<u>DAVID W. SCHINDLER & JOHN R. VALLENTYNE, *THE ALGAL BOWL – OVERFERTILIZATION OF THE WORLD'S FRESHWATERS AND ESTUARIES* (EDMONTON, ALBERTA, CANADA: THE UNIVERSITY OF ALBERTA PRESS, 2008. PP IX – 334. COLOUR SECTION.) A BOOK REVIEW</u>

Abstract:

The Algal Bowl by Schindler and Vallentyne addresses the scientific, technical, social and political aspects of eutrophication in freshwater and estuary ecosystems. An overview of lake ecosystems and classifications provides needed background for the discussion of eutrophication. The authors discuss the importance of the nutrients nitrogen, phosphorous and carbon in controlling eutrophication, and conclude that phosphorous is the most important nutrient to control if the aim is to prevent eutrophication in fresh water. The technical challenges to successfully protecting water resources against eutrophication are identified, and the authors argue that preventing eutrophication through the use of available technology is preferable to trying to treat waters that have already been degraded.

The Algal Bowl is a well-written and thorough study on the phenomenon of eutrophication. This is the second edition of the book, with the first edition published in 1974. The central premise of the book is that humanity has been careless in its management of our freshwater and estuary resources, and that our continued negligence may result in ecosystem collapse. Schindler and Vallentyne draw parallels between the widespread collapse of freshwater and estuarine ecosystems in the 1960's and today with the Dust Bowl in the 1930's, as both resulted from human mismanagement of natural resources and could be prevented.

Freshwater lakes are the focus of the authors, as both are trained limnologists. The authors present a concise, but not excruciatingly detailed, overview of lake ecosystems and classifications. Lakes are classified on a scale of nutrient content and plant productivity from low (oligotrophic) to high (eutrophic), with intermediate levels classified as mesotrophic. It is easy to discern between an oligotrophic and eutrophic lake, as oligotrophic lakes have clear water and eutrophic lakes have murky water and a high amount of aquatic plant life. Lakes exist naturally in any of these states, based mainly on the productivity of their catchments, with oligotrophic lakes typically having smaller, naturally vegetated catchments and eutrophic lakes having larger catchments that supply a high amount of nutrients to the lake. (P. 4) Oligotrophic lakes are free of “dead zones” that may occur due to anoxic conditions (low or no oxygen in water). Anoxic conditions are typically brought about in eutrophic lakes when dead plankton sink to the bottom of the lake and decompose; this decomposition consumes oxygen, which is not replaced through photosynthesis making the affected water inhospitable or deadly to organisms that use oxygen in respiration.

Eutrophication is a process that aquatic ecosystems experience as a result of increased levels of nutrients in water. These increased levels of nutrients lead to an increase in the amount of photosynthetic life, which leads to other chemical and ecological changes in the system. The nutrients most important to the process of eutrophication are nitrogen (N), phosphorous (P) and carbon (C). Aquatic ecosystems can undergo “cultural eutrophication” through the actions of humans. This process is typically the result of the direct input of nutrient bearing material, such as sewage or animal waste, but may result from non-point sources of these nutrients. While most people don’t think of algae and phytoplankton much, if at all, our perception of them as small and insignificant is far from their actual impact on aquatic ecosystems. (P 81)

The authors make a strong case that while increased production is desirable in terrestrial agriculture it causes several problems for humans who seek beneficial use of water resources. The increased production in aquatic ecosystems can drastically change the biota in the lake, decrease waters palatability or usability as a drinking water source and decrease its appeal for recreation. Many aquatic ecosystems that were once a productive fishery have succumbed to eutrophication, and some that were overfished became more susceptible to the change. Some types of phytoplankton, specifically blue-green algae, release toxins that can make freshwater unusable as a drinking water source.

