



American Fisheries Society

Organized in 1870 to Promote the Conservation, Development and Wise Utilization of Fisheries

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January 10, 2020

Dr. Thomas Armitage
Designated Federal Officer
Science Advisory Board
U.S. Environmental Protection Agency

Via Email: armitage.thomas@epa.gov

Dear Dr. Armitage:

On behalf of the American Fisheries Society and the science societies with whom we have jointly commented on the Environmental Protection Agency's and the Army Corps of Engineers' proposed Waters of the U.S. rule (Proposed Rule), I respectfully submit the attached information.

The definition of Waters of the U.S. in the 2015 Clean Water Rule was overwhelmingly supported by peer-reviewed science. The Proposed Rule is not based on sound science or the best-available peer-reviewed information and will remove or decrease protection for our nation's waters, including millions of miles of streams and millions of acres of wetlands that are critical for sustaining water quality and healthy watersheds.

The Proposed Rule seeks to exclude numerous waters and wetlands that directly affect the chemical, physical, and biological integrity of primary waters. The loss of protections for our nation's waters called for in the proposed Rule would have far-reaching implications for fish, wildlife, and their habitats, as well as causing economic impacts by harming recreational and commercial fisheries and reducing water quality.

Attached please find the comment letters submitted to EPA and the Army Corps of Engineers during the recent rulemaking to redefine Waters of the U.S. In addition, attached is a publication developed by the American Fisheries Society that catalogues the impacts to fish and fisheries as a result of the loss of protections for waters under the Proposed Rule, entitled "Headwater streams and wetlands are critical for sustaining fish, fisheries, and ecosystem services."¹

Please feel free to contact me if the members have any questions or would like to discuss this information further.

Thank you for your consideration.

Sincerely,

Drue Banta Winters
Policy Director

ⁱ Colvin, S. A. R., S. M. P. Sullivan, P. D. Shirey, R. W. Colvin, K. O. Winemiller, R. M. Hughes, K. D. Fausch, D. M. Infante, J. D. Olden, K. R. Bestgen, R. J. Danehy, and L. Eby. 2019. Headwater streams and wetlands are critical for sustaining fish, fisheries, and ecosystem services. *Fisheries* **44**:74-91.



April 10, 2019

Mr. Andrew R. Wheeler
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Mr. R.D. James
Assistant Secretary of the Army for Civil Works
U.S. Army Corps of Engineers
441 G Street, N.W.
Washington, D.C. 20314

Via regulations.gov: Docket ID No. EPA-HQ-OW-2018-0149

Re: Scientific Societies Comments on Proposed Rule - Revised Definition of “Waters of the United States” (84 FR 4154; Docket ID No. EPA-HQ-OW-2018-0149)

CC: Michael McDavid, Oceans, Wetlands, and Communities Division, Office of Water, EPA
Jennifer A. Moyer, Regulatory Community of Practice, U.S. Army Corps of Engineers

Dear Administrator Wheeler and Assistant Secretary James:

On behalf of the undersigned science societies, we respectfully submit the following comments in response to the proposed Rule “Revised Definition of ‘Waters of the United States’” (proposed Rule) (84 FR 4154; Docket ID No. EPA-HQ-OW-2018-0149), published in the Federal Register on February 14, 2019.

The undersigned scientific societies represent more than 200,000 individuals with diverse areas of expertise in the aquatic, ecological, hydrologic, biogeochemical, biological and ecological restoration sciences. Our members have deep subject matter expertise and a commitment to independent objectivity and peer-review of science and work in the private sector, academia, and various tribal, state and federal agencies. We support wetland, aquatic, and ecological resource research, education, restoration and sustainable management. We promote the development and use of the best available science to sustainably manage and restore our freshwater, estuarine, coastal, and ocean resources for the benefit of the U.S. economy, environment, and public health and safety.

The undersigned societies strongly oppose the proposed Rule and the U.S. Environmental Protection Agency’s and the U.S. Army Corps of Engineers’ (Agencies) decision to re-write and rescind the science-based definitions contained in the 2015 Clean Water Rule (2015 CWR). By redefining waters of the United States (WOTUS), and related terms, the Agencies have cast aside the “significant nexus” standard from the 2015 CWR, based on Justice Kennedy’s opinion in *Rapanos v. United States*, 547 U.S. 715 (2006), in favor of a much narrower standard based on Justice Scalia’s opinion in *Rapanos*. The proposed Rule is not based on sound science or the best-available peer-reviewed information and will, as a result,

exclude numerous waters and wetlands that directly affect the chemical, physical, and biological integrity of primary waters making it impossible to achieve the objectives of the Clean Water Act (CWA).

We fully support the definition of WOTUS in the 2015 CWR, which was overwhelmingly supported by peer-reviewed science. The EPA's Office of Research and Development prepared a comprehensive scientific report to accompany the 2015 CWR, the "Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence" (herein the "Connectivity Report" but which was described in the 2015 CWR as the "Science Report"). The intent of the CWA is to restore and maintain the physical, chemical, and biological integrity of the nation's waters. This can only be achieved if the definition of WOTUS is grounded in sound science and recognizes all five parameters of connectivity (hydrologic, chemical, physical, biological, ecological), as documented in the Connectivity Report (EPA 2015). The Connectivity Report synthesized more than 1,200 peer-reviewed publications and provided the technical basis for the 2015 CWR. The 2015 CWR also underwent an extensive stakeholder review process. Since the completion of the Connectivity Report, substantial additional literature has emerged that reaffirms the report and the 2015 CWR (e.g., Cohen et al. 2016, Rains, et al. 2016, Fritz et al. 2018, Harvey et al. 2018, Leibowitz et al. 2018, Schofield et al. 2018, Colvin et al. 2019.)

We oppose¹ the proposed Rule because it is unsupported by peer-reviewed science. It has not been developed using the critical scientific analysis that supported the 2015 CWR rulemaking process, and it has not been subjected to a rigorous independent scientific review process. The proposed Rule only recognizes a limited subset of connectivity. Its reliance on flow permanence and physical abutment as measures of jurisdiction arbitrarily ignores other aspects of physical connectivity such as bed, banks, and high-water marks, as well as chemical, biological and ecological connectivity. In contrast, the 2015 CWR is built upon a scientific basis that incorporates these elements.

The 2015 CWR reflects the best available science regarding connectivity. In essence, what happens to the waters and wetlands in the upper reaches of a watershed, including ephemeral, intermittent, or perennial streams, will affect downstream waters and wetlands. That is, they are hydrologically, chemically, physically, biologically and ecologically connected to what happens downstream. Aquatic ecosystems cannot function properly without functional biological and chemical connectivity, as well as physical connectivity, and therefore cannot provide essential ecosystem services without it.

The functioning of the circulatory system in the human body is a useful metaphor to demonstrate the importance of watershed connectivity. Introduction of toxins, such as cigarette smoke, to the smallest capillaries in the lungs ultimately delivers those toxins to the larger blood vessels and the main organs. The heart itself can ultimately be damaged beyond repair by the cumulative effect of toxins introduced at the peripheries of the circulatory system. The health of the whole organism cannot be preserved without consideration of the smaller features. Watersheds function in a similar way. Pollutants introduced into ephemeral waters and wetlands ultimately make their way to the largest waterways and water bodies with deleterious effects on the functioning of downstream ecosystems. Eliminating protections for smaller, intermittent, non-floodplain, geographically isolated and/or ephemeral waters degrades the large downstream waters in the same way that introduction of toxins to small blood vessels jeopardizes the health of the human body if the toxins are potent enough and in large enough

¹ We incorporate by reference the comments submitted by the undersigned societies on September 21, 2017, regarding the proposed rule, Definition of "Waters of the United States" – Recodification of Pre-existing Rules, EPA-HQ-OW-2017-02-03 and on November 20, 2017, regarding the proposed rule, Definition of "Waters of the United States" – pre-proposal Outreach Comments, EPA-HQ-OW-2017-0480. These comments are in Appendix A.

quantities. Restoring and maintaining the structural and functional integrity of the Nation's waters is only possible if the ephemeral and headwater aquatic systems are protected.

Many of the definitions and terms in the proposed Rule lack clarity, are not based in science or the criteria for determining jurisdiction are not based in science. Particularly problematic are the definitions for "adjacent", "intermittent", and "tributary" as discussed below.

Adjacent: The Agencies have proposed a significant re-definition of "adjacent" that strays from the dictionary definition that the Agencies rely on, but also in relation to settled science and decades of past regulatory precedent (p. 4187 of the proposed Rule). The agencies cite a 1994 dictionary definition for the word "adjacent" and note that the common understanding for the term "adjacent" means "next to", "adjoining", "to lie near" or "close to", and state that this meaning is consistent with the *Rapanos* plurality's "physical-connection requirement," 547 U.S. at 751 n. 13 (see page 4187 of proposed Rule). However, the *Rapanos* plurality physical connection requirement ignores three out of the four synonyms given for "adjacent" (i.e., "next to", "to lie near", and "close to"), and instead adds a requirement that an adjacent feature must "abut" a jurisdictional water, and that "abut" means "to touch at least at one point or side of". The three "adjacency" terms that the proposed Rule ignores are better encompassed by Justice Kennedy's "significant nexus" standard. We request that the Agencies acknowledge and incorporate both the full meaning of the word "adjacent" into any proposed rule revision, and the science that supports this more complete meaning of the word.

The Agencies request comment on, "Wetlands that do not abut or have a direct hydrologic surface connection to other waters of the United States in a typical year are not inseparably bound up with the waters of the United States and are more appropriately regulated as land and water resources of the States and Tribes pursuant to their own authorities." (page 4186 of the proposed Rule). Here, the Agencies appear again to be proposing to restrict the definition of "adjacent" to one that requires contact (i.e., converting "adjacent" to "abut" and relying on direct surficial hydrologic connection). Such a definition ignores other forms of ecological connectivity, like ephemeral hydrological connections and contributions of water, solutes and pollution through groundwater flows. In addition, defining a "typical year" ignores the periodic and substantial connectivity that occurs during increasingly frequent atypical years resulting from climate change. This substantial re-definition of the term lacks a scientific basis. The term "inseparably bound up with" is not a scientifically defined term but suggests the concept of functional connection. As documented in the Connectivity Report, wetlands that neighbor other waters of the United States, but are not necessarily abutting or having a direct hydrologic surface connection in a typical year, often exhibit functional connection with other WOTUS, as recognized by Justice Kennedy's "significant nexus" concept and should be protected.

Further, on page 4187, the Agencies note that their "proposed definition of "adjacent wetlands" would not require surface water exchange between wetlands and the jurisdictional waters they abut to create the jurisdictional link, consistent with case law and for ease of implementation." Here, they appear to acknowledge that surface water exchange is not required for a functional relationship to exist, but only grant regulatory status to wetlands that "abut" other WOTUS. This is not only inconsistent with other parts of the proposed Rule, but also inconsistent with settled science and regulatory precedent. The Agencies acknowledge the history of case law that supports functional connection without surface water exchange, yet they exclude adjacent wetlands lacking a direct surficial hydrologic connection in a typical year when those adjacent wetlands do not abut other WOTUS. The Agencies should revert to the 2015 WOTUS or provide a proposed Rule that is logically consistent with settled science, regulatory precedent, and past case law on this issue.

Intermittent: The Agencies request comment on whether or not the definition of “intermittent” should require continuous flow for a specific duration (page 4178). There is wide variability across the United States regarding how hydrologic systems function, their flow durations, and long-term flow trends. Intermittent streams may exhibit substantial variation in flow duration from year to year. Adding a requirement for a specific flow duration to the definition of “intermittent” would be impractical and would likely fail to achieve the CWA mandate, given the flow variabilities across the country. The Agencies should not add such a requirement to any proposed Rule.

Tributary: The Agencies request comment on whether or not the definition of “tributary” should refer only to perennial waters, whether there should be a requirement that a tributary originate from a particular source such as groundwater interface, snowpack, or lower stream orders that contribute flow (page 4177 of the proposed Rule), and request comment on whether the definition should be changed to focus on “seasonal flow” rather than on intermittent flow (page 4178).

The definition for tributary should be based on the best available science and should contribute to the mandate of the CWA and the objectives that Congress set when it passed the CWA. Thus, “tributary” should not refer only to perennial waters, the source of the tributary should not be restricted, and the focus should not shift to “seasonal flow”. The point is that the water flowing in a tributary contributes to the downstream waters, and therefore contributes to the chemical, physical, and biological integrity of those downstream waters, and that this relationship (based on chemical, physical and biological [aka ecological] connectivity) is the justification for regulating the tributary.

In addition to the above problems with terminology, the proposed Rule fundamentally fails to protect the Nation’s waters, wetlands, and the important and economically valuable ecosystem services that they provide. The proposed Rule will have the effect of removing protections afforded to headwaters, tributaries, wetlands (including non-floodplain wetlands and geographically isolated wetlands) and non-surficially connected adjacent waters. Each of these changes, in turn, will have costly and significant negative consequences for American citizens, businesses, communities, and public health. The economic value of these ecosystem services is increasing as waters face mounting risks from land use, water withdrawals, storms, drought, wildfires and rising seas.

Wetlands and headwater streams (regardless of flow duration and location in the watershed) provide essential ecosystem services to communities, such as protection of drinking water quality and quantity, provision of flood storage, storm damage mitigation, resilience against sea level rise and drought, and essential fish, shellfish, waterfowl and wildlife habitat. Loss of protections for headwater streams and wetlands would diminish ecosystem services provided by those waters and wetlands, increase the threat to imperiled species, affect commercial and recreational fisheries, and degrade fishes of cultural value to Native Americans and the recreating public. (Colvin et al. 2019). As an example of impacts of the proposed Rule, non-contiguous wetlands, lakes, and headwater streams within the Great Lakes basin are connected via subsurface flow or groundwater. The loss of protections for wetlands and headwater streams threatens to degrade the smaller systems, which will ultimately degrade the Great Lakes themselves. Wetlands and tributary streams surrounding the Great Lakes and connecting channels provide important refugia for migrating wildlife as well as spawning and nursery grounds for numerous species. These wetlands also contribute important ecosystem services. The Laurentian Great Lakes contain 20% of the world’s surface freshwater. They enhance recreational opportunities and improve water quality in nearshore areas, and are the source of drinking water for 26 million Americans residing in the Great Lakes basin.

To put the importance of non-floodplain wetlands and headwater streams in perspective:

- Headwaters comprise 79% of the total length of rivers in the US, drain more than 70% of land area (Colvin et al. 2019), and supply clean water for 1/3 of the US population (EPA 2009).
- Ephemeral streams may comprise 96% of stream system lengths (Meyer et al. 2003).
- Wetlands located outside of floodplains (including vernal pools, prairie potholes, etc.) occupy 6.59 million hectares (Lane and D'Amico 2016). As a point of comparison, the state of West Virginia occupies 6.27 million hectares.
- On an annual basis, headwater streams provide \$15.7 trillion and wetlands outside of floodplains/geographically isolated wetlands provide \$673 billion in ecosystem services for the conterminous US and Hawaii (Creed 2017).
- Commercial and recreational fisheries contributed over \$208 billion in economic impact and 1.62 million jobs in 2015 (NMFS 2015). Headwaters have both direct and indirect impacts on the health of fisheries.
- Nationally, trout anglers spent \$3.5 billion on their pursuits, supported over 100,000 jobs, and had a \$10 billion economic impact, including \$1.3 billion in federal and state tax revenues in 2006 (USFWS 2014) and 30.1 million freshwater anglers spent \$29.9 billion on freshwater fishing trips in 2016 (USFWS 2018).

