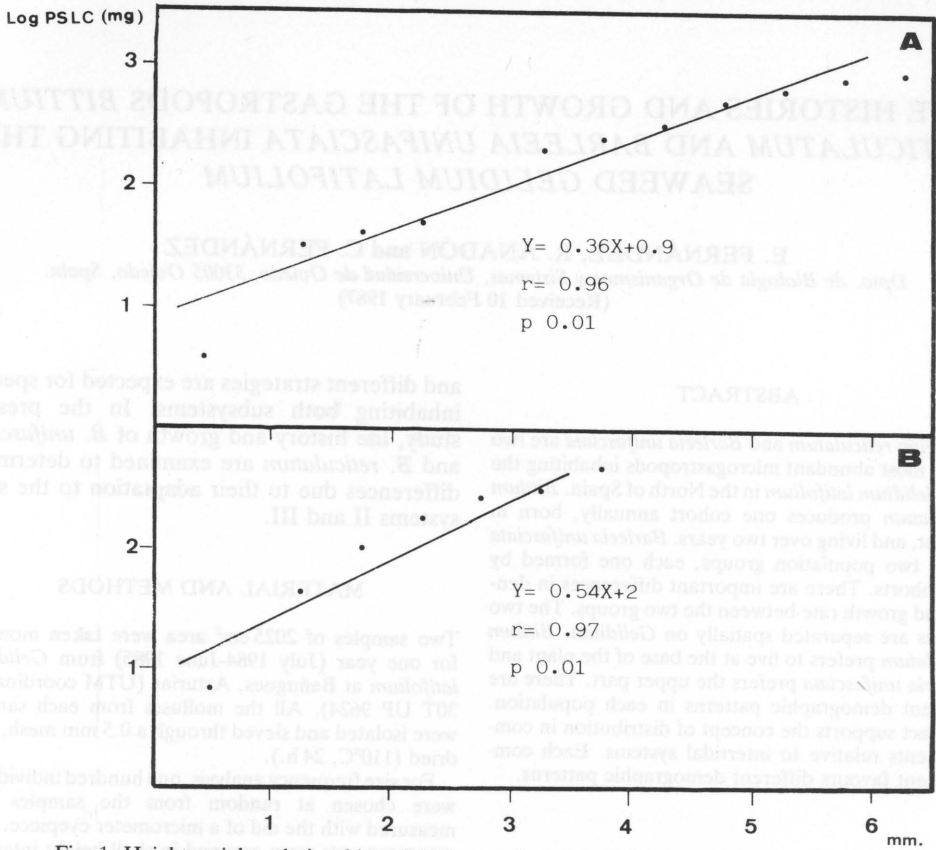


Fig. 1. Height-weight relationships of *Bittium reticulatum* (A) and *Barleeia unifasciata* (B).

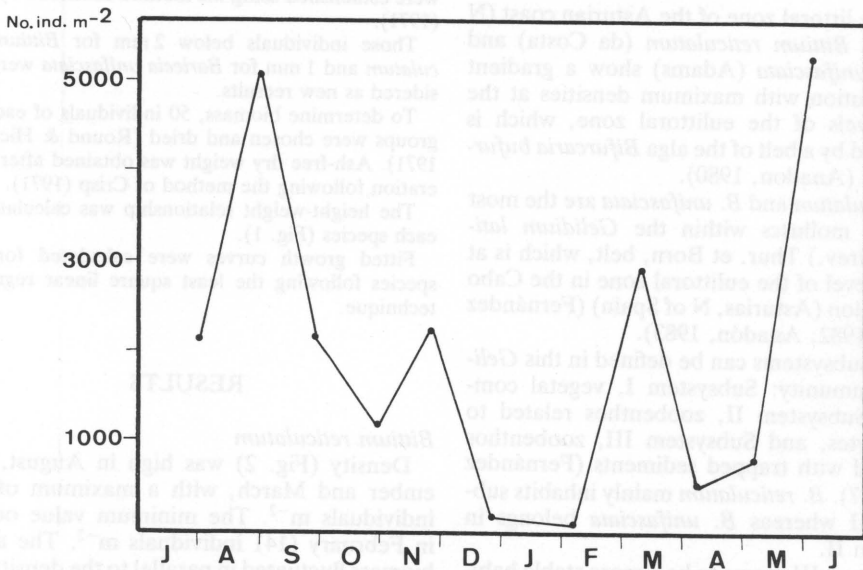


Fig. 2. Density cycle of *Bittium reticulatum*.

