

**Testimony of Dr. Bruce Alberts
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Thank you, Admiral Watkins.

I am a great admirer of your Chairman. In fact, I wish he was still around Washington working on education. Maybe we would have solved the problem by now. But we continue, as you will hear at the end, to be very concerned about science education, which of course is a great opportunity to produce the interest that we have in bringing children into contact with real science and real problems that are not yet solved and are important issues for the country and the world. Rather than making science education as a chore – memorize all the facts, the 30 kind of whales we've learned about – there is a different kind of science education that the Admiral and I have been trying to promote.

As the Chairman said, I am the president of the National Academy of Sciences. My background is not ocean sciences, but cell biology. So I am not an expert in your area. The National Academies, however, have a long history of doing studies on the oceans. We started in 1863 when we were incorporated by Abraham Lincoln as a private nongovernmental organization. And, in fact, our first three studies were ocean related. I'm not going to tell you how well we did on those or how well they were received or how successful. I think we have learned a lot since then. Today our interests extend from wetlands, estuaries, and beaches out to the deepest ocean and from practical issues like dredging to more esoteric scientific themes.

The way we work is perhaps new to most of you. Basically, after we get asked a question by the government, we bring together a group of ten or twelve experts from as broad a range of disciplines as we can. They sit there, meet several times, get to know each other, and get to know how to communicate across disciplines. These committee meetings are educational for the committee, which is why these very busy people accept serving on our panels. Then we ask them to come up with a consensus view, and most of the time they do reach a consensus despite starting from very different perspectives. I can only highlight a few of the things that we've done and of course as Admiral Watkins said, our web site makes freely available the full text of 2,500 reports. You can read them all in your spare time. There is a good search engine if you want to quickly find the most relevant material.

I'll reference a few reports and talk about some broad issues. The first issue I'd like to discuss concerns the impacts of land-based activities on coastal areas.

Human activities on land produce many waterborne and airborne pollutants, such as pesticides, oil and grease, and nutrients such as nitrogen or phosphorus, that end up in coastal waters. Nutrient pollution from land-based sources is the common thread that links an array of problems along the nation's coastline, including harmful algal blooms, "dead zones" of oxygen depletion, and fish kills. Nationwide, nearly two thirds of U.S. coastal rivers and bays have been rated as moderately to severely degraded by nutrient pollution. Several of our studies, including the recent report "Clean Coastal Waters," address this issue. This report makes detailed suggestions for improving the current situation with regard to non point-source pollution.

My second point is that the direct disposal of materials into the ocean also remains a major concern. Despite international regulatory frameworks, illegal dumping of waste, ship ballast discharge, abandoned nets and gear from fishing boats, shipping containers lost in rough weather, and the discharge of oil continue to pose significant threats to marine life. Impacts can include beach closings, introductions of non-native species, and loss of marine wildlife through entanglement. In this area, we are currently finishing up a major report that focuses on Oil in the Sea – expected to be released by early Spring.

Physical alteration of the marine environment through dredging and the disposal of dredge spoils must also be carefully examined. Our most recent report on this issue, called Environmental Windows, was released just last week. Although dredging is critical to maintaining ports and harbors, it also produces large quantities of sediment, typically disposed of at sea. Our committee concluded that the long-term impacts of this offshore disposal needs more study.

My third issue involves the management and governance of resources in U.S. waters. There is a growing sense that the system for governing the use of living marine resources, especially fisheries, is broken. Academics, users of marine resources, environmentalists, and government officials have identified a number of thorny issues, many of which are addressed in recent NRC reports on this topic. We took a very broad look at this subject in this 1999 report called Sustaining Marine Fisheries. The most recent report in this series is entitled Marine Protected Areas: Tools for Sustaining Ocean Ecosystems.

Agencies must be able to work better together. We addressed this general issue in our 1992 report entitled Oceanography in the Next Decade: Building New Partnerships. We were very pleased to see that NOPP was established as a result, and we are optimistic about its promise for the future.

Another important governance issue involves the way mineral, oil, and gas resources are leased in federal offshore waters. With the laudable goal of protecting the ocean environment, the present system has prohibited some potentially benign developments that could benefit a majority of Americans. These prohibitions have sometimes been based more on perceptions than on

scientific facts or measurable risks. Better approaches may be possible that maximize the wise, environmentally sensitive, and effective use of offshore resources. This issue will be addressed in the Oil in the Sea report that I mentioned, expected next Spring.