The book provides several brief histories of modern human's interaction with freshwater and estuarine ecosystems, including information on the first documented cases of cultural eutrophication in Lago Di Monterosi in Italy around 171 B.C. and Lake Zurich in Switzerland in the late 1800s. The case of Lago Di Monterosi is not well documented and the information presented is limited to the theory that the construction of the Via Cassia near the lake lead to increased human presence in and around the lake, which lead to cultural eutrophication (P 217). The case of Lake Zurich is presented in more detail, and identifies several culprits for its cultural eutrophication, including municipal sewage and agricultural wastes. (P 21) Early studies of Lake Zurich identified two nutrients that typically limit the growth of algae, nitrogen and phosphorous, as increasing in concentration along with the observed eutrophication.

The authors discuss the importance of the three nutrients mentioned above in controlling eutrophication, and conclude that phosphorous is the most important nutrient to control if the aim is to prevent eutrophication in fresh water. Fortunately, it is also the easiest of the three to control at sewage treatment plants using currently available techniques. (P 109) The authors' note that phosphorous is not processed cyclically in nature, and that it is on a one-way route to the sea once it enters most water bodies. As phosphorous is an element, there is no way for us to synthesize; it is a limited resource that should be managed as such to preserve its availability for future use. (P 94) In some estuarine or marine ecosystems, nitrogen may be the nutrient that limits productivity.

In the 1960s the governments of Canada and the U.S. established a joint committee to study the causes of eutrophication in the lower St. Lawrence Great Lakes (lakes Ontario and

Erie). After considerable study and debate it was determined that removing phosphorous (in the form of phosphates) from sewage was the most effective method to address the problem. Studies showed that detergents for washing clothes and dishes accounted for over 50% of the phosphorous in municipal sewage. (P 120) The detergent industry made several attempts to counter the recommendations, using misinformation in an attempt to sow doubt in the public and policy makers, and claiming that the phosphates were necessary to get dishes and laundry clean. (P 127) The authors dedicate several pages to rebut the claims that were made by the detergent industry. (P 128 – 131) Fortunately, policy makers ended up on the environmentally protective side of this issue, and the impacted lakes, as well as many others, benefitted from the reduced phosphorous loading.

While the problem of phosphorous in detergents was successfully addressed, the authors assert that many other nutrient sources continue to negatively impact aquatic ecosystems. These sources include agricultural run-off from animal waste and fertilizer, as well as human sewage treatment facilities and other industries. The authors argue that humanity has already developed the technology needed to prevent eutrophication from impairing freshwater and estuarine ecosystems. They state that preventing the eutrophication of aquatic ecosystems is preferable to attempting to treat waters that have been degraded by eutrophication. Their argument is based largely on the facts that attempting to treat water involves many of the same actions that would prevent eutrophication (removing external nutrient inputs), water bodies may not return to their original state, and the high cost of the treatment techniques. (P 263-264)

The Algal Bowl is intended for policy makers and citizens who are concerned about the health of their water resources. Schindler and Vallentyne present a complex topic in a manner that is easy to understand for readers who are not trained scientists. They use many charts and figures to present information, but all of these aids help clarify the topic being addressed. In addition to the scientific side of this topic, the authors address the social and policy aspects. They present information about the clustering of humanity around water sources and how our cumulative actions have degraded many of our water resources. The authors identify likely arguments against their preferred course of action and present concise counter-arguments. They identify the technical challenges that policy makers and environmental advocates will need to address to successfully protect water resources. Specific information on the deficiencies in government regulation of factors that affect eutrophication is presented, focusing on the fragmentation of oversight between federal, state and municipalities for different aspects of the issue. (P 264) The authors also present information on how current regulation allows certain sectors to pass along costs associated with their activities to society. (P 267)

Schindler and Vallentyne successfully address the scientific, technical, social and political aspects of eutrophication, and do so in a very approachable manner. *The Algal Bowl*, either sections or in its entirety, is a book that policy studies students should consider reading, as they will recognize many of the concepts presented in policy studies courses in the book.