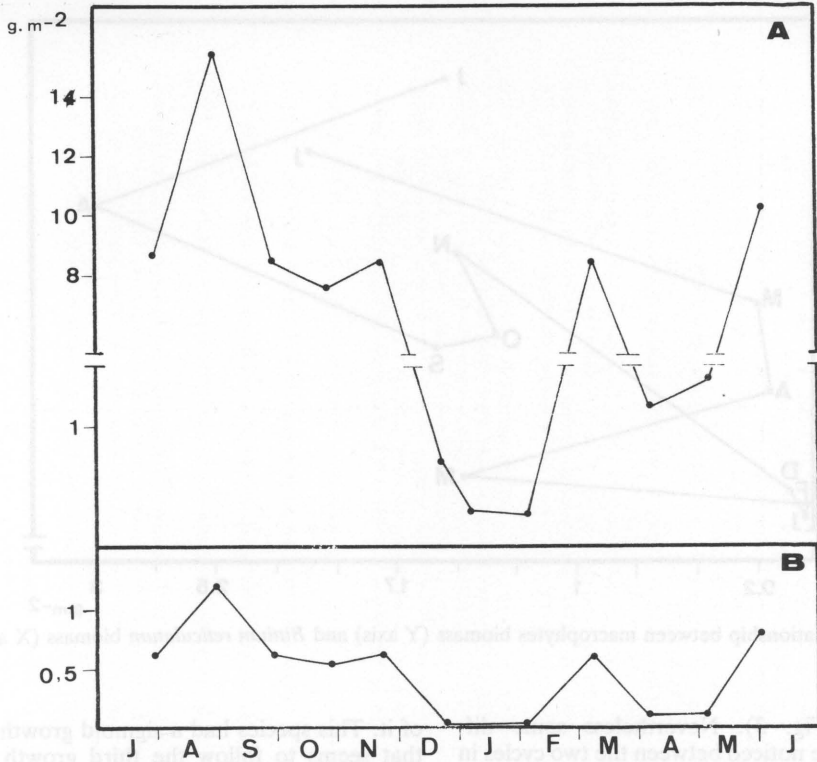


Fig. 3. Biomass cycle of *Bittium reticulatum*. A) Dry weight. B) Ash-free dry weight.

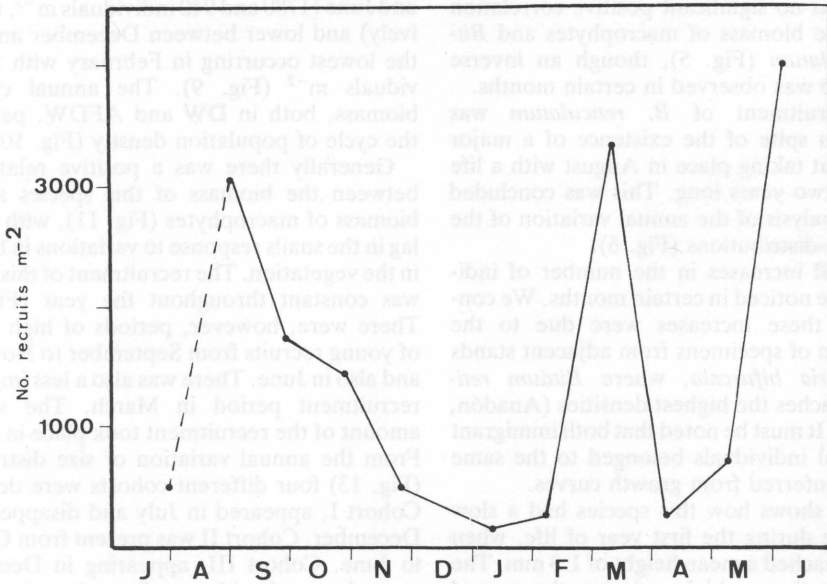


Fig. 4. Density cycle of *Bittium reticulatum* recruits.

