Management of Biological Invasions (2017) Volume 8, Issue 3: 267–272
DOI: https://doi.org/10.3391/mbi.2017.8.3.01

Special Issue: Management of Invasive Species in Inland Waters

Editorial

Management of invasive species in inland waters: technology development and international cooperation

Wai Hing Wong[1,2,*], Marina Piria[3], Frank P.L. Collas[4], Predrag Simonović[5] and Elena Tricarico[6]

[1]*Massachusetts Department of Environmental Protection, Division of Watershed Management, 8 New Bond Street, Worcester, MA, 01606 USA*
[2]*State University of New York at Oneonta, Biology Department, 108 Ravine Parkway, Oneonta, NY 13820 USA*
[3]*University of Zagreb, Faculty of Agriculture, Department of Fisheries, Beekeeping, Game management and Spec. Zoology, Svetošimunska cesta 25, 10000 Zagreb, Croatia*
[4]*Radboud University, Department of Environmental Science, Institute for Water and Wetland Research, Heyendaalseweg 135, 6525 ED Nijmegen, the Netherlands*
[5]*University of Belgrade, Faculty of Biology, Studentski trg 16, PO Box 550, 11000 Belgrade, Serbia*
[6]*Dipartimento di Biologia, Università degli Studi di Firenze, via Romana 17, 50125 Firenze, Italy*

Author e-mails: david.w.wong@state.ma.us (WHW), F.Collas@science.ru.nl (FPLC), mpiria@agr.hr (MP), pedja@bio.bg.ac.rs (PS), elena.tricarico@unifi.it (ET)

Corresponding author

Received: 7 July 2017 / Accepted: 18 July 2017 / Published online: 31 July 2017

Handling editor: Vadim E. Panov

In 2016 two important aquatic invasive species conferences occurred. The 19th International Conference on Aquatic Invasive Species (ICAIS) was held in Winnipeg, Canada from April 10 to 14, 2016 and was hosted by the Western Canada Chapter of the International Society for Ecological Restoration (SER-WC) (https://www.icais.org/html/previous19.html and http://chapter.ser.org/westerncanada/event/19th-international-conference-on-aquatic-invasive-species/). The ICAIS is widely recognized as the most comprehensive international forum on aquatic invasive species and continues to evolve and address new and emerging issues. In recent years, the conference has typically involved over 400 participants from over 30 countries from the fields of academia, industry, government, non-government organizations (NGOs) and other stakeholders involved in this issue (Lucy and Panov 2014). The 2nd "Freshwater Invasives – Networking for Strategy II" (FINS-II) Conference was held in Zagreb, Croatia from July 11 to 14, 2016, organised jointly by the University of Zagreb and the European Inland Fisheries and Aquaculture Advisory Commission (EIFAAC) (http://finsconference.eu). At FINSII, top 10 new key threats and opportunities related to invasive species to be addressed up to 2020 were identified by 80 academics, applied scientists, policy makers and stakeholders from 14 European Union (EU) and three non-EU countries (Piria et al. 2017). This special issue of *Management of Biological Invasions* titled "*Management of Invasive Species in Inland Waters*" presents outcomes from these conferences. Specifically, this special issue contains eleven research papers presented in the 19th ICAIS, five papers presented in the FINS-II Conference, and one applied paper presented at the special session on aquatic invasive species at the 33rd Congress of the International Society of Limnology (SIL) (31 July – 5 August 2016, Torino, Italy) (http://limnology.org/meetings/past-sil-congress/).

The theme of 19th ICAIS conference was "Global Advances in Research and Management of Aquatic Invasive Species". The following sessions were covered: 1) global AIS policy and legislation drivers, 2) outreach, education, and extension, 3) management and control, 4) vectors and pathways, 5) early detection and monitoring, 6) prevention and risk assessment, 7) ballast water, 8) eDNA, 9) species of interest, 10) aquatic plants, 11) Asian carps, 12) other invasive fishes, and 13) dreissenid mussels (http://www.icais.org/pdf/abstracts_2016.pdf). Papers collected for this special issue are representative samples of topics from the 19th ICAIS. As shown in previous ICAIS conferences (Lucy and Muckle-Jeffs 2010; Karatayev et al. 2012; Lucy and Panov 2014), dreissenid mussels are still a major topic for ICAIS, which includes mussel population dynamics, control and treatment, eDNA and genetics (http://chapter.ser.org/westerncanada/event/19th-international-conference-on-aquatic-invasive-species/). This dominance is due to these mussels' profound impacts to both water industry and lake/river ecology as well as their continuous spread in North America and Europe (Karatayev et al. 2007, 2011; Molloy et al. 2007; Bij de Vaate 2010; Wong and Gestenberger 2011; MacNeil and Campbell 2014; Ashton and Klauda 2015; Gingera et al. 2017).

