assess the TBT pollution in the environment. Under the variety of pathological conditions produced by this biocide in animals at relatively low concentrations, none rivals that of the imposex phenomenon in prosobranch gastropods speaking in terms of sensitivity. Imposex or pseudohermaphroditism is characterized by the superimposition of male sex characters (penis, vas deferens and/or prostate) on females and is induced by concentrations as low as 0.5 ng TBT as Sn/l. The final point of imposex development is a sterilization of females by malformations of the pallial oviduct with resulting reproductive failure or even a protogyne sex change in very sensitive species (Floroni *et al.*, 1991).

The degree of imposex in a population can by determined by different biomonitoring indices. The average female penis length and the vas deferens sequence (VDS) index, calculated as the mean imposex stage of a population, proved to be the best and most valid indices (Floroni *et al.*, 1991). Because imposex development is initiated by TBT in a time and concentration dependent manner, also the TBT pollution of a coastal region can by assessed by analysing the imposex levels of different species in this area. The imposex development in dependence of ambient TBT concentrations has been calibrated for various prosobranchs (Oehlmann *et al.*, 1991, 1992 ; Stroben *el al.*, 1992a-c). As a result scales were obtained which allow to calculate the TBT pollution of the coastal environment basing on imposex intensities in populations of six different species (*Trivia arctica*, *T. monacha*, *Nucella lapillus, Ocenebra erinacea, Hinia reticulata* and *H. incrassata*).

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Tide level preference of *Littorina brevicula* in relation to its reproduction

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Littorina brevicula is one of the most common snails found in the upper intertidal zone of Japan. Its reproductive season is winter and it produces pelagic egg capsules by the late winter (Kojima, 1957). In Amakusa, Japan, *L. brevicula* shows a behavioral dimorphism on seasonal migration. Some part of the snails migrate to the lower zone in the winter, while the others stay in the upper zone (Takada, 1992). Thus, the population of *L. brevicula* is divided into two sub-populations during its reproductive season. These facts leads to a hypothesis that the behavior of migration is genetically controlled and it is ensured by the reproductive isolation between the two sub-populations.

In order to test this hypothesis, the following three points were investigated ; 1) consistency of migration behavior, 2) tide level preference, and 3) schedule of migration and

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).

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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)

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