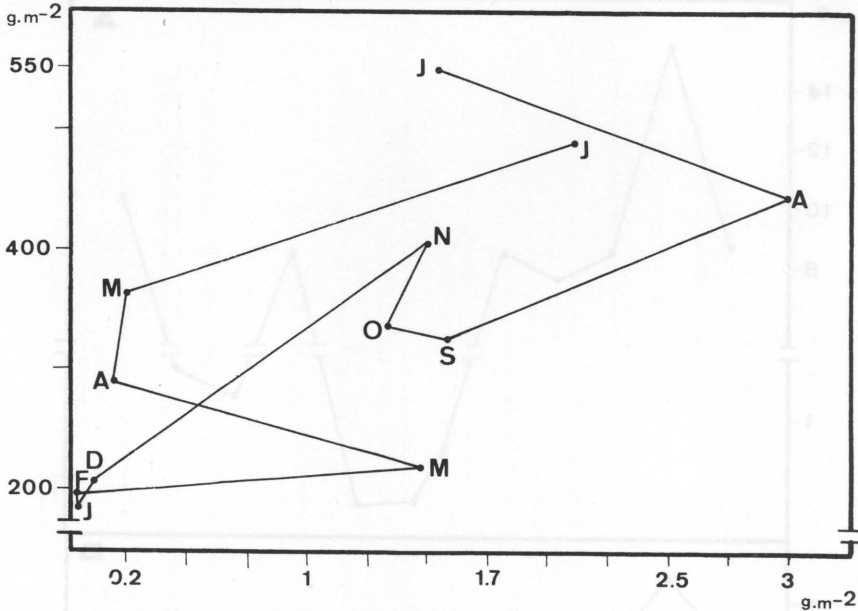


Fig. 5. Relationship between macrophytes biomass (Y axis) and *Bittium reticulatum* biomass (X axis).

(AFDW) (Fig. 3). Nevertheless some differences were noticed between the two cycles in March and November, and in June and August. This time-lag can be attributed to the high ratio of young:adults that is observed between March and June (Fig. 4).

There was no significant positive correlation between the biomass of macrophytes and *Bittium reticulatum* (Fig. 5), though an inverse relationship was observed in certain months.

The recruitment of *B. reticulatum* was constant, in spite of the existence of a major annual input taking place in August with a life span over two years long. This was concluded from the analysis of the annual variation of the species size-distributions (Fig. 6).

Abnormal increases in the number of individuals were noticed in certain months. We consider that these increases were due to the immigration of specimens from adjacent stands of *Bifurcaria bifurcata*, where *Bittium reticulatum* reaches the highest densities (Anadón, pers. obs.). It must be noted that both immigrant and original individuals belonged to the same cohort, as inferred from growth curves.

Figure 7 shows how this species had a slow growth rate during the first year of life, when the snails reached a mean height of 1.3 mm. The rate of growth was higher during the second year and the mean height was 5 mm at the end

of it. This species had a sigmoid growth curve, that seems to follow the third growth model described by Von Bertalanffy (1968).

Barleeia unifasciata

The population density was high in November and June (1780 and 940 individuals m⁻², respectively) and lower between December and May; the lowest occurring in February with 25 individuals m⁻² (Fig. 9). The annual cycle of biomass, both in DW and AFDW, paralleled the cycle of population density (Fig. 10).

Generally there was a positive relationship between the biomass of this species and the biomass of macrophytes (Fig. 11), with a time-lag in the snails response to variations in biomass in the vegetation. The recruitment of this species was constant throughout the year (Fig. 12). There were, however, periods of high density of young recruits from September to November and also in June. There was also a less important recruitment period in March. The smallest amount of the recruitment took place in winter. From the annual variation of size distribution (Fig. 13) four different cohorts were detected. Cohort I, appeared in July and disappeared in December. Cohort II was present from October to June. Cohort III, appearing in December, was ephemeral, with a small number of survivors which probably took part of cohort IV. This last