Among the five selected dreissenid papers, two of them are about quagga/zebra mussel control technology. Pucherelli and Claudi (2017) evaluate the effects of ultra-violet (UV) treatment on quagga mussel settlement and veliger survival. Unlike most previous studies that studied *in vivo* exposure of veligers to UV light sources in laboratory settings (Chalker-Scott and Scott 1998; Mackie and Claudi 2010; Delrose et al. 2015; Stewart-Malone et al. 2015), Pucherelli and Claudi (2017) utilized *in situ* UV equipment in treating an industrial facility. This very practical assessment of the UV treatment to control veliger settlement makes it a valuable contribution to the field. The second control technology tested by Luoma et al. (2017) is the use of electrified fields to control adult zebra mussels under different laboratory conditions. They demonstrate that 20% duty cycle square-wave pulsed direct current requires less energy than sinusoidal alternating current to induce the same level of adult zebra mussel mortality (Luoma et al. 2017). The results from their research will add information to the literature where little data are currently available.

The remaining three dreissenid papers mainly discuss detection of the veliger mortality using a simple stain (Stockton-Fiti and Claudi 2017) and early detection of the dreissenid mussel veligers using eDNA (Hosler 2017; Gingera et al. 2017). The most frequently used methods for analyzing mussel veliger mortality through observing and scoring the condition of treated dreissenid mussel veligers is often complicated and time consuming (e.g., Stockton-Fiti and Claudi 2017). Stockton-Fiti and Claudi (2017) tested a fast green stain, which is typically used as a food coloring dye, to aid in determination of live and dead veliger tissues. The staining method resulted in more rapid and precise results with no need for a long recovery step. This fast green stain method, which is relative easy to use in the field or laboratory setting, is going to be helpful in improving accuracy and efficiency of detecting mussel veliger mortality.

After reviewing the history, activities, and evolution of the United States (U.S.) Bureau of Reclamation's detection laboratory for exotic species (RDLES) in invasive mussel detection in western U.S. waters, Hosler (2017) demonstrates RDLES' persistent efforts over time to develop the best protocols for detecting and identification of dreissenid mussels. Since 2006, the RDLES laboratory has examined over 17,000 raw water samples representing over 400 western U.S. water bodies using both eDNA and microscopy. Their testing program revealed some unique information on the invasion of mussels in the western U.S. both from the way samples are collected and preserved, to the slower than anticipated spread of these pest species.

Building upon the concept of detection, Gingera et al. (2017) provided a case study using eDNA as a tool for detecting dreissenid mussels in Lake Winnipeg, Canada, where zebra mussels were first recorded in 2013. They developed two species-specific and one *Dreissena*-specific qPCR-based environmental DNA (eDNA) assays designed as a single multiplexed reaction able to identify the presence of zebra mussel and infer the presence of quagga mussel in water samples from at-risk and invaded locations in 2014. This case study demonstrates that eDNA is an early indicator of the presence of zebra mussels, a useful detection tool at the forefront of their recent invasion in Manitoba and provides the foundation for the development of a zebra mussel eDNA monitoring program for waterbodies in Manitoba and western Canada (Gingera et al. 2017). At the same time, there are still critical knowledge gaps for eDNA being recognized as a reliable management tool (Fischer et al. 2012; Lance et al. 2017). In this special edition, a case study on decay of eDNA from bighead and silver carps provides more detailed information about the fate of eDNA materials in the aquatic environment (Lance et al. 2017). Lance and colleagues (2017) found that the decay patterns of eDNA associated with both carp species significantly fit monophasic exponential decay curves. Temperature, microbial loads, and pH affected eDNA degradation significantly, while water turbulence did not show apparent effect. It is clearly demonstrated that the environmental factors can potentially influence the decay of eDNA over time and space (Lance et al.

