

Future of the Nation's Fisheries and Aquatic Resources

The Challenges We Face in 2017 and Beyond



Presented by the American Fisheries Society

2016



What Are Fisheries?

Simply defined, a fishery is people catching or rearing fish. Fisheries also encompass our interactions with fish, including direct interactions such as seafood consumption, angling, and diving tourism along with indirect interactions like the effects of pollution, changes to habitat, and other human influences on aquatic ecosystems. Fisheries provide much needed protein and essential nutrients for the world's tables, as well as the opportunity to relax, recreate, and reconnect with the natural world. Fisheries also serve as an early warning system for the loss of clean water that we all need to survive. As the oldest, largest, and most influential collective of fisheries professionals in the world, AFS is dedicated to the science and polity of sustaining fisheries for the benefit of humankind.

This document represents a comprehensive set of considerations for the next presidential administration, created by AFS following several months of engaging with the fisheries and aquatic resources community to identify the principal issues affecting fisheries and aquatic resources. These are the issues that need to be addressed in 2017 by our new president.

All of these issues are important and are not necessarily presented in order of significance. Many of the areas of concern described herein are interrelated, but each is a significant, stand-alone subject that the next administration should address through proper engagement and investment in existing policies and programs and those still in development. All topics need to be evaluated appropriately, as determined by the prospects of influencing a fish-related decision.

The geographic extent of the topics covered within this report includes the contiguous United States, along with Alaska, Hawaii, and the U.S. territories. We do not discuss international jurisdictional issues that pertain to treaties or issues related to fisheries on the high seas.

After reading our document, you might wish we had added another topic or two—training the next generation of fisheries professionals, increasing diversity in fisheries staffs, or water quality. Those and other topics are reflected in our writing even if they are not among our 12 primary topics.

Through this document we invite you to learn more about the value of our Nation's fisheries and to appreciate the challenges faced by aquatic ecosystems. We urge you to understand the needs of fisheries conservation and to act in the interests of fisheries and the American people who rely upon them.

We also would like to thank all of the organizations that participated in this collaborative process. Our discussions with other organizations that work on aquatic resource and fisheries issues helped to provide a well-rounded set of recommendations, and we appreciate all of their efforts.

Thank you for reading this report. The American Fisheries Society (AFS) is the world's oldest and largest organization dedicated to strengthening the fisheries profession, advancing fisheries science, and conserving fisheries resources. AFS has more than 8,000 members around the world representing fisheries managers, biologists, ecologists, aquaculturists, economists, engineers, geneticists, and social scientists, along with industry, governments, academics, and other nonprofit organizations. Our mission is to promote science-based management of sustainable fisheries resources.

This document includes a set of issues that are affecting our Nation's fisheries and aquatic resources. Our Nation's fisheries face chronic and acute threats, and positive action is needed to reverse damage to aquatic resources and prevent future losses. The time to make the necessary improvements and take decisive action for our Nation's aquatic resources is now.

Our Nation's Valuable Fisheries and Aquatic Resources in a Changing World¹

Proven Benefits

- ◆ Fisheries are commercially, recreationally, ecologically, and culturally important resources that support and strengthen the U.S. economy and the American way of life. This is as true today as it was in previous centuries.
- ◆ There are approximately 60 million anglers in the United States, of which 46 million are estimated to fish in a given year, who generate US\$115 billion in annual economic output, providing \$15 billion in annual state and federal taxes and creating 828,000 jobs.
- ◆ Recreational fishing in the United States is mainly supported by license fees and excise taxes on materials used by anglers—a true “user pay–user benefit” system that is widely supported by the recreating public.
- ◆ Recreational angling resulting from National Fish Hatchery stocking programs has been estimated to annually generate approximately \$554 million in retail sales, \$903 million in industrial output, 8,000 jobs, \$256 million in wages and salaries, \$37 million in federal tax revenues, and \$35 million in local tax revenues.
- ◆ In 2014, domestic commercial catches and supporting seafood industries produced \$54 billion in annual sales and supported 811,000 jobs.
- ◆ The commercial value of U.S. fisheries from coral reefs is estimated to be more than \$100 million. Other geographically important areas like estuaries and wetlands also produce significant societal values.
- ◆ Shellfish and finfish culture operations around the Nation are vital to regional economies. Currently, there are 3,093 farms across the Nation providing \$1.4 billion in farm-gate (net value) income, creating significant and critical jobs and income for rural inland and coastal communities.
- ◆ In 2011, on-the-ground habitat restoration programs administered through the U.S. Fish and Wildlife Service (USFWS) to states created more than 3,900 jobs, generating a total economic stimulus of \$327.6 million.
- ◆ It is estimated that coastal restoration projects alone create more jobs (direct, indirect, and induced) per \$1 million invested than both oil and gas and road construction industries combined.

Areas at Risk

- ◆ Without adequate planning and built-in resiliency, aquatic systems are vulnerable and can lead to significant financial liabilities. For example, South Carolina's 2015 flood caused estimated damages of roughly \$1 billion to local economies, including fishing.
- ◆ Alaskan waters provided 60% (by volume) of seafood landed in the United States in 2014. Today, these same waters are experiencing rapid acidification, threatening some of the world's most productive fisheries and 70,000 jobs.
- ◆ Rising ocean temperatures are affecting the distribution and abundance of U.S. fish stocks: fish that are traditionally found in southern waters are being found in northern waters, and northern stocks are migrating even further north. These shifts are expected to increase in geographic extent and ecological implications, and may affect fishing in U.S. waters in the future.
- ◆ Coral reefs have a mutually beneficial relationship with algal communities that live in them and provide food for the coral. A slight increase in ocean temperature can sever this relationship, disrupting and damaging these natural wonders and biodiversity hotspots.
- ◆ More than 90% of the American seafood supply (by value) is imported, creating an annual trade deficit of \$11.2 billion.
- ◆ Trout habitat is projected to decline almost 50% in the western United States by 2080 due to climate change impacts.

