Before the House Subcommittee on Water Resources and Environment

Great Lakes Regional Collaboration Strategy

Can it be implemented to restore and protect the Great Lakes?

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Mr. Chairman, Members of the Subcommittee, I thank you for this opportunity to testify today on implementing the Great Lakes restoration and protection strategy. My name is Don Scavia. I am Professor of Natural Resources and Environment at the University of Michigan and Director of the Michigan Sea Grant program. I am also the science advisor to the Healing our Waters Great Lakes coalition steering committee. The coalition represents 85 national, regional, state, and local organizations, including Great Lakes conservation organizations such as the Alliance for the Great Lakes, Great Lakes United, and the Ohio Environmental Council; national conservation organizations like Ducks Unlimited, Trout Unlimited, the Sierra Club, and the Audubon Society; and educational institutions such as Shedd Aquarium and the Brookfield Zoo.

My testimony today focuses on four areas: 1) the need to act now to protect and restore these national treasures; 2) restoration and protection priorities identified by the scientific community in the white paper: "A Prescription for Great Lakes Ecosystem Protection and Restoration", 3) the need for a strong science base for restoration, and 4) the critical role for an independent voice that Great Lakes universities can provide.

A significant portion of my testimony draws directly from the white paper: *Prescription for Great Lakes Ecosystem Protection and Restoration: Avoiding the Tipping Point of Irreversible Changes*[1], which I include as part of my written testimony. The paper was written by 8 Great Lakes scientists in response to the HOW Coalition's request for a scientific perspective on restoration needs. The paper has been endorsed by over 209 scientists from every state in the Great Lakes basin, as well as from states like California, Florida, Maryland, Hawaii, Colorado, and Tennessee. In fact over one-third of the endorsements were from outside the basin! This is truly an issue of national significance.

It is critical to act now

The view from the majority of the science community is that we know enough now to take action to restore and protect the Great Lakes. This is a significant recommendation because it comes from a community that often calls first for more research. While there are, indeed, important science needs, they should not create a rationale for inaction. Making a substantial investment in the Great Lakes restoration and protection now will ensure that the economic and ecological

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[1] http://www.restorethelakes.org/PrescriptionforGreatLakes.pdf

health of the Great Lakes region is strong and healthy. This is not only of great importance to the region, but also to the nation. Delaying that investment will make future actions far more costly and could result in irreversible damage to this national and global treasure.

The authors and endorsers of the Prescription Paper point out that Great Lakes ecosystems may be nearing a tipping point – beyond which the lake ecosystems would move to a new state, one that is less desirable from a recreational, commercial, and aesthetic perspective and, more importantly, one from which it will be very difficult, if not impossible, to recover. The problem with ecological tipping points, though, is that you cannot be sure you have reached it until it is too late. Thus, we urge a precautionary approach to avoid passing that critical point.

In another consensus report (*Scientific Consensus on Marine Ecosystem-Based Management*)[2] over 200 scientists cautioned against reaching thresholds beyond which altered marine ecosystems may not return to their previous states. In that report, they also state that because the tipping point for these irreversible changes may be impossible to predict, increased levels of precaution are prudent. While the same ecological principles cited for the world's oceans apply to the Great Lakes, the lakes may be even less able to cope with stress than typical coastal marine environments because the Lakes are relatively closed and evolutionarily younger systems ill-adapted to large fluctuations.

Symptoms of stress

There is widespread agreement among scientists that the Great Lakes are exhibiting symptoms of stress from toxic chemicals, invasive species, excess nutrients, shoreline modifications, change in land use, hydrologic alterations, and climate change. While most of these stresses are not new, more than ever we are seeing symptoms of ecosystem breakdown -- in other words an ecosystem nearing its "tipping point" - caused by the combinations of these stresses that overwhelm natural buffering capacities that enable ecosystems to be resilient. Large areas in the lakes are undergoing rapid changes where these combinations of persistent and new stresses are interacting to trigger synergistic ecosystem degradation. Rapid ecological responses to new stresses that may interact with each other and with remnant features of past responses to older stresses, have exhibited sudden and unpredicted changes in the past 5 to 10 years, to an extent that is unique in Great Lakes' recorded history. The new stresses have complicated past and current efforts to remediate earlier harmful phenomena, such as:

- Extirpation or major declines in important native species (such as lake trout and deepwater ciscoes) due to over fishing and invasive species (such as sea lamprey predation on lake trout, and competition with deepwater ciscoes by invasive alewives and rainbow smelt);
- Declines in other valued and important native aquatic species (including certain plankton, unionid clams, and certain native fish species) caused by altered food webs and introductions of aquatic invasive species (e.g., zebra and quagga mussels, round gobies and predatory zooplankton such as *Bythotrephes cederstroemi* and *Cercopagis pengoi* (two species of water fleas);

[2] http://compassonline.org/files/inline/EBM%20Consensus%20Statement_FINAL_July%2012_v12.pdf

- Widespread reproductive failures of keystone, heritage, and other (both native and introduced) fish species, including lake trout, sturgeon, lake herring, coaster brook trout, and Atlantic and Pacific salmon caused by toxic contamination and loss of habitat, including loss of over 90% of wetlands along the Huron/Erie corridor;
- Approximately 50% of the threatened and endangered birds are wetland dependent species, and no wonder given the estimated 60% loss of wetlands in the Great Lakes watershed.
- Toxic contamination of fish threatens not only the species themselves, but also other wildlife and people, resulting in fish consumption advisories throughout the Great Lakes and inland lakes and rivers;
- General reduction in water quality, increased toxic algal blooms, Type E botulism in fish and waterfowl, and contamination of drinking water.
- Fouling of coastlines and near-shore areas from sewage overflows and contaminated runoff, resulting in beach closings, and loss of habitat for fish and waterfowl;
- Elimination of the rooted plant community and disruption of food webs in Sandusky Bay and Cootes Paradise in Hamilton Harbour, due to sediment and other pollutant loads.

Critical food-web disruptions are a particular case in point with regard to the tipping point. These disruptions date back to at least the invasion of the sea lamprey and the cascade of loss of native fishes and invasions of alewife, rainbow smelt, and a host of others.

However, more recent dramatic disruptions include the now well-documented rapid disappearance of the once abundant benthic invertebrate, *Diporeia*, from large areas of all the lakes except Superior. For example, the abundance of the critical member of the Lake Michigan food web declined from 5,200 individuals per square meter in 1994/95 to 300 per square meter in 2005. These dramatic declines are likely linked quite closely with the zebra and quagga mussel invasion, and may be one of the clearest warning signs of a tipping point where the Lakes may be moving into a new regime where these mussels maintain high populations, and prevent any substantial recovery of *Diporeia,* the once primary diet of important fish. In fact, Dave Jude - my colleague at the University of Michigan - found enormous numbers of quagga mussels in Lake Michigan this summer at depths where only few or none were found before. At a 100-meter depth, he pulled up between 600 and 700 pounds of quagga mussels in just a 10 minute bottom trawl tow. So many members of the fish community have historically depended on *Diporeia* that lacking this critical food source is another clear indicator of the ecosystem reaching a tipping point.

Restoration and Protection Priorities

The Strategy developed through the Great Lakes Regional Collaboration (GLRC) does a good job of identifying major stresses, and their recommendations for addressing them come just in time. The Collaboration is an historic event in two important respects. First, it is the first time that all levels of government and virtually all private stakeholders have come together to draft and support a single Great Lakes restoration plan. Over 1,500 people participated in the drafting of the final plan, including representatives from cities, counties, state agencies, tribal representatives, federal agencies, Congressional staff, businesses, conservation organizations, university scientists, and concerned citizens. All of the scientists who authored the Prescription Paper, and many of those that subsequently endorsed it, actively participated in the Collaboration.

The GLRC Strategy is also the most comprehensive Great Lakes restoration and protection plan in history. It documents virtually every major problem besetting the Great Lakes; it recommends concrete solutions; identifies programs to implement those solutions; and recommends the funding needed for those programs to succeed. This level of consensus is unprecedented. And unlike so many other plans that have come before it, this isn't a plan for any one stakeholder or any one lake, but rather one for the entire basin. It has received input and endorsement from the scientific community, agencies, public interest organizations, businesses, and recreationists. And, it comes as a result of the president's May 2004 Executive Order. Importantly, many of the GLRC recommendations build upon and strengthen successful existing efforts.