2017). There is a growing interest in the field of eDNA, which is becoming an important consideration for aquatic resource managers dealing with invasive species. We believe that these eDNA research projects will contribute significantly to the field of aquatic invasive species' early detection (Darling and Mahon 2011; Jerde et al. 2011, 2013; Fischer et al. 2012; Amberg et al. 2015; Carmon and Hosler 2015).

Six additional papers on aquatic invasive species control technology, monitoring, risk assessment and management from the 19th ICAIS Conference are also selected for this special edition. A potential management tool to control invasive alien species is the sterile male release technique (SMRT). Descamps and de Vocht (2017) examine inducing sterility in male American bullfrogs through creating triploid individuals, which is the initial step before introduction of sterile males into wild invasive populations can take place. They found that applying a cold shock to fertilized eggs did not result in triploid individuals while 54% triploidy was obtained by applying pressure shocks. The induced triploidy indicates that the SMRT technique might potentially be a useful management technique of American bullfrog populations, though further research on the reproductive behavior of the sterile frogs is necessary before implementation. To determine effective techniques for controlling invasive silver carp, such as herding fish into a net for removal, Vetter et al. (2017) studied the response of wild silver carp to broadband sound. In their experiment, broadband sound (0.06–10 kHz) elicited jumping behavior from silver carp and the number of jumping fish decreased with subsequent sound exposures.

Detection of species is an important management consideration. The amphipod *Apocorophium lacustre* is a recent colonizer of freshwater ecosystems in the U.S. and Europe. There is strong interest in preventing spread of the species into the Great Lakes Basin, but there has been no systematic sampling in the Illinois River and Chicago Area Waterway System. The paper by Keller et al. (2017) presents the results of a geographically extensive sampling effort designed to detect whether *A. lacustre* has spread upstream into Lake Michigan. It was found that the species is not abundant upstream of the previously measured extent, and additional/alternative sampling methods are needed to get more certainty about the species range in this system.

Although not present in North America yet, Oliveira et al. (2010) predicted that there is a potential that the golden mussels (*Limnoperna fortunei*) can establish in the Mississippi River below its confluence with Ohio River, the Colorado River and Rio Grande. It is also reported that the golden mussel has a high probability of establishment if introduced to the Great Lakes (Great Lakes Aquatic Nonindigenous Species Information System 2015). To assess the risk of the golden mussels arriving, establishing and spreading within the Province of Ontario, Canada, Mackie and Brinsmead (2017) undertook a 4-step risk assessment. Mackie and Brinsmead (2017) determined that the likelihood of the arrival, survival, establishment, and further spread of the golden mussel was "low", due to its physiological intolerance of cold winter waters. Based on the current distribution of golden mussel being limited mostly to waters with minimum temperatures of 10 °C to 12 °C at 36^{o} latitude and the number of degree days required for reproduction and establishment, the level of risk for invasion into Ontario waters is low and the level of uncertainty is moderate. This risk outcome would likely apply to all of the waters in Canada and most of the USA north of the 36th parallel that is covered by snow or where lakes have ice cover for at least two months of the year (Mackie and Brinsmead 2017).

In order to face biological invasions in aquatic environments, the project Marie Sklodowska Curie 2014 ITN (Innovative Training Network) H2020 Aquainvad-ED (AQUAtic INVaders: Early Detection, Control and Management; 2015–2019) was developed to tackle alien invasive species in Europe and to harmonize with the Marine Strategy Framework Directive and the Water Framework Directive (Tricarico et al. 2017). The main research goal of Aquainvad-ED is to exploit novel tools combined with the power of crowd data sourcing (citizen science) to develop innovative methods for early detection, control and management of aquatic alien invasive species. Aquainvad-ED network, consists of universities, research centres and companies from different European countries, offers a multidisciplinary approach (genetics, behaviour, ecology, citizen science, risk assessment), and brings the expertise of academic and non-academic partners to the assessment and management of biological invasions in aquatic habitats.