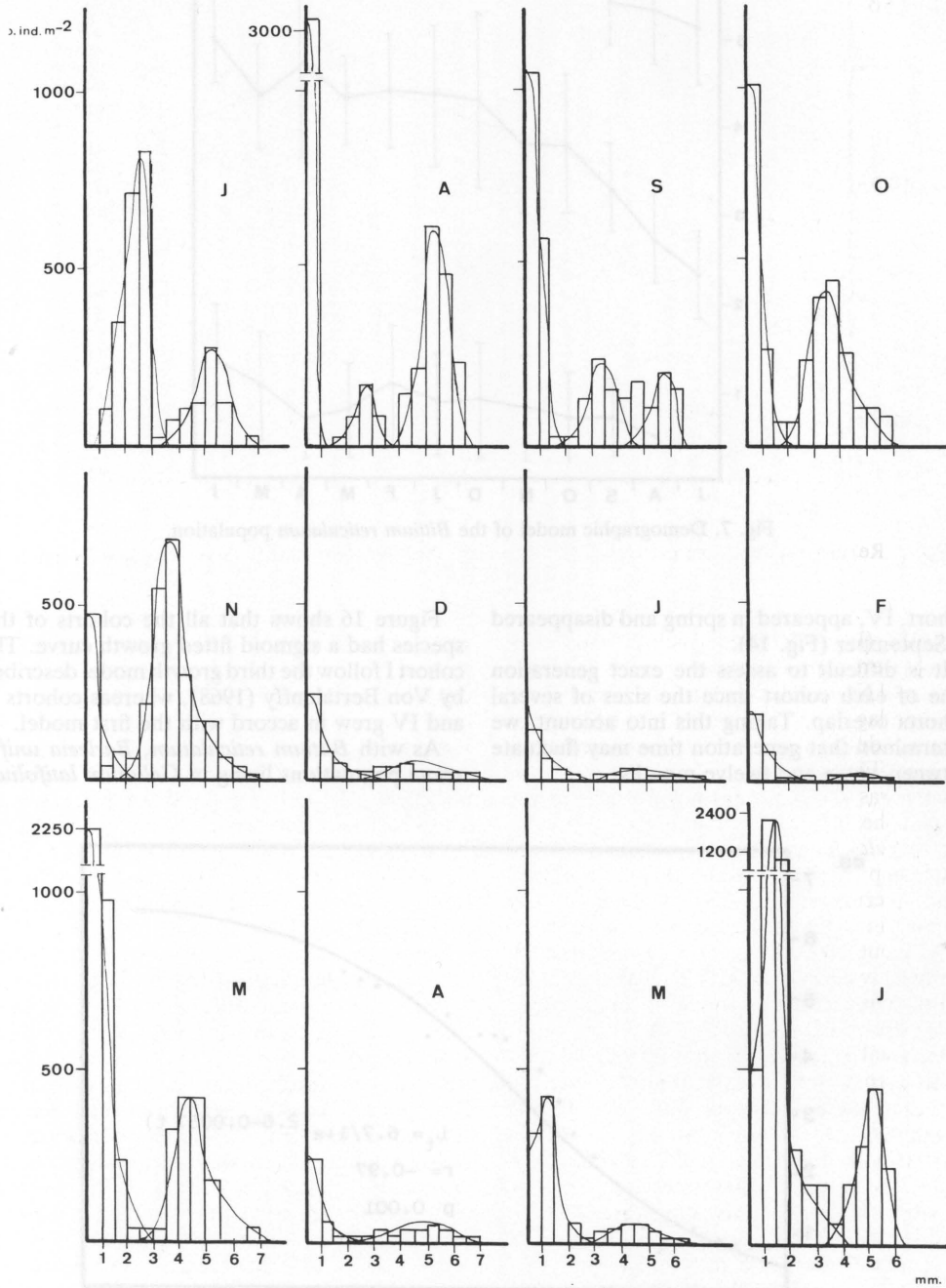


Fig. 6. Annual variation in the size distribution of *Bittium reticulatum*.

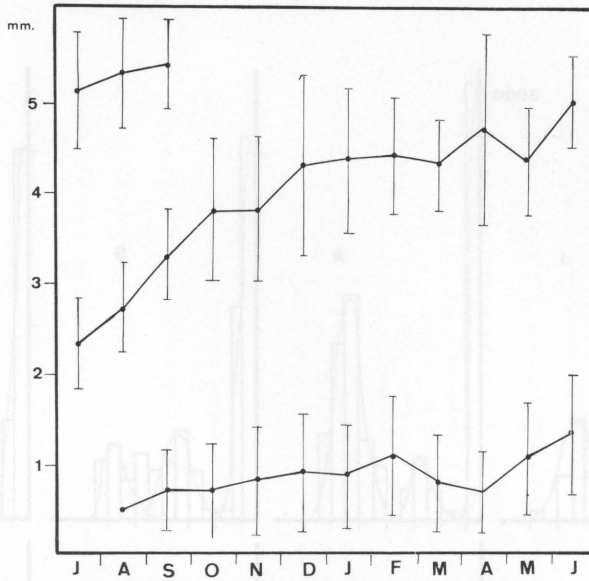


Fig. 7. Demographic model of the *Bittium reticulatum* population.

cohort, IV, appeared in spring and disappeared in September (Fig. 14).