> ***An international caveat*** -- The GLRC was a critical first step in forming a permanent institutional mechanism to guide restoration efforts and to facilitate coordination among public agencies, research institutions, and stakeholder organizations to reach consensus on specific priority actions and integrated measures of progress. It is important, however, to also recognize that the Great Lakes are international waters and they require strong coordination and cooperation with Canada. So, the next step in planning should integrate GLRC efforts with those of the Great Lakes Fishery Commission, International Joint Commission, and environmental and resource programs of Great Lakes states and provinces.

While the GLRC Strategy outlines the issues and plans for addressing each of the Lakes' stresses, the Prescription paper provides science-based criteria for setting priorities within that plan. With an emphasis on addressing multiple stresses and repairing the Lakes' nearshore buffering capacity, the Paper sets the highest priorities for Prevention, Protection, Restoration, and Monitoring:

<u>Prevent.</u> This category of projects and programs includes efforts to prevent additional stress from new invasive species, new chemicals, and new physical modifications. The highest priorities are to prevent new stresses that have impacts at watershed, lake, or basin scales. For invasive species, for example, projects that contribute to prevention of introduction of a new species that can potentially impact the entire Basin may rank higher than a project to prevent the spread of an invasive species already established in one part of the Basin.

<u>Protect</u>. This category includes efforts to protect areas of the Great Lakes that currently posses the characteristics we are striving for in restoration. Thus, the highest priorities are for projects and programs that prevent decline in regions that currently maintain resilient, well-functioning ecological processes. Certain nearshore areas of Lake Superior and northern Lake Huron could be examples of locations at which such protection projects would be encouraged.

<u>Restore.</u> The GLRC recommendations aim to reduce the key stresses that prevent these ecosystems from delivering the services society desires of them. However, it will never be possible to eliminate the stresses completely, and even when possible, it will likely take decades to achieve. So we must, at the same time, and perhaps with more urgency work to restore the Lakes' natural buffering capacity by increasing its resiliency – or ability to cope with stress. Therefore, this category focuses priority on efforts to restore areas that have lost their ability to assimilate stress (i.e., have lost resiliency and one or more of their primary ecological functions).

Highest priority projects should address nearshore (terrestrial and aquatic) regions, tributaries and their watersheds, and connecting waters.

Why focus on the nearshore? -- Over time, the combined effects of the suite of stresses have overwhelmed the ecosystem's self-regulating mechanisms. In the past, healthy nearshore communities and tributaries helped reduce the impact of many stresses on or entering the lakes. We now recognize that these nearshore and tributary areas constitute a buffer zone and add to the lakes' ability to rebound from stress, and without healthy buffers, the lakes' health is much more vulnerable. For this reason, it is of critical importance to ensure that the nearshore and tributary areas receive the most significant and urgent restoration attention.

Specific geographic areas where stresses have contributed or are likely to contribute to the degradation of the nearshore/tributary areas should be targeted first. These areas may well include those locations already identified as Areas of Concern by the International Joint Commission (expanded geographically to ensure they include all the major sources of stress) as well as nearshore/tributary areas that are now showing symptoms or vulnerability to multiple sources of stress. And this may require increased institutional focus (including increased emphasis within LaMP efforts) on these nearshore areas. This also has the added advantage of restoring urban coastlines, which in many instances have the most potential for restoration and is consistent with the Great Lakes Cities-St. Lawrence Cities Initiative "urban revitalization" agenda. The goal should be to reestablish the natural states critical to nearshore and tributary communities so they can once again perform their stabilizing function, or, if that is not feasible, enhance critical elements that play a role in stabilizing the communities. Many of the GLRC recommendations, if implemented properly, will provide this needed emphasis on near-shore (e.g., recommendations related to the AOCs, wetlands, coastal health, nonpoint source pollution).

<u>Measure.</u> Monitoring of agreed-upon integrative indicators is extremely important. This effort should build on ongoing efforts such as the development and application of State of the Lakes Ecosystem Conference (SOLEC) indicators. However, major negative changes in the ecosystem are occurring while many of the indicators that governments have traditionally used to measure Great Lakes health (water clarity, ambient water pollution levels, and certain contaminant levels in wildlife) actually show improvement. Because nonlinear changes may confound expected relationships between sources of stress and the lakes' response, traditional indicators alone may not be adequate descriptors of ecosystem health and may not be useful in predicting future conditions. While some type of consensus on indicators is desirable, given the dynamic nature of the system and our understanding of it, flexibility must also be included in their development and use.