The primary objective of the FINS-II conference was to provide a forum where international scientists, policy makers and stakeholders could discuss designated themes in areas related to aquatic invasive species and to develop up to date information for improvement of management and policy in EU and non EU countries (Piria et al. 2017). The following topics were discussed during the FINS-II Conference: 1) legislation remit in both EU and non-EU countries; 2) best management and biosecurity practice for control; 3) data management and early warning; and 4) pathways of introductions and citizen science. The selected papers presented at the FINS-II conference provide more insights into particular problems of invasive species that are not well regulated by legislation, and gives insight on priorities and opportunities to resolve invasive species issues through strategic cooperation among European counties. Thus, Varray and Hudin (2017) presented the management strategy on invasive alien species of the Loire-Brittany basin through multi-level coordination groups. Based on the learnings of more than 10 years, the Loire basin invasive alien species management strategy 2014–2020 is articulated with the strategies at European, national and regional levels. These strategies led to 24 priority actions such as coordination, knowledge and exchanges, monitoring and early intervention, management and awareness, communication and training.

In order to respond to the growing concern on invasive alien species and their impact in freshwater environments in France, a working group on biological invasions in freshwater environments was created in 2009 to increase management capacity by valuing and promoting expert knowledge, digesting and giving access to scientific information, and providing guidance on decision-making (Sarat et al. 2017). The group is coordinated by the French Biodiversity Agency and the IUCN French Committee. The group's activities are determined by the shared needs of the formed network, such as the: development of an internet platform to provide access to information; publication of a best practices guide with fully detailed feedbacks from management efforts; and setting up of an information database focused on the operational management of introduced aquatic species in France (Sarat et al. 2017).

After studying the origin and pathway (or reason for translocation) of fish introductions and/or translocations between the Danube and Adriatic basins of Croatia, Pofuk et al. (2017) found that sport and recreational fishing has played a very important role for translocations of non-native fish both socially and economically. It is recommended that the issue of translocation should be addressed in the Croatian legislation to reinforce control measures to prevent translocations, particularly for the Adriatic region (Pofuk et al. 2017). Copp et al. (2017) provided solid evidence in a case study from England that the introduction of pumpkinseed *Lepomis gibbosus*, a North American sunfish, into an angling lake is a contaminant of native aquatic plants during their stocking to enhance the fishery there. This study highlights the importance of adhering to current guidelines on the movement of aquatic plants (e.g. Great Britain's "Be Plant Wise" educational initiative) with the aim to prevent unwanted transfer of aquatic organisms. Furthermore, Piria et al. (2017) provide a synopsis on threats and opportunities to tackle freshwater invasive species based on outcomes of the FINS-II conference. The top 10 identified threats are:

- lack of funding and resources;
- lack of responsible lead agencies;
- lack of awareness and education;
- lack of standardisation in data management;
- lack of common approaches to biosecurity;
- conflicts of interest;
- insufficient monitoring;
- poor communication;
- limited access to and possible interventions on private property; and
- difficulties in the implementation of legislation in bordering non-EU countries.

The top 10 identified opportunities are:

- cooperation and communication;
- funding and related economic issues;
- education and outreach;
- increased interdisciplinarity in invasive species analysis and management;
- sharing of data and expertise;
- common practices;
- competent authorities;
- enhanced cross-legislation monitoring and management;
- use of legislation to enforce compliance;
- increased assessment of relevant natural capital including ecosystem services.

These sets of threats and opportunities underline the importance of international cooperation on invasive alien species issues in communication, education and funding, as priorities, as well as in standardisation of legislation, control methods and best practise of research (Piria et al. 2017). For a timely response to alien species it is vital to have accurate and up to date knowledge regarding their distribution. Lozano et al. (2017) compared native and alien plant species distributions in South America using the GBIF database and a separate database constructed through traditional literature searches. Their results indicate that depending on the database used outcomes can differ significantly. Thus, in order to facilitate prevention and monitoring it is important to combine existing databases with additional literature derived data.

