

Testimony to the U.S. House of Representatives, Natural Resources Subcommittee on Energy and Mineral Resources in support of a bill for the Authorization of the National Climate Adaptation Science Center

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Good afternoon, Chairman Lowenthal, Ranking Member Stauber, and members of the subcommittee.

My name is Douglas Austen and I am the Executive Director of the American Fisheries Society. AFS is the oldest and largest organization of fisheries professionals in the world. We work 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. I have been in the fisheries field for over 40 years including with the U.S. Fish and Wildlife Service, as executive director of the Pennsylvania Fish and Boat Commission, and with the Illinois Department of Natural Resources and Illinois Natural History Survey.

On behalf of AFS and our 7,500 members, thank you for the honor of testifying in support of the Climate Adaptation Science Center Act.

Climate change is creating new and constantly evolving challenges for fish and wildlife across the Nation. The USGS National and Regional Climate Adaptation Science Centers (CASCs) address these challenges by partnering scientists with natural and cultural resource managers. This results in actionable science to help fish, wildlife, waters, lands, and people across the country meet the challenges of these changing conditions.

During 2016-2018, AFS and Cornell University completed the first five-year reviews of each of the regional CASCs. After organizing and co-leading these reviews, I can say without reservation, that the CASCs are serving the needs of their partners. They are producing high-quality, actionable science, and making climate science usable for on-the-ground resource managers. Clearly the good work of the CASCs meets critical management needs that will only be magnified by the continuing challenges of climate change.

Fishes are especially threatened by climate change. Currently, forty percent of freshwater fish species in North America are imperiled due to pollution, habitat loss, water withdrawals, invasive species, and other impacts. Climate change is compounding these challenges and will continue to do so. In the U.S., the value of our fisheries is substantial. Approximately 50 million American go fishing every year and generate about \$52 Billion in retail sales and support more

than 826,000 jobs¹ When commercial fisheries are added, the total value of sales increases to \$238 Billion and supports over 1.7 million jobs²

Recognizing the existential threat of climate change to fish and fisheries, AFS in partnership with 111 aquatic science organizations worldwide, released a “Statement of World Aquatic Scientific Societies on the Need to Take Urgent Action against Human-Caused Climate Change, Based on Scientific Evidence” ([Attached](#)). The extent and diversity of impacts upon fisheries underscore the need to significantly cut greenhouse gas emissions to address the root causes of climate change. This also reinforces the importance of providing resource managers with tools to address the very real impacts that are already challenging the sustainability of fish and wildlife.

While my focus is on fishes and fisheries, climate change affects all species. With 12,000 species across all taxa in the U.S. already in need of conservation, and many more sliding towards imperilment, natural resource managers will need many tools to address the fish and wildlife crisis that is compounded by climate change. One of these key tools will be the Recovering America’s Wildlife Act, a bill that will provide dedicated, proactive funding for states and tribes to implement their science-based State Wildlife Action Plans. We thank the House Natural Resources Committee for the bi-partisan mark-up on that bill last month.

One brief example helps to illustrate how the CASCs work with the states in developing these Plans.

While preparing for the congressionally required State Wildlife Action Plan revisions in 2015, the Northeast states, from Maine to Virginia, including my home state of Pennsylvania, requested assistance from the Northeast CASC to compile and review data and adaptation strategies for use in these important documents. The Northeast CASC provided crucial support by synthesizing the most current science, offering technical support, and providing guidance that was essential to incorporate climate change into each state’s Plan. CASC involvement allowed the states to better understand climate change challenges like sea level rise, changing water temperatures, and species movement within a regional context. The result was targeted, coordinated conservation for Species of Greatest Conservation Need across the region. The Northeast CASC continues to provide important technical support for states as they work toward the next revisions of their state plans. It is important to note that these states would not have otherwise had access to this kind of applied, actionable science capacity with the Northeast CASC.

The need for climate data compilation, synthesis, and analysis will only increase. The external reviews made it strikingly clear that there is an extensive unmet information need among

¹ Sportfishing in America: A Reliable Economic Force. Produced for the American Sportfishing Association by Southwick Associates via Multistate Grant #F20AP00183 awarded by the Wildlife and Sport Fish Restoration Programs of the U.S. Fish and Wildlife Service. 2020.

² National Marine Fisheries Service. 2021. Fisheries Economics of the United States, 2018. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-225, 246 p.

natural and cultural resource managers across the nation. The stakeholder needs are already outpacing the capacity of the CASCs to provide crucial science support, data delivery, community engagement, and workforce development required for adapting to our changing climate. Indeed, many natural resource managers rely on the CASCs for the science to drive their management decisions in the face of climate change.