It is difficult to assess the exact generation time of each cohort since the sizes of several cohorts overlap. Taking this into account, we determined that generation time may fluctuate between seven and twelve months.

Figure 16 shows that all the cohorts of this species had a sigmoid fitted growth curve. The cohort I follow the third growth model described by Von Bertalanffy (1968), whereas cohorts II and IV grew in accord with the first model.

As with *Bittium reticulatum*, *Barleeia unifasciata* populations living in *Gelidium latifolium*

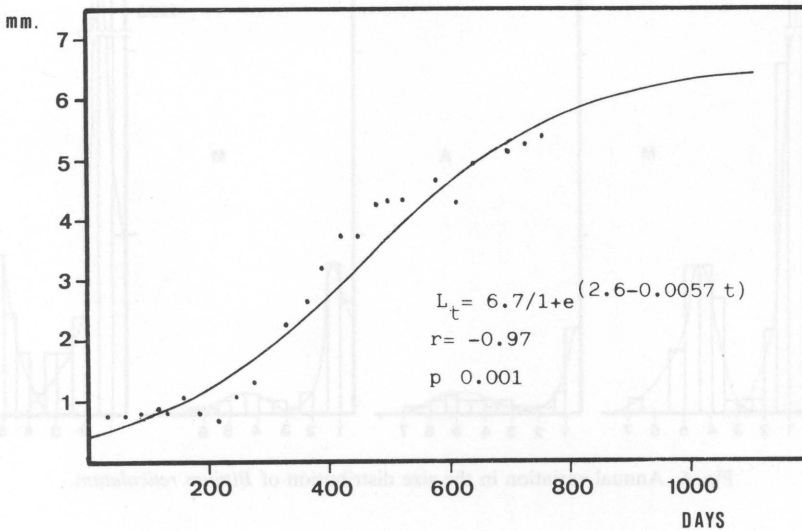


Fig. 8. Fitted growth curve of *Bittium reticulatum*.

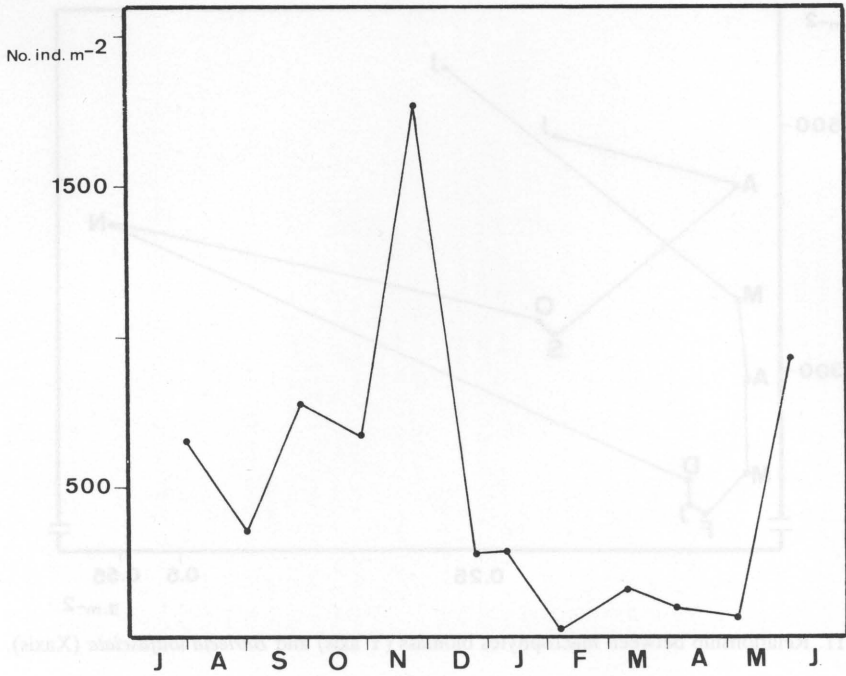


Fig. 9. Density cycle of *Barleeia unifasciata*.

