Pollution, Disease, and the Escalating Freshwater Crisis: An Integrated Review of the Mississippi and Missouri River Studies by K.R. Olson

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This review examines a recent book by Professor Kenneth Olson that synthesizes a series of studies (2021–2025) on the Mississippi and Missouri River systems, interpreting them through the interconnected lenses of pollution, disease, and the escalating global freshwater crisis. Rather than treating rivers solely as hydrological or economic infrastructures, the review conceptualizes large river systems as integrated socio-ecological corridors that mediate long-term environmental exposure and public health risk. Particular attention is paid to the cumulative effects of anthropogenic pollution, historical land-use decisions, and institutional management strategies on freshwater quality and disease dynamics. Drawing on the framework of infectious ecology, the review also discusses hypotheses linking chemical contamination of freshwater systems to the activation of pathogenic properties in aquatic microorganisms, including pandemic-scale processes. The Mississippi and Missouri River cases are presented as model systems reflecting broader global trends in freshwater degradation and health vulnerability. The review concludes by emphasizing the need for epistemological integration across hydrology, ecology, epidemiology, and governance in order to address pollution-related diseases in an era of intensifying freshwater stress.

Key words: freshwater systems, environmental pollution, disease dynamics, Infectious ecology, river governance, public health risk.

A new book (*Olson, 2025*). This is always a pleasure. The foundation of Professor Kenneth Olson's new book is a series of articles written between 2021 and 2025. The book constitutes a conceptually unified body of research focused on the Mississippi and Missouri Rivers as *continental-scale freshwater systems under cumulative environmental stress.* Although published as separate contributions in the *Open Journal of Soil Science*, these studies collectively reveal how pollution, disease risk, and freshwater degradation emerge from long-term interactions between infrastructure, governance, hydrology, and historical land-use decisions.

Freshwater Infrastructure, Pollution Accumulation, and Health Risk. The foundational framework is established in *Chapter 1* (*Olson, Indorante & Miller, 2021*), which analyzes water resources and infrastructure restoration in the Upper Mississippi River Basin. While the article focuses on soil and hydrological systems, its implications for pollution-related disease risk are substantial. Aging infrastructure, contaminated sediments, and altered flow regimes facilitate the *accumulation and downstream transport of chemical pollutants, nutrients, and microbial agents*. From a public health perspective, the basin functions as an upstream generator of exposure pathways that manifest far beyond their point of origin.

Crucially, the chapter demonstrates that freshwater degradation operates on long temporal scales, producing delayed and spatially displaced biological effects. This structural property complicates infectious attribution and contributes to the chronic underestimation of river-mediated health risks.

Historical Expansion and the Institutionalization of Environmental Damage. In *Chapter 2* (*Olson, 2023*), the Mississippi and Missouri Rivers are examined as drivers of 19th-century U.S. territorial expansion. This historical perspective is essential for understanding contemporary pollution and disease patterns. The systematic modification of river systems—channelization, floodplain occupation, drainage ditches, wetland removal—normalized environmental disruption as a prerequisite for economic growth.

From the standpoint of pollution and disease, this chapter reveals a form of *path dependency*: present-day freshwater crises are not anomalies, but predictable outcomes of institutional logics established during early territorial expansion. Environmental and health externalities were deferred rather than eliminated, creating cumulative risk structures that persist into the present.

Flooding, Transport, and Ecological Stress as Disease Amplifiers. *Chapter 3* (*Olson, 2025*) analyzes the Middle Mississippi River as a transportation corridor simultaneously shaped by flooding and ecological stress. Flood events are shown to be critical mechanisms for *mobilizing contaminated sediments*, redistributing pollutants, and increasing human exposure to hazardous substances and waterborne pathogens.

From a disease-oriented perspective, flooding represents a hybrid process in which climatic variability, infrastructure rigidity, and ecological simplification converge. Floodwaters compromise drinking-water quality, overwhelm sanitation systems, and create conditions favorable to infectious disease transmission. These processes transform episodic hydrological events into *chronic public health stressors*.

Navigation, Flood Control, and Bureaucratic Blind Spots. In *Chapter 4* (*Olson & Speidel, 2021*), management strategies for navigation and flood control in the Lower Mississippi River are critically examined. While technically effective in maintaining commerce, these strategies often displace pollution burdens downstream and obscure disease pathways.

This chapter highlights a central institutional problem: freshwater is treated primarily as an *engineering and economic object*, rather than as a biological medium. As a result, pollution and disease risks become secondary considerations, managed indirectly or ignored altogether. Such frameworks systematically externalize health costs, particularly affecting vulnerable downstream communities.

Delta Degradation, Salinization, and Systemic Collapse. The cumulative consequences of upstream interventions are most clearly visible in *Chapter 5* (*Olson & Suski, 2021*), which addresses land subsidence and coastal erosion in the Mississippi River Delta. The delta functions as both a sink for contaminants and a natural filtration system. Its degradation represents a *loss of ecological buffering capacity*, accelerating salinization, pollution retention, and disease risk.

Delta collapse illustrates a broader principle: when freshwater systems lose their natural regulatory mechanisms, *health risks increase non-linearly*. Drinking-water insecurity, ecosystem collapse, and disease vulnerability become tightly coupled, forming a self-reinforcing cycle of degradation.