Another key role of the CASCs is developing the next generation of scientists and resource managers. Over the past decade, CASC-affiliated universities have taught cutting-edge climate-adaptation science, stakeholder engagement, and communication skills to hundreds of graduate students and postdoctoral fellows. The CASCs play a critical role in developing the workforce that will address the complex and multidisciplinary challenges that climate change is and will continue to have on our fish and wildlife resources.

Finally, successful collaborative science requires trust and mutual respect between scientists and managers. The CASC Act will provide the funding and administrative certainty necessary to develop and maintain enduring, productive relationships, leading to more timely and actionable science.

The science, data, and tools that the CASCs provide help to conserve and manage wildlife and their habitats. This actionable science will help protect water supplies, critical ecosystem services like flood attenuation, and clean water. Their essential work will help to maintain our cherished traditions like hunting and fishing.

Respectfully, I encourage you to support and pass the Climate Adaptation Science Center Act.

Thank you again for the opportunity to testify.

Statement of World Aquatic Scientific Societies on the Need to Take Urgent Action against Human-Caused Climate Change, Based on Scientific Evidence

For the full statement, including citations, please go to <https://climate.fisheries.org/world-climate-statement/>

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American Fisheries Society (AFS) • American Institute of Fishery Research Biologists
American Society of Ichthyologists and Herpetologists • American Water Resources Association
Asian Fisheries Society • Asociación de Oceanólogos de México, A.C.
Asociación Internacional de Hidrogeólogos - Mexico Chapter
Asociația Română de Limnogeografie (Romanian Limnogeographical Association)
Association Française de Limnologie / French Limnological Association [EFFS member*]
Associazione Italiana di Oceanologia e Limnologia [EFFS member*] • Australian Coral Reef Society
The Australian Freshwater Sciences Society • Australian Marine Sciences Association
Australian Meteorological and Oceanographic Society • Australian Society for Fish Biology • BirdLife Australia
Blue Ventures • The Brazilian Society of Ichthyology • British Phycological Society
Canadian Aquatic Resources Section (CARS) of AFS • Canadian Centre for Evidence-based Conservation
Canadian Conference for Fisheries Research • Canadian Society of Zoologists
Coastal & Estuarine Research Federation • Coastal Research and Education Society of Long Island (CRESLI)
The Coastal Society • Community of Arran Seabed Trust • Conchological Society of Great Britain and Ireland
Croatian Association of Freshwater Ecologists (CAFÉ, HUSEK) [EFFS member]
Czech Limnological Society [EFFS member*] • Deep Ocean Stewardship Initiative (Climate and Fisheries WG)
Desert Fishes Council • EFYR European Fresh and Young Scientists [EFFS member]
European Federation for Freshwater Sciences (EFFS) • Finnish Limnological Society [EFFS member]
Fisheries Society of the British Isles • The Freshwater Biological Association [EFFS member*]
Freshwater Fisheries Society of BC • Freshwater Mollusk Conservation Society • German Ichthyological Society
German Limnological Society (DGL) [EFFS member*] • Gilbert Ichthyological Society
Hungarian Hydrological Society [EFFS member] • Hydroecological Society of Ukraine
The Hydrographic Society of America • The Hydrozoan Society • Iberian Association of Limnology [EFFS member]
Ichthyological Society of Japan • Ichthyological Society of Ukraine • The Institute of Fisheries Management
International Association for Danube Research • International Association for Great Lakes Research (IAGLR)
International Association of Aquatic and Marine Science Libraries and Information Centers (IAMSLIC)
International Coral Reef Society • International Federation of Hydrographic Societies • International Peatland Society
International Phycological Society • International Seaweed Association • International Society of Limnology
International Water History Association • Irish Freshwater Sciences Association [EFFS member]
The Japanese Society of Fisheries Science • Lake Victoria Fisheries Association
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Malacological Society of London • Marine and Oceanographic Technology Network
The Marine Biological Association of India • Marine Biological Association of the United Kingdom
Marine Stewardship Council • National Association of Marine Laboratories (NAML)
Netherlands Malacological Society (Nederlandse Malacologische Vereniging)
The New Zealand Freshwater Sciences Society (NZFSS) • North American Lake Management Society
Oceania Chondrichthyan Society • Ocean Conservation Society • Philippine Association of Marine Science
Phycological Society of America • Polish Hydrobiological Society [EFFS member*] • Polish Limnological Society
Romanian Ecological Society [EFFS member] • Scientific Committee on Antarctic Research
Serbian Water Pollution Control Society SWPCS [EFFS member] • SIL Austria [EFFS member*]
Slovak Ichthyological Society • Slovak Limnological Society (SLS) [EFFS member*] • Sociedad Chilena de Limnología
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Sociedad Mexicana de Planctología A.C.
Sociedad Mexicana para el Estudio de los Florecimientos Algales Nocivos (SOMEFAN; Mexican Society for the Study of Harmful Algal Blooms) • Sociedade Brasileira de Carcinologia • Société Française d'Ichtyologie
Society for Conservation Biology Marine Policy Section • Society for Freshwater Science
The Society for Marine Mammalogy • Society for the Study of Amphibians and Reptiles
Society of Canadian Limnologists/Société canadienne de Limnologie (SC) • Society of Wetland Scientists