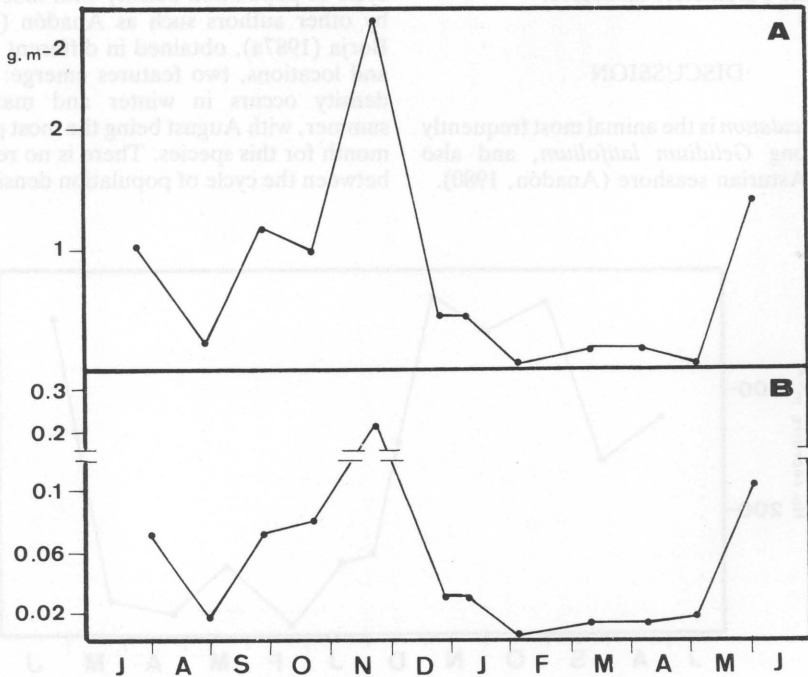


Fig. 10. Biomass cycle of *Barleeia unifasciata*. A) Dry weight. B) Ash-free dry weight.

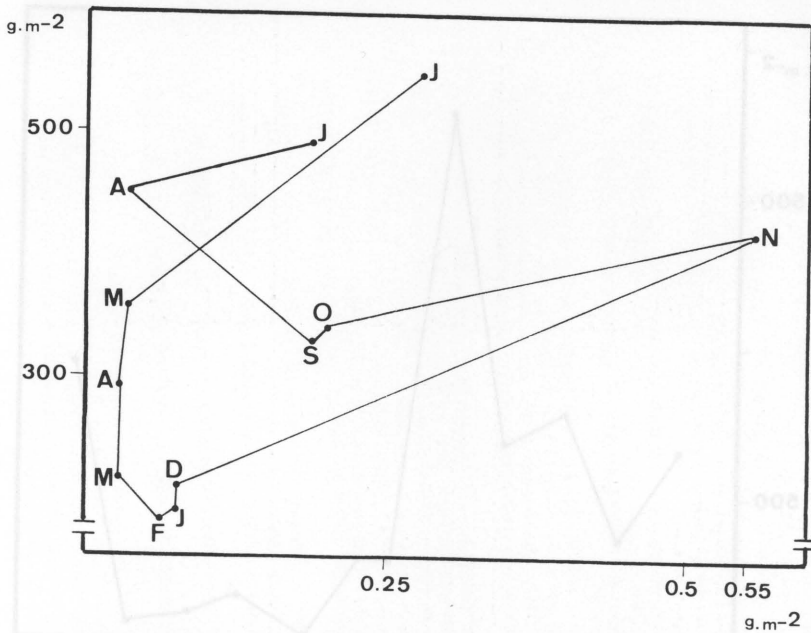


Fig. 11. Relationship between macrophytes biomass (Y axis) and *Barleeia unifasciata* (Xaxis).

did not constitute a closed population. This phenomenon hinders the calculation of the demographic parameters as before.

DISCUSSION

Bittium reticulatum is the animal most frequently found among *Gelidium latifolium*, and also along the Asturian seashore (Anadón, 1980).

