

## The Special Column of Aquatic Invasive Species Science

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We were delighted when Zhi-Yun Jia, Executive Editor of Current Zoology, approached us with a proposal to engage in a special column on invasive species science. Six papers have been written for this special column, all containing new information and approaches in the field of aquatic invasive species science. Each paper has gone through the rigorous peer review process used at Current Zoology, and Zhi-Yun Jia was very helpful by contacting reviewers and improving the manuscripts.

Invasive species science is a relatively recent scientific discipline that includes ecology, environmental processes, the impact of and on human society, and management. Due to human activities lifting dispersal barriers, exotic species settle in new areas outside their original biogeographic area and go through several steps in the invasion process, depending on the conditions: survival, reproduction, establishing a population, dispersal, boom and bust. All newly arrived species must traverse several environmental filters and only a selected number of species become really invasive. When settled they can interact, for the first time, with native species, a process that leads to often unpredictable outcomes. The strongest impact of the new comer is reached at peak density.

When a species is discovered in an area where it was previously absent a series of questions arise. What is the name of the species (sometimes taxonomically difficult)? Where has it come from (biogeographical area)? How did it arrive and what vectors were used? What can the species do? What impact will the species have on ecosystems, the economy or human health? To answer these questions several techniques and methods are needed. To complicate the matter the environments in which species arrive are often altered by human impacts such as climatic change, eutrophication and pollution. Therefore approaches to understand and predict aquatic invasions focus on species traits, environmental invasibility and a combination of these.

The series of papers in this issue focus on possible vectors for dispersal, the ecological impact of invaders and the vulnerability of waters for aquatic invasions.

Van Riel et al. (2011) demonstrate how fast colonization can take place by drift in rivers, especially in the case of amphipods when the barrier for dispersal between two rivers is lifted. In drift samples from the River Rhine 91 % were exotic macroinvertebrates with a contribution of Ponto-Caspian amphipods of 70%–90% during the year. From the water column fast colonization of the hard substrates by these amphipods takes place, where they reproduce and drift again to colonise new areas.

Fish louse belonging to the genus *Argulus* can survive for several days to two weeks off-host depending on their stage and species (Walker et al., 2011). *Argulus japonicus* originates from Japan and China and is nowadays known from all continents. Off-host survival is compared with the European species *A. foliaceus*. It appears that *A. japonicus* survives longer off-host at higher temperatures than *A. foliaceus* which is more resistant to starvation at lower temperatures. This is in favour for *A. japonicus* at global warming. The study demonstrates that transport of water in which a host was present can be a vector besides introductions attached to the host and by eggs attached to water plants and other substrates. This information can be used to prevent introductions which can be disastrous for aquaculture.

Stoffels et al. (2011) developed a simple test to establish the predatory abilities of native and non-native gammaridean species. A better predatory ability of invasive species could be demonstrated by which they can dominate macroinvertebrate communities by top down control. The test can be used for quick screening of invasive species in order to predict their impacts.

Another mode of interaction is competition for a resource, as can be the case when the interacting species belong to the same guild. Van Kessel et al. (2011) tested by habitat shifts how far newly invaded gobiid species

compete for shelter with native small benthic fish species. Two out of four invasive gobiids (*Neogobius kessleri* and *Proterorhinus semilunaris*) appeared to be competitive for shelter and are suggested to be competitively superior when this resource is limiting. The bull-head *Cottus perifretum* was especially vulnerable to this competition.

Leuven et al. (2011) analysed the effects of changes in thermal regimes on native and non-native fish diversity in the river Rhine by deriving site-specific potentially affected fractions of the regional fish species pool from species sensitivity distributions. Using this technique, it can be estimated how global warming may limit the full recovery of native fish after ecological rehabilitation and how these developments facilitate establishment of exotic species. This new approach needs further consideration and analysis using complete fish assemblages will surely lead to interesting results.

Finally, Leewis and Gittenberger (2011) developed a new assessment method for the vulnerability of water bodies to exotic species based on the properties of species as well as the water bodies themselves.

These studies provide novel information on aquatic invasive species science and new approaches to the ecological problems caused by these species. Investigations into the effects of temperature on invasive species

and on the invasibility of ecosystems increases our body of knowledge on the mechanisms and possible effects of global warming, making this special column highly relevant for biological conservation and invasive species management.

## References

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