Water is the most important natural resource on Earth as it is vital for life. Aquatic ecosystems, freshwater or marine, provide multiple benefits to human society, such as provisioning of oxygen, food, drinking water, and genetic resources; regulation of atmospheric composition and climate; water purification; storm buffering; mitigation of floods/droughts; recreation areas, and other purposes. Our existence and well-being depend on the health and well-functioning of aquatic ecosystems. People naturally distribute around water—approximately 40% of the world's population lives within 100 km (62 mi) of a coast.¹

The world's aquatic resources are now under their greatest threat in human history. Human-caused climate change is accelerating the degradation of aquatic ecosystems and the services they provide. Aquatic ecosystems are among the most affected worldwide, e.g., in case of freshwater ecosystems, a biodiversity decline of 83% was recorded just between 1970 and 2014 while up to 90% of coral reefs will disappear by mid-century if the current trends continue.²

We, the world's aquatic scientists, spend our lives studying these systems. We see exceptional and disturbing changes in the world's aquatic ecosystems due to climate change, and believe that we must continue to share peer-reviewed scientific findings with the public and policymakers to emphasize the seriousness of this threat and the need for immediate action. For the first time, the assessment of global risks conducted by the World Economic Forum, ranked the impact of “climate action failure,” “biodiversity loss,” and “water crisis” among the top five risks over the next decade.³ In recent years, migration has increased and geopolitical tensions have been exacerbated: between 2008 and 2016, more than 20 million people per year have been forced to move due to extreme weather events, while according to the United Nations, in 2017, water was a major conflict factor in 45 countries.³ These negative effects are expected to increase under current climatic trends. For example, in the United States, the climate-related economic damage is estimated to reach 10% of the gross domestic product by the end of the century.³ In Europe, the minimum cost of not adapting to climate change is estimated at €100 billion per year in 2020 and €250 billion in 2050.⁴

Experts in environmental, social, and economic fields collectively point towards a severe environmental and humanitarian crisis, with repercussions at a global level, unless worldwide concerted climate actions are implemented urgently.

This document summarizes key scientific findings highlighting the effect of climate changes on aquatic ecosystems. These findings provide evidence of what effects are currently happening and why world policymakers and all of humankind need to act jointly and launch concerted actions now if they wish to mitigate these impacts.

The Challenge

- Thousands of peer-reviewed studies by scientists from authoritative institutions worldwide have documented evidence for climate effects on aquatic systems that are already occurring and are extensive.⁵

- Many globally respected sources, including the American Geophysical Union,⁶ National Academies of Science from dozens of countries,⁷ the Intergovernmental Panel on Climate Change,⁸ and the Fourth U.S. National Climate Assessment⁹ support findings that increased atmospheric concentrations of greenhouse gases from fossil fuels (i.e., emissions) and land use changes such as deforestation are driving current climate change.
- Many of these changes are and will be irreversible. They will continue to worsen if we persist on our current trajectory.¹⁰
- Impacts already occurring range from increased frequency, intensification, and severity of droughts, heat waves, floods, wildfires, and storms; melting glaciers; destabilization of major ice sheets; shifting ocean currents, rising sea level; ocean acidification and deoxygenation; shifts in species ranges, including expansion of alien-invasive species; aquatic plant and wildlife disease outbreaks; mass coral bleaching events; and more, with a mounting toll on vulnerable ecosystems, human societies, and local and global economies.¹¹
- These events are precursors of even more damages to fisheries, biodiversity, and human society at large.¹²
- Delaying action to stop underlying causes of climate change will increase the economic, environmental, and societal consequences.¹³
- If humanity wishes to avoid calamitous consequences for our aquatic ecosystems and humans that depend on them, the time to curb greenhouse gas emissions, sequester greenhouse gasses, and adapt to an already changing climate is now.¹⁴ Intelligent, rapid movement toward such goals will provide great benefits to aquatic ecosystems and the humans that depend on them.
- Rapid global response and large-scale actions are possible if public and government commitment exists.¹⁵

