

Susceptibility and resilience to invasions: macrozoobenthic communities in the Dutch delta waters

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An increasing number of exotic macrozoobenthic species is recorded in the Dutch delta waters. With respect to the ecological integrity of these systems, it is important to know what determines the successful settlement and expansion of these populations. Based on a long-term monitoring data set for the Dutch delta waters it was investigated whether the susceptibility and resilience of benthic communities to invasion differs with the biotic and abiotic conditions prevailing in these systems. Large differences in the level of invasion were found between the water bodies. The share of exotic species varied between 9 and 23% of the total density and 40 to 81% of the total biomass. These striking differences in dominance patterns of the exotic species between water bodies were related to the prevailing community structure resulting from the level of environmental degradation, the water exchange rate with the open sea, and/or the size of the water body. It is hypothesized here that successful settlement is determined by local physical-chemical characteristics fitting species tolerances and necessities to fulfil their life-cycle. Relative high exotic species concentrations can therefore be found in areas with a high rate of species introductions on a daily basis (hot spots of introduction). Local dominance of exotic species is however related to disturbances decreasing competitive abilities of (native) species already present. When potentially competitive (native) populations are weakened in entire regions, exotic species can become successful in larger regions taking over a particular niche, as was observed for the shore crab communities of the Dutch delta waters (Van den Brink *et al.*, 2012). Generally the success of newly introduced species is only temporary; after the introduction, a lag-phase and an exponential increase of the populations, those populations start to decline and balanced co-existence with native species is reached. The total sequence from introduction to decline typically takes about 15 years in the Dutch delta waters (Hummel & Wijnhoven, 2013). Whether exotic species become invasive seems to be related to the environmental quality state of systems in which they have settled successfully. The environmental quality state determines the resistance of communities already present. Most successful exotic species appear to be those changing their environment; i.e. ecosystem engineers. Moreover these exotic engineering species facilitate associated communities and thereby suppress settlement and expansion of other (native) species. The consequences and potentials for policy and water management will be discussed.

References

Hummel, H., Wijnhoven, S. 2013. Long-term patterns in the establishment, expansion and decline of invading macrozoobenthic species in the brackish and marine waters of Southwest Netherlands. *Marine Ecology* (In press: doi: 10.1111/maec.12085).

Van den Brink A.M., Wijnhoven, S., McLay, C.L. 2012. Competition and niche segregation following the arrival of *Hemigrapsus takanoi* in the formerly *Carcinus maenas* dominated Dutch delta. *Journal of Sea Research* 73:126-136.