My fourth point is that good decisions must be underpinned by accurate information. Each year, hundreds of local, state, and federal managers and elected officials take actions that affect environmental quality and the economy. Despite the enormous physical, ecological, economic, and human resources involved, these decisions are often made in the absence of adequate information. Delaying decisions is no answer, as lack of action may itself lead to undesirable results that can only be reversed at great expense. Ocean managers need improved information about the physical features of the coastline, the status of important marine populations, and the locations of various energy and mineral resources. Similar efforts to understand changing land-use patterns could help minimize the impact of land-based activities on coastal environmental quality.

Well planned, scientifically designed data collection efforts, aimed at optimizing the acquisition and dissemination of useful information, can improve decisions regarding future development, environmental permitting, and regulatory review. As just one example, we have published a series of reports on improving fish stock assessments.

My fifth point is that appropriate infrastructure and technological innovation are needed to improve our decisions. Understanding the ocean, and using its resources wisely, will require new levels of infrastructure. For example, a routine, sustained ocean observing system, along with supporting communication, navigation, and information processing systems, could improve weather prediction, search and rescue operations, resource management, and the efficiency of shipping. In addition, ocean scientists rely on research vessels, observatories, and submersible vehicles to improve our understanding of the fundamental processes that lie at the heart of many marine policy questions. All of these enhanced demands will take place in the context of rapidly changing technologies. We have most recently discussed this issue in last year's report, *Illuminating the Hidden Planet: the Future of Seafloor Observatory Science*.

As we have recently been so brutally reminded, the United States must remain productively engaged with the rest of the world. My sixth point is that governance of activities on the high seas can be especially tricky. Large parts of the world's oceans lie outside of any nation's jurisdiction. Although the U.N. Convention on the Law of the Sea addresses the governance of some aspects of non-territorial waters – mineral extraction from the sea floor, for example – it is appropriate for this Commission to consider whether the Convention needs to be updated as well as ratified by the United States.

Examples of particular concerns include deep-water fisheries which are currently harvested without restraint – as well as highly mobile fish resources, such as tuna and salmon, that move freely from one country's jurisdiction to another. There is also the issue of management and regulation of carbon sequestration in international waters. The concept of sequestering carbon in the ocean, through ocean fertilization or direct injection of carbon dioxide, is still quite new. Although its potential for removing atmospheric carbon dioxide is real, ocean sequestration could also lead to unforeseen problems. Because these practices are beyond the jurisdiction of any single nation, some form of international framework will be needed to further explore this concept.

This is an area where the Academies, believe it or not, have not done any work recently. I think there is an opportunity to do some of this work in partnership with other academies from around the world. There's an organization called "The InterAcademy Panel" composed of the academies of 80 nations. We wouldn't want to work with all 80 at once, but I think there is a real opportunity because of the way that scientists communicate free of bureaucratic constraints. We might think about a study that involves some of the major actors and see if the scientists at least can come to some conclusion that governments might then respect. And that's the whole dynamic that makes strengthening international science such an important global objective.

We are trying to see more generally, not only in this oceans area, but also in many others, how the world scientific community can pull together and try to reach agreements independent of policymakers about the science. Then each of us in our own countries – the Japanese scientists with their government, we with our government, can try to make our own governments adopt wise policies. I think there's a great potential there that's not yet well enough exploited.

I want to end by talking about the Admiral's major passion, education. We produced the National Science Education Standards in early 1996. This is a document that was called for by the 50 governors in Charlottesville in 1989, and it calls for a revolution in how we think about science education.

First of all, science education starts in kindergarten and should be in every year of school a core subject. And the reason why we can talk about that is because we don't mean science education as memorizing all the things that science has learned, but rather learning how to do: looking at evidence, arguing from logic, and looking around and investigating the world around you. If you think about it, every kindergarten is a science class. That's what they do in kindergarten, but then when they get to first and second grade, we start them memorizing stuff. Not that knowledge is bad, but the more important thing is to get kids to exploit the curiosity they come to school with and maintain that through all their years of school. And there is a great way of doing that through scientific inquiry.

The other major point in the Standards is that we need to connect science to people's lives. Science can be a very abstract thing that is not interesting to kids. They've got so much competition from MTV and the Internet, that it's a different world for kids than it was for us. If we don't make school interesting, they're not going to pay any attention and they're not going to have the motivation to learn. I think young people would be fascinated to argue about some of the things that you're talking about concerning the oceans and to recognize that the adults haven't solved this problem yet and there is something for them to work on. This provides a great opportunity that I think we're missing.

In conclusion, the Academies believe that Congress was very wise in calling for the creation of a Science Advisory Panel for your Commission. That panel would help you in all your deliberations and conclusions by providing a strong science base. We were requested through our Ocean Studies Board to supply nominations which we've done, and I urge you to move ahead with the formation and appointment of these panel members.

In ending, I want to make it clear that we are here to help you in any way we can. We wish you the best of luck in your ambitious journey ahead. Thank you.