Integrative Perspective: Freshwater Crisis as a Health Crisis

Across all five chapters, a unifying conclusion emerges: pollution, disease, and freshwater degradation are inseparable processes. Rivers operate as *integrated socio-ecological systems,* transmitting both material resources and biological risk across space and time. The Mississippi and Missouri Rivers, as analyzed in this book, serve as model systems reflecting global trends in freshwater stress.

For *Pollution and Diseases*, the significance of this book lies in its implicit challenge to disciplinary fragmentation. The studies demonstrate that effective responses to pollution-related diseases require epistemological integration, linking hydrology, ecology, epidemiology, and governance. Freshwater crises are not future threats; they are active processes with measurable and escalating health consequences.

Conclusion

The Mississippi River studies by Olson and colleagues provide a robust analytical foundation for understanding how large freshwater systems mediate pollution and disease dynamics. Their combined value lies not only in empirical detail, but in revealing the structural and historical roots of contemporary health risks. As global freshwater stress intensifies, this body of work offers essential insights for rethinking river governance, environmental responsibility, and public health resilience.

Freshwater as a Priority Theme of the Journal

The journal Pollution and Diseases considers freshwater issues to be one of its priority thematic areas (*Nikolaenko, 2025*). Problems related to freshwater are clearly intensifying. They manifest in multiple forms and are often region-specific, shaped by local geochemistry, infrastructure histories, climatic regimes, and patterns of industrial and agricultural pressure. Nature seems to be improvising its own kind of jazz, producing novel responses to decades of anthropogenic pollution. In the United States, freshwater-related challenges take one form; in southern Africa, they may be entirely different. Yet even this comparison is incomplete: in many regions the same stressors generate divergent outcomes because freshwater systems are not merely conduits of water, but complex ecological media with their own internal dynamics, thresholds, and feedbacks. The full geographical diversity of emerging freshwater problems has yet to be comprehensively understood, and the scientific vocabulary for describing these emerging configurations remains, in many respects, underdeveloped.

Much remains to be discovered in the study of this topic. *The issue is no longer limited to the stable provision of populations with high-quality drinking water—this stage has already been passed. Freshwater now appears as an arena in which multiple crises converge: chemical contamination, microbial transformations, sediment remobilization, infrastructure aging, climate-driven hydrological volatility, and governance failures that are often invisible until their biological consequences become irreversible.* A Russian proverb states that misfortune never comes alone. In this respect, Russians could be considered world champions: no one generates as many problems for themselves and others as they do. *The situation with freshwater is far worse and far more complex.* What has occurred is an intrusion into a natural system of extraordinary complexity—one that functions through multi-scale interactions among chemical signals, biological adaptation, and ecological regulation. In this sense, *freshwater degradation should be understood not as a linear decline in "quality," but as a restructuring of environments, where new and insufficiently studied states can arise, including states with unexpected infectious properties.*

According to one hypothesis, the recent COVID-19 pandemic was linked to aquatic microorganisms (hydrobionts), for which freshwater—and aquatic environments in general—constitute a natural habitat (*Nikolaenko, 2018; Nikolaenko, 2018; Nikolaenko et al., 2020; Nikolaenko, 2021*). Within the framework of the cognitive standard of infectious ecology, this is explained through strictly defined types of physicochemical signals. Put more simply, *chemical pollution of freshwater systems may, at a certain point, trigger the activation of pathogenic properties in microorganisms*. Such processes may assume a pandemic scale. In the case of COVID-19, this was associated with SARS-CoV-2. The broader implication is that freshwater should be treated as an active interface where chemical perturbations, biological plasticity, and microbial community restructuring may jointly generate new risk trajectories that are difficult to anticipate using conventional epidemiological models. If this hypothesis is correct even in part, then freshwater systems represent not only a resource under threat, but also a poorly mapped domain of potential emergence, where seemingly incremental changes in contamination or habitat conditions may yield qualitatively new biological responses.

The pandemic itself disappeared in an unknown direction. However, the registration of pathogenic activity of SARS-CoV-2 continues. This reflects a familiar yet paradoxical situation in contemporary epidemiology: individual cases are studied, vaccines are developed in response to specific infectious agents, yet no one truly knows or understands where mass infectious processes originate or where they ultimately disappear. In the case of COVID-19, these processes were undoubtedly linked to freshwater systems. More generally, *the freshwater problem increasingly reveals a scientific asymmetry: we possess sophisticated tools for detecting individual pathogens and quantifying pollutants, but we remain weak in explaining system-level transitions—how complex aquatic environments shift from one functional regime to another, and how these shifts reconfigure the probability landscape of disease emergence.* For the journal, this is precisely the point of prioritizing freshwater: it is a field where uncertainty is not a marginal detail, but a defining characteristic of the object of study, and where the next decisive findings may emerge from integrative work that connects hydrology, chemistry, ecology, microbiology, and infectious ecology into a single analytical frame.

Be that as it may, a new book has now been published on this extraordinarily timely subject. Professor Kenneth Olson and his co-authors are to be congratulated on this achievement. Readers, in turn, may be congratulated on the opportunity to engage with a compelling and thoughtful exploration of the problems facing the great rivers—the Mississippi and Missouri Rivers.

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