The proposed rule fails the fundamental test of being functional, and promises to leave the citizens, communities and businesses of the United States with diminished ecosystem services including:

- reduced water quality;
- less dependable water supplies, resulting in higher costs for drinking water
- increased vulnerability to wildfires;
- reduced flood storage capacity;
- reduced and degraded fish, shellfish and wildlife habitat, thereby undermining the commercial operations that are dependent on them;
- reduced capacity to mitigate storm damages to properties and infrastructure;
- reduced recreational opportunities and the economic benefits accrued to the recreational and tourism industries;
- greater exposure to pollutants in food and water;
- much higher associated costs to taxpayers, insurance companies and insurance rate payers, who will have to absorb the resulting damages and property and health care costs, and fund replacement of these services; and
- negative economic impacts for many businesses and industries.

Moreover, the proposed Rule fails to meet the stated goal of clarity, predictability and consistency. The agencies claim that the average landowner will have sufficient knowledge to understand how water moves through their properties to be able to determine whether it is a WOTUS. In reality, the average landowner is unlikely to be able to conduct sophisticated professional-level field evaluations or to be able to use the science-based tools necessary for assessing flow regimes, such as regional regression analysis, hydrologic modeling, USGS topographic data, various modeling tools, drainage area, precipitation data, soils maps, climate change, land use, vegetative cover, geology, and national hydrography data necessary for determining jurisdiction under the proposed Rule. Further, the proposed Rule's regulatory structure and language (definitions, concepts and criteria) lack clarity, simplicity, predictability and consistency. Given those issues, the proposed Rule appears to be an

attempt to eliminate Federal oversight of national resources rather than to increase clarity in the regulatory landscape.

The 2015 CWR only protected an additional five percent of streams under the Clean Water Act. However, the proposed Rule would go much further than simply reversing the 2015 CWR. It would eliminate protections from more than 18 percent of the nation's stream miles and more than 50 percent of our remaining wetlands, including critical habitat for fish, fur bearers, ducks, and other migratory birds. The proposed Rule would reverse decades of protections that were put in place to ensure that clean water would be available for future generations.

History and current experience demonstrate that few states have the legal authority, capacity, or funding in place to fill the gaps in jurisdiction left by the proposed Rule. Since 1977, states have had the authority to assume the CWA Section 404 program, but only two (Michigan and New Jersey) have done so (ASWM & ECOS 2011). Financial constraints play a substantial role in states declining to accept this responsibility. Furthermore, many states have provisions in their state laws that prohibit state agencies from regulating more stringently than the CWA regulates (ELI 2013). Whereas state legislatures may amend their laws to broaden state protections, in practice such efforts take time. It is more likely that states will follow the federal lead. In California, for example, it took a decade to develop a state response to restricted federal jurisdiction after *Rapanos* (Wittenberg 2019). If the proposed Rule went into effect, states would not be able to respond in a timely manner.

In conclusion, the undersigned scientific societies strongly oppose the proposed Rule, strongly support the 2015 CWR, and reject any definition of WOTUS that is not based in sound, peer-reviewed science. The proposed Rule does not meet this standard. Effective implementation of the CWA requires science as its foundation. There have been significant advances and discoveries in aquatic science since the CWA was passed 50 years ago. These advances, meticulously documented and vetted in the Connectivity Report, conclusively demonstrate the need for the proposed rule to protect the chemical, physical, and biological integrity of our nation's waters. Through an evaluation of the best available science (including the Connectivity Report), we conclude that the proposed Rule poses a significant threat to the integrity and security of our drinking water (quality and quantity), public health, and to fisheries, shellfish habitat and wildlife habitat. It increases the threat of damage to communities and infrastructure from flooding, severe storm events, and sea-level rise, all of which have negative economic impacts on citizens, communities and businesses.

The proposed redefinition of WOTUS will make it impossible to achieve the objectives of the CWA because it excludes numerous waters and wetlands that directly affect the chemical, physical, and biological integrity of primary waters. Furthermore, many of the definitions and terms in the proposed Rule lack clarity and/or are not based in science. Likewise, many of the criteria for jurisdiction are not based in science and fail to meet the stated goal of clarity, predictability and consistency.

Under this proposed Rule, the CWA's primary goal of maintaining and restoring the chemical, physical, and biological integrity of downstream traditional navigable waters would not be possible. In conclusion, we wish to state in the strongest possible terms that the proposed Rule should be rejected.

Thank you for considering these comments. If you have further questions, please do not hesitate to contact Drue Winters at dwinters@fisheries.org or telephone at 301-897-8616 x202.

Sincerely,

American Fisheries Society
American Institute of Biological Sciences
Association for the Sciences of Limnology and Oceanography
Coastal and Estuarine Research Federation
Ecological Society of America
Freshwater Mollusk Conservation Society
International Association for Great Lakes Research
North American Lake Management Society
Phycological Society of America
Society for Ecological Restoration
Society for Freshwater Science
Society of Wetland Scientists

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Headwater Streams and Wetlands are Critical for Sustaining Fish, Fisheries, and Ecosystem Services

Photo credit: Peter Turcik

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Headwater streams and wetlands are integral components of watersheds that are critical for biodiversity, fisheries, ecosystem functions, natural resource-based economies, and human society and culture. These and other ecosystem services provided by intact and clean headwater streams and wetlands are critical for a sustainable future. Loss of legal protections for these vulnerable ecosystems would create a cascade of consequences, including reduced water quality, impaired ecosystem functioning, and loss of fish habitat for commercial and recreational fish species. Many fish species currently listed as threatened or endangered would face increased risks, and other taxa would become more vulnerable. In most regions of the USA, increased pollution and other impacts to headwaters would have negative economic consequences. Headwaters and the fishes they sustain have major cultural importance for many segments of U.S. society. Native peoples, in particular, have intimate relationships with fish and the streams that support them. Headwaters ecosystems and the natural, socio-cultural, and economic services they provide are already severely threatened, and would face even more loss under the Waters of the United States (WOTUS) rule recently proposed by the Trump administration.

INTRODUCTION

Headwaters are broadly defined as portions of a river basin that contribute to the development and maintenance of downstream navigable waters including rivers, lakes, and oceans (FEMAT 1993). Headwaters include wetlands outside of floodplains, small stream tributaries with permanent flow, tributaries with intermittent flow (e.g., periodic or seasonal flows supported by groundwater or precipitation), or tributaries or areas of the landscape with ephemeral flows (e.g., short-term flows that occur as a direct result of a rainfall event; USEPA 2013; USGS 2013). Headwater streams comprise the majority of river networks globally (Datry et al. 2014a); in the conterminous United States, headwater streams comprise 79% of river length, and they directly drain just over 70% of the land area (Figure 1). Along with wetlands, these ecosystems are essential for sustaining fish and fisheries in the USA (Nadeau and Rains 2007; Larned et al. 2010; Datry et al. 2014b). When headwaters are polluted, or headwater habitats are destroyed, fish, fisheries, and ecosystem services (i.e., benefits that humans gain from the natural environment and from normally functioning ecosystems) are compromised or completely lost.

With the U.S. Clean Water Act of 1972 (Federal Water Pollution Control Act), Congress recognized the importance of aquatic habitat and ecosystem connectivity in the stated objective of the Act “to restore and maintain the chemical, physical, and biological integrity of the nation’s waters.” Biological integrity has been defined as “the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region” (Frey 1977; Karr and Dudley 1981). The Act provides authority for the federal government to protect navigable waterways from channelization, pollution, and other forms of impairment by making it unlawful to discharge dredged or fill material into “navigable waters” without a permit, 33 U. S. C. §§1311(a), 1342(a). This authority extends to wetlands that are not navigable but adjacent to navigable-in-fact waterways (*United States v. Riverside Bayview Homes, Inc.*, 474 U.S. 121, 1985). The authority does not extend to waters that lack a “significant nexus” to navigable waters (*Solid Waste Agency of Northern Cook County [SWANCC] v. Army Corps of Engineers*, 531 U. S. 159, 2001). However, federal jurisdiction over non-navigable and their adjacent waters remained unclear.

The 2006 Supreme Court decision *Rapanos v. United States* (547 U.S. 715, 2006) did little to resolve the confusion, with a split decision from the Court regarding the extent of federal jurisdiction. In writing for four justices, Justice Scalia defined “waters of the United States” as only those waters

Headwaters in a Nutshell

- Headwater streams comprise 79% of our nation’s stream networks; wetlands outside of floodplains comprise 6.59 million ha in the conterminous USA.
- Headwater streams and wetlands strongly influence ecological functions and fisheries not only within headwater regions, but also in downstream rivers, lakes, and coastal areas.
- Headwater ecosystems provide habitat for many endemic and threatened fish species as well as species supporting economically important fisheries.
- Headwaters provide native fish species with refuge from invasive aquatic species and can provide threatened species with critical refuge habitat.
- Commercial and recreational fisheries, which are dependent on headwaters, are vital economic components of local and regional economies.
- Headwater streams and wetlands are culturally important for many segments of U.S. society, with particularly high significance for many native peoples.
- Estimates of headwaters at risk under a narrower rule are likely low, because many of the 33% of streams in the conterminous western USA mapped as perennial were found to be intermittent or ephemeral.
- Headwater ecosystem impairment, loss, or destruction is assessed under the revised WOTUS rule proposed, and would have severe and long-lasting negative consequences for fisheries and environmental conditions throughout the USA.

and wetlands that contain “a relatively permanent flow” or that possess “a continuous surface connection” to waters with relatively permanent flow. Scalia’s definition excluded intermittent and ephemeral streams, and wetlands that lack a continuous surface connection to other jurisdictional waters (i.e., wetlands outside of floodplains). This definition differs from that posited by Justice Kennedy in an opinion concurring with the plurality judgment to remand the case for further proceedings but not agreeing with the reasoning of the four justices represented by Scalia. In contrast, Kennedy gave deference to Congressional intent to allow the agencies to regulate pollution (dredge and fill) of waters of the United States. Justice Kennedy ruled that wetlands outside of floodplains, and intermittent and ephemeral streams should be included as waters of the United States if they “significantly affect the physical, chemical, and biological integrity” of downstream navigable waters. Therefore, Kennedy’s definition of waters of the United States includes headwaters that are not necessarily navigable but are nevertheless connected to some degree with navigable waters downstream.

Following an extensive scientific review of the literature on waterbody connectivity (USEPA 2015), which included a detailed review by a U.S. Environmental Protection Agency

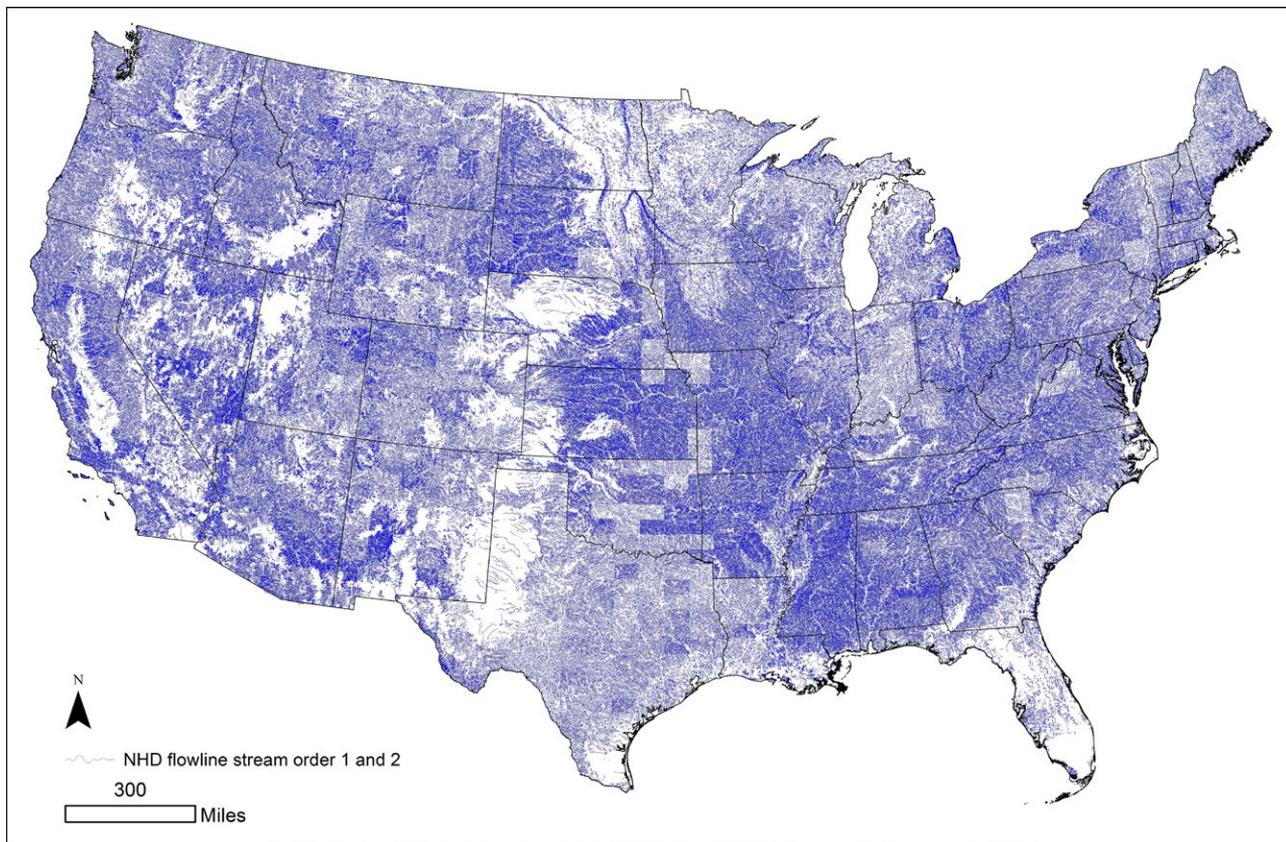


Figure 1. Map of 1st- and 2nd-order tributaries (a stream lacking a tributary and a stream with only first-order tributaries, respectively) comprising river networks of the conterminous United States as characterized by the 1:100,000 scale National Hydrography Dataset Plus Version 2 (NHDPlusV2; USEPA & USGS 2012). However, this is not a full accounting of all 1st- and 2nd-order headwater streams. Currently, it is not possible to comprehensively map all headwater streams because of the sheer number of headwater tributaries that comprise river networks, variability in tributary flow permanence, and the resolution and accuracy of available spatial data necessary to accurately map or model streams and other overland flows (Hughes and Omernik 1981). For example, note the differing stream densities that occur within different regions of the USA (e.g., Indiana versus the Central Plains) or even within states (e.g., varied densities throughout Oklahoma). The differences in density result from state-by-state differences in how streams are mapped or modeled. Despite these limitations, the NHDPlusV2 represents the most comprehensive coverage of tributaries and catchments available for the U.S., allowing us to assess their general prominence of headwaters in U.S. river networks.