Poor Conditions

- ◆ Throughout the Nation, the biological quality of our rivers and streams is in jeopardy. Between 27 and 50 percent of rivers and streams are in poor condition from chemical and physical habitat stressors, with 13,144 river miles containing fish that exceed the level of mercury within their tissue that is safe for human consumption.
- ◆ Each year, 1.2 trillion gallons of untreated sewage, storm water, and industrial waste are dumped into U.S. waters.
- ◆ There is a \$1.3 billion gap in annual funding needed to effectively implement state wildlife action plans.

¹ Information for this report was found through a process of examining the most recent government documents and websites, along with the most recent scientific journals and other publically available scientific information. References are available upon request or may be found at <http://fisheries.org/policy-media/future-of-the-nations-aquatic-resources/>.

Effective Fisheries Management

The need to encompass all factors which have an effect on our Nation's fisheries and aquatic resource drives the need for cross sector and interagency collaboration. Currently, issues are focused in "silos" or singly focused program areas. While this programmatic layout works well for distributing program funding, its functional improvement of our natural resources is limited. There is an essential need to break down silos and enable greater collaboration among resource conservation, management, and restoration programs found in several cabinet departments and many federal agencies.

Interagency communication is essential among federal agencies, between federal and state agencies, and between the United States and other sovereign entities. Interjurisdictional issues are common throughout natural resources management but are especially prominent in the fisheries and aquatic resources realm. Functional, cooperative federalism (the cooperative relationship between state and federal governments) is key to upholding international treaties and agreements and proper management of shared resources.

As managers continue to adapt to changing climate and habitat conditions affecting the range and condition of managed species, there is a need to provide ease and transparency within the management process. Dynamic ocean management,



or the use of near-real time data that guide the spatial distribution of commercial and other activities, has been shown to be effective at reducing bycatch and unintended species interactions in the New England region.

Large-scale regional approaches can yield great returns. The Mississippi River Basin Healthy Watersheds Initiative, administered by the U.S. Department of Agriculture's (USDA) Natural Resource Conservation Service, underscores the value of approaching freshwater resource conservation in partnership. Each of the

The Alaska Model

As illustrated by well-managed groundfish and other fisheries, the Alaskan model exemplifies proper management.

Alaskan fisheries management uses a balance of precautionary harvest strategies, careful monitoring and conservation of multispecies fish stocks, closures and gear restrictions to protect habitat, and ecosystem health indicators. This balance of management strategies has proven successful and has stakeholder approval. This model can be applied to other program areas around the country.

13 member states works with the federal government to provide funding for on-the-ground conservation projects to reduce the nonpoint source pollution that enters our waterways, while simultaneously making improvements to fish habitat.

Collaborative management is also needed to address conflicting uses of our aquatic resources. Commercial, recreational, and subsistence/aboriginal fisheries occur in many areas of our Nation, requiring dialog and inter-jurisdictional coordination to address issues of competing uses.



Action Items:

- Continue to support and strengthen cooperative federalism and its associated programs. There is a great need to enhance the state and federal partnership approach towards natural aquatic resource management through proper funding to the states, so they can implement their federally mandated programs.
- Ensure the continuation of a partnership process that includes a regular collaborative review of authorized purposes for many federal projects.
- Encourage collaborative, adaptive management planning, supported by the best available natural and social science, to address environmental issues.



For more information, go to www.fisheries.org

Angling and Fisheries Conservation

Whether it is to spend time with family and friends, for relaxation, or for sport, Americans enjoy fishing. A survey conducted by the U.S. Census Bureau in 2011 noted that there were 33.1 million sportspersons solely participating in fishing activities, in both freshwater and marine/coastal environments (27.5 million—freshwater, 8.9 million—saltwater). According to recent research by Southwick Associates, that number has grown to roughly 60 million anglers, of which 46 million are estimated to fish in a given year. Expenditures for fishing activities in 2011 totaled \$41.8 billion, with \$15.5 billion coming from equipment expenditures.

Overall, the economic impact of recreational angling cannot be overstated. Recreational fishing contributes \$115 billion in annual economic output, providing \$15 billion in annual state and federal taxes and creating 828,000 jobs.

A major nexus between federal and state governments, as well as federal and state fisheries managers, is the Sport Fish Restoration Program. Passed in 1950, the Dingell-Johnson Act authorized grant programs that provide funding, derived from an excise tax on fishing gears and equipment, for on-the-ground fisheries science and conservation programs. State fish and wildlife agencies use this funding for a wide variety of projects, including fisheries research and management, habitat protection, fishing access projects, hatchery operations, aquatic education, and public outreach initiatives. In 2016, the Sport Fish Restoration Program distributed just over \$360 million to states and territories. This program is only made possible with the participation of our anglers.

However, as shown in past surveys, recruitment for future anglers has been decreasing over the years. The U.S. Fish and Wildlife Service has data showing an overall declining

trend in angling “initiation” (people who take up fishing) from 53% in 1990 to 43% in 2010. The declining recruitment percentages are also accompanied by a decline

in angler participation due to many anglers advancing in age. These trends, along with decreased access to fishing opportunities, are troublesome for the recreational angling community. If our country is to sustain the level of conservation funding received through the Sport Fish Restoration Program, along with fishing license sale fees, there needs to be a dedicated effort to engage young people in outdoor recreational opportunities and to make angling a core component of those outreach activities.

Action Items:

- Ensure that angling is a component of outdoor recreation and education policies.
- Address the gaps in data collection programs, such as the Marine Recreational Information Program and the National Angler Expenditure Survey.
- Reauthorize the Sport Fish Restoration and Boating Trust Fund created by the Dingell-Johnson Act.
- Dedicate new streams of funding for fisheries conservation and science to fill the gap between fisheries conservation needs and the available funding through the Sport Fish Restoration Program (See *Blue Ribbon Panel on Sustaining Fish and Wildlife Resources* recommendation in Conservation Science Funding section).
- Make a dedicated effort to increase recreational angling opportunities and public use and enjoyment of aquatic resources, wherever possible.



