

tion points out a seasonal variation of male penis length which is not visible when animals are not narcotized. This seasonal variation in penis length leads to a seasonal variation of RPSI ($RPSI = [\text{mean female penis length}/\text{mean male penis length}]^3 \times 100$) what has for consequence to obtain no good correlation between RPS indices of the three species *Nucella lapillus*, *Ocenebra erinacea* and *Hinia reticulata*. Nevertheless VDSI is not different with the two methods and we obtain a good correlation between these indices in the three species. *Nucella lapillus* is the most sensible with TBT while *Hinia reticulata* is the less one. Two sterilized females of the mud-snail *Hinia reticulata* have been discovered but it seems this sterilization is not due to the overgrowth of vas deferens tissues in the vaginal opening. A more complete research will be necessary to observe intermediary stages between stage 4+ (see Stroben *et al.*, 1992) and sterilized females in this species. An abnormality in *Nucella lapillus* in Brest region (West Brittany) has conducted us to discard some animals from the calculation of the indices : aphyallic males and females in polluted areas. This last point was first discovered by Gibbs (1993) in England and a research on this phenomenon is in preparation.

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An experimental analysis of resource allocation in relation to the radiation of life histories within the *Littorina saxatilis* group

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Responses in flesh growth, shell growth and reproductive output to limited food ration were measured in *Littorina arcana*, *L. neglecta* and in *L. saxatilis*. Flesh growth in fertilized *L. saxatilis* was significantly less than in unfertilized snails taken from the same population sample, indicating a trade off in resource allocation to somatic and reproductive functions. Decreasing food ration significantly depressed flesh growth in all species, but had no significant effect on reproductive output. Priority in resource allocation therefore was given to reproduction. The degree of this priority was similar among species, since their responses to food ration were not significantly different. The principle of allocation therefore appears to have been irrelevant in the radiation of life histories in the *L. saxatilis* group. *

Aminotransferases in *Littorina* : is there a functional story ?

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The Aat-1 locus of the enzyme aspartate aminotransferase (Aat, E.C. 2.6.1.1) appears to be under some form of differential selection in both *Littorina saxatilis* (Johannesson & Johannesson 1990) and *L. arcana* (Grahame, Mill, Double & Hull 1992). In both species, Aat-1 120 predominates in high shore populations, whereas the Aat-1 100 allele occurs in high frequencies in low shore populations. The aim of this study was to determine if there was any physiological basis for the reported pattern of allozyme variation.

The activity of Aat and a related enzyme alanine aminotransferase (Alat E.C. 2.6.1.2) was determined from crude tissue homogenates of *L. saxatilis*, *L. arcana*, *L. littorea*, *L. obtusata* and sympatric small *L. saxatilis* and *L. neglecta* forms. In all the species Aat activity was inversely related to body wet weight and was greater than Alat activity. *L. saxatilis* (both forms) and *L. arcana* showed proportionally more Alat activity than the other species. The sympatric small *L. saxatilis* and *L. neglecta* forms showed no difference in Aat activity, but the *L. neglecta* form contained significantly less Alat activity than the small *L. saxatilis* (t-test, $P = 0.02$). Using ANOVA, we found a significant difference in mean enzyme activity between the species, Aat, $P = 0.031$ and Alat, $P = 0.001$.

After heat treatment at various temperatures Aat appears to be more heat labile than Alat. High shore *L. saxatilis* showed the greatest heat stability; how shore and small *L. saxatilis* were more heat stable than *L. arcana*, *L. littorea*, *L. obtusata* and *L. neglecta*. The enzymes were distributed throughout the body tissues, but the kidney of *L. saxatilis* contained at least twice the activity of both enzymes than was found in the kidneys of the other taxa (except in the case of *L. neglecta*, which has yet to be determined).

The rate of ammonia excretion correlated with Aat activity in *L. saxatilis*. Glutamate dehydrogenase levels were very low in all species, suggesting that the major route of catabolism of aspartate to ammonia is via the purine nucleotide cycle rather than the transdeaminase pathway (Sollock, Vorhaben & Campbell 1979).

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Dispersal and population expansion in a direct developing marine snail (*Littorina saxatilis*) following a severe population bottleneck

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The littorinid snail *Littorina saxatilis* (Olivi) has no pelagic larval phase and is therefore thought to be an organism of poor dispersal. Nevertheless, this species inhabits small intertidal skerries on the Swedish west coast, which are of a recent geological origin due to post-glacial land elevation. We report the effects of an extremely dense bloom of the toxic-producing flagellate (*Chrysochromulina polylepis*) in May 1988. During the bloom of this flagellate all *Littorina saxatilis* of intertidal skerries and nearly all individuals living in moderately to extremely wave exposed shores were killed in the study area (the south part of the Koster archipelago in the northern part of the Swedish west coast).

Almost all intertidal skerries visited before the flagellate bloom had populations of *Littorina saxatilis*. Exposed intertidal skerries had, however, more dense populations than protected intertidal skerries although the former category were more remote from the nearest islands than was the latter. The bloom eliminated the snail populations of all of 34 stu-