The Evidence: Effects on Marine Resources

- Shifts in species composition, behavior, abundance, and biomass production are now occurring.¹⁶
- Lobster,¹⁷ cod,¹⁸ mackerel,¹⁹ coral reef fishes,²⁰ and other species important to fisheries²¹ are either moving poleward to deeper waters or declining²²
- Coastal ecosystems are being transformed, degraded, or lost, either largely²³ or in part due to climate change, including seagrass meadows,²⁴ mangroves,²⁵ coral reefs,²⁶ and kelp forests.²⁷
- Effects of altered species compositions are affecting entire ecosystems.²⁸
- Carbon emissions cause global ocean acidification, which is affecting the survival of organisms, especially shellfish, and accelerating coral reef erosion.²⁹
- Rising frequency and intensity of marine heatwaves has been documented and is projected to continue.³⁰
- Reductions in global ocean dissolved oxygen concentrations have occurred over the past five decades.³¹
- Climate change is interacting with other stressors such as excess nutrient input,³² overharvesting,³³ and novel species interactions³⁴ to further suppress marine ecosystems.
- Climate change is linked to emerging and re-emerging disease outbreaks in marine wildlife and plant species.³⁵
- Global production of marine animals continues to decrease and shifts in species composition will increase unless greenhouse gas emissions are reduced.³⁶

- Seabirds are recognized as indicators of long-term environmental change: nearly three out of four of the world's seabirds have disappeared since 1950, and more than half the remaining species face substantial threats.³⁷ In North America alone, two-thirds (389/604) of bird species, which includes waterbirds, are moderately or highly vulnerable to climate change under a 3°C scenario.³⁸

The Evidence: Effects on Freshwater Resources

- Freshwater ecosystems are among the most threatened on Earth.³⁹
- Freshwater ecosystems cover less than 1% of the planet's surface but support one-third of vertebrate species and 10% of all species.⁴⁰
- The capacity of all freshwater ecosystems to adapt is relatively low given the nature of freshwater systems and the scale of impacts of climate change.⁴¹
- Climate change is altering abundance, predator–prey dynamics, expansion of invasive species, growth, recruitment of species, and novel species interactions, leading to declines in the number and diversity of freshwater aquatic organisms.⁴²
- Increased frequency, intensity, and length of drought are affecting the amount and quality of freshwater available for both aquatic ecosystems and humans.⁴³
- Climate change impacts on flow regimes, including both increased droughts and low-flow periods, and increased flooding impact native species with narrow ranges of flow requirements and allow expansion of alien-invasive species that affect recreational and commercial harvest of fishes and clog waterways.⁴⁴
- Geographic ranges of many plants and animals have moved poleward and to higher altitudes while alien-invasive species expand with the increasingly warm conditions.⁴⁵ Unlike marine systems, pathways to other habitats are often blocked, leading to localized extinctions.⁴⁶
- Temporal shifts in seasonal cues, such as spring runoff or monsoon seasons, affect spawning success of fish, resulting in poor survival.⁴⁷
- Higher incidence of wildfires is affecting aquatic systems by making watersheds more susceptible to flooding and by reducing water quality, especially with post-fire ash and sediment deposition.⁴⁸
- Wetlands capacity for carbon storage and mitigation of climate change are being damaged by changes linked to climate shifts and other components of global change, such as increased land development and fires.⁴⁹
- Higher temperatures and precipitation runoff have increased harmful algae blooms, which can hurt fish, mammals, birds, and even humans.⁵⁰
- Climate change may act synergistically with nutrients to magnify eutrophication and further degrade water quality and ecosystem services, including affecting drinking water.⁵¹
- Organisms dependent on snow melt and glacial streams are declining or shifting their distribution.⁵²
- Release of heavy metals such as mercury, currently stored in glaciers and the permafrost, is projected to further affect freshwater organisms.⁵³
- Climate change is linked to emerging and re-emerging disease outbreaks in freshwater wildlife and plant species.⁵⁴
- These seemingly diverse and small-scale changes combine to create multiple, cumulatively stressful challenges to aquatic species.⁵⁵

The Evidence: Effects on World Society Dependent on Aquatic Resources.