For more information, go to www.fisheries.org

Climate-Related Impacts on Coastal and Marine Systems

Increased concentrations of atmospheric carbon dioxide levels and other consequences of human activity are contributing to global climate change, profoundly



altering our Nation's marine and coastal ecosystems and the communities that depend on them. Warming oceans, coastal inundation, changing water availability (coastal droughts, floods), ocean acidification, and other environmental changes affect the productivity, resilience, and value of marine resources. At risk are marine fisheries supporting \$214 billion in annual sales and

1.83 million jobs, as well as habitats that provide recreational opportunities, drive local tourism, support real estate values, and help protect coastal communities from storm surges and inundation.

To conserve and manage marine and coastal resources, reduce impacts, and increase resilience in a changing world, we need tools to assess current and future risks and integrate this information into climate-ready planning and informed decision making. For example, the NOAA (National Oceanic and Atmospheric Administration) Fisheries Climate Science Strategy identifies the seven key areas where additional information and tools are needed for effective fisheries management decisions with changing climate and ocean conditions.

Similarly, NOAA Fisheries is acting to better understand, prepare for, and respond to the consequences of a changing climate for marine species and the many people who depend on them. The NOAA Ocean Service's National Estuarine Research Reserve System and the Environmental Protection Agency's Climate Ready Estuaries program are building resiliency within coastal areas that are important nursery areas for young fish.

Adverse Economic Impacts

Coastal and island communities depend on marine ecosystems that contribute substantial value to our Nation's economy.

Recent coral bleaching events show how detrimental climate change impacts can be. The loss of our Nation's coral species could have significant negative impact to the ecosystem and local economies. A 2011 economic valuation of Hawaii's coral reefs estimated the total value to be close to \$34 billion annually.

Ocean acidification is impacting shellfish along the West Coast and crustaceans in the northern Atlantic region. Acidification threatens Washington State shellfish industry, valued at \$270 million in 2012, and the 3,000 jobs it supports. For crustaceans, Maine's lobster fishery alone contributes close to \$1.7 billion to the state's economy. Without a concerted effort to address these problems, increasingly serious economic consequences will result.

Protecting and restoring coastal habitats such as sea grass meadows, salt marshes, and mangroves help provide vital services such as storm protection and fisheries nursery areas. These vegetated coastal systems are also highly efficient sinks for "blue carbon," the carbon captured by the world's oceans. Their large contribution to global carbon sequestration can help reduce overall greenhouse gas levels and global warming.

Action Items:

- Incorporate coastal blue carbon into ecosystem services valuation within the National Environmental Policy Act process to ensure that the value of coral reefs and vegetated wetlands are taken into consideration.
- Continue to support NOAA's Regional Integrated Sciences and Assessments program, and define gaps in programmatic support and address these needs accordingly.
- Support and uphold the actions and recommendations put forward by the NOAA Fisheries Climate Science Strategy.
- Reauthorize and support the Federal Ocean Acidification Research and Monitoring Act, which provides funding for monitoring and research to improve our understanding of how ocean chemistry is changing.
- Continue and increase the NOAA Fisheries Ecosystem Resilience Grants to reduce impacts and increase resilience of coastal and marine resources and the people who depend on them.



For more information, go to www.fisheries.org

Climate-Related Resiliency for Inland Aquatic Systems

Like marine and coastal waters, inland waters and the people who live near them face significant challenges associated with climate change. The frequency and severity of weather events are increasing, as evidenced by recent severe flooding in Louisiana and Texas and severe drought in several western states.

The federal government is taking steps to combat the effects of climate change to make our ecosystems more resilient. The National Fish, Wildlife, and Plants Climate Adaptation Strategy is a set of goals and strategies to reduce climate change impacts on our communities. The resulting implementation of the strategy's recommendations shows that tribal, state, and federal agencies, along with nongovernmental partners have come together to reduce the effects of climate change on our Nation's living systems through on-the-ground projects such as improving salmon habitat on the upper Quinault River in Washington State.

Water supply and demand play a large role in building resilient aquatic systems. Empowering local, state, and regional entities to effectively balance their water budget is essential. While

Building Resiliency for Fish and the Economy

Lake Wichita in Wichita Falls, Texas was built in 1901, and fisheries habitat declines due to reservoir aging decimated the fish and wildlife resources. A holistic reservoir restoration plan, which includes watershed, wetland, and in-lake habitat, will provide healthy fish and wildlife populations and lay a foundation for an increased quality of life that supports the local economy.

Innovative methods have been included to make the lake more drought resistant and more resilient to climate change. A recent study estimated this project will provide 11,800 jobs and \$300 million in annual retail sales to the local economy while annually supporting 250,000 hours of recreational use.

flood control and water conservation historically meant construction of dams that fragment waterways and increase water loss through evaporation, modern management structures and approaches can maintain flow and proactively conserve wet meadows, riparian areas, floodplains, and wetlands. Existing res-

ervoirs can be improved to achieve similar goals and benefit surrounding communities. Similarly, the partnership between California and the federal govern-

ment shown in the mid-2016 release of the Delta Smelt Resiliency Strategy is a great example of federal–state cooperative effort to use best-available science to voluntarily improve conditions of a species that is negatively affected by drought.

Continuing to support programs that build resilient systems and adapt to our changing climate is essential for proper management of our Nation's aquatic resources.

Action Items:

- Make climate change adaptation a priority through programs included within the recommendations of the National Fish, Wildlife, and Plants Climate Adaptation Strategy, and advance projects beyond the implementation of the 232 projects that create resilient communities.
- Ensure that climate resiliency and climate adaptation language is inserted into all agency planning, capacity building, training, and infrastructure programs.
- Support NOAA's Integrated Water Prediction program to ensure the continuation of flood and drought forecasts.
- Support the use of natural landscape features, which allow for the endurance of hydrologic changes, such as flooding and droughts.
- Establish a Flood Control System Policy incorporating ecosystem services and an emphasis on functioning floodplains.
- Provide funding for schools in all grade levels to emphasize sustainability concepts such as living sustainably within the environment, along with the importance of carrying capacity.