Biological invasion costs are often an unintended side effect of international trade (Perrings et al. 2005). As globalization increases, there will be a foreseeable increased risk of invasion (Karatayev et al. 2007). Therefore, it is critical for invasive species communities to adopt efficient, cost-effective, and environmentally friendly technologies for early detection and rapid response, for eradication and control of the targeted invasive species population in a manageable level. In the meantime, international cooperation is also the key for ensuring worldwide invasive species education, awareness, communication, and legislation. Let's embrace all possible best management practices while collaborating as much as possible in a global scale to minimize the risks posed by invasive species to the economy, environment, and public health of human beings.

References

Amberg JJ, McCalla SG, Monroe E, Lance R, Baerwaldt K, Gaikowski MP (2015) Improving efficiency and reliability of environmental DNA analysis for silver carp. *Journal of Great Lakes Research* 41: 367–373, https://doi.org/10.1016/j.jglr.2015.02.009

Ashton MJ, Klauda RJ (2015) The spread of zebra mussel (*Dreissena polymorpha*) from the lower Susquehanna River into the upper Chesapeake Bay, Maryland, USA. *BioInvasions Records* 4: 199–195, https://doi.org/10.3391/bir.2015.4.3.07

Bij de Vaate A (2010) Some evidence for ballast water transport being the vector of the quagga mussel (*Dreissena rostriformis bugensis* Andrusov, 1897) introduction into Western Europe and subsequent upstream dispersal in the River Rhine. *Aquatic Invasions* 5: 207–209, https://doi.org/10.3391/ai.2010.5.2.13

Carmon J, Hosler DM (2015) Understanding Dreissenid Veliger Detection in the Western United States. In: Wong WH, Gerstenberger SL (eds), Biology and Management of Invasive Quagga and Zebra Mussels in the Western United States. CRC Press. Boca Raton, Florida, pp 123–139, https://doi.org/10.1201/b18447-14

Chalker-Scott L, Scott JD (1998) Effectiveness of ultraviolet radiation for control of *Dreissena polymorpha*: A four-year study. *Dreissena!* 9: 1–5

Copp GH, Britton JR, Wesley KJ, Davison PI (2017) Non-native fish dispersal as a contaminant of aquatic plant consignments—a case study from England. *Management of Biological Invasions* 8: 437–442, https://doi.org/10.3391/mbi.2017.8.3.17

Darling JA, Mahon AR (2011) From molecules to management: Adopting DNA-based methods for monitoring biological invasions in aquatic environments. *Environmental Research* 111: 978–988, https://doi.org/10.1016/j.envres.2011.02.001

Delrose P, Gerstenberger SL, Wong WH (2015) The effectiveness of SafeGUARD ultraviolet radiation system as a biocide against quagga mussel veligers (*Dreissena rostriformis bugensis*). In: Wong WH, Gerstenberger SL (eds), Biology and Management of Invasive Quagga and Zebra Mussels in the Western United States. CRC Press, Boca Raton, Florida, pp 479–485, https://doi.org/10.1201/b18447-39

Descamps S, De Vocht A (2017) The sterile male release approach as a method to control invasive amphibian populations: a preliminary study on *Lithobates catesbeianus*. *Management of Biological Invasions* 8: 361–370, https://doi.org/10.3391/mbi.2017.8.3.09

Fischer ME, Kelly KL, Nierzwicki-Bauer SA (2012) Accuracy and reliability of *Dreissena* spp. larvae detection by cross-polarized light microscopy, imaging flow cytometry, and polymerase chain reaction assays. *Lake and Reservoir Management* 28: 265–276, https://doi.org/10.1080/07438141.2012.731027

Gingera TD, Bajno R, Docker MF, Reist JD (2017) Environmental DNA as a detection tool for zebra mussels *Dreissena polymorpha* (Pallas, 1771) at the forefront of an invasion event in Lake Winnipeg, Manitoba, Canada. *Management of Biological Invasions* 8: 287–300, https://doi.org/10.3391/mbi.2017.8.3.03

Great Lakes Aquatic Nonindigenous Species Information System (2015) *Limnoperna fortunei* USGS Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI

Hosler DM (2017) Where is the body? Dreissenid mussels, raw water testing, and the real value of environmental DNA. *Management of Biological Invasions* 8: 335–341, https://doi.org/10.3391/mbi.2017.8.3.07