Monitoring is essential to not only identify emerging issues, but importantly in the context of restoration, to track progress. Most managers and scientists now embrace the notion of adaptive management where adjustments in strategies are made as restoration proceeds. But, without effective monitoring systems, geared toward tracking progress at the right scales, adaptive management is not possible. A key issue for an effective monitoring network in this context is the ability for rapid detection of change on scales relevant to local and state decision makers, as well as Federal policy makers. Therefore, a priority should be placed on the nearshore terrestrial and aquatic ecosystem in concert with the geographic focuses of restoration. This requires close coordination of state and tribal agencies and the academic community to add higher spatial resolution to the Lake- and region-scale efforts of the Federal agencies.

Setting Restoration and Protection Priorities:

The GLRC Strategy lists a wide range of efforts, with some estimates of the costs of implementation reaching $20 billion over the next decade. While we support these efforts and the appropriations needed for implementation, it is clear that priorities must be set because the Nation can neither afford to pay for this all at once nor wait for full funding in the future.

We have been working with the Healing Our Waters-Great Lakes Coalition[3] and others to help identify the highest priority protection and restoration needs of the Lakes and our region. We suggest setting project priorities based on the following criteria. The intent is to provide a means to evaluate specific projects that various Great Lakes programs can support.

- *Does the project improve and/or protect ecosystem resiliency, functioning, and sustainability?*

A primary goal outlined in the Prescription Paper is to increase the Lakes' ability to assimilate stresses so they can maintain essential ecosystem functions (e.g., productivity, stable and healthy food webs) for the long term. In many places, this natural buffering capacity (or resiliency) has been lost (in particular in nearshore areas), and one of the highest priorities is to re-establish this capacity. Restoring resiliency should lead to improved sustainability, both for the ecosystem itself and for human use of it (e.g., exploitation of fisheries).

- *Does the project recognize and attempt to address all relevant stresses?*

While progress has been made in addressing some of the key stresses on the Lakes, the interactions of these stresses have now complicated the Lakes' recovery. Cumulative impacts and interactions among toxic chemical and nutrient loads, invasive species, modifications of physical structure, and habitat loss, for example, are now recognized as increasingly important in determining the ability of all components of the lake ecosystems to recover. To be most effective, projects need to take into account these cumulative impacts and interactions. In addition, a better understanding of all stresses will ensure that management decisions affecting one stress do not lead to conditions that exacerbate another stress. One challenge in this regard is that additional potentially significant stresses may only be recognized once a project is underway. Ideally, strong project proposals will note the potential of many such stresses to affect the project outcome in the proposal stage, based on previous experience and the scientific literature on relevant topics.

- *Does the project clearly address significant and well-documented current or anticipated impacts?*

While many projects are designed to address presumed stresses, the highest priorities should be those projects that demonstrate clear connections between the proposed actions and impacts. While the inherent complexity of the system will not allow for perfect predictions of future states in response to management actions, these connections should be explored with scientifically rigorous assessments.

- *Is there a plan to measure, assess, and communicate results?*

Many if not most protection and restoration projects are likely to be long-term in nature, and therefore need to be designed in an adaptive framework. To be adaptive, there needs to be a clear plan to monitor activities and the target impacts, assess progress, and potentially make adjustments as necessary in order to maximize likelihood of project success. In addition, to maintain stakeholder support for the effort, these results and assessments need to be communicated to decision makers and the public. Is there a plan to do so?

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[3] www.restorethelakes.org

Setting Science Priorities

While investments in long-range, basic research is important, and such investments in the Great Lakes lag significantly behind those of coastal and marine environments, these investments need to be complemented with science that directly supports restoration. I should note, however, that thoughtful research can be both basic and useful as Donald Stokes outlined clearly in his book, *Pasteur's Quadrant*[4]. I recommend a science plan with two additional components beyond the monitoring efforts described above. These two components are Integrated Assessment and Restoration Innovation.

Integrated Assessment **–** Decades of research and monitoring have produced vast quantities of data and information on Great Lakes conditions, processes, and functioning. However, much of this information is inaccessible or not organized and synthesized in ways most useful to local, state, and Federal decision makers. Providing this information, along with its level of certainty, in credible and timely ways on issues identified by decision makers is an essential element of science support for restoration and protection.

