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Adaptation to the Baltic Sea - the case of isopod genus *Idotea*

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Abstract

The three marine isopods of the genus *Idotea*: *I. balthica*, *I. chelipes* and *I. granulosa* have an important functional role as meso-grazers in the Baltic food web. These meso-grazers are key species in the *Fucus* belt and in *Zostera marina* beds and are characterized by top-down effects through impressive feeding rates on filamentous algae as well as through their importance as prey for 23 fish species (bottom-up effects). In the Baltic Sea, the three *Idotea* spp. show clear habitat segregation, but may also coexist and compete for food and space. The habitat differences are also reflected in their different life history strategies. Whereas *I. balthica* is more of a generalist and *K*-selected species, *I. chelipes* shows characteristics of an *r*-selected species. The third species, *I. granulosa*, is displaced by *I. balthica* to less favorable habitats, why the adversity strategy fits best for this species.

A phylogeographic study and reconstruction of demographic history indicated that after the Baltic Sea became a marine habitat, *I. granulosa* first invaded into the young Baltic Sea from the Atlantic followed by *I. balthica* and *I. chelipes*. Small estimated population sizes and the haplotype networks, suggest that *I. balthica* and *I. granulosa* have gone through a bottleneck during colonization, losing genetic diversity in Baltic populations. Although Baltic populations of *I. chelipes* were genetically distinct from populations outside the Baltic Sea, differentiation was ten times lower than in the other two species. Distribution patterns over the past 150 years, showed fairly constant large-scale distributions for the *Idotea* spp., but changes in distribution could be found. *I. chelipes* and *I. granulosa* shifted southwards, probably as a consequence of changes in salinity and temperature reported for the Baltic Sea. In general, the distribution patterns of *Idotea* spp. seem to be more determined by temperature than by salinity as supported by ecological niche modelling. Predicted distributions under a climate change scenario (ECHAM5) demonstrated a northern shift of *Idotea* through increased temperature, deeper into the Bothnian Sea. Such distribution changes may have serious consequences, since the endemic narrow wrack, *Fucus radicans*, today may be protected from intensive grazing pressure through the distribution limit of *Idotea* to the southern parts of the Bothnian Sea.

Demographic analysis demonstrated that all three species live closely to their limits under the Baltic Sea extremes. The obvious change in life history from the North Sea to the Baltic Sea can be a cost of acclimation or adaptation. Whereas *I. balthica* lives close to its carrying capacity, several local extinctions of *I. granulosa* have been reported. As a typical *r*-selected species and with the highest genetic diversity, *I. chelipes* may have the highest capacity to adapt to further predicted climate changes.

Today it is not clear if *Idotea* spp. are locally adapted to the Baltic extremes or showing phenotypic plasticity in response to abiotic factors, which calls for further studies.

Keywords: *Idotea* spp., Baltic Sea, life-history strategies, adaptation, phylogeography, ecological niche modelling, climate change