For more information, go to www.fisheries.org

The Need for Advancements in Aquaculture

Aquaculture—the rearing of aquatic organisms for food, fisheries restoration, or for ornamental or other purposes—is a critical element of food security and natural resource management. About half of the seafood we eat comes from farms, and many wild fisheries would not exist as we know them without hatcheries.

Modern aquaculture is so diverse that it defies even the most basic of categorizations: more than 1,500 species of freshwater and marine, finfish, mollusks, crustaceans, reptiles, amphibians, and plants are raised in the United States in open water, land-based systems, and everything in between. More than 653 million pounds of seafood, valued at \$1.38 billion are produced by the U.S. aquaculture industry annually. An important strength for U.S. aquaculture is the diversity of species and life forms produced and marketed locally, regionally, national, and internationally. Unfortunately, the United States lags behind in the “blue revolution,” contributing only 1% to global aquaculture production.



More than 1.75 billion fish are produced and stocked annually in U.S. waters by state and federal natural resource agencies. These fish support commercial and recreational fishing opportunities, some of which would face collapse without these periodic influxes. These fisheries are significant contributors to the U.S. economy: American anglers contribute \$62 billion to gross domestic product. The estimated return on investment for federal production and stocking of catchable Rainbow

Trout is more than 36 to 1. Hatcheries contribute more than \$270 million to commercial salmon fisheries, with hatchery-origin fish making up about 40% of the salmon caught in Alaska and 80–90% in the Pacific Northwest. Hatchery-origin fish also help to fulfill tribal trust responsibilities and in the restoration of imperiled species. Hatcheries and commercial aquaculture may alleviate overfishing of wild stocks by providing acceptable alternatives.

Aquaculture also helps coastal fishing communities diversify their fisheries portfolios in response to changing ocean and marine resource conditions. The phrase “working waterfronts” used to mean fishing and processing alone;

today, aquaculture is an increasingly important means of sustaining fishing communities in the face of climate change, urbanization, and other challenges.

In addition to providing a secure source of food, aquaculture can also be used as a tool for habitat and fisheries species restoration. Oysters (and other bivalves) are filter feeders that clarify the water while capturing microscopic and particulate foods. Hatcheries have contributed to rebuilding native oyster populations, helping to improve water quality and habitat around the country, including the Chesapeake Bay and the Puget Sound, both of which are important fishery nurseries.

Action Items:

- Address the needs gap for the USDA’s Aquaculture Research and Extension program to achieve recommendations provided within the National Strategic Plan for Federal Aquaculture Research.
- Support the USDA Commercial Aquaculture Health Program Standards to enhance detection and response to disease in the U.S. aquaculture industry and facilitate international and interstate movement of healthy aquatic animals.
- Address unmet infrastructure and personnel needs within the USFWS’s National Fish Hatchery System, and provide for comparable investment in state hatcheries.
- Harmonize federal, state, and municipal regulation of commercial aquaculture, allowing for appropriate oversight of industry development while limiting economic burdens of compliance.
- Develop and implement simplified permitting processes that ensure environmentally sustainable aquaculture in marine and inland waters.

The Maine Leader

Nationally, aquaculture growth has been relatively flat; however, in Maine it has become an ever-growing business. Fish farmers in Maine are selling between \$50 million and \$100 million in aquaculture products annually.

Investments like the \$20 million grant from the National Science Foundation to the Aquaculture Research Institute at the University of Maine will help to improve aquaculture sustainability within the state by establishing a Sustainable Ecological Aquaculture Network.



For more information, go to www.fisheries.org

Medications for Aquaculture Programs

Public hatcheries and private aquaculture farms invest significant time and resources to prevent disease, emphasizing vigilance and proactive approaches to fish health management. When prevention is not enough, safe and effective medications are needed to treat common and emerging diseases. Aquatic animal drugs are essential tools used in the propagation of fish for the table, imperiled species recovery, creation of fishing opportunity, and fulfillment of tribal trust responsibilities.

The ability to apply timely, effective medication can mean the difference between losing a few fish and losing the production of an entire hatchery.

For example, treating bacterial infections in steelhead with Aquaflor (an approved drug) has been shown to reduce mortality from 35% or more to less than 5%. An estimated 20% of the 1.75 billion fish raised annually by federal or state agencies receive treatment—either to prevent damage to developing eggs or to treat an infection later in life—some time before they are stocked in public waters. Effective medications likely save at least 20% of fish that would otherwise succumb to common illnesses—a well-stocked medicine chest may save 68 million fish per year.

Stocking the medicine chest with safe and effective drugs means shepherding them through the U.S. Food and Drug Administration's (FDA) drug approval process, a process which typically takes 10–20 years and as much as \$40 million in research and development costs per drug. Legal access to aquatic animal medications is the result of intensive effort by a federal and state partnership to develop treatments and help drug companies to complete the approval process. Consis-



tent investment in aquatic animal drug research and development, commensurate with the importance of public and private aquaculture in the United States, is needed to address current and future fish health challenges.

Action Items:

- Provide sufficient staff and resource support for the FDA Aquatic Animal Drug Approval Partnership Program.
- Identify means of fulfilling the rigors of the FDA drug approval process while reducing the time and resources needed to satisfy requirements related to aquatic animal drugs.
- Support programs offering training in fish health to ensure workforce readiness in the veterinary and fisheries science communities and compliance with forthcoming regulations related to aquatic animal medicine.



For more information, go to www.fisheries.org

Conservation Science Funding

In the current fiscal climate, funding for research and conservation science is often cut in favor of other short-term projects. However, as President Reagan once said, “Our physical health, our social happiness, and our economic well-being will be sustained only by all of us working in partnership as thoughtful, effective

stewards of our natural resources.” To sustain our Nation’s aquatic resources, we must maintain, and in some cases increase, funding of essential conservation and research programs.