Integrated Assessment (IA) is a formal approach to synthesizing and delivering relevant, independent scientific input to decision making through a comprehensive analysis of *existing* natural and social scientific information in the context of a policy or management questions. These assessments not only draw on the talents of subject matter experts, but also engage the broader stakeholder community in defining boundaries, integrating traditional knowledge, and identifying socially-acceptable solution options. The IA results are peer reviewed and subject to public comment, and the process should be supported by funds independent of those with vested interests in any particular solution option. IA takes the following structured approach:

1. Define the policy relevant question around which the assessment is to be performed. This is done in conjunction with managers and policy makers such that the analysis is directed toward solving specific policy or management needs.
2. Document the status and trends of appropriate environmental, social, and economic conditions related to the issue. This is a value-independent description of current conditions and, to the extent possible, the historical trends in those properties.
3. Describe the environmental, social, and economic causes and consequences of those trends. This often includes simulation, statistical, and other explanatory models and analyses. Again, these descriptions are fact-based although subject to analysis and interpretation.
4. Provide forecasts of likely future conditions under a range of policy and/or management actions. This can be quantitative forecasts from models or other trend analysis tools. These are subject to considerable scientific evaluation and interpretation.
5. Provide technical guidance for the most cost effective means of implementing each of those management options. These efforts are designed to provide those who are

[4] Stokes, D.E. 1997. Pasteur's Quadrant. Basic Science and Technological Innovation. Brookings. Washington, DC. 180 Pg.

responsible for implementation the menu of approaches available to them, along with some evaluation of their potential for success and cost-effectiveness

6. Provide an assessment of the uncertainties associated with the information generated for the above steps and outline key monitoring, research, and modeling needs to improve future assessments in this area. This assessment of uncertainties is often a guide to future research needs.

Such approaches have been very useful, for example, in assessments of the impacts of climate variability[5] and the causes and consequences of hypoxia in the Gulf of Mexico[6] (called for in the Harmful Algal Bloom and Hypoxia Research and Control Act), as well as a key element of the new science program for Michigan Sea Grant[7]. The Gulf of Mexico Hypoxia IA, for example, led to a Federal-state-tribal Action Plan for reducing nutrient loads to the Gulf, the primary anthropogenic driver of hypoxia.

***Restoration Innovation* –** While we have enough information to proceed now with restoration, the task is long term and we need investments in new ways to deal with existing and emerging threats, as well as to find the most cost-effective technologies for identifying threats and restoration approaches. Such innovations could include: new ways to detect and monitor threats to ecosystem structure and functioning; improved methods for synthesizing and integrating information to provide useful forecasts of the impacts of management action or inaction; technologies for restoring wetlands, coastal habitats, and contaminated sites; methods to value ecosystem goods and services; assessments of the social causes and impacts of ecosystem change; and means to reduce uncertainties in Integrated Assessments.

While the needs for such innovations can be identified, their solutions are hard to predict, and are best sought through investing in, and nurturing, the skills and talents of Great Lakes scientists, including through academic programs.

The Role of Universities

A strong and effective science program supporting restoration and protection of the Great Lakes needs the innovation, expertise, and independent voice of the academic community. During the 1960s, 70s, and 80s, the Great Lakes academic community was well-supported and provided an important complement to the science conducted in the Federal and state labs. I know this first hand because I worked in a Great Lakes Federal lab from 1975-1990. Working together, and with state agencies and environmental NGOs, these communities identified and analyzed the most important issues of the time – fisheries decline, eutrophication, and chemical contamination. Academic institutions contributed expertise in fisheries biology, food-web structure, ecosystem dynamics, biogeochemistry, ecosystem modeling, and engineering to these successes through cooperation and participation in activities and programs under the auspices of the bi-national Great Lakes Water Quality Agreement and Great Lakes Fisheries Convention, for example.

Through both applied research and research that improved our fundamental understanding of the Lakes' physical and ecological dynamics, academic research and modeling played historically important roles in critical resource management and policy decisions:

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[5] http://www.usgcrp.gov/usgcrp/nacc/default.htm
[6] http://www.nos.noaa.gov/Products/pubs_hypox.html
[7] http://www.miseagrant.umich.edu/ia/index.html

- Reducing phosphorus inputs to reduce algal growth and improve water clarity;
- Sea lamprey control;
- Reductions in industrial pollution;
- Reduction in contaminants such as DDT and PCBs;
- Reduced occurrences and magnitude of chemical spills and discharge of objectionable and nuisance materials that form scums, sludge, and odors;
- Confinement and removal of contaminated sediment;
- Growing recoveries of some native species, such as the lake trout in Lake Superior and the bald eagle throughout the Great Lakes

And these efforts have had significant impacts. In many places, nutrient control reduced algal overgrowth and increased water clarity, sea lamprey control allowed a rebound in fish populations, reduced industrial pollution resulted in declines of DDT and PCBs in fish and wildlife by as much as 90%, confinement and removal of contaminated sediment are progressing, and populations of native species, such as the lake trout in Lake Superior and the bald eagle throughout the Great Lakes are making substantial recoveries.