(EPA) Science Advisory Board (SAB) of technical experts from the public (“SAB Review;” SAB, 2014 Letter to Gina McCarthy, Review of the Draft EPA Report Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of Scientific Evidence), the Obama administration issued the Waters of the United States (WOTUS) Rule in 2015 that clarified the jurisdiction of the Clean Water Act to include protections for intermittent and ephemeral headwater streams and hydrologically connected wetlands (i.e., with a permanent surface inflow or outflow and directly adjacent to navigable waters), with wetlands outside of the floodplains to be evaluated on a case-by-case basis. The American Fisheries Society (AFS) supports that rule and the science underpinning its development, as documented by review of more than 1,200 peer-reviewed scientific studies by technical experts to determine degrees of connectivity and their ecological consequences between navigable waters, wetlands, and headwater streams (USEPA 2015). On February 28, 2017, the Trump administration issued an executive order directing the EPA and the Department of the Army to review and rescind or revise the 2015 rule. The proposed “Recodification of Pre-Existing Rules” (U.S. Army Corps of Engineers, Department

of Defense, USEPA 2018 Revised Definition of “Waters of the United States”) establishes a narrower legal definition, implementing the pre-Obama era regulations that provided fewer protections for thousands of miles of headwater streams and millions of acres of wetlands outside of floodplains. Those wetlands are distributed across 6.59 million ha in the conterminous USA as, for example, playa lakes, prairie potholes, Carolina and Delmarva bays, pocosins, and vernal pools; they provide valuable habitat for fish and other organisms and are particularly vulnerable ecosystems (Tiner 2003; Lane and D’Amico 2016; Creed et al. 2017; Figure 2). We refer to headwater streams and wetlands outside of floodplains collectively as “headwaters.” However, we also emphasize the inherent complexity of natural systems, and recognize and provide examples of waterbody types that provide similar functions as headwaters such as floodplain wetlands that lack a continuous hydrologic surface connection to a river, low-gradient streams that flow through floodplains, and sloughs and side-channels of navigable rivers.

Headwaters provide numerous services that are essential to ecosystems (Peterson et al. 2001; Meyer et al. 2003), including sustaining aquifers and supplying clean water for more than

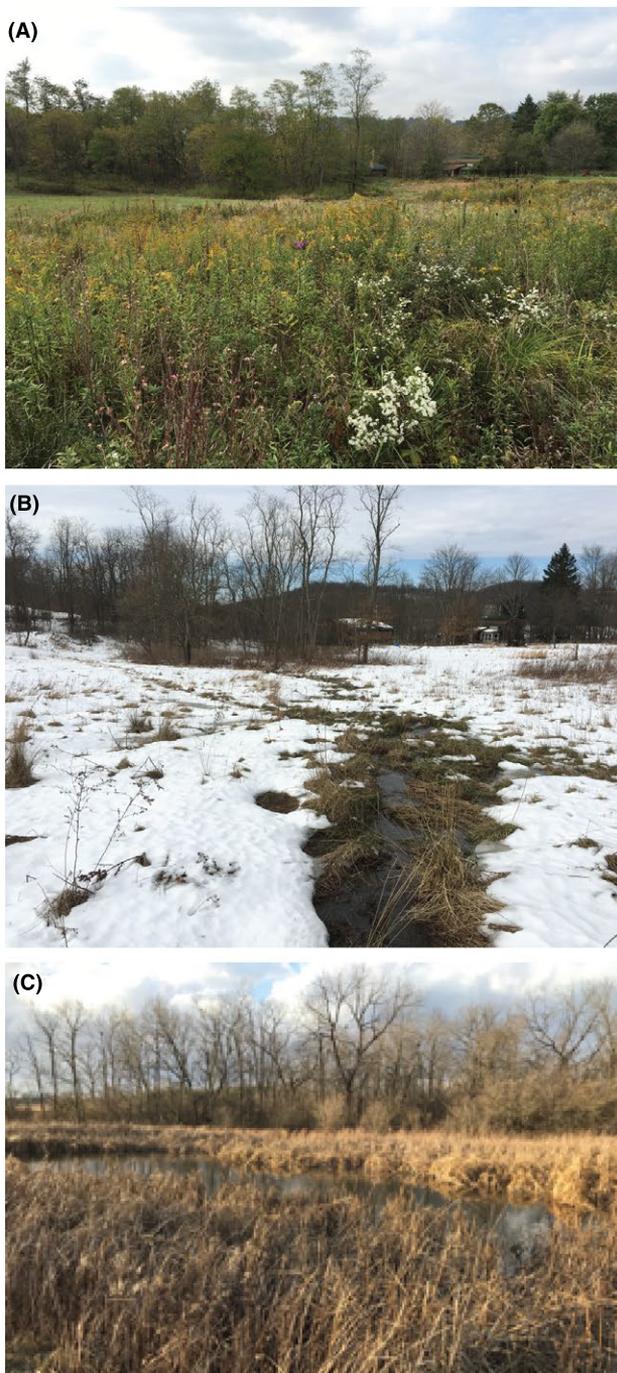


Figure 2. Wetlands outside of floodplains—such as the headwater/source wetland (A) in summer and (B) winter in Pennsylvania and the (C) prairie wetland in Ohio—would be particularly vulnerable to loss of protections. Photo credits: P. D. Shirey: A, B; S. M. P. Sullivan: C.

one-third of the U.S. population (USEPA 2009). At regional scales, headwaters are critical for sustaining aquatic biodiversity (Meyer et al. 2007; Clarke et al. 2008) and for providing vital spawning and rearing habitat for migratory fishes, including commercially fished species (Quinn 2005; Schindler et al. 2010; McClenachan et al. 2015). Headwaters provide dispersal corridors and habitat for fishes and other aquatic and semi-aquatic organisms (e.g., invertebrates, amphibians, and birds), including many endemic and rare species (Steward et al. 2012;

Jaeger et al. 2014; Sullivan et al. 2015). Ephemeral headwater streams can support levels of aquatic invertebrate diversity and abundance comparable to, or greater than, those estimated for perennial headwaters, as well as taxa found nowhere else in the watershed (Dieterich and Anderson 2000; Progar and Moldenke 2002; Price et al. 2003).

Headwaters and their ecosystem services are tightly intertwined with the nation's cultural landscape (Boraas and Knott 2018) and are highly vulnerable to a host of human impacts (Creed et al. 2017). Climate change, channel modification, water diversion, and land development (e.g., urbanization, agriculture, mining, deforestation) impair and destroy headwaters by, for example, increasing erosion, sedimentation, and desiccation in both headwaters and downstream reaches of river networks (Walsh et al. 2005; Freeman et al. 2007; Perkin et al. 2017). Pollution of headwaters, including runoff of excess nutrients and other pollutants, degrades water quality affecting downstream ecosystems. Two striking U.S. examples are discharge effluent from mining (Woody et al. 2010; Daniel et al. 2015; Giam et al. 2018) and nutrient loading in the Mississippi River causing the Gulf of Mexico's "dead zone," a vast area of hypoxia that reduces biodiversity and commercial fisheries, with major economic and social costs (Rabalais et al. 1995; Rabotyagov et al. 2014). Similarly, polluted headwaters contribute to harmful algal blooms that result in toxic water, fish kills, domestic animal and human morbidity, and economic damage (Tango 2008; Zimmer 2014; Staletovich 2018). For wetlands outside of floodplains, global estimates indicate continued loss of >30% since 1970 (Dixon et al. 2016).

Discrepancies between actual and estimated stream length and type have long been recognized as problematic and may lead to increased ambiguity in applying a narrower WOTUS rule, especially over time. Headwater stream losses in many regions of the USA are underestimated because drainage networks have not been mapped at sufficiently fine spatial scales (Hughes and Omernik 1981; Meyer and Wallace 2001; Colson et al. 2008), thus posing serious risk to ecological and societal benefits (Creed et al. 2017). Stream type is also often misattributed or changes over time, for example, 207,770 km (33%) of the total length of stream networks in the conterminous western USA mapped as perennial was determined to be non-perennial or not a stream. The map error varied from 55% of stream length in the Southwest to 33% in the western Great Plains to 24% in the western mountains (Stoddard et al. 2005). Changes in estimates from perennial to intermittent or ephemeral streams is a result of mapping errors, climate change, and water withdrawals. Similarly, Perkin et al. (2017) determined a loss of 558 km (21%) of stream length from 1950 to 1980 in the Upper Kansas River Basin, presumably as a result of ground-water pumping accentuated by climate change. These investigators projected a cumulative loss of 844 km (32%) by 2060. In other words, highly vulnerable intermittent and ephemeral streams and rivers are increasingly replacing perennial streams and rivers.

Non-perennial streams and non-floodplain wetlands are integral components of aquatic ecosystems, especially when considered in the aggregate. As supported by the SAB Review (SAB, 2014 Letter to Gina McCarthy, Review of the Draft EPA Report Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of Scientific Evidence), connectivity between headwaters and downstream waterbodies reflects a gradient in the variability of the frequency, duration, magnitude, predictability, and consequences of physical, chemical, and biological connections. The SAB Review notes

BOX 1. LONGNOSE SUCKERS LINK TRIBUTARY STREAMS AND LAKES

Several fish species migrate from the Laurentian Great Lakes into headwater tributaries to spawn. During spring, Longnose Suckers *Catostomus catostomus* undergo massive spawning runs from Lake Michigan into tributary streams (Figure 3). Egg and larval survival to outmigration appears to be strongly influenced by spring flow and temperature, and this variability can influence stock dynamics (Childress et al. 2016). Egg mortality and excretion by migrating adult suckers contributes significant amounts of nitrogen and phosphorus to stream ecosystems. The millions of larval suckers that may be exported from a single stream to the lake provide a significant nutritional subsidy for a host of recreational fishes that include Walleye *Sander vitreus*, bass, and salmon (Childress and McIntyre 2015). Stream network connectivity has been reduced over large portions of Great Lakes drainage basins, with negative effects on Longnose Suckers, the ecosystem functions they support, and stocks of other fishes that migrate into tributaries for spawning.

that even low levels of connectivity can be important relative to impacts on the chemical, physical, and biological integrity of downstream waters. The SAB Review also highlights the importance of the cumulative effects of streams and wetlands on downstream waters. These relationships also vary spatially and temporally as in some areas, such as arid regions, ephemeral streams comprise the majority of the stream network. Although they flow infrequently during an annual cycle, they are integral to the ecological function of their watersheds, which have evolved with this type of flow network (Meyer et al. 2003). In these and other systems, ephemeral streams and wetlands provide unique and essential habitat for species for which there is no known perennial equivalency (Falke et al. 2010, 2012; Medley and Shirey 2013; Hutson et al. 2018).

Because of the importance of headwaters, any rule that excludes their protection will have far reaching implications for fish, wildlife, and their habitats, as well as economies dependent on those ecosystems. Headwaters are key to the sustainability of fish stocks in both upstream and downstream waters. Threatened and endangered species will be harder to

recover, and more species will be at risk of becoming imperiled. Simply put, loss of protections for headwaters would have grave consequences for fish and fisheries. Ultimately, communities across the USA would lose the economic, social, and cultural benefits derived from headwaters. In the following sections, we provide a brief overview of scientific evidence supporting the ecological, social, economic, and cultural importance of headwaters, and highlight some implications of returning to reduced federal protections.

HEADWATERS SUPPORT ECOSYSTEMS

Headwaters perform ecological functions (i.e., biological, geochemical, and physical processes that occur within an ecosystem) that are critical for ecosystem services throughout their drainage basins. Headwaters deliver water, sediments, and organic material to downstream waters; contribute to nutrient cycling and water quality; enhance flood protection and mitigation; and provide recreational opportunities (Gomi et al. 2002; Richardson and Danehy 2007; Hill et al. 2014; Cohen et al. 2016). Headwater ecosystems provide both habitat and food resources for fish and other aquatic and riparian organisms; in turn, fish in headwaters affect food-web dynamics and contribute to the functioning of headwater ecosystems (Richardson and Danehy 2007; Sullivan 2012; Hill et al. 2014). Ecosystem functions in headwaters also maintain aquatic and riparian biodiversity and the sustainability of fish stocks not only in headwater reaches, but also in larger downstream habitats. These and other functions of headwater streams make them economically vital, with recent estimates at \$US15.7 trillion/year in ecosystem services for the conterminous USA and Hawai'i (Nadeau and Rains 2007). For wetlands outside of floodplains, ecosystem service estimates are \$673 billion/year for the conterminous USA (Lane and D'Amico 2016).

Headwaters receive runoff and groundwater from watersheds and discharge to larger waterbodies downstream. In doing so, they transport sediment and organic material, including large wood from adjacent and upstream riparian systems that are essential for the ecological condition of downstream ecosystems (Gregory et al. 1991; Benda and Dunne 1997). Drifting organic matter (organisms and particulate organic matter) from headwaters provides food for fishes and invertebrates in downstream reaches (Gomi et al. 2002; Wipfli and Gregovich 2002; Wipfli and Baxter 2010). The provisioning of

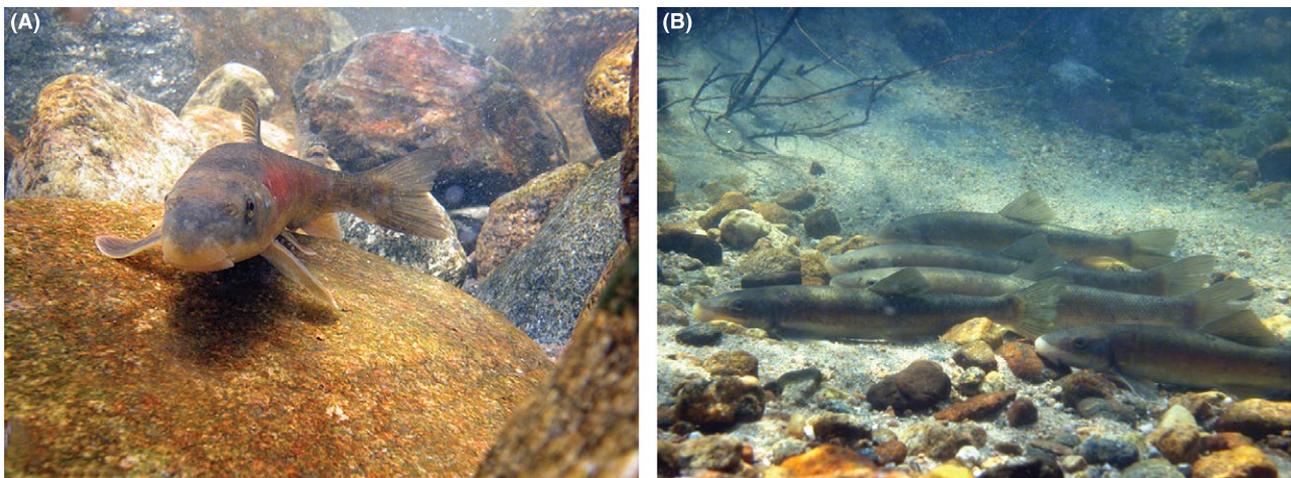


Figure 3. An individual Longnose Sucker (A), and an aggregation (B) similar to those that spawn en masse in tributaries of Lake Michigan. Photo credit: Jeremy Monroe, Freshwaters Illustrated.

large wood for habitat development is crucial for aquatic biota, including juvenile salmon and trout (Bilby and Ward 1991; Bilby et al. 2003; Herdrich et al. 2018). Changes in the large-wood recruitment regime resulting from timber harvests have depleted complexity in many mountain streams (Fausch and Young 2004) as well as in streams in other areas of the country (e.g., upper Midwest; Richards 1976; Wohl 2014). Removing wood from streams can also result in reduction of pools and overall habitat complexity as well as fewer and smaller individuals of both coldwater and warmwater fishes (Fausch and Northcote 1992; Dolloff and Warren 2003). Unpolluted headwaters are essential for maintenance of coldwater fish stocks, including Chinook Salmon *Oncorhynchus tshawytscha*, Coho Salmon *O. kisutch*, Steelhead *O. mykiss*, Cutthroat Trout *O. clarkii*, Bull Trout *Salvelinus confluentus*, Apache Trout *O. apache*, Gila Trout *O. gilae*, Golden Trout *O. aguabonita*, Redband Trout *O. mykiss*, Brook Trout *S. fontinalis*, Brown Trout *Salmo trutta*, and Atlantic Salmon *S. salar*.