The populations recorded are similar to those obtained by Anadón (1980). Comparing the cycle of population density with those reported by other authors such as Anadón (1980) and Borja (1987a), obtained in different algal belts and locations, two features emerge: minimum density occurs in winter and maximum in summer, with August being the most productive month for this species. There is no relationship between the cycle of population density and the

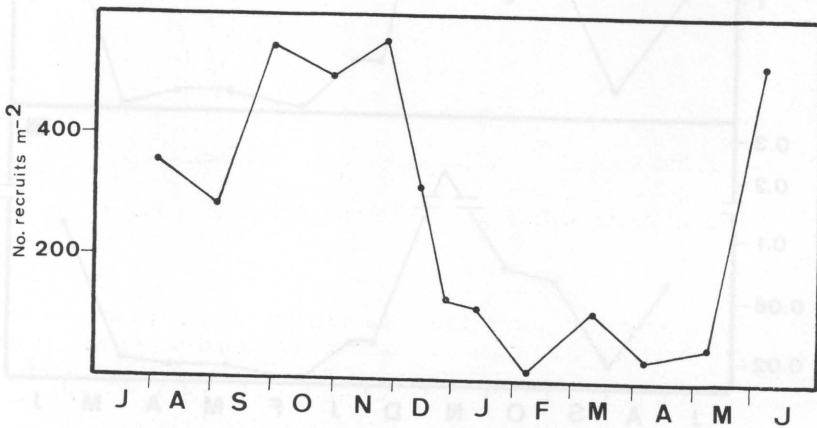


Fig. 12. Density of *Barleeia unifasciata* recruits.

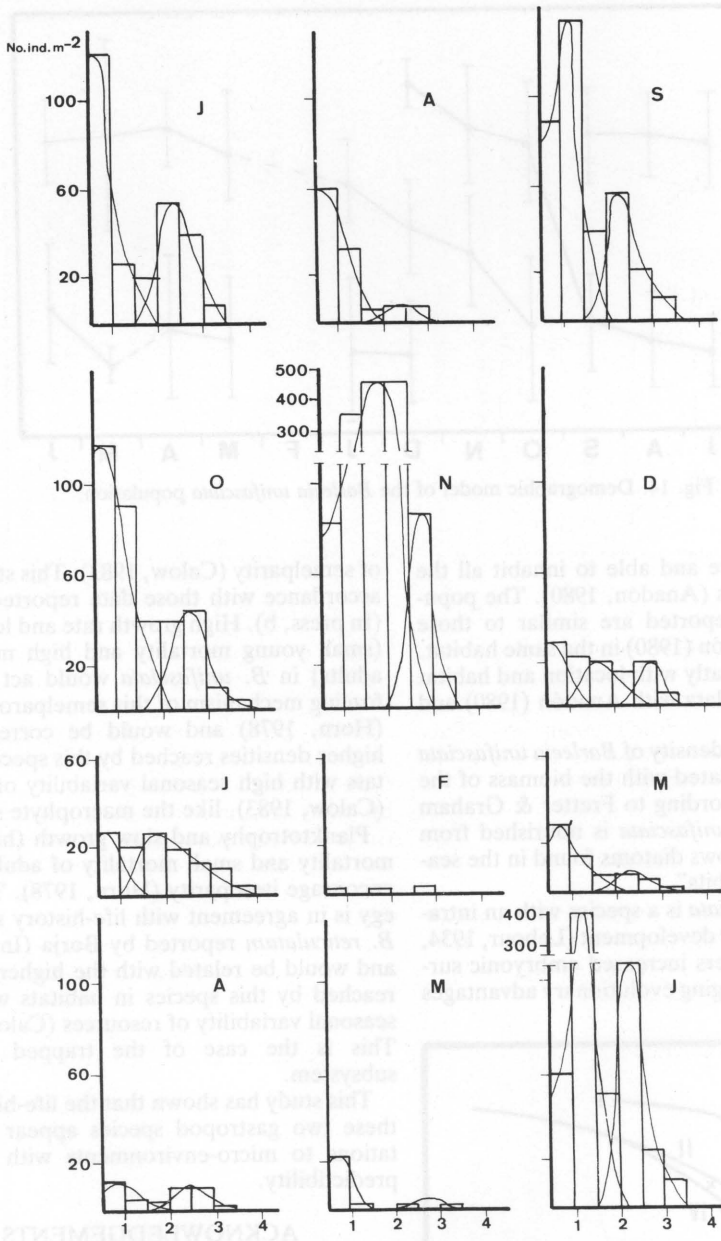


Fig. 13. Annual variation in size distribution of *Barleeia unifasciata*.

dynamics of the vegetal community, as the snail feeds mainly on sponges, benthic foraminifera and small molluscs, which allows a great independence from the macrophyte habitat (Fretter & Graham, 1981). Recruitment to the benthic population occurs at the time when increased

the numbers of veliger larvae of this species have been reported in the plankton of the Mediterranean (Vives, 1966) and off Plymouth (Fretter & Shale, 1973). This cycle accords with that proposed by Rasmussen (1973).

