

Book Review

Book Review: Biology and Management of Invasive Quagga and Zebra Mussels in the Western United States

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Received: 7 October 2015 / Accepted: 10 November 2015 / Published online: 14 November 2015

Handling editor: Marnie Campbell

This attractive volume, the most recent in a series of like volumes documenting dreissenid biology, impacts and control will be a direct benefit to anyone involved with their management. The book will facilitate communication among state and federal agencies and those managing aquatic resources by documenting the technologies used to control the increasing range of dreissenid mussels in the western states (Wong and Gerstenberger 2015).

Zebra, then quagga mussels, were first documented in North America the northeast, zebra mussels in 1986, quaggas in 1991, both in the St. Lawrence drainage. They took almost three decades to spread to their present range east of the Mississippi. In less than two years after their discovery in 2007 in Lake Mead in the Colorado River System, they have been documented in five western states (Britton 2015a). This reference work describes their biology relevant to management concerns, their increasing distribution in the west, a history of the management activities undertaken to prevent further range expansion, technologies used in attempts to contain mussels concurrently with methods used for prevention, monitoring, early detection rapid response (EDRR), control and management.

The book is divided into seven sections incorporating 34 contributions. Technologies used in attempts to contain mussels are summarized by presenting a synthesis of the efforts of scientists and managers and the impacts of management

activities on the distribution of dreissenid mussels within the western states using case studies from Nevada, Arizona, Utah, California, Idaho, Wyoming and Texas.

Lake Mead, in Nevada and Arizona, appears to have had the most intensive research conducted in the western states addressing the biology and life cycles of dreissenids relevant to their management. Methods of study have centered on their reproductive biology (Moore et al. 2015) thermal tolerance of adults (Kappel et al. 2015) and temporal population trends of quaggas on soft sediments (Caldwell et al. 2015). The detection of veligers and adults, population densities and the carrying capacities of dreissenid habitats on the lake are documented (Misamore 2015; Cross and Wong 2015). Nearby Lake Mohave downstream on the Colorado River served as a site for the study of the potential impacts of dreissenids on a striped bass fishery (Ianniello 2015).

Twenty-two contributions in sections on monitoring (McMahon 2015; Culver et al. 2015, Hatcher and McClelland 2015; Bryan 2015) detection (Steele and Wong 2015; DeShon et al. 2015; Carmon and Hosler 2015; Nelson et al. 2015), prevention (Tait and Dingman 2015; Comeau et al. 2015; Zook and Phillips 2015; Britton 2015a; DiVittorio 2015; Dalton 2015; Anderson 2015) and control (Merten et al. 2015; Skaja 2015; Moffitt 2015; Delrose et al. 2015; Sykes and Wilson 2015; Watters et al. 2015; Rackl and Link 2015) clearly illustrate the interplay

between these protocols. Four contributions discuss dreissenid monitoring programs in California, Arizona and Texas (McMahon 2015; Culver et al. 2015; Hatcher and McClelland 2015; Bryan 2015). A diversity of temporal and spatial logistic formats are presented regarding monitoring requiring the utilization of a number of detection strategies including artificial substrates for adults and microscopic observations of water samples for veligers (enhanced by the use of automated water samplers) in lake waters (Steele and Wong 2015; Carmon and Hosler 2015; Nelson et al. 2015). These are presented along with the unique training involved with the use of dogs for detection of larval and adult dreissenids in and on vessels (DeShon et al. 2015).

Additional contributions on dreissenid prevention and detection address strategies and protocols to disinfect recreational water craft entering and leaving waterbodies (Comeau et al. 2015), Hazard Analysis at Critical Control Points (HACCP) to address transport pathways (Britton 2015b) and decontaminating equipment and source waters during wildfire abatement operations. In addition to the latter, preventive activities address problems concerning uniform protocols for the inspection of, cleaning and decontamination of recreational boats, commercial vessels (barges, cranes) and seaplanes (Zook and Phillips 2015; DiVittorio 2015). Problems associated with fish transport tanks during stocking operations and other natural resource management activities are considered as are stakeholder outreach and education (Sykes and Wilson 2015; Volkoff et al. 2015).

The above strategies to prevent colonization by dreissenid mussels are identical to control including mechanical protocols, drying of boats and equipment as well as limnological and biological treatments preventing byssus attachment. Coatings including antifouling paints, copper, zinc and silicone based materials (Skaja et al. 2015) and challenges with ultraviolet radiation (Delrose et al. 2015), molluscicides, and fish including water transferred during a variety of activities are considered (Sykes and Wilson 2015). Government responses to those with conflicting agendas while making and implementing policy decisions are documented from several States including Nevada, California, Texas, Wyoming and Idaho (Volkoff et al. 2015; Chilton II et al. 2015; Bear and Rahe 2015; Chilton 2015; Ferriter and Anderson 2015).

In developing this review I have had problems with redundancy because of the book's organization. There are clearly difficulties in separating a volume

into discreet sections such as; Prevention, Monitoring and Detection when case studies documenting efforts in a particular region, in order to be complete, must necessarily include elements of at least all three of these interrelated activities. Unfortunately contributions have been assigned to sections that imply discreet functional attributes. Since the work is restricted to the western states I think it might have been better organized by drainage system or state.

This book is an excellent contribution to the literature of both the science and management of dreissenid mussels. It superbly documents the history and management of quagga and zebra mussels in our Western States. Anyone working with the policy and management of these organisms in the United States, should have this on their shelf.

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