

## Does the alien barnacle species *Elminius modestus* Darwin fill up an empty ecological niche in the German waddensea?

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*Elminius modestus* Darwin is the only alien barnacle at the German North Sea coast besides the native species *Semibalanus balanoides* (Linnaeus) and *Balanus crenatus* Bruguière. Alien species have in general a bad reputation. They are known to displace native species and change ecosystems tremendously. The conducted research tried to answer the question whether this is true for *Elminius*. The research determined the barnacle species distribution at different water depths. The results indicate that *Elminius* settles on the upper intertidal zone and under rough conditions were no other barnacles can live. Probably it will not displace *Balanus* as *Elminius* does not occur in high densities at sub tidal zones. It could be threatening for *Semibalanus* as *Elminius* maybe competes for space with *Semibalanus* at the mid-littoral but this is not sure. We assume that *Elminius* fit into a mostly empty ecological niche.

### Material and methods

We estimated barnacle density and distribution on a row of wooden piles at 40cm, 80cm, and 130cm water depth (measured at high tide) on June, 3<sup>rd</sup> 2008 at List, Sylt close to the biological station of the AWI (see **picture 1**). The piles have a height of 120 cm and we took our samples from the top, the middle and the bottom part of the piles.

To estimate density we counted the abundance of the different species within a 10x10 cm quadrat and replicated this procedure 8 times at each depth. We collected shells and stones from the waterline at low tide to include a 4<sup>th</sup> water depth which was around 2 m.

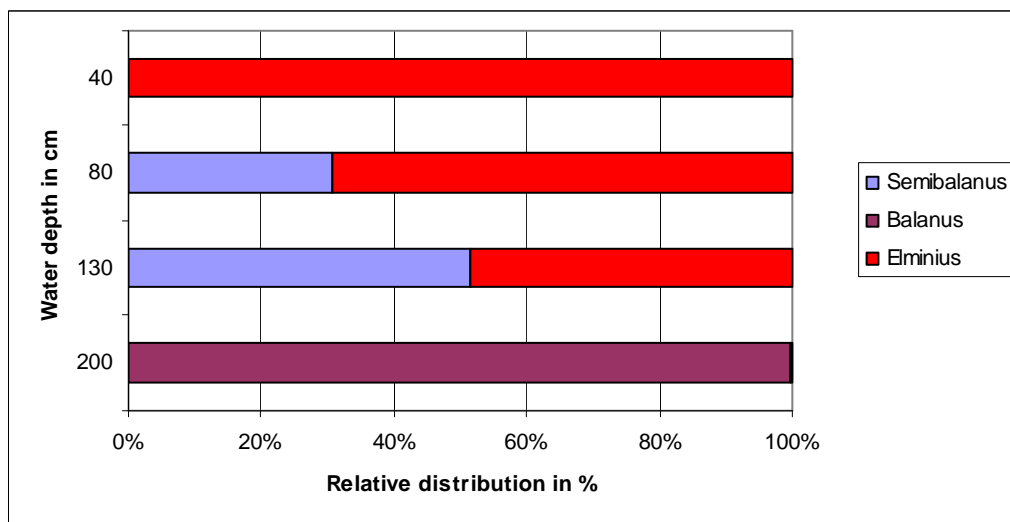
Additionally we sampled snails (*Littorina littorea* (Linnaeus)) covered with barnacles on the waterline at low tide and at a rock pile approximately one meter higher. Afterwards we determined the barnacle species.



