copulation frequency. At first, a mass marking experiment was carried out to test the consistency of the migration behavior. In winter, snails from the upper zone and the lower zone were marked in different color and released at their respective zones. In the next winter, statistically significant number of snails were recaptured from the same tide level where they were released. This result confirmed the consistency of the migration pattern ; ie, the same snails migrated downward in every winter, and the same snails stayed in the upper zone in every winter.

Second, a transplantation experiment was carried out to test whether *L. brevicula* had any tide level preference. In winter, snails were marked and transplanted reciprocally between the upper zone and the lower zone. Positions of the marked snails were recorded daily for one month period. Transplanted snails moved towards the original zones where they were caught. This result suggested that the snails actively selected their tide levels in winter.

Third, the schedule of the downward migration and the frequency of the copulation was observed. The frequency of the copulation reached at the maximum after dividing into two subpopulations. Therefore, the copulation of *L. brevicula* was assorted with respect to the migration dimorphism. In conclusion, the migration behavior of *L. brevicula* is determined by each individual and might be controlled genetically. This behavioral dimorphism may be maintained by the assortive mating of the snails.

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Genetic heterogeneity in populations of *Littorina brevicula* (Philippi) (Mollusca : Gastropoda) in the northern part of Peter the Great Bay (Sea of Japan).

A.N. Tatarenkov
Institute of Marine Biology, Vladivostok 690041, Russia

Genetic differentiation among eight samples of *Littorina brevicula* in Peter the Great Bay was surveyed using five highly polymorphic allozyme loci as genetic markers. Geographic distances between samples ranged between a few meters and more than a hundred kilometers. The coefficient of relative gene differentiation was quite low, $G_{ST} = 1.6$ % only. Such low level of differentiation was expected because *L. brevicula* has a planktonic larval stage lasting two weeks. Despite the low level of gene differentiation, there was significant heterogeneity in allele frequencies among samples at three loci. Most surprisingly, microgeographic differention (within a few dozen meters) among samples within continuous settlements was found to be significant in the loci *Pgi, Aladh* and *Fdh*. The differential natural selection was suggested as a possible cause for this.

Ultrastructure of the cephalic sensory organ in larvae of *Littorina littorea* (Mesogastropoda, Littorinidae)

Daniela Uthe
Institut für Spezielle Zoologie und Vergleichende Embryologie der Universität Münster, Hüfferstraße 1, D-48149 Münster

The ultrastructure of the cephalic sensory organ (CSO) was first investigated by Bonar (1978) in the veliger larvae of the nudibranch *Phestilla sibogae* and by Chia & Koss (1984) in the larvae of *Rostanga pulchra* (Nudibranchia). The existence of the CSO can also be proved for larvae of several prosobranchs (Uthe, 1991).

The CSO of *Littorina littorea* is situated dorsally between the velar lobes at the level of the shell aperture. It consists of ciliated cells, which are primary sensory cells, adjacent accessory cells and supporting epidermal cells. Cell bodies of the ciliated cells originate in the cerebral commissure and their dendrits pass to the epidermis. Axons of the sensory cells run into the mass of neurites of the cerebral commissure. The flask-shaped sensory cells are characterized by a deep invaginated lumen, with modified cilia arising from the cell surface in the lumen. These cilia are presumed to be non-motile because they lack striated rootlets and show modified microtubuli pattern (7+2, 8+2) (Laverack, 1988). The adjacent accessory cells never possess an invaginated lumen, occasionally cilia and branched microvilli arise from the apical surface. These cells may be sensory, but no direct connection with the nervous system was obvious. The supporting epithelial cells are part of the epidermis and cover the basal portions of the sensory cells and the accessory cells. Ciliated cells almost identical to those described for *Littorina littorea* have been reported from the olfactory organs of several juvenile and adult cephalopods (Wildenburg & Fioroni, 1989). Morphological evidence suggests that the CSO may function in chemoreception and mechanoreception related to substrate selection at settlement, feeding, or other behaviors.

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Maintenance of zonation patterns in *Littorina obtusata* and *L. mariae*

Gray A. Williams[1]

Zoology Department, University of Bristol, BS8 1UG, U.K.

Littorina obtusata (L.) and *L. mariae* Sacchi et Rastelli are epiphytic littorinids found on sheltered rocky shores (Williams, 1990). On these shores *L. obtusata* reaches a peak of abundance at the mid shore inhabiting *Ascophyllum nodosum* Le Jol which it feeds on. *L. mariae* in contrast lives in the low shore and browses epiphytes off it's host alga *Fucus serratus* (L.). The zonation patterns of these species are very clear and are consistent on sheltered shores. The patterns do not vary annually although the life histories of the two species do ; *L. obtusata* living for 3+years on the perennial *Ascophyllum* whilst *L. mariae* is an annual whose life cycle is closely related to frond shedding in *F. serratus* (Williams, 1992).

Marked individuals of both species were artificially displaced from their host algae and normal vertical range and placed at the preferred height and algae of the other species.