

Detection to Dissemination, Pathways in Aquatic Invasive Species Research

This special edition of *Aquatic Invasions* contains zebra mussel research papers presented at the 15th International Conference on Aquatic Invasive Species, which was held in September 2007 in Nijmegen, the Netherlands. The International Conference on Aquatic Invasive Species (<http://www.icaiss.org>) has evolved over the last fifteen years into a broad comprehensive international forum for the dissemination, outreach and review of information on the biology and impacts of all aquatic invasive species in freshwater, marine and estuarine environments. Included in the conference series are topics pertaining to prevention of spread of aquatic invasive species, technological and engineering advances in control strategies, modeling and risk assessment, information management, public education and outreach, and pertinent policy and legal issues. The next conference will be held in Montreal, Canada (April 19-23, 2009). The theme for the 2009 ICAIS conference is 'Aquatic Invasive Species in a Changing World'.

Several other independent papers are also included in this edition of *Aquatic Invasions* with the scope of these papers providing direction for this editorial paper.

It is now internationally recognized that invasive species are one of the major threats to world species biodiversity, second only to habitat destruction. In aquatic habitats, physically destructive anthropogenic alterations and changes to the landscape and environment tend to be clearly evident, e.g. the construction of dams or tidal barrages, and opportunities for ecological management and actions are provided in the forms of monitoring, baseline studies and environmental impact assessments. Unfortunately these pre-planning options to counter changes

to species biodiversity, are not available to prevent the introduction of aquatic invasive species to new waters. In fact invasions are often detected only when a species has become established in an ecosystem, with subsequent ecological, economic, and public health impacts. Delayed detection of invasive species precludes the 'rapid response' mechanism to remove, reduce or effectively manage and control an invasive species at the early stages of an invasion. Hence the changes to biodiversity may be initially insidious and in the long-term highly detrimental.

Detection of new invasions is dependant on the provision of effective field staff (e.g., fisheries and wildlife staff) well-trained to recognize flora or fauna, which is 'new or out of the ordinary' for a particular catchment or habitat. This basic field research can then be reported to biologists who can verify, validate and assess the extent of an invasion, and also provide information on the geographic spread in locations of the recorded sites. The stage at which a new invasive species is detected depends on a number of factors including (1) how conspicuous it is in terms of visibility and habitat, (2) frequency and mode of monitoring and sampling within a watercourse, (3) environmental conditions at time of sampling and (4) pure chance events. Several papers in this edition of *Aquatic Invasions* provide information for new records of the New Zealand mud snail *Potamopyrgus antipodarum* (Son 2008: Azov-Black Sea; Filippenko and Son: Baltic Sea coast; Radea et al 2008: Greece; Davidson et al 2008: North Pacific), the purple dye murex *Bolinus brandaris* (Bañón et al 2008: Galicia, Spain), the marine mussel *Mytilopsis adamsi* (Wangku-

langkul and Lheknim 2008: Gulf of Thailand) and the Asian clam *Corbicula fluminea* (Pérez-Quintero 2008: Iberian Peninsula). Detecting and reporting new bioinvasions provide the first building blocks and steps for further ecological studies and also act as an information resource, which can be used as invasive species management tools. Biological monitoring programmes for the EU water framework directive (<http://ec.europa.eu/environment/water/water-framework/>) and other international legislation may identify new aquatic invasive species. However, these programmes tend to be undertaken on a three to five year cycle, so that a newly introduced invasive species may already be established and at the stage of exponential growth before it has been identified and recorded.

Following initial detection of invasives, further ecological studies are required to determine and assess the impacts and population dynamics of these new keystone species within specific ecosystems. Examples of such studies are provided by the three zebra mussel papers in this special International Conference in Aquatic Invasive Species edition of *Aquatic Invasions* (Makerivich et al. 2008; Millane et al. 2008; Lucy et al. 2008). While long-term datasets are essential to determine population stability and ecological impacts, it is unfortunate that the provision of funding for invasive species research rarely extends beyond a three year period, with further research dependant on subsequent extramural grant funding.

In a positive context, aquatic invasive species may provide useful tools to monitor the environment for alteration, changes, and anthropogenic impacts. Because of their invasive characteristics, i.e. abundance in the environment and fecundity, they can act as effective sentinels for anthropogenic changes to water quality. Zebra mussels are effectively used to detect the presence of waterborne human and animal pathogens in aquatic habitats, originating from a variety of point and non-point sources. As these pathogenic microorganisms impact public health due to drinking and recreational water contamination, zebra mussels are an essential key organism in providing evidence of contamination and development of risk assessment (Graczyk et al. 2008).

Dissemination of information on aquatic invasive species can be provided internationally by the free of charge provision of internet-based open-access electronic journals and information

systems. The European Commission Sixth Framework Programme for Research and Technological Development (EC FP6) Integrated Project ALARM (<http://www.alarmproject.net>) provides the main funding for the recently established electronic journal *Aquatic Invasions*, including this special ICAIS issue. One of the main objectives of *Aquatic Invasions* is to provide an early warning system on aquatic invasive species in inland and coastal waters. Other electronic resources on the world-wide-web encourage the feedback of both scientists and the general public in both recording and electronic uploading new sightings of invasives and also publicise and outreach codes of practice for various aquatic users (<http://www.invasive-speciesireland.com>). The development of invasive species conference series and workshops are also productive because they (1) disseminate information on ongoing research, (2) provide scientific networking and communications, which often leads to new research projects and (3) publicise and outreach the importance of invasive species via media coverage.

Today's technological advances in environmental monitoring, information flow, dissemination, and communication, eliminate the concept of 'remote, unreachable sites' and can allow for early detection of new invasions, rapid assessment of their ecological impact, and deployment of the intervention and control strategies. Successful intervention however, depends on well managed and synchronized actions of scientists, policy-making organizations, legislation-implementation bodies, local authorities, and the public.

Frances E. Lucy

Department of Environmental Science
and

Centre for Biomolecular Environmental and Public Health Research

Institute of Technology, Sligo, Ireland

E-mail: lucy.frances@itsligo.ie

and

Thaddeus K. Graczyk

Department of Environmental Health Sciences

Johns Hopkins Center for Water and Health

and

Department of Molecular Microbiology and Immunology

Johns Hopkins Bloomberg School of Public Health

Baltimore, Maryland, USA

E-mail: tgraczyk@jhsph.edu