Environmental change often appears to be insignificant until a tipping point is reached, causing widespread environmental and economic damage. The information needed to effectively manage aquatic resources cannot be gathered in a handful of field seasons or even the span of a career. Long-term monitoring and “big data” programs such as the U.S. Geological Survey’s (USGS) National Hydrography Dataset, continuously compile critical data that allow for the effective targeting of restoration and protection projects throughout the country. Programs like these are investments that pay dividends over the long term that may exceed the short-term savings achieved by cutting budgets.

Creating dedicated funding streams for conservation science is essential if we wish to apply the best available science in

addressing natural resource issues. Aquatic resource science should also be prioritized within agency discretionary spending. Ocean science and research continue to drop as a priority item within funding structures and could benefit from the creation of an ocean trust fund. Additional resources are also urgently needed to increase the production, delivery, and use of climate-related information required to reduce impacts and increase the resilience of the Nation’s fish stocks and fisheries as called for in the NOAA Fisheries Climate Science Strategy and parallel efforts by other state and federal agencies.

Trusts such as the Land and Water Conservation Fund and Sportfish Restoration and Boating Trust Fund provide critical support for aquatic resource conservation, but needs have far exceeded available apportionments for years. These and other trusts need to be reauthorized and would benefit from additional appropriations or the creation of additional funding sources, as recommended by the bipartisan *Blue Ribbon Panel on Sustaining America’s Diverse Fish and Wildlife Resources*.



Action Items:

- Enact legislation recommended by the *Blue Ribbon Panel on Sustaining America’s Diverse Fish and Wildlife Resources* to create an additional \$1.3 billion in annual funding for the Wildlife Conservation Restoration Program from the revenue of energy and mineral development on federal lands and waters.
- As suggested by the Joint Ocean Commission, create a national ocean trust fund to provide additional sources of funding for ocean science and research projects.
- Provide an emphasis on support for increased, strategic delivery of fisheries and aquatic resource conservation through the National Fish and Wildlife Foundation’s National Wildlife and Fisheries Management program funding.
- Heighten critical research and development needs for the advancement of fisheries science through programs such as National Science Foundation grants, U.S. Forest Service (USFS) Research and Development program, USFWS Science Support program, USFWS Service Science program, USFWS Adaptive Science program, USGS Ecosystem—Fisheries program, and NOAA Fisheries Ecosystem Science programs and services, among others.
- Allow for increased restoration through elevated support of the Priority Watershed Restoration program within the USFS’s Watershed Condition Framework.
- Reverse the trend in declining federal support to bring research initiatives to fulfillment and meet the needs of the state, federal, and nongovernmental organization cooperators within the USGS Cooperative Fish and Wildlife Research Units.



For more information, go to www.fisheries.org

Management in Ecosystems Context

Management of our Nation's aquatic resources historically focused on a single sector or species, but modern management strategies include many interrelated factors. Ecosystem-based management is a widely accepted and actively implemented holistic approach to aquatic resource management.

In 2016, NOAA Fisheries released its Ecosystem-Based Fisheries Management Policy. The incorporation of these ideals into fishery management plans and fishery ecosystem plans will advance our efforts towards encompassing ecosystem values within management decisions. The National Ocean Policy's planning process, including the mid-2016 release of the Northeast Ocean Plan and Mid-Atlantic Ocean Plan, reflects significant progress. Fishery Management Councils are part of those regional ocean planning efforts and are applying an ecosystem context by including species low on the food web within certain management plans as species that need to be considered as a portion of the overall ecosystem.



A Tribal Example

In order to modernize the Columbia River Treaty, the Columbia River Tribes proposed the integration of ecosystem-based function operations into flood risk and hydropower management provisions of the treaty.

The ecosystem-based operations include adaptive management to address climate change, along with increased dry year flows and conditions for salmon and other fish and wildlife. It also includes recommendations for providing fish passage in watersheds that are blocked today but historically had significant fish populations.

Building partnerships is essential for an ecosystems approach. The USFWS Landscape Conservation Cooperative program builds partnerships throughout the country to benefit aquatic habitat. Through 22 different landscape conservation cooperatives, conservation professionals and scientists collaborate and share information to identify best practices that use an ecosystems approach to address pressing habitat issues. The National Fish Habitat Partnership (NFHP) also involves a wide array of stakeholders in partnerships. The NFHP provides leadership and continuing coordination to conserve fish and to build healthy aquatic systems. More on NFHP is discussed within the Habitat Protection and Restoration section.

Action Items:

- Support the National Ocean Policy and its respective planning process.
- Incorporate landscape and ecosystem considerations within management decisions.
- Support NOAA's Ecosystem-Based Solutions for Coastal Resilience program, which provides actionable intelligence for state and local decision makers.
- Provide additional support for the USDA Joint Chiefs' Landscape Partnership to increase conservation efforts beyond the existing 39 projects.
- Provide sufficient funding for the 20 new cross-boundary projects within the USFS Landscape Scale Restoration program, targeting priority areas within State Forest Action Plans.
- Support and advance the NOAA Fisheries Ecosystem-Based Fishery Management Policy.
- Continue to invest in the USFWS Landscape Conservation Cooperative program.
- Create a dedicated system to enhance interagency communication around specific aquatic resources issues, to help break down agency silos surrounding resource management.
- Fully fund the state-led, public-private National Fish Habitat Partnership.



For more information, go to www.fisheries.org

Imperiled Species

Changing climate, pollution, loss of habitat, invasive species, overfishing and other factors have contributed to aquatic species becoming threatened or endangered.

States Can Help with Sufficient Resources

A species that has been listed as endangered for 31 years but remains on the ESA list is the Tar River spiny mussel. Though very rare and known only to the Tar and Neuse River basins, this species provides essential ecosystem services in the form of water filtration. Excluding recent restocking by the U.S. Fish and Wildlife Service, many of the activities that would be necessary to recover the species fall outside of the federal government's implementation authority.

This is a prime example for state and local government intervention. However, given sparse resources and diverging priorities, no state or local government with jurisdiction has issued ordinances or regulations that have been adequate enough to protect the species from the effects of surrounding land uses on its habitat.