When the natural flow regimes of headwater streams are altered, downstream water quality often is impaired. Headwaters mediate the intensity and frequency of downstream floods, and play a significant role in global carbon and nitrogen cycling (Gomi et al. 2002; Bernhardt et al. 2005; Lowe and Likens 2005; Marx et al. 2017). Discharge from headwaters also influences downstream fluxes of dissolved and particulate organic matter and nutrients (Alexander et al. 2007; Lassaletta et al. 2010). The cycling of nutrients—including rates of nitrogen uptake, storage, regeneration, and export—is a critical function of headwaters. For instance, Peterson et al. (2001) reported that the most rapid uptake and transformation of inorganic nitrogen can occur in the smallest streams of a catchment, particularly temporary streams, where tightly coupled water-streambed interactions facilitate in-stream retention of nitrogen. Most nitrogen flowing through a drainage network is estimated to come from headwater streams; in the northeastern USA, headwater tributaries can deliver up to 45% of the nitrogen load flowing downstream (Alexander et al. 2007). Additionally, transfer of nitrogen to the atmosphere occurs in headwater systems through denitrification (Mulholland et al. 2009). Hotspots of nutrient transformations are typically linked to physical and microbial processes in headwaters (e.g., McClain et al. 2003). Channel alterations, excess nutrients and sediments, and losses of flows in headwater streams deteriorate water quality (e.g., eutrophication and hypoxia) in downstream systems throughout the USA (Alexander et al. 2007; USEPA 2016a, 2016b; USEPA 2009). Further loss of headwater systems is expected to have major negative consequences for biogeochemical cycles at local to continental and global scales.

Important ecological functions and ecosystem services are provided even by ephemeral and intermittent headwaters (Steward et al. 2012). In arid and semi-arid regions, dry streambeds are “seed and egg banks” for aquatic biota, and when flowing, function as dispersal corridors and temporal ecotones linking wet and dry phases. During dry phases, ephemeral streams store organic material; when flowing, these streams are hotspots for nutrient cycling and other biogeochemical processes (Fisher et al. 1982; McClain et al. 2003). In some arid regions, up to 96% of streams contain little or no flow during much of the year; however, during monsoons they are critical for conveying runoff (Meyer et al. 2003). Permeable surficial geology and low slopes can reduce flood peaks in headwaters and extend the flow of cool water to downstream reaches, thereby expanding thermal refuges (Gomi et al. 2002).

Cool headwaters provide important thermal refuges in regions especially susceptible to climate change, including the desert Southwest and intermountain western United States.

Although fish abundance and diversity generally are lower in headwater systems compared to downstream reaches (Schlosser 1987), species composition can be distinct from the rest of the network (Paller 1994). Further, headwaters often support ecological specialist as well as threatened taxa not found elsewhere within the river network (DeRolph et al. 2015; Liang et al. 2013; Lowe and Likens 2005; also see *The importance of headwaters for imperiled species*). Fish inhabiting wetlands located outside of floodplains may benefit from greater availability of food resources compared to habitats in other aquatic ecosystems (Snodgrass et al. 2001; Baber et al. 2002).

Fish contribute both directly and indirectly to headwater ecosystem processes (e.g., Hanson et al. 2005) that, in turn, affect biodiversity and productivity in the receiving river network (Meyer et al. 2007). Through their spawning and foraging activities, fish influence local biotic communities by modifying substrates (e.g., spawning salmonid redds; Montgomery et al. 1996; Moore et al. 2004) and resuspending detritus and other particulate organic matter into the water column (e.g., benthic feeding by the Ozark Minnow *Notropis nubilis*; Gelwick et al. 1997) where it drifts downstream to support populations of aquatic invertebrates. Furthermore, fish feeding and excretion increase availability of inorganic nutrients and stimulate aquatic primary productivity (McIntyre et al. 2008).

Fish are often the top predators in headwater food webs, and thereby exert top-down control of invertebrate assemblages and indirectly affect ecosystem functions such as aquatic primary and secondary production, the latter including emergent aquatic insects that export biomass from streams to terrestrial food webs (Nakano et al. 1999; Baxter et al. 2004). Fish also link aquatic and terrestrial ecosystems in other, more direct ways. During annual leaf-out periods, insectivorous fishes feed on arthropods that fall from riparian vegetation into streams (Wipfli 1997; Baxter et al. 2005). Fish also provide important nutritional subsidies for terrestrial consumers, such as the American dipper *Cinclus mexicanus*, North America’s only aquatic songbird (e.g., Sullivan et al. 2015), and grizzly bear *Ursus arctos* (e.g., Matt and Suring 2018).

Many fish species occupy both headwater and downstream habitats during their life cycles (Fausch et al. 2002). For instance, most anadromous salmonids return to their natal streams after spending most of their lives in the ocean. In doing so, fish transport marine-derived nutrients to headwater streams (Zhang et al. 2003). Marine-derived nutrients from salmon carcasses have been shown to increase production of aquatic basal resources, macroinvertebrates, and resident fish stocks (Zhang et al. 2003; Janetski et al. 2009). Marine-derived nutrients are especially important for oligotrophic streams, which are predominant in the Pacific Northwest and Alaska where even small inputs of certain nutrients and sources of organic matter can significantly augment ecosystem productivity (Bilby et al. 1996). Moreover, fish in headwater streams are an important food source for terrestrial consumers, thereby transferring nutrients and energy from aquatic to terrestrial ecosystems. By linking nutrients, energy, and gene pools across space and time, fish migration has been characterized as a type of ecological “memory” of an ecosystem (Holling and Sanderson 1996). Headwaters, their receiving waters, and their functions already have been severely degraded by multiple human activities, including channel alteration, water diversion, and

land modification by agriculture, livestock grazing, mining, and urbanization (e.g., Hughes et al. 2010, 2014, 2016; Beschta et al. 2013). These land uses and others have eliminated countless headwater streams and wetlands that once served as natural primary, secondary, and tertiary nutrient, sediment, and contaminant treatment systems, thereby leading to untreated runoff from diffuse pollution sources (Karr and Schlosser 1978; Karr 1991; Gammon 2005; Woody et al. 2010; Hughes et al. 2014; Daniel et al. 2015). These stressors have caused biological and environmental degradation to over 70% of stream and river length in the conterminous USA (USEPA 2009; Crawford et al. 2016; USEPA 2016a, 2016b). Wetland loss—including but not limited to wetlands outside of floodplains—across the USA is staggering, with some Midwestern states (e.g., Illinois, Indiana, Ohio, Missouri) having lost >85% of wetland area since the 1780s (Dahl 1990). Given the vulnerability and many important ecosystem functions provided by headwaters, policies that would reduce protections are a serious concern.

HEADWATERS SUPPORT IMPERILED SPECIES

Habitat loss and pollution are the primary causes of extinction of aquatic biota (Miller et al. 1989; Dudgeon et al. 2006; Arthington et al. 2016), and emerging threats

exacerbate population decline of rare or range-restricted species (Minckley and Deacon 1991; Reid and Mandrak 2008; Shirey et al. 2018). Many threatened desert fishes, such as pupfishes *Cyprinodon* spp., have geographic distributions limited entirely to one or more isolated spring-fed headwaters (Rogowski et al. 2006; Dzul et al. 2013; Figure 4) but many such isolated waters would likely not be protected under a narrower rule. In the 1950s and 1960s, groundwater pumping in Nevada destroyed springs and associated spring-fed wetlands, resulting in the extinction of Las Vegas Dace *Rhinichthys deaconi* and Ash Meadows Poolfish *Empetrichthys merriami*, and put other species at risk of extinction, including the Devils Hole Pupfish *Cyprinodon diabolis*. By highlighting the plight of the remaining imperiled desert fishes, fisheries professionals increased public awareness of the nexus between groundwater and surface water habitat (Deacon and Williams 1991). This awareness stimulated support for halting groundwater pumping in order to protect the remaining habitat and avert further extinctions, although new threats continue to emerge (Deacon et al. 2007). For instance, up to 31 rare and endangered fish species or subspecies that inhabit headwater streams or springs of Nevada, Utah, and California are threatened by proposed groundwater withdrawals in southern Nevada.



Figure 4. (A) Death Valley Pupfish *Cyprinodon salinus* spawn during spring flows in (B) Salt Creek, Death Valley National Park, California. (C) a boardwalk provides access to view the Death Valley Pupfish during winter and spring flows. (D) Salt Creek ceases to flow during the remainder of the year and Death Valley Pupfish take refuge in headwater pools. Photo Credit: A-C, National Park Service; D, Jessica Wilson, Creative Commons.

Again, the primary objective of the Clean Water Act (1972) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. That objective includes species that have become imperiled and are listed as threatened or endangered federally under the Endangered Species Act or protected by states and other entities (Angermeier and Karr 1994). If headwater impairment threatens a federally listed species residing in navigable waters downstream, then that headwater clearly would merit protection under the Clean Water Act because it meets the "significant nexus" test (after SWANCC 2001), and this would be true whether flows are intermittent or ephemeral.

Cavefish habitat demonstrates the importance of the significant nexus perspective, because ephemeral or intermittent headwaters support habitat for imperiled species living in habitat farther downstream (Figure 5). Aquatic habitats of federally listed Ozark Cavefish *Amblyopsis rosae* (threatened)

in Cave Springs Cave, Arkansas (Graening et al. 2010), and Alabama Cavefish *Speoplatyrhinus poulsoni* (endangered) in Key Cave, Alabama (USFWS 2017), are supplied water from streams that flow intermittently above and below the surface at intervals as well as seeps, sink holes, and fractures in karst formations. Headwater streams in this region are not navigable, but they are essential for cavefish habitat, and their discharge contributes to flows in the Illinois (Arkansas; Brown et al. 1998) and Tennessee (USFWS 2017) rivers. Therefore, pollution of a sinkhole impacts both cave habitat and navigable waters downstream. A narrower rule defining waters of the United States that excludes headwaters in karst terrain would allow cavefish habitat to be polluted or destroyed such as by filling of or discharging to sinkholes.

Whereas cavefish are restricted to habitats fed by headwaters, other fishes use headwater streams and wetlands that are intermittent or ephemeral during specific stages of



Figure 5. (A) Fed by headwaters in karst topography, Cave Springs Cave discharges groundwater to Osage Creek, a tributary to the navigable Illinois River. The Cave Springs Cave headwater (Photo Credit: Arkansas Natural Heritage Commission) provides habitat for (B) the federally threatened Ozark Cavefish *Amblyopsis rosae* (Photo Credit: Jim Rathert, Missouri Department of Conservation). (C) The Calapooia River's lowland tributaries provide habitat to several species including the first fish species to be delisted under the Endangered Species Act (Photo Credit: Randall Colvin), (D) the Oregon Chub *Oregonichthys crameri* (Photo Credit: USFWS). (E) The Arikaree River (Photo Credit: Jeff Falke) is an intermittent plains streams in eastern Colorado that supported 16 native fish species adapted to this harsh habitat, including (F) the Orangethroat Darter *Etheostoma spectabile* (Photo Credit: Jeremy Monroe, Freshwaters Illustrated) that is imperiled in Colorado.

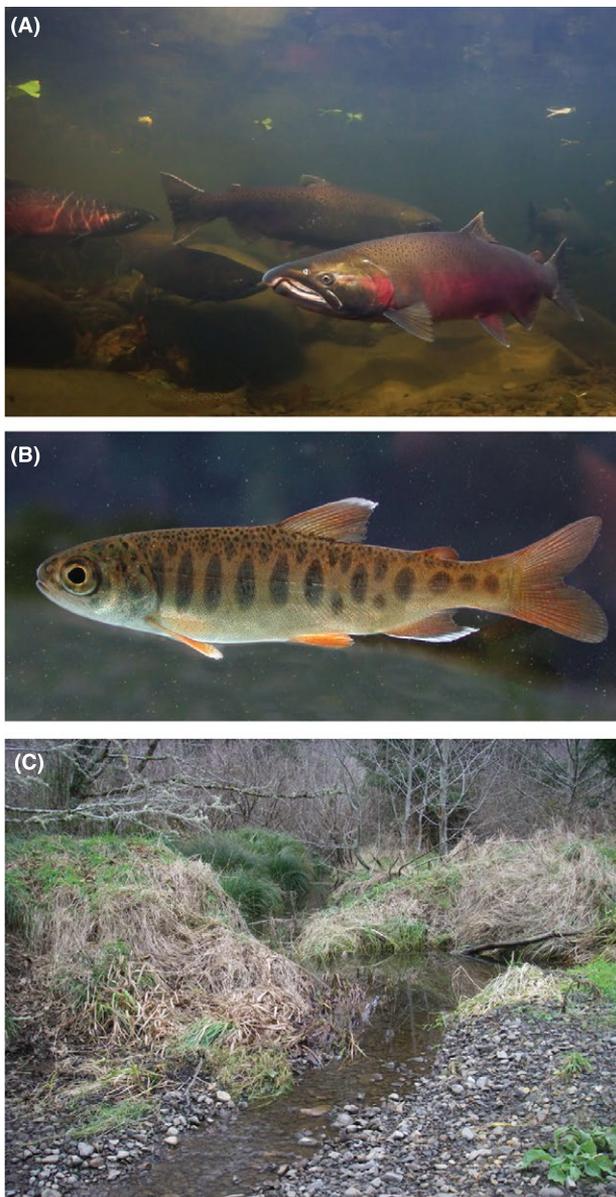


Figure 6. The Oregon Coast Coho Salmon (A; Jeremy Monroe, *Freshwaters Illustrated*) is an evolutionarily significant unit listed as threatened under the Endangered Species Act. Juvenile coho (B; Lance Campbell); of several life history types of this species use very small headwater habitats in coastal streams that are wet only in winter, including side-channels and backwaters that are dry during summer like Crowley Creek, Oregon in the Salmon River watershed (C; Trevan Cornwell).

their life cycles. Because they may be dry for much of the year, these headwaters might seem unimportant for fishes, and yet they can be essential for the persistence of certain stocks. Intermittent streams are important spawning and refuge habitats for imperiled salmon, trout, darters, minnows, suckers, and other fishes (Figures 5 and 6). Examples include federally listed Coho Salmon and Chinook Salmon, species with juveniles that occupy headwater tributaries and seasonal floodplain wetlands during winter. During the rest of the year, these habitats are either dry or so small that they are not considered suitable salmon habitat (Brown and Hartman 1988; Sommer et al. 2001; Jones et al. 2014; Katz et al. 2017; Woelfle-Erskine et al. 2017). Nonetheless, these

intermittent habitats can play a critical role in recruitment. Coho Salmon smolts that inhabit pools in intermittent headwater streams in Oregon are larger than smolts from perennial streams in the same river basin (Wigington et al. 2006). Because larger smolts have higher ocean survival rates, the loss of these intermittent streams could be detrimental to salmon populations in coastal drainages.

