MSc Thesis subject:

Supervisors: Paul van Zwieten, Leo Nagelkerke, Karen van de Wolfshaar

Thesecret of invasion success: size of invaders and size structure of the resident community.

Invasive animal species are considered a threat to biodiversity. Increasing numbers of exotic animals appear in ecosystems worldwide, often with unpredictable consequences. Such consequences include animals spreading pathogens, such as dengue fever by tiger mosquitoes (*Aedes albopictus*) in Europe, or animals disrupting ecosystems, such as Nile perch (*Lates niloticus*) in Lake Victoria. Especially top predator invasions in freshwater systems are known for their dramatic effects on aquatic communities

which even may lead to shifts between alternative stable states. Invasion success and subsequent shifts between states are commonly attributed to the number of invaders and invasion events, and to invader characteristics, such as voracity. Yet, it is unclear why some invasions succeed and others do not, as mechanistic, or in other words detailed causal explanations are lacking. We have the idea that size characteristics of the resident community in which the introduced fish invades play an important role. Furthermore we think that alternative stable states in lake fish communities can be characterized by differences in the size-structure of the prey populations. In particular the size-ratio between predator and prey is thought to have a decisive role in invasion success by providing optimally-sized prey for the invading individuals. The starting hypothesis of this research program is that changes in the size-structure of predator and prey that leads to an optimal size-ratio for the predator, provides a mechanistic explanation for invasion success.

In this research we will test the robustness of this mechanism by determining invasion success with a size-based approach using a predator-prey model, where we will use the Nile perch invasion in Lake Victoria as a case study. To be able to parameterise and test such a model we will first analyse an extensive, but as yet undisclosed, historical data set of the haplochromine fish community on it’s size-structure and spatial distribution. The data set represents the fish community as caught by experimental trawling in the Mwanza gulf in southern Tanzania before, during and after the Nile perch invasion. Questions to be answered from these empirical observations are (1) what is the size structure of the haplochromine fish stock before, during and after the Nile perch invasion (2) what is the spatial distribution of the species and size-frequencies of haplochromines before, during and after the Nile perch invasion (3) how is this related to the size-structure of the Nile perch resident in the area and invading from adjacent areas of the Mwanza gulf to arrive at a detailed description of the changes in predator-prey size-ratios shortly before, during and after the Nile perch invasion. The work on the empirical observations allows for a number of MSc thesis studies each taking a specific aspect of the three questions posed. The information will be subsequently used in the development of, potentially, two different models: a first model could be a detailed population model on individual growth, based on size-dependent metabolism and consumption. Next to that we aim to develop a new generic community size-spectrum model where species and species-groups are labelled according to life-history characteristics as maximum size, trophic position and spatial occurrence. The population model allows for an in-depth analysis at the individual level, while the community-size spectrum model gives a test for the generality of observed phenomena at the community level. The results of both models will be compared to field data. For this modelling work als a number of MSc studies are envisaged.

Contact: Paul van Zwieten [paul.vanzwieten@wur.nl](mailto:paul.vanzwieten@wur.nl) , Leo Nagelkerke [leo.nagelkerke@wur.nl](mailto:leo.nagelkerke@wur.nl)