Picture 1: Wooden piles where the research were mostly conducted

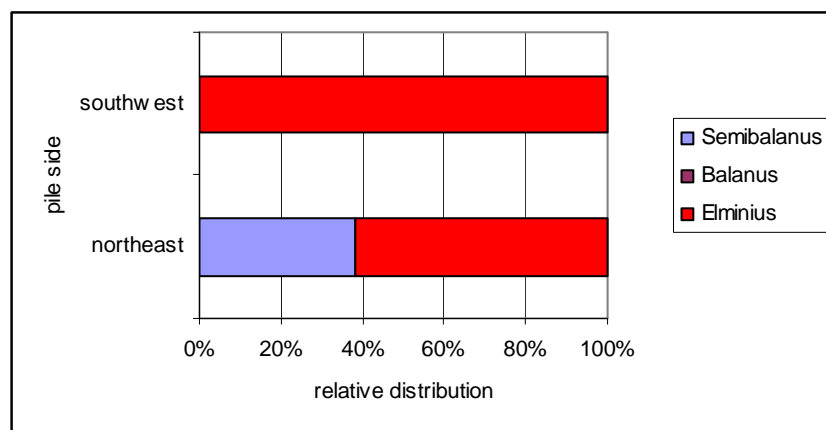
**Results and discussion**

The density estimation of the wooden piles and of collected stones and shells show a clear pattern (see figure 1). The uppermost part of the pile was settled only by *Elminius* but with ongoing depth the relative density of *Elminius* decreased. At 200 cm depth only *Balanus* could grow. This pattern occurred because *Elminius* tolerates a wide range of ecological parameters whereas *Balanus* is the only species to survive in sub tidal zones and *Semibalanus* prefers intertidal zones. It should be kept in mind that the total number of barnacles per depth is very various. At 40 cm, in average 29 barnacles per 100 cm<sup>2</sup> grow, in 80 cm 95 barnacles, and 81 barnacles at 130 cm. The barnacle density at 200 cm depth was not determined but we observed 72 barnacles per *Mytilus edulis* shell with a lot of very small individuals. In the intertidal zone, the absolute numbers of *Elminius* even increased (29 barnacles in 40 cm, 68 barnacles in 80 cm depth). There *Elminius* was the dominating species. We cannot say for sure whether here *Elminius* will displace the native *Semibalanus* or just fills up empty spatial gaps between *Semibalanus* individuals which have been there before.



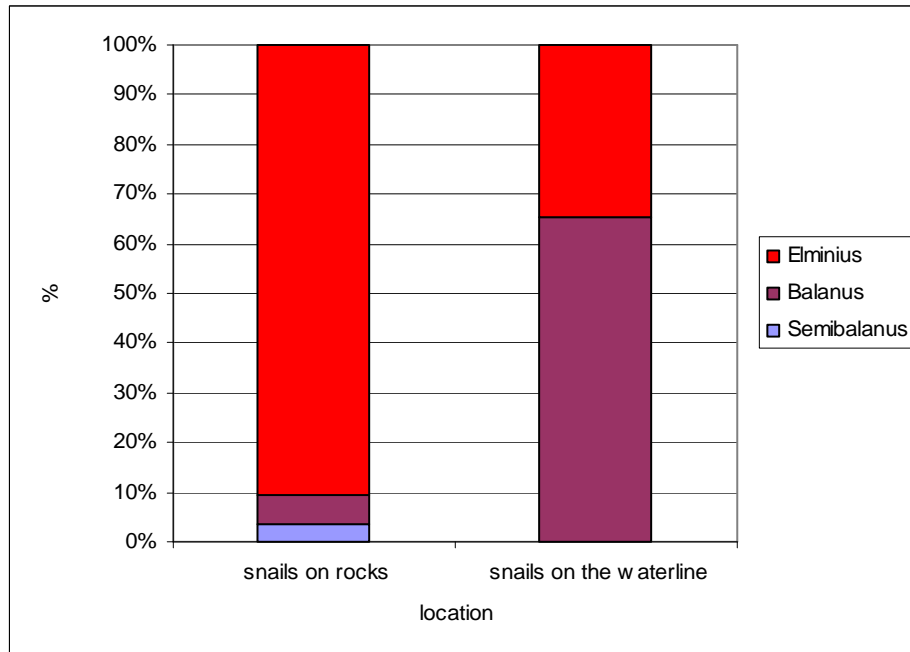
**Figure 1: Relative distribution of barnacle species at different water depths**

Very interesting is the fact that the two sides of the wooden pile showed different communities (see figure 2). It can be assumed that the larger irradiation and less splashing water (drier environment) on the south western side restrict growth of barnacles and other sessile animals. Only the “robust” alien *Elminius* can settle here. So an alien species closes an open ecological niche.



**Figure 2: Comparison on the barnacle distribution of the wooden pile sides at 40 cm water depth**

Snails with barnacles collected from a large rock pile (water depth: 130 cm) close to the wooden piles show a high abundance of *Elminius*. In opposite to this, snails collected from a lower level show a dominance of *Balanus*. Still the abundance of native species is lower on snails than on comparable dead substrate as the wooden pile at 130 cm water depth and the collected shells from the waterline (see figure 3 and figure 1). We suggest that snails evolved some kind of defence against native barnacle species. The introduced barnacle species seems not to be influenced by this defence.



**Figure 3: Barnacle species distribution on snails collected from a rock pile and the low tide waterline (ca. 1 m lower)**

*Elminius* has not displaced yet any of the native species and this research shows only little evidence that it will do in future. But as future is unpredictable, it can not be foreseen which influence for example climate change will have.