Historically, western Oregon's upper Willamette River was bordered by a floodplain forest 2–9 km wide with multiple shaded waterways; winter floods markedly increased its floodplain stream network (Hughes et al. in press). During the past century, agriculture and channelization have altered or eliminated most intermittent water bodies in the valley. However, the remaining temporary streams and ditches still provide critical habitat for a wide diversity of native fish species, such as Cutthroat Trout, Rainbow Trout *O. mykiss*, endangered Chinook Salmon, and the endemic Oregon Chub *Oregonichthys crameri*. These seasonal habitats provide flood refuge, rearing habitats, and separation from invasive alien fish species, all of which are essential for recovering and maintaining valuable sport and commercial fisheries and endangered species (Colvin et al. 2009; Hughes et al. in press; Figure 5). Collaborations with Willamette Valley landowners have been instrumental in improving Oregon Chub habitat and its delisting, and farmers are pleased to know that their winter-wet waterways offer important habitats for valued salmonids.

Headwater streams also are important for salmon in the eastern USA. In Maine, federally endangered Atlantic Salmon migrate up rivers and streams in early summer to take residence in deep pools with cool, well-oxygenated water prior to their ascent into tributaries for spawning during fall (Baum 1997; NMFS 2009). Atlantic Salmon eggs, larvae, and juveniles require clean gravel and cool, oxygenated water to ensure adequate growth and survival in headwaters until returning to marine habitat to mature (Danie et al. 1984; NMFS 2009). Recovery of Atlantic Salmon stocks may also require reestablishing populations of other diadromous species, such as Alewives *Alosa pseudoharengus*, that also depend on headwaters and that were important prey (Saunders et al. 2006). A narrower rule that excludes intermittent headwaters in the Pacific Northwest and New England would allow pollution and destruction of significant salmon habitat and further risk the extirpation of salmon.

Non-anadromous trout and charr also use headwaters as critical habitats, including for spawning and refuge from harsh conditions. Nearly half of the population of Rainbow Trout in a Sierra Nevada mountain stream spawned in an intermittent tributary that provided refuge from flood disturbance and nonnative Brook Trout (Erman and Hawthorne 1976). In their native range, Brook Trout are highly reliant on cool headwaters (Figure 7) and face declines in much of their native distribution due to impacts from dams, water diversion, channelization, and sedimentation (Curry et al. 1997; Etnier 1997; Hudy et al. 2008). Throughout the western United States, the many subspecies of native Cutthroat Trout persist primarily in small headwater streams above natural or created barriers that create refuges from nonnative species (Shepard et al. 2005; Roberts et al. 2013).

Many headwaters of the western Great Plains and dry valleys of the intermountain western United States are ephemeral, and yet are important habitats for fish during months when they have water (Figures 5 and 8). Several imperiled minnow species use ephemeral or intermittent backwaters in floodplain wetlands adjacent to stream channels for spawning and rearing (e.g., *Hybognathus* spp.; Falke et al. 2010, 2012; Medley

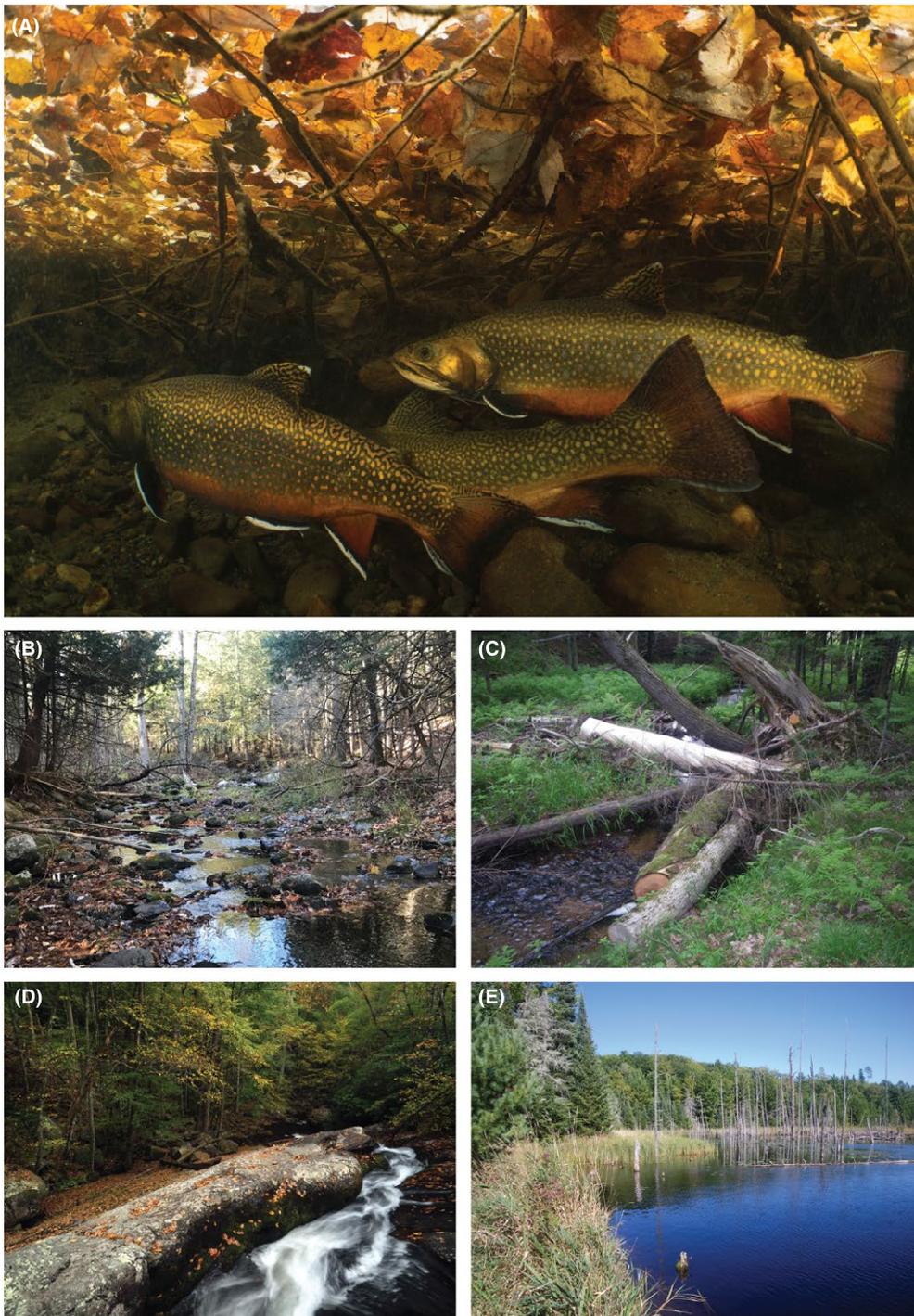


Figure 7. (A) Brook Trout *Salvelinus fontinalis* require cold, clear, and well-oxygenated water often found in headwater habitats. Examples of headwater streams inhabited by Brook Trout are shown for (B) a stream which becomes intermittent and composed of isolated pools in dry years in Maine (Photo Credit: Susan A.R. Colvin), (C) Michigan (Photo Credit: Patrick D. Shirey), and (D) an Appalachian headwater stream (Photo Credit: David Herasimtschuk, Freshwaters Illustrated). (E) an intermittent stream in Wisconsin impounded by beaver *Castor canadensis* creates diverse headwater habitat and provides ecosystem services of nutrient cycling and floodwater storage (Photo Credit: Patrick D. Shirey).

and Shirey 2013; Hutson et al. 2018). Many minnows, suckers, sunfishes, and darters in arid-land streams disperse between deep pools that retain water by exploiting ephemeral channels when flowing (Fausch and Bramblett 1991; Labbe and Fausch 2000). Though adjacent floodplain wetlands of navigable waters that are defined as wetlands are currently regulated under the Clean Water Act (*United States v. Riverside Bayview* 1985),

if the protection of temporary headwaters were to be rescinded, significant amounts of this essential fish habitat would be at risk from changes in headwater source flows or pollution resulting from fill and contaminated discharges.

Headwaters sometimes provide the last refuge for species threatened by loss of habitat elsewhere in the watershed. Examples include the federally endangered Yellowcheek



Figure 8. (A) Cottonwood Creek is an intermittent tributary of the Gunnison River (Colorado River basin) in western Colorado that hosts large numbers of (B) Bluehead Sucker *Catostomus discobolus*, (C) Flannelmouth Sucker *C. latipinnis*, and (D) Roundtail Chub *Gila robusta* during spring spawning. Stream discharge varies widely based on snowfall, but these three imperiled species show considerable behavioral plasticity in timing their entry from the main river to this headwater tributary to take advantage of the seasonally available spawning habitat it provides. Fish enter the stream as soon as water depths permit, often in consecutive years. Spawning suckers of both species displayed tributary residency of more than 25 days in years when March or early April flows were adequate (E and F), and more than 10,000 individuals used the stream annually (Hooley-Underwood et al., in press). Adults and just-hatched larvae subsequently moved out of the stream (G), and by mid-June (H) flow ceased and the streambed dried completely. Intermittent tributaries like these are critical for sustaining populations of these three species, which are the subject of rangewide conservation efforts to prevent listing under the Endangered Species Act.

Darter *Etheostoma moorei* (endemic to the Boston Mountains of Arkansas; Robison and Buchanan 1988; Magoulick and Lynch 2015) and the federally threatened Leopard Darter *Percina pantherina* (endemic to a few headwater streams in the Ouachita Mountains of southeastern Oklahoma and southwestern Arkansas; Zale et al. 1994). The endangered Shortnose Sucker *Chasmistes brevirostris* and Lost River Sucker *Deltistes luxatus* depend on clean gravel in headwater tributaries or springs for spawning as well as adjacent wetlands and nearshore vegetation for juvenile rearing (USFWS 2012b). Wetlands that were replaced by pasture and cropland have contributed to the continued listing of these species. Thermal habitats unique to mountain headwater streams throughout the western United States are expected to provide important refuges for native species in the face of climate change, including many of conservation concern, such as Bull Trout and many subspecies of Cutthroat Trout (Wenger et al. 2011; Isaak et al. 2016). For the highly endemic Miller Lake Lamprey *Lampetra minima* and southeastern pygmy sunfishes *Elassoma* spp., headwaters provide refuge from thermal stress, extreme hydrological conditions, and exposure to invasive species (Hayes et al. 1998; Meyer et al. 2007).

Protecting headwater habitats is critical for the recovery and delisting of several endangered fishes. For instance, the recently delisted Modoc Sucker *Catostomus microps* is abundant in intermittent and low-flow headwater streams in northeastern California and southern Oregon (Moyle and Marciochi 1975). Delisting resulted from protecting headwater tributaries and wetlands on public and private lands from threats that included livestock grazing and stream channelization that eliminated refuge pools (Moyle and Marciochi 1975; USFWS 2015). By protecting headwaters, the United States can not only reduce the uncertainty and economic costs that come with an imperiled species being listed under the ESA, but also provide the foundation for successful recovery and delisting of species.

HEADWATERS SUPPORT RECREATIONAL AND COMMERCIAL FISHERIES

Inland and coastal fisheries resources have tremendous economic and social importance. In the USA, commercial and recreational fisheries contributed over \$208 billion in economic impact and 1.62 million jobs in 2015 (NMFS 2015). Fishing is a major recreational activity in the USA, with nearly 12 million participants in 2011 and creating 439 thousand jobs and generating more than \$63 billion across the United States in 2015 (USFWS 2012a, NMFS 2015). For instance, headwater tributaries in the western USA are visited annually by thousands of anglers for both catch-and-release as well as harvest fishing. Nationally, trout anglers spent \$3.5 billion on their pursuits, supported over 100 thousand jobs, and had a \$10 billion economic impact, including \$1.3 billion in federal and state tax revenues in 2006 (USFWS 2014).

An important consideration for the protection of headwaters is to safeguard recreational and commercial fisheries from point and non-point sources of pollution. Removing those protections will perpetuate current sources of pollution and worsen future impacts to downstream fisheries. In many regions of the USA, past and current pollution continues to degrade fisheries. For example, in the western USA, legacy metal and acid-mine drainage into headwater systems continue to threaten recreational trout fisheries (Woody et al. 2010). In 2015, the Gold King Mine spilled approximately 3

million gallons of untreated acid mine drainage into a headwater stream, instantly changing the color and turbidity of the stream for 2 days, and closing a valuable trout fishery for the entire summer (Rodriguez-Freire et al. 2016). Climate change and the increased frequency of warmer and drier years is predicted to extirpate trout from nearly half their habitat throughout the interior western United States by the 2080s (Wenger et al. 2011), as well as fragment the remaining habitats and reduce trout population sizes and their connectivity (Williams et al. 2015; Isaak et al. 2016). Further erosion of protections for headwaters may reduce or end opportunities to catch trout in these waters and have huge impacts on recreational angling tourism.