- Clean and sufficient water is needed by all life forms.
- Fisheries provide quality protein sources not easily replaced by terrestrial sources. According to the Food and Agriculture Organization of the United Nations, fish accounts for 17% of animal protein consumed globally, fishing and aquaculture directly employ almost 60 million people, and global trade in fish products has reached US\$152 billion per year, with 54% originating in developing countries.⁵⁶
- In the short term, new fisheries are appearing in some newly formed ice-free areas⁵⁷; however, overall fisheries catch is projected to decline related to increasing declines in water quality and primary production as a result of climate change, with corresponding effects on food security.⁵⁸ Ocean warming and changes in primary productivity are related to changes in many fish stocks. Fish population reestablishment has declined 3% per decade, and maximum catch potential declined 4.1% over the 20th century.⁵⁹ Water temperature increases due to climate change are projected to exceed the tolerance limits of 10–60% of freshwater and marine species by 2100, depending on the amount of greenhouse gas emissions allowed.⁶⁰
- Climate change impacts on aquatic ecosystems are affecting incomes, food security, key cultural dimensions, and livelihoods of resource-dependent communities.⁶¹
- Species shifts are affecting traditional fisheries from the tropics to the polar regions through reduced access to fish stocks, fishing areas, and loss of local knowledge.⁶²
- Climate change compounds the impact of other practices such as pollution, overfishing, and unsustainable coastal development. These combined impacts are projected to drive many small-scale fisheries and economies out of existence.⁶³
- Warming of waters affects seafood safety through elevated bioaccumulation of heavy metals and pollutants and an increased prevalence of waterborne pathogens affecting both human and animal health.⁶⁴
- Tourism and tourist sites are being affected in many areas that are dependent on local ecosystems. Sustainable diving, snorkeling, angling, marine mammal and bird watching, and other recreational activities and businesses depend on maintenance of healthy aquatic resources.⁶⁵
- Climate change degrades coastal ecosystems such as mangroves, sea grasses, marshes, peatlands, and coral reefs that provide services to humans such as protecting coasts from erosion, storms, and flooding, providing key wildlife habitat and sequestering carbon.⁶⁶
- Climate change damages riparian ecosystems that provide services to humans, such as protecting streams from flooding, intercepting pollutants, reducing erosion, providing shade and wildlife habitat, sequestering carbon, and storing water during high-flow events.⁶⁷
- Climate change contributes to harming wetlands, which provide many of the same services to humans, as stated above. Wetlands play a critical role in carbon storage and sequestration. In particular, peatlands, despite occupying on 3% of the land surface, store *twice* as much carbon as the world's forests.⁶⁸
- The level of impacts will be governed by the level of protective limits our nations place on future emissions combined with riparian and coastal zoning, and changes in fisheries management practices.⁶⁹

The Needed Responses

- We assert that rapid action is necessary to drastically curb release of greenhouse gas emissions and to remove and store CO₂ from the atmosphere to prevent the most calamitous consequences of human-caused climate change to marine and freshwater ecosystems on which all humankind depends.
- Global and national targets are necessary to protect and restore carbon dense ecosystems, such as peat, sea grasses, and other wetlands to sequester carbon, prevent greenhouse gas emissions, and reduce the impacts of climate change.
- Governments, the public, industry, academia, and all other sectors of society must prioritize actions and act in a concerted way to halt human-caused climate change if they are to prevent dire consequences.
- A rapid transition towards energy sources and other products and services that do not release greenhouse gases, and research and policies that favor an efficient transition to a low carbon world is required to slow the degradation of aquatic systems, as above. Such a transition could be accomplished by all governments by immediately acting on the advice of specialists in green energy technology, carbon sequestration, marketing, education, socioeconomic principles, and related disciplines.
- Robust adaptation measures; identification and easing of other environmental stressors that act synergistically with climate change; and additional resources for data collection, mapping, and research to better understand potential impacts and to arm natural resources agencies with the tools to mitigate these impacts are essential to better understand and plan for changes in aquatic ecosystems.
- Done intelligently, movement to curtail human-caused climate change can result in advanced, novel technologies; strong economies; healthier aquatic ecosystems; greater food security; and human well-being.

It is time to acknowledge the urgent need to act to address climate change. Delaying action to control greenhouse gas emissions is not an option if humankind wishes to conserve the aquatic resources and environmental safety of the world.