With proper coordination and adequate resources, the Tar River spiny mussel could serve as a gleaming example of cooperative management of our aquatic resources. Instead, the tiny bivalve species listed continues to be listed as endangered—for more than three decades.

plans after listing have been estimated to exceed the cost of protection plans implemented prior to reaching a listing threshold. Though not a panacea, early protection of habitat is a promising approach to preventing species declines and ESA listings.

Fortunately, progress continues in the fight to save species on the brink of extinction.

The Endangered Species Act (ESA) has been the primary vehicle for protecting imperiled species and has been successfully implemented in recovery. For example, the Oregon Chub, listed in 1993, was delisted in 2015 following a 20-year collaborative partnership to restore its historical habitat. The U.S. Fish and Wildlife Service Cooperative Endangered Species Conservation Fund invests in such public and private habitat conservation partnerships. Unfortunately, other cases are not as successful and the cost of listing a fish species and working towards its recovery continue to rise. In 2011, for example, West Coast populations of steelhead received \$263 million in funding, along with West Coast populations of Chinook Salmon receiving \$240.7 million, and each state has its own program with separate funding.

Given the immense challenge of recovering ESA-listed species, should more emphasis be paid to the protection of a species and its habitat prior to its need for listing? Interagency collaboration to establish habitat improvement and species management plans can be a useful alternative to recovery within the traditional ESA framework. The costs of critical habitat designation, land use restrictions, and preparation of species recovery

Listed species depend upon healthy ecosystems. A healthy ecosystem has a better chance of serving the needs of the listed and other species, including ourselves. State Wildlife Action Plans (SWAPs) provide clear roadmaps for the conservation of aquatic Species of Greatest Conservation Need and their habitats. Efficiently implemented SWAPs can significantly reduce the risk of ESA listing for many of these species. However, State Wildlife Grants fund only a fraction of on-the-ground conservation actions. Full implementation of SWAPs, as identified in the bipartisan *Blue Ribbon Panel on Sustaining America's Diverse Fish and Wildlife Resources* recommendations, is key to keeping common species common and reducing reliance on the ESA as the primary mechanism for conservation of at-risk species.



There is a continuing need for effective solutions in preventing listings and recovering populations of sensitive species.

Action items:

- Support the recent increased requests in funding for Cooperative Endangered Species Conservation Fund, providing resources to states and territories to implement conservation projects for listed and candidate species.
- Revise recovery criteria to ensure that the central points are quantitative and science-based.
- Examine the use of an “at-risk” category within ESA listings to incentivize voluntary conservation actions that may circumvent the need for a species to be listed as threatened or endangered.
- Identify and implement administrative and legislative strategies to fully fund SWAPs, including the *Blue Ribbon Panel on Sustaining America's Diverse Fish and Wildlife Resources* recommendations.



For more information, go to www.fisheries.org

Habitat Protection and Restoration

One of the main threats to our Nation's aquatic resources is habitat loss. Whether through water quality degradation from nonpoint source pollution or hydroconnectivity issues from the damming of streams or overpumping of groundwater, aquatic habitat is greatly degraded by unsustainable human use.



Fortunately, numerous programs focus on restoring and protecting our Nation's vital aquatic habitat. Many states self-fund local projects and establish habitat restoration and rehabilitation programs. Nebraska established an Aquatic Habitat Stamp in 1997 and

has collaborated with 63 different partners to fund \$59 million in aquatic rehabilitation efforts at 90 locations. Iowa dedicates \$2–12 million annually to a lake restoration program.

Through various public–private partnerships, state and federal governments coordinate with local and regional stakeholders to improve and protect the aquatic habitat. An example of effective collaboration can be seen within the NFHP, a program that was born in 2001 from efforts of the Sportfishing and Boating Partnership Council that coordinates efforts from 18 regional partnerships spread across the United States.

Dam removal projects and the installation of natural and nature-based features are only a small sampling of what can be done to restore our Nation's aquatic resources.

es. But the protection of these economically and ecologically vital resources is just as crucial and perhaps more cost-effective, especially in terms of water quality. As stated within the preamble of the Clean Water Act, it is our Nation's duty to “[r]estore and maintain the chemical, physical, and biological integrity of the [n]ation's waters.”

Fish diseases from water-quality-degrading pollution are wide ranging in both their effects and from their root cause. Various bacterial infections have diverging impacts on fish species, including, surface lesions, fin and tail rot, gill disease, vibriosis, and enteric redmouth (hemorrhaging of the mouth, fins, and eyes). The quality of



water is related to the survivability and spread of bacteria within our watersheds. High quantities of organic material, dissolved oxygen depletion, changes in water pH values all have an effect on bacterial populations within our waterways.

Endocrine disrupting pollution from various types of chemicals are another major concern within our Nation's fish populations. Changing the chemistry of the water has a dramatic effect on fisheries health.



Programs that help to provide habitat and species protection before restoration is needed can help to preserve our Nation's aquatic resource while also saving American taxpayers' money.

Action Items:

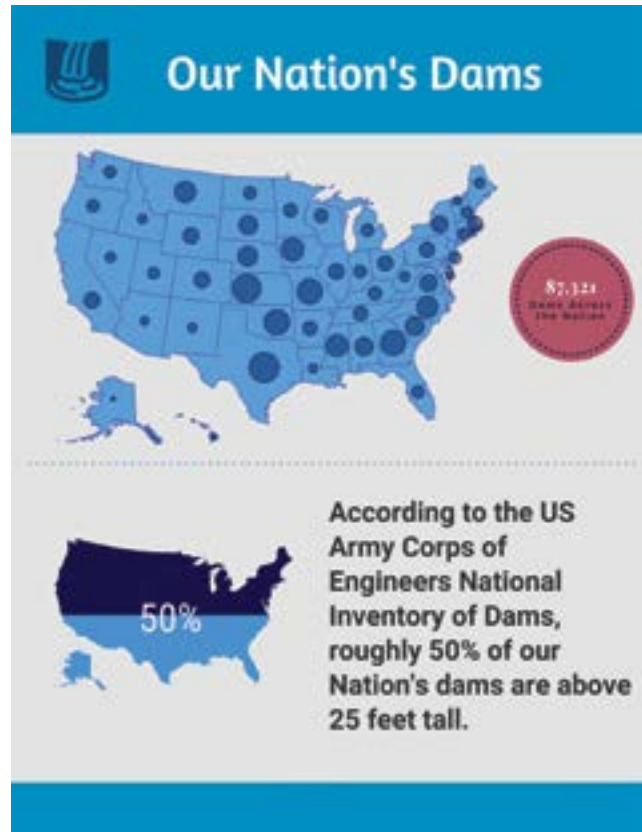
- Pass legislation to formally put into law the NFHP and support dedicated and sustainable funding for this program.
- Continue to make investments in and improvement to the Essential Fish Habitat provisions of the Magnuson–Stevens Fishery Conservation and Management Act.
- Advance similar programs to the Sage Grouse Initiative, which may circumvent the need for a species to be listed as threatened or endangered.
- Collaborate with state, regional, and local entities performing on-the-ground aquatic habitat restoration work.



For more information, go to www.fisheries.org

Hydroconnectivity

Our Nation's 2,110 watersheds are becoming increasingly fragmented. Dams have provided power generation, water storage and delivery, agricultural irrigation, and other human benefits, but at the cost of restricting access for migratory fish species to large segments of their native ranges. According to the National Inventory of Dams, there are 87,321 registered dams across the United States, nearly 44,000 of which are more than 25 feet tall. Many of these dams provide needed services to society, but others no longer serve a viable purpose. Accumulating sediment behind them impedes the transport of essential nutrients that support healthy riverine ecosystems as well as water levels that dictate the formation of riverine habitats essential to aquatic resources. Similarly, river fragmentation blunts large flood pulses that nourish our aquatic ecosystems. Where appropriate, allowing rivers to reconnect with their floodplains allows for the distribution of nutrients to riparian areas, allows fish to utilize valuable channel and floodplain habitats, and benefits these ecosystems in numerous other ways.



Dams are not the only impediments to fish movement. Roadways throughout the country have culverts and bridges that restrict or prevent fish from accessing their native streams. While cost considerations are usually the dominant factor in determining what types of culverts should be installed, accommodations (flow, water level) for fish migration can be aligned with plans to prevent structural damage to the infrastructure. Intense precipitation events, notably Hurricane Irene in 2011, cause culvert damage and failures and scour fish habitat. Planning for these future repair/replacement costs should incentivize the



construction of roadway crossings that are resilient to storms, as well as provide effective fish passage.

Diversion of historical stream flows and overuse of groundwater has threatened stream flows essential to maintain aquatic communities. Keeping instream flows sufficient for the propagation of aquatic resources is essential for fish and humans. The overuse of water from local streams for drinking water and irrigation impairs essential fish habitat and can dewater stream reaches, effectively cutting off migratory pathways.



Action Items:

- Make alternative sources of funding more readily available for stream passage restoration and dam removal projects (e.g., transportation funding, Farm Bill funding, etc.).
- Increase coordination between federal and state agencies, along with non-governmental organizations to determine where the greatest migratory fish impediments are, and how those watersheds can be restored.
- Ensure that effective fish passage is installed in all dams, using the most current and innovative technology.
- Use USGS gage station data to partner with states to help them protect base flows and water levels for aquatic natural resource management purposes.



For more information, go to www.fisheries.org

Invasive Species

Invasive species have been introduced to our waterways through navigation projects and discharge of ballast water from shipping vessels, illegal release or escapement, and intentional but ill-advised stockings by management authorities. According to the USGS's Non-indigenous Aquatic Species Database, the total number of introduced nonindigenous aquatic species in all categories is 1,158 and the total number of established species is 680. Collectively, invasive species have a dramatic effect on aquatic resources and, in turn, our wallets.



to difficulties such as technological infeasibility associated with implementing ballast water standards and the large geographic scope and scale of the problem.

Action Items:

- Rank aquatic invasive species prevention and control programs as a high priority and provide sufficient funds to implement state management plans.
- Where appropriate, remove impediments and encourage alternative approaches to invasive species eradication, such as the creation of commercial or recreational fisheries to exploit nonnative fish, without encouraging species to remain as a supported fishery (e.g. Asian carp).
- Sponsor technological advances to control ballast water introductions of nonnative organisms.
- Restore at least \$10,000 to each of the Regional Aquatic Nuisance Species Panels to bring them to the original \$50,000 in annual support that is authorized within the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990.
- Work with state and industry partners to provide additional support for the implementation of the Aquatic Nuisance Species Task Force Strategic Plan, including identifying and securing additional and dedicated sources of support for the Regional Panels.

The Great Lakes Have a Great Problem

The Great Lakes economy employs 125,000 people in the region in the fisheries, water treatment, power generation, and other sectors that use surface water. Great Lakes fisheries alone generate an estimated \$7 billion annually in economic activity. These economic drivers are greatly compromised by aquatic invasive species.

Zebra mussels have caused such widespread damage in the Great Lakes ecosystem that raw water users within the area pay roughly \$30 million a year for control and adaptation costs.

Overall, the actual cost of aquatic invasive species to the Great Lakes region is estimated to be well over \$100 million per year.

As a Nation, we must focus on preventing introduction of new invasive species and control of existing invasive species.

Introduced species could reduce diversity and abundance of native species through direct predation, alteration of food webs, habitat alteration, interbreeding with native species, introduction of diseases, and other interactions. Invasive species have contributed to the decline or interfere with the recovery of 42% of the federally endangered aquatic species. If an area is too inundated with invasive species, recovery to original conditions may not be possible, either because the restoration is not biologically feasible or because it is too costly. Overall, the costs from environmental damage and losses associated with invasive species add up to nearly \$120 billion per year.