Recreational fisheries and headwaters are tightly interconnected. Depending on the state and location, the daily economic value of trout angling was \$50–157 per person (USFWS 2012a). For example, blue-ribbon trout streams in two Idaho and Wyoming river basins yielded \$12 million and \$29 million in county income and 341 and 851 jobs in 2004, respectively (Hughes 2015). The trout fishery in Colorado alone was valued at \$1.3 billion in 2011 (Williams et al. 2015). Brook Trout fishing in northern Maine generated over \$150 million in 2013 and anglers spent \$200 per day on fishing logistics (Fleming 2016). In Pennsylvania, trout anglers spent \$45 per day and generated \$2 million annually for rural economies (MDNR 2018). North Carolina trout anglers generated \$174 million in economic output (NCWRC 2013). Based on travel cost modeling, Georgian trout anglers spent \$60–160 per trip, generating \$70–200 million annually (Dorison 2012). Recent estimates of freshwater fishing contributions to U.S. Gross Domestic Product total \$41.9 billion while providing 526.6 thousand jobs nationwide (Allen et al. 2018). Economic contributions from freshwater fishing is also increasing, growing 11% since 2011 (Allen et al. 2018). It is also critical economic growth when compared to other sectors, collectively the outdoor recreation economy grew 3.8% in 2016 while the overall economy grew 2.8% during the same time period (Allen et al. 2018).

The headwater systems that support these recreational fisheries are typically found at higher elevations, with critical physical habitat requirements (e.g., temperature, flow, and dissolved oxygen) for prized trout species. Species-specific habitat requirements are uniquely provided by these streams and driven by annual snow accumulation (and snowmelt). Recreational anglers avidly pursue several target fishes (Cutthroat Trout, Rainbow Trout, Bull Trout, Brook Trout, Brown Trout, and Arctic Grayling *Thymallus arcticus*) found in these higher-elevation streams. Although they represent a small proportion of recreational angling nationally, these stocks sustain a huge market for fly-fishing anglers from throughout the USA and other nations.

Trout are not the only prized fishery that depends on headwaters. The Alligator Gar *Atractosteus spatula*, one of the largest and most primitive fishes in North America, is a popular target for anglers and archers in the southeastern USA. This fishery has created a booming market for gar-fishing guides that charge \$750 per day (Benning 2009). Alligator Gar stocks have declined throughout their native ranges, including apparent extirpations in many regions. During late spring and summer high flows, adult gar move from rivers into small floodplain tributaries (and ditches) to spawn in flooded ephemeral wetlands and fields containing submerged vegetation (Solomon et al. 2013; Kluender et al. 2016). Recruitment success of juvenile gar is correlated with large, long-duration

summer floods and spawning habitat availability (Buckmeier et al. 2017; Robertson et al. 2018). This connectivity allows for gar dispersal between rivers and ephemeral floodplain headwaters, which is critical for sustaining this species (Robertson et al. 2018).

Commercial fisheries are affected by headwaters both directly and indirectly. Among the most valuable commercial fisheries dependent on headwaters are the salmon fisheries of Alaska and the Pacific Northwest. From 2012 to 2015, salmon commercial and recreational fisheries were valued at \$3.4 million in economic output and produced \$1.2 million in wages and 27 thousand full-time jobs annually (Gislason et al. 2017). The world's most valuable wild salmon fishery in Bristol Bay, Alaska, where headwaters remain relatively pristine, generates \$1.5 billion in annual economic activity and 20 thousand full-time jobs (BBNC 2017). As mentioned previously, spawning Pacific Salmon *Oncorhynchus* spp. import marine-derived nutrients into nutrient-poor headwaters, thereby augmenting production of basal resources in aquatic food webs. In the northeastern United States, a burgeoning commercial fishery has developed for juvenile American Eel *Anguilla rostrata* to supply Asian markets. American Eel catches in Maine were valued at more than \$10 million annually from 2015 to 2017 (ASMFC 2017b), and the fishery provided well over \$20 million in 2018 (Whittle 2018). Some estimates suggest American Eel stocks along the eastern coast of North America have declined dramatically in the last several decades (Busch et al. 1998). However, conclusions from recent assessments on stock status are variable, ranging from “threatened” and “endangered” to “not threatened or endangered” (Jessop and Lee 2016). More clearly, headwaters are important rearing habitats for American Eel, and stream restoration has been recommended as an important strategy for recovery where depleted (Machut et al. 2007).

Protections currently afforded to headwaters through the 2015 WOTUS rule help maintain and contribute to the stability of commercial and recreational fisheries and the rural economies that they support. In rural areas, nature tourism also contributes to sustainable economic growth where visitors spend recreational dollars to see rare fish up close (Figure 4). For example, the Ash Meadows National Wildlife Refuge is home to the highest concentration of endemic species in the USA and draws nearly 70 thousand visitors annually that contribute over \$3 million to the local economy (unpublished data from Ash Meadows National Wildlife Refuge, Visitor Service Staff).

HEADWATERS ARE CULTURALLY SIGNIFICANT

Cultural values of headwaters and the downstream rivers they support are diverse, and clearly expressed in nature-based tourism, aesthetic values, recreational fishing, and other activities (Beier et al. 2017). Human–natural resource relationships have evolved in the context of intricate interactions among cultures, communities, and water (e.g., its quality, access, use, and associated resources) for both native and other peoples (Johnston 2013). Wild salmon, for example, hold central roles in the creation and migration narratives of native peoples, and continue to be present in prayers and visions in addition to diets (Stumpff 2001). Fly fishing for trout can be a religious, transformative experience for many. This pursuit strengthens ties with nature, shapes local-to-regional economies, and has a complex history with environmental stewardship (Hemingway 1973; Maclean 1976; Brown 2012, 2015). However, impairment of headwaters has strongly altered the interactions

between people and nature, with the ecosystem services provided by rivers to society declining over time (Gilvear et al. 2013; Lynn et al. 2013; Marttila et al. 2016).

The spiritual and socio-cultural values of fish and healthy ecosystems—which are dependent on clean, free-flowing headwaters—are intangible and extend well beyond any economic measures (Boraas and Knott 2018). Pacific Salmon fisheries are a major source of subsistence and income for many native peoples in Alaska and the western USA (e.g., Boraas and Knott 2018). Salmon are also a traditional “first food,” honored in many tribal traditions and strongly linked to cultural identities (e.g., CRITFC 2018; NPT 2018). For example, the Nimiipuu (Nez Perce) view salmon as economic and spiritual keystones, with the survival of the tribe and the salmon being interdependent (Colombi 2012).

Similar to Pacific Salmon, Bull Trout inhabiting western streams are culturally important to many groups, including the Confederated Salish and Kootenai Tribes. Bull Trout are part of the history, oral traditions, culture, and identity that are passed down among generations (CSKT 2011). The Confederated Tribes of western Montana credit the abundance of Bull Trout for preventing starvation during harsh winters (Laughlin and Gibson 2011). Even though Bull Trout are not currently harvested for subsistence and economic purposes, Rich Janssen, the natural resource manager for the Confederated Salish and Kootenai Tribes, highlights their interrelationship as follows: “It’s part of who you are. It’s part of your culture. It’s part of your history. You don’t want to lose who you are. You don’t want to lose that connection” (Laughlin and Gibson 2011).

The importance of headwaters to indigenous cultures extends beyond the well-established examples from Alaska, the Pacific Northwest, and intermountain western USA. For instance, the Ash Meadows National Wildlife Refuge is also culturally important to the Timbisha Shoshone and Southern Paiute peoples because of its life-giving pools fed by headwater springs (Shirey et al. 2018). The Rio Grande and Colorado River flow from headwaters in the Rocky Mountains through traditional lands of the largest concentrations of indigenous peoples within the conterminous USA (Navajo, Apache, Pueblo, and others) and intersect the ranges of Apache Trout and Gila Trout. These headwater ecosystems and the services they provide are central to traditional place-based lifestyles of indigenous tribes (Johnston 2013). Eastern North Carolina Cherokee highly value headwater streams for their cultural significance (extending back thousands of years) as well as for fishery-based tourism (Balster 2018). For the Passamoquoddy of present-day Maine, water and fish are sacred and inextricably linked to their history, culture, traditional beliefs, lore, and spirituality (Bassett 2015). Caloric-rich Alewife and Blueback Herring *A. aestivalis* migrate from the ocean to spawn in the headwaters of the St. Croix River, Maine, where they were a key resource with cultural importance for the Passamoquoddy for thousands of years before European colonization and habitat impairment from pollution, dams, overfishing, and stocking of alien species. In 2013, in cooperation with the Bureau of Indian Affairs, U.S. Fish and Wildlife Service, NOAA and others, the Passamoquoddy began restoring the St. Croix Watershed and returning these species to the ecosystem and the Passamoquoddy people. Traditional ecological knowledge provides an important line of evidence supporting protection and restoration of headwaters. For example, Maine Sea Grant and the National Marine Fisheries Service (NMFS) collaborated to document and disseminate harvesters’ knowledge of

BOX 2. ALEWIVES IN MAINE

Alewives *Alosa pseudoharengus*, ascend freshwater rivers and tributaries in early summer to access lakes and headwater ponds where they spawn; in the fall, juvenile Alewives migrate from headwaters to the marine environment (Saunders et al. 2006; Figure 9). Alewife recovery resulting from dam removals and improved access has provided an additional food resource for endangered Atlantic Salmon and terrestrial piscivores, such as the bald eagle *Haliaeetus leucocephalus*. Restored Alewife stocks also have enhanced local economies by diversifying fisheries, including creation of a major fishery for bait to supply the lobster fishery (Saunders et al. 2006; McClenachan et al. 2015). Lakes with restored alewife populations also have shown improvements in water quality and clarity because out-migrating juveniles remove phosphorus from these systems (McClenachan et al. 2015). Despite some recent population recoveries of Alewife in Maine, coastwide populations of river herring, including both Alewives and Blueback Herring *A. aestivalis*, are depleted and near historic lows (ASMFC 2017a).

Alewife, Blueback Herring, and American Eel, all of which are returning to headwater streams following recent dam removals (Hitt et al. 2012; Hogg et al. 2015). Similarly, the Yurok and Karuk people of the Klamath region in northern California, who have deep cultural and subsistence ties with Pacific Lamprey *L. tridentata*, provided important information that improved understanding of lamprey population crashes in the Klamath Basin (Lewis 2009).

The strong interrelationships between native peoples, fish, and fluvial systems also implicate environmental justice issues, particularly as related to chemical contaminants and traditional food systems that include fish (Kuhnlein and Chan 2000). Contaminants affect not only human health, but also broader issues of food security and social and cultural wellbeing (Jewett and Duffy 2007). Impairment of headwaters and water quality extends to many other groups as well, and can lead to greater environmental inequality (e.g., Elkind 2006). Moving forward, heightened respect for and recognition of the rights and values of culturally diverse peoples in the use of river systems, including headwaters and associated resources, warrants additional and thoughtful consideration when legislating and implementing protections (Johnston 2013).



Figure 9. Juvenile Alewife *Alosa pseudoharengus* from Unity Pond, Maine. Photo Credit: Susan A. R. Colvin.

HEADWATERS NEED CONTINUED PROTECTION

The repeal and replacement of the 2015 Clean Water Rule would roll back Clean Water Act protections for a majority of the nation's streams and wetlands, including thousands of miles of headwater streams and millions of acres of wetlands that provide invaluable ecosystem services and habitat for many species of fish. The recently proposed rule, which excludes wetlands outside of floodplains (or those that lack a continuous surface connection to other jurisdictional waters), ephemeral streams, and likely some intermittent streams, would threaten fish and the headwater ecosystems on which they rely, result in severe economic losses, and cause irreparable cultural and social damage. To recap, some examples of headwaters that would not meet Scalia's definition and could lose protection under the new rule include the karst features, critically important to threatened and endangered cavefish (Figure 5); intermittent streams used by imperiled fish for spawning and early rearing (Figure 8); and intermittent side channels and floodplains that provide critical habitat for juvenile salmon (Figure 6). Justice Scalia's definition, which largely aligns with the proposed rule, ignored the intent of Congress in passing and updating the Clean Water Act, failed to give deference to the agencies that implement the law, and issued a decision not grounded in science. In contrast, Justice Kennedy's definition deferred to Congressional intent and federal agency experts and relied on the available scientific evidence. The science of waterbody connectivity has advanced markedly in the time since the *Rapanos* case, and the 2015 Clean Water Rule was based on the demonstrated importance of physical, chemical, and biological connections of headwaters to the ecological condition of navigable waters and their biota (Leibowitz et al. 2018).

Headwaters are critically important for many ecosystem functions, including sustaining fish stocks, with influences extending from small tributary streams and wetlands to navigable waterbodies downstream. The recently proposed rule offers protection only to a narrower subset of headwaters and will have far-reaching implications for fish, wildlife, and humans that depend on freshwater ecosystems. Species already at risk of extinction would be more difficult to recover, and it is highly likely that many fishes and other aquatic taxa would face greater imperilment. It is clear that communities across the USA would lose significant economic, spiritual, and socio-cultural benefits that are derived from headwaters under the proposed rule. Therefore, we recommend that the EPA follow the approach in its National Aquatic Resource Surveys and conduct a formal ecological and economic risk assessment to quantify the potential effects of changing the current WOTUS rule.

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AUTHORS' CONTRIBUTIONS

S.A.R.C. and S.M.P.S. conceived the original structure of the manuscript. S.A.R.C. served as overall lead author and

led the writing of the Introduction. S.M.P.S led the Ecosystem Function and Cultural Significance sections. P.D.S. led the Endangered Species section, with contributions from K.D.F. R.W.C. led the section on Commercial and Recreational Fishing. These authors wrote the manuscript with contributions from all authors. R.M.H., K.O.W., and K.D.F. provided important editorial suggestions.

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April 12, 2019

Via regulations.gov: Docket ID No. EPA-HQ-OW-2018-0149

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Re: Revised Definition of “Waters of the United States” (84 FR 4154; Docket ID No. EPA-HQ-OW-2018-0149)

Dear Administrator Wheeler and Assistant Secretary James:

On behalf of the more than 20,000 members of the American Fisheries Society (AFS) and The Wildlife Society (TWS), we respectfully submit the following comments in response to the proposed rule (proposed Rule), “Revised Definition of ‘Waters of the United States’” (84 FR 4154; Docket ID No. EPA-HQ-2018-0149) published in the Federal Register on February 14, 2019.

AFS is the world’s oldest and largest professional society of fishery and aquatic scientists and managers. The Society seeks to improve the conservation and sustainability of fishery resources and aquatic ecosystems by advancing fisheries and aquatic science and promoting the development of fisheries professionals.

TWS and its network of affiliated chapters and sections represent professional wildlife biologists, managers, and educators dedicated to excellence in wildlife stewardship. The Society’s mission is to inspire, empower, and enable wildlife professionals to sustain wildlife populations and habitat through science based management and conservation.

Our societies are strongly opposed to the proposed Rule. We greatly value the country's clean waters and healthy aquatic ecosystems as they are critical to maintaining fisheries, ecosystem services, and biodiversity. The limited protections proposed for our nation's waters under the proposed Rule threaten fish, fisheries, and the terrestrial wildlife and human populations that rely on them, and places the highly valued ecosystem services that are derived from these systems in great peril.