Barleeia unifasciata is quite widespread along

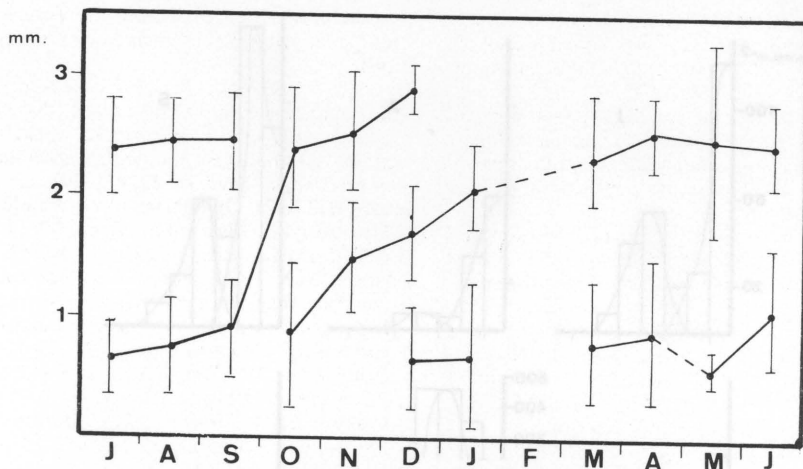


Fig. 14. Demographic model of the *Barleeia unifasciata* population.

the Asturian shore and able to inhabit all the lower littoral belts (Anadón, 1980). The population densities reported are similar to those obtained by Anadón (1980) in the same habitat. Density varies greatly with location and habitat type (cf. present data with Anadón (1980) and Borja (1987a)).

The population density of *Barleeia unifasciata* is positively correlated with the biomass of the algal canopy. According to Fretter & Graham (1978) "*Barleeia unifasciata* is nourished from detritus and swallows diatoms found in the seaweeds that it inhabits".

Barleeia unifasciata is a species with an intracapsular benthonic development (Lebour, 1934, 1937), which confers increased embryonic survivorship, encouraging evolutionary advantages

of semelparity (Calow, 1983). This strategy is in accordance with those data reported by Borja (In press, b). High growth rate and lecithotrophy (small young mortality and high mortality of adults) in *B. unifasciata* would act as a reinforcing mechanism of this semelparous strategy (Horn, 1978) and would be correlated with higher densities reached by this species in habitats with high seasonal variability of resources (Calow, 1983), like the macrophyte subsystem.

Planktotrophy and slow growth (high young mortality and small mortality of adults) would encourage iteroparity (Horn, 1978). This strategy is in agreement with life-history studies on *B. reticulatum* reported by Borja (In press, a) and would be related with the higher densities reached by this species in habitats with small seasonal variability of resources (Calow, 1983). This is the case of the trapped sediment subsystem.

This study has shown that the life-histories of these two gastropod species appear as adaptations to micro-environments with different predictability.

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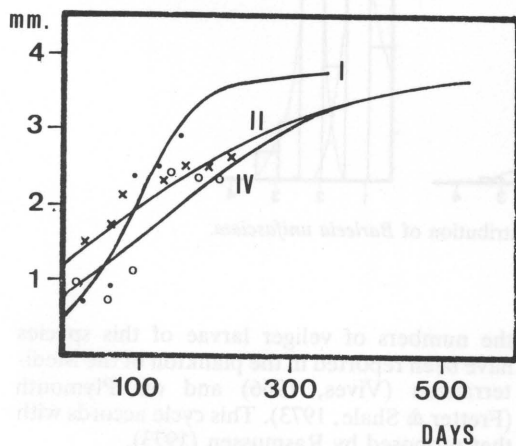


Fig. 15. Fitted growth curve of *Barleeia unifasciata*.

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