Legislative and executive efforts have been enacted to limit introductions outside native ranges, including the Non-indigenous Aquatic Nuisance Prevention

and Control Act (1990), National Invasive Species Act (1996), and Executive Order 13112 – *Invasive Species* (1999). However, implementation has faltered due



For more information, go to www.fisheries.org

Publications

For a historical and more detailed scientific perspective on some of the action items listed, please reference the list of published books and reports by the American Fisheries Society.

Publications may also be found online at www.fisheries.org/books-journals.

- Fisher, N., P. LeBlanc, C. A. Rose, and B. Sadler, editors. 2015. Managing the impacts of human activities on fish habitat: the governance, practices, and science. American Fisheries Society, Symposium 78, Bethesda, Maryland.
- Murchie, K. J., and P. P. Daneshgar, editors. 2015. Mangroves as fish habitat. American Fisheries Society, Symposium 83, Bethesda, Maryland.
- Hubert, W. A., and M. C. Quist, editors. 2010. Inland fisheries management in North America, 3rd edition. American Fisheries Society, Bethesda, Maryland.
- McLaughlin, K. D., editor. 2007. Mitigating impacts of natural hazards on fishery ecosystems. American Fisheries Society, Symposium 64, Bethesda, Maryland.
- Brown, L. R., R. H. Gray, R. M. Hughes, and M. R. Meador, editors. 2005. Effects of urbanization on stream ecosystems. American Fisheries Society, Symposium 47, Bethesda, Maryland.
- Shipley, J. B., editor. 2004. Aquatic protected areas as fisheries management tools. American Fisheries Society, Symposium 42, Bethesda, Maryland.
- McGinn, N. A., editor. 2002. Fisheries in a changing climate. American Fisheries Society, Symposium 32, Bethesda, Maryland.
- Fuller, P. L., L. G. Nico, and J. D. Williams, editors. 1999. Nonindigenous fishes introduced into inland waters of the United States. American Fisheries Society, Special Publication 27, Bethesda, Maryland.
- Benson, N. G., editor. 1970. A century of fisheries in North America. American Fisheries Society, Special Publication 7, Bethesda, Maryland.
- Trushenski, J., L. Juarez, G. L. Jensen, M. Freeze, M. Schwarz, J. Silverstein, J. Bader, J. Rolland, and M. Rubino. 2012. AFS and aquaculture—addressing the high stakes of a sustainable seafood supply. *Fisheries* 37:390–396.
- Trushenski, J. T., and D. J. Maynard, organizers. 2015. Special section: hatcheries and management of aquatic resources (HaMAR), 7 papers. *North American Journal of Aquaculture* 77:327–422.

Photo Credits

Page 1 (front page), from top to bottom: Claire Fackler/NOAA Photo Library; Mandy Lindeberg/NOAA Photo Library; Kayt Jonsson/USFWS. Page 6: Roger Hewitt/NOAA Photo Library. Page 7, top to bottom: USFWS; NOAA Photo Library. Page 9, top to bottom: William Folsom/NOAA Photo Library; Jesse Jobs/USFWS. Page 10: Aleria Jensen/NOAA Photo Library. Page 11: Pablo Clemente-Colon/NOAA Photo Library. Page 12: NOAA Photo Library. Page 13: Albert E. Theberge/NOAA Photo Library. Page 14: Carla Stehr/NOAA Photo Library. Page 17, top to bottom: Julie Timmer/USFWS; Stephanie Raine/USFWS. Page 18, top to bottom: NOAA Photo Library; NOAA Photo Library. Page 19: Gary Peeples/USFWS. Page 20, top to bottom: NOAA Photo Library; NOAA Photo Library. Page 21: Kevin Lino/NOAA Photo Library. Page 23, clockwise from top: Olin Feuerbacher/USFWS; Katie Steiger-Meister/USFWS; Dan Cox/USFWS. Page 24: David Goodrich/NOAA Photo Library. Page 25, top to bottom: Ellen McVey/NOAA Photo Library; NOAA Photo Library. Page 26: USFS. Page 27, top to bottom: USFWS; USFS; Pete Fickenscher/NOAA Photo Library. Page 28: Steve Hillebrand/USFWS. Page 29, top to bottom: Marsha Skoczek/NOAA Photo Library; Amy Scaroni/NOAA Photo Library. Page 32 (back page), top to bottom: Jim Mogen/USFWS; USFWS; David Csepp/NOAA Photo Library.

We thank those who contributed to the development of this document in 2016

- January 20: Presented effort to the National Fish Habitat Board on conference call
- January 28: Presented to the Joint Implementation Working Group of the National Fish, Wildlife and Plants Climate Strategy in Washington, D.C.
- February 3: Submitted public comment during the Atlantic States Marine Fisheries Commission Executive Committee meeting in Alexandria, VA
- February 5: Presented to the Theodore Roosevelt Conservation Partnership Water Working Group
- February 9: In-person strategy meeting in Washington, D.C. The meeting included 15 aquatic resource specialist attendees representing federal and state interests, industry associations, and environmental groups
- February 10–11: Presented and held informal discussions at the Social Coast Forum in Charleston, SC
- February 11: Presented to the AFS Pennsylvania Chapter during their business meeting at their spring technical meeting
- February 18: Submitted public comment on the initiative at the 35th Coral Reef Task Force Meeting in Washington, D.C.
- February 19: Presented to the AFS Southern Division Meeting in Wheeling, WV
- February 23: Held informal discussions at the Coastal States Organization meeting in Washington, D.C.
- February 24: Presented to the NOAA Fisheries Council Coordination Committee meeting in Washington, D.C.
- March 14–18: Presented at the North American Fish and Wildlife Conference in Pittsburgh, PA, including a discussion session with staff from the Association of Fish and Wildlife Agencies
- March 20–24: Presented at the AFS Western Division annual meeting in Reno, NV
- April 3–5: Held informal discussions at the Northeast Fish and Wildlife Conference in Annapolis, MD
- April 6: Presented to the AFS Governing Board in Potomac, MD
- August 23: Presented at the AFS Annual Meeting in Kansas City, MO