AFS and TWS fully support the definition of Waters of the U.S. (WOTUS) in the 2015 Clean Water Rule (2015 CWR), which was overwhelmingly supported by peer-reviewed science. The EPA's Office of Research and Development prepared a comprehensive scientific report to accompany the 2015 CWR, the "Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence" (herein the "Connectivity Report" but which was described in the 2015 CWR as the "Science Report"). The Connectivity Report synthesized more than 1,200 peer-reviewed publications and provided the technical basis for the 2015 CWR. The 2015 CWR also underwent an extensive stakeholder review process. Since the completion of the Connectivity Report, substantial additional literature has emerged that reaffirms the report and the 2015 CWR (e.g., Cohen et al. 2016, Rains, et al. 2016, Fritz et al. 2018, Harvey et al. 2018, Leibowitz et al. 2018, Schofield et al. 2018, Colvin et al. 2019.) The 2015 CWR reflects the best available science in regards to connectivity, but unfortunately, the proposed Rule is unsupported by peer-reviewed science. It was developed without the critical scientific analysis that supported the 2015 CWR rulemaking process and it has not been subjected to a rigorous independent review process.

Further, the proposed Rule fails to align with the original intent of the Clean Water Act to 'to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.' This can only be achieved if the definition of WOTUS is grounded in sound science and recognizes all five parameters of connectivity (hydrologic, chemical, physical, biological, ecological), as documented in the Connectivity Report (EPA 2015). Unfortunately, the proposed Rule only recognizes a limited subset of connectivity and relies on flow permanence and physical abutment as measures of jurisdiction while arbitrarily ignoring other aspects of physical connectivity such as bed, banks, and high-water marks, and chemical, biological and ecological connectivity that were incorporated in the 2015 CWR. The proposed Rule is inconsistent with more than a half century of scientific research that demonstrates that the integrity of "traditionally navigable" waters fundamentally depends on ephemeral, intermittent, and perennial headwater streams, as well as the many associated lakes, wetlands, and off-channel habitats (USEPA, 2015).

The proposed Rule would eliminate protections from many headwaters across the country. Headwaters are broadly defined as portions of a river basin that contribute to the development and maintenance of downstream navigable waters including rivers, lakes, and oceans. Headwaters include wetlands outside of floodplains and small streams with permanent flow, intermittent flow, and ephemeral flows. The waters and wetlands in the upper reaches of a watershed, including ephemeral, intermittent, or perennial streams, affect downstream waters and wetlands; that is, they are hydrologically, chemically, physically, biologically and ecologically connected to what happens downstream. Aquatic ecosystems depend upon transfer of chemical components and organic materials to support the life in and around their shores. Headwater streams act as a conveyor of nutrients, a path for migrating organisms such as fish and wildlife, and a drainage and storage system for floodwaters. These and other ecosystem services depend on watershed connectivity.

AFS convened a group of scientists to look at the value of headwater streams for their critical importance to fish and fisheries. As detailed in their report, "Headwater Streams and Wetlands are Critical for Sustaining Fish, Fisheries and Ecosystems," (Colvin et al. 2019) the loss of Clean Water Act

protections for headwaters would diminish ecosystem services provided by those waters, increase the threat to imperiled species, affect commercial and recreational fisheries, and degrade fishes of great cultural value to Native Americans and the recreating public. Headwaters are key to the sustainability of fish stocks in both upstream and downstream waters and should be protected.

In addition to the loss of protection for headwaters, the proposed Rule seeks to eliminate protections for wetlands that do not abut or have a direct hydrologic surface connection to other WOTUS. Wetlands provide essential ecosystem services such as protection of drinking water quantity and quality, provision of flood storage, storm damage mitigation, resilience against sea level rise and drought, and essential fish, shellfish, waterfowl, and wildlife habitat. Wetland loss in some regions of the U.S. already approaches or exceeds 85%. As documented in the Connectivity Report, wetlands that neighbor other waters of the United States, but are not necessarily abutting or having a direct hydrologic surface connection in a typical year, often exhibit functional connection with other WOTUS, and should be protected. These waters equal the size of West Virginia and the loss of ecosystem services they provide would be staggering.

In addition, unique, isolated wetlands like prairie potholes and vernal pools across the U.S. would be excluded from protection under the proposed Rule. These unique wetlands ecosystems are essential for maintaining regional biodiversity and buffering floods and droughts. For example, the Prairie Potholes of the Upper Midwest provide habitat for 50% of North American migratory waterfowl and are often the only surface water source. Further reductions in regionally unique wetlands will lead to irrevocable losses in biodiversity and ecosystem services and should be protected.

The proposed rule is an unprecedented rollback of the Clean Water Act, yet the agencies have not offered an analysis of the impacts of the new rule nor any rigorous scientific or economic evaluation of the rule change. Removing existing protections from the millions of miles of ephemeral headwater streams in the US will only exacerbate the transformation of historically perennial streams and rivers into highly vulnerable intermittent and ephemeral streams and rivers driven by climate change and extensive and intensive land use. For example, as a result of climate change, land use changes, and water withdrawals, one-third (125,000 miles) of the mapped perennial stream length in the conterminous western US was found to have been reduced to non-perennial streams or even no longer a stream. The decline varied from over half of the stream length in the Southwest, to one-third in the Great Plains, to one-fourth in the western mountains (Stoddard et al. 2005). Similarly, Perkin et al. (2017) estimated a loss of one-fifth (334 miles) of the stream length in the Upper Kansas River Basin, which was linked to ground-water pumping and climate change. The losses not only pertain to small streams. For example, the once perennial Gila, lower Colorado, Grande, and Nazas Rivers are now intermittent or ephemeral as a result of anthropogenic pressures--including climate change (Hughes et al. 2005).

The agencies' assessment of annual avoided costs from the proposed Rule fails to recognize the huge financial losses to the country as a result of reduced fisheries. Nationally, freshwater fishing contributes \$41.9 billion and over 500,000 jobs our economy, often in otherwise economically depressed regions (Allen et al. 2018). Without continued protection of headwaters necessary for valuable recreational fisheries and endangered species, economically vital fisheries are likely to decline or collapse and endangered species are likely to become further imperiled. A shift of this magnitude merits a full assessment of the risks of eliminating protections for so many waterways, as well as the justification for doing so.

In conclusion, AFS and TWS strongly oppose the proposed Rule, strongly support the 2015 CRW, and reject any re-definition of WOTUS that is not based in sound, peer-reviewed science. The proposed redefinition of WOTUS will make it impossible to achieve the objectives of the Clean Water Act because it excludes numerous waters and wetlands that directly affect the chemical, physical, and biological integrity of primary waters. The loss of protections for our nation's waters called for in the proposed Rule would have grave consequences for fish and fisheries and would have far-reaching implications for fish, wildlife, and their habitats, as well as the thousands of economies dependent on those systems. We urge you to revise the proposed Rule in accordance with well-established science on connectivity that will ensure the chemical, physical, and biological integrity of our nation's waters are restored and maintained.

Thank you for your consideration.

Sincerely,

Douglas J. Austen, Ph.D.
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The American Fisheries Society • American Institute of Biological Sciences • Association for the Sciences of Limnology and Oceanography • Coastal and Estuarine Research Federation • Ecological Society of America • Freshwater Mollusk Conservation Society • International Association for Great Lakes Research • North American Lake Management Society • Phycological Society of America • Society for Ecological Restoration • Society for Freshwater Science • Society of Wetland Scientists

September 21, 2017

The Honorable Scott Pruitt
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The Honorable Douglas W. Lamont
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Re: Docket ID No. EPA-HQ-OW-2017-0203; FRL-9962-34-OW; Definition of “Waters of the United States” - Recodification of Pre-existing Rules

Dear Administrator Pruitt and Deputy Assistant Secretary Lamont:

We are submitting these comments regarding the proposed rule, Definition of “Waters of the United States” - Recodification of Pre-existing Rules, EPA-HQ-OW-2017-0203; FRL-9962-34-OW, published in the Federal Register on July 27, 2017; on behalf of the approximately 200,000 members of the Societies listed in the next paragraph. Our societies ***strongly oppose the proposed rule to rescind*** the definition of “Waters of the United States” (WOTUS) as promulgated by the Agencies in 2015 (Clean Water Rule: Definition of Waters of the United States; 80 FR 37054, June 29, 2015) (2015 CWR).

The American Fisheries Society (AFS), American Institute of Biological Sciences (AIBS), Association for the Sciences of Limnology and Oceanography (ASLO), Coastal and Estuarine Research Federation (CERF), Ecological Society of America (ESA), Freshwater Mollusk Conservation Society (FMCS), International Association for Great Lakes Research (IAGLR), North American Lake Management Society (NALMS), Phycological Society of America (PSA),

Society for Ecological Restoration (SER), Society for Freshwater Science (SFS) and Society of Wetland Scientists (SWS) support the sustainable management of the nation's waters. We are science-based organizations with diverse areas of expertise in the ecological and biological sciences. Our collective 200,000+ members and 130+ professional societies and research organizations work in the private sector, academia, and various tribal, state and federal agencies. As non-profit organizations, we support and foster sound science, research, and education on, and restoration and management of, wetlands and other aquatic resources. Thus, we track policies and actions that affect these aquatic resources and we promote science-based policy-making.

Wetlands sustain essential habitat for wildlife, fish, and waterfowl to feed, breed, nest, spawn, and rear their young. The areas comprising our nation's wetlands have been reduced by over 50% over the past 200 years and now cover a small portion of our landscapes (<6% of the land area in the lower 48 states), but they play a disproportionately significant role in protecting our nation's waters.

Wetlands and headwater streams provide vital services that promote human health and safety, and support American businesses. These essential components of our hydrologic networks improve water quality in our streams, lakes, and groundwater by naturally cleansing surface waters, including urban, mining, timber harvesting and agricultural runoff; they also provide stored water during drought, and absorb stormwater runoff and floodwaters, reducing disaster recovery costs. A 2016 study (Narayan et al)¹ found that coastal wetlands prevented \$625 million in property damages during Hurricane Sandy, and that coastal wetlands reduced annual property damages in Ocean County, New Jersey by nearly 20%.

The proposed repeal of the 2015 Clean Water Rule, unlike the 2015 Clean Water Rule itself, is unsupported by the peer-reviewed science and evidentiary analysis, has not been subjected to rigorous independent peer review, nor to a robust public comment process, and poses a significant threat to the integrity and security of our drinking water, public health, fisheries, and wildlife habitat while significantly increasing the risks and costs associated with flood and storm damage. We submit the following comments for your consideration.

Comment #1: The Agencies should provide a body of peer-reviewed publications, comparable to those supporting the 2015 CWR, providing scientific evidence that repeal of the 2015 CWR will not negatively impact the ability of the CWA “to restore and maintain the chemical, physical, and biological integrity of the nation’s waters,” and will not lead to financial losses resulting from deterioration of WOTUS and their associated ecosystem services, as defined by the 2015 CWR.

The 2015 CWR is supported overwhelmingly by the scientific evidence, documented in the EPA *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence* report², which underwent external peer review by the EPA Science Advisory

Board, and incorporates results from over 1,200 peer-reviewed scientific publications. Further support for the 2015 CWR is provided by a Brief of the *Amici Curiae* in Support of Respondents and in Support of Upholding the Clean Water Rule³, filed with the U.S. Court of Appeals for the Sixth Circuit, as well as numerous peer-reviewed studies (e.g., Golden et al. 2017)⁴, Agency experience and U.S. Supreme Court precedent. The protection of water quality, water supply, aquatic ecosystem health, prevention of storm, flood, property, and infrastructure damage, and protection of the chemical, physical, and biological integrity of WOTUS will be jeopardized without the protection afforded to headwaters, tributaries, wetlands (including some isolated wetlands), and adjacent waters by the 2015 CWR. Reverting to previous definitions of WOTUS and prior Agency guidance documents has led to incomplete achievement of the CWA mandate, as noted in this comment letter, with costly and significant negative consequences for American citizens, businesses, and communities, as they experience deteriorated water quality, more limited water supplies, more severe flood and storm damage to properties and infrastructure, reduced fisheries, reduced recreational activities supporting American businesses, and degraded ecosystem and wildlife habitat conditions. Compensating for these ecosystem service losses will incur significant financial losses, as mentioned above.

Comment #2: The Agencies should provide extensive, substantive and valid documentation to demonstrate how reverting to a case-by-case approach leads to greater certainty, consistency, clarity, and stability of regulation.

The 2015 CWR establishes greater certainty, consistency, clarity, and stability of regulation than the preceding WOTUS definition and 2003 and 2008 agency guidance documents. Reverting to case-by-case “significant nexus” evaluations will add to the financial and permitting burden of businesses and communities, and will perpetuate the current level of confusion and inconsistency for an unknown period of time. The lack of scientific, peer-reviewed studies in support of repealing the 2015 CWR will likely trigger costly and time-consuming court challenges and contribute further to regulatory uncertainty, instability, and costs to both private and public sectors.

Comment #3: The Agencies should provide a complete economic analysis that includes economic benefits associated with wetlands protected by the 2015 CWR as well as the costs and lost revenues associated with rescinding the 2015 CWR, many of which are enumerated in this comment letter. The revised economic analysis should be supported by peer-reviewed publications, and should provide peer-reviewed publications to support any removal of economic benefits or additions of economic costs associated with rescinding the 2015 CWR, and this economic analysis should be subject to a robust peer review and public comment process.

The proposed rule to rescind is dependent upon, and largely justified by, a highly flawed, incomplete, and weak economic analysis (see: https://www.epa.gov/sites/production/files/2017-06/documents/economic_analysis_proposed_step1_rule.pdf). The Federal Agencies that drafted this rescission rely on an economic analysis conducted for the 2015 CWR, but with one major

change—the Agencies removed the estimated \$313 to \$513 million in annual benefits that resulted from wetland protection under the 2015 CWR, and they failed to provide any other means of estimating the economic value of wetlands protected by the 2015 CWR.

They justify this removal of benefits, in part, by stating that, “public attitudes towards nature protection *could* have changed” over time, but provide no documentation to support this assertion. According to survey results (among others, see <http://www.trcp.org/2017/06/28/new-national-poll-shows-hunter-angler-support-conservation-crosses-party-lines/>), Americans place greater value on clean water than on any other environmental factor, and *increasingly* value wetlands (Costanza et al. 2014)⁵. Further, the Agencies make the specious argument that they were unable to find updated studies of “willingness to pay” wetlands valuation studies, such as those that were part of the 2015 CWR economic analysis. Several contingent valuation studies were conducted between 2005 and 2014 (including Whitehead et al (2005), Whitehead et al (2009), Awondo et al (2011) and Petrolia et al (2014))⁵. In addition, according to John Loomis, Colorado State University professor, and author of “Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation”, which includes over 1,000 citations and received the Publication of Enduring Quality Award from the Agricultural and Applied Economics Association, there have been no major changes to the scientifically accepted methods for valuing clean water since the studies that support the 2015 CWR, and his seminal 1991 work continues to be used today (personal communication, 8/10/2017). OMB and USACE continue to utilize the “willingness to pay” approach, as do others. Two meta-analyses conducted in 2006 (Brander et al.)⁵ and 2010 (Ghermandi et al.)⁵ continue to support the conclusions of the studies in support of the 2015 CWR.