In spite of this progress, and as outlined above and in the GLRC report and the "Prescription paper", the Great Lakes are exhibiting a multiplicity of nagging and emerging issues that are impeding further ecological and economic recovery. Just when we need more research and monitoring to assist sound, science-based management and policy decisions, the Great Lakes research community is in decline. An aging work force will soon retire taking with it historical knowledge and perspective because of limited ability to hire young scientific replacements. Old and outdated scientific tools, facilities, and vessels are not being upgraded to address the complex problems of today. Funding for both Federal and state science agencies are not keeping up with inflation and funding to the Great Lakes academic community is scarce, resulting in a significant loss of Great Lakes researchers from Great Lakes academic institutions.

Academics can and should play strong, even dominant, roles in Integrated Assessment, in assisting in and interpreting results from monitoring programs, in identifying and clarifying emerging issues, and in providing innovative solutions to both long-standing and new issues. Academics are knowledgeable and interested parties in this management, but not constrained by the mission and viewpoints of their home organization. To be most effective, their work needs to be independent, based on competition and peer review, and well-funded. There are existing models for Federal programs that can provide that support in ways that are connected to and integrated with Federal and state science, but not handmaiden to it. These include EPA's Science to Achieve Results (STAR) program, NOAA's Center for Sponsored Coastal Ocean Research (CSCOR), and the Great Lakes Sea Grant programs. Each of these programs has a distinct mission that complements the others, as well as those of the Federal labs. They have established processes for interacting with the academic community and administering effective extramural grant programs. They require increased funding and encouragement to continue to expand their programs in the Great Lakes, focused on supporting restoration and protection needs.

It is important to build upon proven models of academic-governmental partnerships like Sea Grant and NOAA's CSCOR with well-funded, objective, and independent academic research that has strong linkages to resource management and policy needs. These programs can supply the people and new technologies for problem-solving, technology transfer, and the communication of science to policymakers and the public.

Summary and Conclusion

In closing, Mr. Chairman, I would like to thank you and the Subcommittee for your leadership in scheduling this hearing and maintain the momentum for Great Lakes restoration. We believe it is time to invest in the restoration and protection of the Great Lakes to avoid reaching a tipping point, beyond which it may not be possible to restore their great service to society. We also recommend a set of criteria to be used to set priorities for restoration and protection efforts to ensure the most important and effective measures are taken first.

It is also critical to ensure there are sufficient investments in science to both monitor and help guide restoration efforts. Without a strong science base, restoration will be less effective and more costly to the taxpayers.

Thank you for inviting me to participate in this hearing. The Great Lakes science academic community looks forward to working with you and all of our Collaboration partners to continue this important work, because it is only through concerted, coordinated action that we will realize our mutually-held goal of a cleaner, healthier Great Lakes.

I would be happy to answer any questions that you may have.

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As the Chief Scientist of NOAA's National Ocean Service between 2002 and 2005, Dr. Scavia was responsible for the quality, integrity, and responsiveness of NOS's science programs, and for ensuring that NOS's operations and resource management are based on solid science and technology. Before becoming the NOS Chief Scientist, Dr. Scavia was Director of the National Centers for Coastal Ocean Science and Director of NOAA's Coastal Ocean Program, where he managed coastal and Great Lakes research programs in NOS laboratories, monitoring and assessment offices, and extramural research.

Between 1975 and 1990, Dr. Scavia was a research scientist with NOAA's Great Lakes Environmental Research Laboratory in Ann Arbor, Michigan, focusing on modeling and empirical studies on nutrient cycling, bacteria and phytoplankton production, food-web dynamics, and biological-physical coupling at all scales.

Dr. Scavia holds Bachelors, Masters, and Doctorate degrees in Environmental Engineering from Rensselaer Polytechnic Institute and the University of Michigan. He has published over 60 articles in the primary literature and led development of dozens of interagency scientific assessments and program development plans.