Jerde CL, Chadderton WL, Mahon AR, Renshaw MA, Corush J, Budny ML, Mysorekar S, Lodge DM (2013) Detection of Asian carp DNA as part of a Great Lakes basin-wide surveillance program. *Canadian Journal of Fisheries and Aquatic Sciences* 70: 522–526, https://doi.org/10.1139/cjfas-2012-0478

Jerde CL, Mahon AR, Chadderton WL, Lodge DM (2011) "Sight-unseen" detection of rare aquatic species using environmental DNA. *Conservation Letters* 4: 150–157, https://doi.org/10.1111/j.1755-263X.2010.00158.x

Karatayev AY, Burlakova LE, Mastitsky SE, Padilla DK, Mills EL (2011) Contrasting rates of spread of two congeners, *Dreissena polymorpha* and *Dreissena rostriformis bugensis*, at different spatial scales. *Journal of the Shellfish Research* 30: 923–931, https://doi.org/10.2983/035.030.0334

Karatayev AY, Claudi R, Lucy FE (2012) History of *Dreissena* research and the ICAIS gateway to aquatic invasions science. *Aquatic Invasions* 7: 1–5, https://doi.org/10.3391/ai.2012.7.1.001

Karatayev AY, Padilla DK, Minchin D, Boltovskoy D, Burlakova LE (2007) Changes in global economies and trade: the potential spread of exotic freshwater bivalves. *Biological Invasions* 9: 161–180, https://doi.org/10.1007/s10530-006-9013-9

Keller RP, Habeeb G, Henry T, Brenner J (2017) Non-native amphipod, *Apocorophium lacustre* (Vanhoffen, 1911), in the Illinois River and Chicago Area Waterway System. *Management of Biological Invasions* 8: 377–382, https://doi.org/10.3391/mbi.2017.8.3.11

Lance RF, Klymus KE, Richter CA, Guan X, Farrington HL, Carr MR, Thompson N, Chapman D, Baerwaldt KL (2017) Experimental observations on the decay of environmental DNA from bighead and silver carps. *Management of Biological Invasions* 8: 343–359, https://doi.org/10.3391/mbi.2017.8.3.08

Lozano V, Chapman DS, Brundu G (2017) Native and non-native aquatic plants of South America: comparing and integrating GBIF records with literature data. *Management of Biological Invasions* 8: 443–454, https://doi.org/10.3391/mbi.2017.8.3.18

Lucy FE, Muckle-Jeffs E (2010) History of the Zebra Mussel/ICAIS Conference series. *Aquatic Invasions* 5: 1–3, https://doi.org/10.3391/ai.2010.5.1.1

Lucy FE, Panov VE (2014) Keep beating the drum: ICAIS confirms aquatic invasive species are of continuing concern. *Aquatic Invasions* 9: 239–242, https://doi.org/10.3391/ai.2014.9.3.01

Luoma JA, Dean JC, Severson TJ, Wise JK, Barbour MT (2017) Use of alternating and pulsed direct current electrified fields for zebra mussel control. *Management of Biological Invasions* 8: 311–324, https://doi.org/10.3391/mbi.2017.8.3.05

Mackie GL, Brinsmead JK (2017) A risk assessment of the golden mussel, *Limnoperna fortunei* (Dunker, 1857) for Ontario, Canada. *Management of Biological Invasions* 8: 383–402, https://doi.org/10.3391/mbi.2017.8.3.12

Mackie GL, Claudi R (2010) Monitoring and control of microfouling mollusks in fresh water systems. CRC Press, Taylor and Francis Group. Boca Raton, Florida, 550 pp

MacNeil C, Campbell ML (2014) The 'grand scheme of things': biological invasions, their detection, impacts and management. *Management of Biological Invasions* 5: 195–196, https://doi.org/10.3391/mbi.2014.5.3.01

Molloy DP, Bij de Vaate A, Wilke T, Giamberini L (2007) Discovery of *Dreissena rostriformis bugensis* (Andrusov 1897) in Western Europe. *Biological Invasions* 9: 871–874, https://doi.org/10.1007/s10530-006-9078-5