Further, many additional studies documenting the economic value of wetlands, as measured in a variety of ways, have been produced recently, and are included in the list of economic valuation studies⁵ below. The references appended to this letter include “willingness to pay” studies, as well as other methods for assessing the economic value of wetland ecosystem services. It should be further noted that each of the references appended to this letter includes additional citations of work related to the topic of the article.

The Agencies’ economic cost-benefit analyses should include estimates of the costs to property owners, communities, governments, taxpayers, and health care insurers associated with replacing the ecosystem services provided by wetlands and headwater streams that would be unprotected with the repeal of the 2015 CWR. These costs include those for the construction and operation of additional water quality treatment, water storage, and flood control facilities and infrastructure, increased health care costs, and increased reconstruction and repair costs associated with higher levels of flood and storm damage to properties, roads, and other infrastructure. Additionally, there would be a loss of revenues to private businesses, including many rural small businesses that benefit from fishing, hunting, boating, and other recreation industries that are dependent upon clean and plentiful waters and the wetlands that sustain them.

Comment #4: The Agencies should provide valid and substantive documentation of the commitment of state agencies to take on wetland protection that would be lost should the 2015 CWR be rescinded, and this documentation should be subject to a robust peer review and public comment process.

The Agencies assert that rescinding the 2015 CWR is justified because states will protect wetlands through state wetland protection programs. States have had the option to assume responsibility for the Section 404 permit program since the Clean Water Act (CWA) passed in 1972, yet only two states have chosen to do so. An additional 21 states have some type of dredge-and-fill permit program, many of which rely on federal grant funding and collaboration⁶. The majority of states rely on the technical and financial support of the federal government in administering wetlands protection policies, and thus are not likely to have the capacity or the inclination to take on wetland protection in the absence of federal protection, which would lead to loss of the economic, ecological, and public health and safety benefits discussed in the preceding paragraph and elsewhere in this letter. Furthermore, the current US Administration has proposed drastic reductions to the EPA budget, which would result in diminished federal financial support of state wetland programs. The reduction of federal financial support must also be considered when evaluating the capability of state programs.

Comment #5: We urge that the current 60-day comment period for the proposed rescinding of the 2015 CWR be extended for an additional six months, so that our members, and other stakeholders directly impacted by the proposed rule to rescind, have sufficient time to submit comments.

Americans submitted over 1.1 million comments on the 2015 CWR, and over 90% were in support of the 2015 CWR and protection of our nation's wetlands and waters. The 2015 CWR underwent an extensive stakeholder process, involving over 400 meetings with small business owners, farmers, energy companies, states, counties, municipalities, other federal agencies, sportsmen, conservation groups and environmental organizations, and a public comment period that lasted for over 200 days. The broad public support for the 2015 CWR should not be overridden by an unduly foreshortened comment period and limited stakeholder process.

Considering the critical functions of our nation's wetlands and headwater streams in providing a broad suite of ecosystem services to society and the costs associated with replacing those ecosystem services, the far-reaching implications for fish, wildlife, and their habitat from rescinding the 2015 CWR, and the robust public participation in developing the 2015 CWR, we urge the EPA and the Army Corps of Engineers to either **withdraw the proposed rule to rescind the 2015 CWR and reaffirm the 2015 CWR**, or to develop a revised rule that is as scientifically, legally, and ecologically robust as the 2015 CWR, and that is supported by an economic analysis that incorporates valuation of ecosystem services provided by WOTUS as defined in the 2015 CWR, so that the concerns and interests of American citizens, businesses, communities, and the approximately 200,000 members of our societies are addressed.

Sincerely,

Douglas J. Austen, Executive Director
American Fisheries Society



Robert R. Twilley, President
Coastal and Estuarine Research Federation



Robert Gropp, Ph.D., Co-Executive Director
American Institute for Biological Sciences



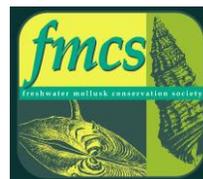
Katherine S. McCarter, Executive Director
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Linda Duguay, President
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Heidi Dunn, President
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Erin Dunlop, President
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Bethanie Walder, Executive Director
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Frank Wilhelm, President
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Colden Baxter, President
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Timothy A. Nelson, President
Phycological Society of America



Arnold van der Valk, President
Society of Wetland Scientists



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The American Fisheries Society • American Institute of Biological Sciences • Association for the Sciences of Limnology and Oceanography • Coastal and Estuarine Research Federation • Ecological Society of America • Freshwater Mollusk Conservation Society • International Association for Great Lakes Research • North American Lake Management Society • Phycological Society of America • Society for Ecological Restoration • Society for Freshwater Science • Society of Wetland Scientists

November 20, 2017

The Honorable Scott Pruitt
Administrator
U.S. Environmental Protection Agency
Office of Policy Regulatory Reform
Mail Code 1803A
1200 Pennsylvania Ave NW
Washington, DC 20460

The Honorable Ryan A. Fisher
Acting Assistant Secretary of the Army for Civil Works
Office of the Assistant Secretary of the Army for Civil Works
Department of the Army
104 Army Pentagon
Washington, DC 20310-0104

Re: Docket ID No. EPA-HQ-OW-2017-0480; Proposed Rule: Definition of “Waters of the United States: Pre-proposal Outreach Comments”

Dear Administrator Pruitt and Mr. Fisher:

On behalf of our nearly 200,000 members, the undersigned science societies respectfully submit the following comments in response to your solicitation regarding the proposed rule, Definition of “Waters of the United States” - Pre-proposal Outreach Comments, EPA-HQ-OW-2017-0480, published in the Federal Register on August 28, 2017. The undersigned societies are science-based organizations with diverse areas of expertise in the ecological, hydrologic and biological sciences. Our members work in the private sector, academia, and various tribal, state and federal agencies. We support wetland and aquatic resource research, education, restoration and sustainable management, and foster sound science. Thus, we promote science-based policy-making for the benefit of aquatic resources and the goods and services these resources supply in support of the health and economy of local communities.

We fully support the definition of “Waters of the United States” (WOTUS) in the 2015 Clean Water Rule: Definition of Waters of the United States as promulgated by the agencies in 80 FR 37054, June 29, 2015 (2015 CWR). **We strongly oppose the repeal of the 2015 CWR rule and vehemently object to a definition of WOTUS based on Justice Antonin Scalia’s plurality opinion in *Rapanos v. United States*, 547 U.S. 715 (2006).** In *Rapanos*, Justice Scalia asserted that the “only plausible interpretation [of WOTUS] includes only those relatively permanent, standing or continuously flowing bodies of water ‘forming geographic features’ that are described in ordinary parlance as ‘streams[,] ... oceans, rivers, [and] lakes’ [and] *only* those wetlands with a continuous surface connection to bodies

that are 'waters of the United States' in their own right, so that there is no clear demarcation between 'waters' and wetlands, are 'adjacent to' such waters and covered by the Act." (Justice Scalia Opinion).

The proposed redefinition of WOTUS based on the Justice Scalia Opinion would make it impossible to achieve the objective of the Clean Water Act (CWA), which is, "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." (33 U.S.C. 1251, Sec 101(a)). Such a definition would exclude numerous waters that affect the chemical, physical and biological integrity of primary waters (traditional navigable waters, interstate waters, and the territorial sea). The proposed redefinition based on the Justice Scalia Opinion reflects a fundamental misunderstanding of the integral role that headwaters, tributaries, and wetlands play in the chemical, physical and biological integrity of the downstream primary waters. Such a definition appears to ignore the functional relationship between headwaters, tributaries, wetlands, and the downstream primary waters that they feed and support, as well as the functional objective of the CWA itself. Excluding the hydrological and ecological function of wetlands and waters that support primary waters poses a significant threat to the integrity and security of our drinking water, public health, fisheries, and wildlife habitat, while significantly increasing the risks and costs associated with flood and storm damage. Limiting jurisdiction of the CWA to tributaries and wetlands that are "relatively permanent" and/or have a "continuous surface connection" to primary waters is unreasonable in light of the scientific literature and current knowledge. **This definition is simply unsupported by the peer-reviewed science.**

Further, the CWA states, "it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985." Should headwaters, wetlands and tributaries with a significant nexus, but not necessarily a continuous surface connection, to primary waters lose protection, pollutant levels will increase and will, more often than not, flow or seep into the downstream/downgradient primary waters. In this provision, **the CWA requires that the "discharge" of pollutants be eliminated, and does not distinguish among the various points at which the pollutants may potentially enter the source waters, as: a) flow from a primary water, b) flow from an intermittent, headwater, or tributary water, or c) unchanneled seepage from a wetland.** In any of these situations, the result is potentially wide-spread pollution of navigable waters, which violates the Clean Water Act.

Headwaters, tributaries, and wetlands with a significant nexus to primary waters transfer the nutrients, pollutants, oxygen, minerals, sediments, fish and other biota that they are carrying to the downstream/downgradient primary waters in much the same way that capillaries, lesser blood vessels, and peripheral organs contribute to the functioning of the heart and brain. Maintaining the chemical, physical and biological integrity of organs receiving blood flow from peripheral regions of the body is not possible if these peripheral features are significantly compromised or polluted. In both cases, the overall health of the human body or the primary water body is damaged or lost if the peripheral features are unprotected from significant damage or pollution.

We are extremely concerned about the implications of a definition of WOTUS based on a Justice Scalia Opinion, because this would likely exclude most wetlands that are currently regulated, as well as those with a significant nexus to primary waters that would be regulated under the 2015 CWR. Such a definition relies on an artificial visual characteristic that is unrelated to the functional connection between waters and wetlands with a "significant nexus" (i.e., functional connection) to primary waters, and is equally unrelated to achievement of the objectives of the CWA. Countless headwater streams, tributaries and millions of prairie pothole and vernal pool wetlands across the country would be unprotected. Many, if not most, forested, shrub/scrub, peatland and marsh wetlands are not continuously connected to relatively permanent or continuously flowing bodies of water and

would not be protected. **Even some iconic waters and wetlands would be excluded from jurisdiction under such a definition including:**

- the iconic Big Cypress Swamp in the Western Everglades,
Parts of:
 - the Okefenokee Swamp in Georgia and Florida,
 - wetland permafrost areas in Alaska,
 - the patterned peatlands in Minnesota such as those in the Lake Agassiz Lowlands,
 - the Atchafalaya Swamp in Louisiana, and
 - the Hockomock Swamp in Massachusetts.

The economic and public health and safety value of the ecosystem services provided by these waters and wetlands cannot be overestimated. Protection of the integrity and function of wetlands and headwaters greatly reduces both risks and costs.

In states that have no state wetland protection laws, these “waters and wetlands that safeguard the chemical, physical and biological integrity of the Nation’s waters” would be unprotected at both the federal and state levels. **Before implementing any new WOTUS definition, we urge the agencies to fully evaluate the impact of such a change at the state level, and the capacity and willingness of states to take on responsibility for ensuring that the chemical, physical and biological integrity of the Nation’s waters is not compromised¹.**

The 2015 CWR was supported by peer-reviewed science and evidentiary analysis, and was subject to rigorous independent peer review and a robust public comment process. We urge you to conduct a similar process for any new definition of WOTUS. Additionally, **any new definition of WOTUS should be consistent with, and supported by, the scientific evidence**, documented in the EPA’s *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence* report², which underwent external peer review by the EPA Science Advisory Board, and incorporates results from over 1,200 peer-reviewed scientific publications. Any new WOTUS definition should also be consistent with scientific evidence presented in the Brief of the *Amici Curiae* in Support of Respondents and in Support of Upholding the Clean Water Rule³, filed with the U.S. Court of Appeals for the Sixth Circuit, as well as numerous peer-reviewed studies (e.g., Golden et al. 2017)⁴, agency experience and U.S. Supreme Court precedent. **Any new definition of WOTUS should be supported by a complete and scientifically valid economic analysis**, like the one conducted for the 2015 CWR, and as supported by the numerous economic studies referenced at the end of this letter⁵.

Wetlands sustain essential habitat for fish, wildlife and waterfowl to feed, breed, nest, spawn, and rear their young. The areas comprising our nation’s wetlands have been reduced by over 50% over the past 200 years and now cover a small portion of our landscapes (<6% of the land area in the lower 48 states), but they play a disproportionately significant role in protecting our nation’s waters.

Wetlands, headwater streams and tributaries provide vital services that promote human health and safety, and support American businesses. These essential components of our hydrologic networks improve water quality in our streams, lakes, and groundwater by naturally cleansing surface waters, including urban, mining, timber harvesting and agricultural runoff; they also provide stored water during drought, and absorb stormwater runoff and floodwaters, reducing disaster recovery costs. A 2016 study (Narayan et al. 2016)⁶ found that coastal wetlands prevented \$625 million in property damages during Hurricane Sandy, and that coastal wetlands reduced annual property damages in Ocean County, New

Jersey by nearly 20%. Many of the stream and wetland resources that provide these economic benefits would not be protected under the definition of WOTUS in the Judge Scalia Opinion.

Should the agencies decide to move forward in developing a new definition of WOTUS, we urge you to include headwaters, tributaries and wetlands with a significant nexus to primary waters (i.e., those covered by the 2015 CWR) even if they do not exhibit a continuous surface connection to primary waters. The protection of water quality, water supply, and aquatic ecosystem health, the prevention of storm, flood, property, and infrastructure damage, and the protection of the chemical, physical, and biological integrity of WOTUS will be jeopardized without the protection afforded by headwaters, tributaries, wetlands (including some isolated wetlands), and adjacent waters as outlined in the 2015 CWR. A definition of WOTUS that provides more limited protection of wetland and aquatic resources than those identified in the 2015 CWR would lead to incomplete achievement of the CWA mandate, as noted in this comment letter, with costly and significant negative consequences for American citizens, businesses, and communities, as they experience deteriorated water quality, more limited water supplies, more severe flood and storm damage to properties and infrastructure, reduced fisheries, reduced recreational activities supporting American businesses, and degraded ecosystem and wildlife habitat conditions. Compensation for losses as well as any restoration of these ecosystem services will result in significant financial costs to our citizens and our nation, which we can ill afford.

Considering the critical functions of our nation's wetlands, headwater streams and tributaries in providing a broad suite of ecosystem services to society and the costs associated with replacing those ecosystem services, as well as the far-reaching implications for fish, wildlife, and their habitat from redefining WOTUS based on the Justice Scalia Opinion or similar narrow definition, we urge the EPA and the Army Corps of Engineers to either **reaffirm the existing 2015 CWR, or to develop a WOTUS definition and associated revised rule that is as scientifically, legally, economically and ecologically robust as the 2015 CWR** so that the concerns and interests of American citizens, businesses, communities, and the approximately 200,000 members of our societies are addressed.

Sincerely,

Douglas J. Austen, Executive Director
American Fisheries Society



Robert Gropp, Ph.D., Co-Executive Director
American Institute for Biological Sciences



Linda Duguay, President
Association for the Sciences of Limnology
and Oceanography



Heidi Dunn, President
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