Oliveira MD, Hamilton SK, Jacobi CM (2010) Forecasting the expansion of the invasive golden mussel *Limnoperna fortunei* in Brazilian and North American rivers based on its occurrence in the Paraguay River and Pantanal wetland of Brazil. *Aquatic Invasions* 5: 59–73, https://doi.org/10.3391/ai.2010.5.1.8

Perrings C, Dehnen-Schmutz K, Touza J, Williamson M (2005) How to manage biological invasions under globalization. *Trends in Ecology and Evolution* 20: 212–215, https://doi.org/10.1016/j.tree.2005.02.011

Piria M, Copp GH, Dick JTA, Duplić A, Groom Q, Jelić D, Lucy FE, Roy HE, Sarat E, Simonović P, Tomljanović T, Tricarico E, Weinlander M, Adámek Z, Bedolfe S, Coughlan NE, Davis E, Dobrzycka-Krahel A, Grgić Z, Kırankaya ŞG, Ekmekçi FG, Lajtner J, Lukas JAY, Koutsikos N, Mennen GJ, Mitić B, Pastorino P, Ruokonen TJ, Skóra ME, Smith ERC, Šprem N, Tarkan AS, Treer T, Vardakas L, Vehanen T, Vilizzi L, Zanella D, Caffrey JM (2017) Tackling invasive alien species in Europe II: threats and opportunities until 2020. *Management of Biological Invasions* 8: 273–286, https://doi.org/10.3391/mbi.2017.8.3.02

Pofuk M, Zanella D, Piria M (2017) An overview of the translocated native and non-native fish species in Croatia: pathways, impacts and management. *Management of Biological Invasions* 8: 425–435, https://doi.org/10.3391/mbi.2017.8.3.16

Pucherelli SF, Claudi R (2017) Evaluation of the effects of ultra-violet light treatment on quagga mussel settlement and veliger survival at Davis Dam. *Management of Biological Invasions* 8: 301–310, https://doi.org/10.3391/mbi.2017.8.3.04

Sarat E, Dutartre A, Soubeyran Y, Poulet N (2017) A French working group on biological invasions in aquatic environments: Towards an improvement of knowledge and management of freshwater invasive alien species. *Management of Biological Invasions* 8: 415–424, https://doi.org/10.3391/mbi.2017.8.3.15

Stewart-Malone A, Misamore M, Wilmoth S, Reyes A, Wong WH, Gross J (2015) The effect of UV-C exposure on larval survival of the dreissenid quagga mussel. *PLoS ONE* 10: e0133039, https://doi.org/10.1371/journal.pone.0133039

Stockton-Fiti KA, Claudi R (2017) Use of a differential simple stain to confirm mortality of dreissenid mussel veligers in field and laboratory experiments. *Management of Biological Invasions* 8: 325–333, https://doi.org/10.3391/mbi.2017.8.3.06

Tricarico E, Borrell YJ, García-Vázquez E, Rico JM, Rech S, Scapini F, Johović I, Rodríguez-Ezpeleta N, Basurko OC, Rey A, Gough P, Aquiloni L, Sposimo P, Inghilesi AF, Haubrock P, Delgado JF, Skukan R, Hall D, Marsh-Smith S, Kilbey D, Monteoliva AP, Muha TP, Rodríguez-Rey M, Rolla M, Rehwald HK, Garcia de Leaniz C, Consuegra S (2017) Developing innovative methods to face aquatic invasions in Europe: the Aquainvad-ED project. *Management of Biological Invasions* 8: 403–408, https://doi.org/10.3391/mbi.2017.8.3.13

Varray S, Hudin S (2017) From networking to a coordinated management strategy for the invasive alien species of the Loire-Brittany basin. *Management of Biological Invasions* 8: 409–413, https://doi.org/10.3391/mbi.2017.8.3.14

Vetter BJ, Calfee RD, Mensinger AF (2017) Management implications of broadband sound in modulating wild silver carp (*Hypophthalmichthys molitrix*) behavior. *Management of Biological Invasions* 8: 371–376, https://doi.org/10.3391/mbi.2017.8.3.10

Wong WH, Gerstenberger SL (2011) Quagga mussels in the western United States: Monitoring and Management. *Aquatic Invasions* 6: 125–129, https://doi.org/10.3391/ai.2011.6.2.01