

A harbor, even if it is a little harbor, is a good thing. . . . It takes something from the world and has something to give in return.

Sarah Orne Jewett, writer (1849–1909)

MARINE AND COASTAL SCIENCE

## U.S. Ocean Policy Report Card

If the U.S. government were a student, it would be on the verge of flunking Ocean Policy 101, to judge by the *U.S. Ocean Policy Report Card* issued 3 February 2006 by the Joint Ocean Commission Initiative. The United States has accomplished far too little in response to a health crisis in the nation's oceans, coasts, and Great Lakes, according to the report card. More than a dozen federal agencies have a say in setting and implementing ocean policy, and they often fail to work together. Policy makers need to repair this fragmented system of ocean governance, and they need to do it fast.

The 10-member initiative was created to track government response to two landmark ocean commissions. In September 2004, the U.S. Commission on Ocean Policy, a presidential panel chaired by retired admiral James Watkins, recommended that Congress boost ocean research funding, improve fisheries management, and consolidate federal oversight over ocean policy. A year earlier, the pri-

vately funded Pew Oceans Commission, chaired by Clinton White House chief of staff Leon Panetta, had reached many of the same conclusions.

Yet policy makers have done too little to fix the nation's confusing system of authority over coastal and marine ecosystems, says initiative member Andrew Rosenberg, a fisheries scientist at the University of New Hampshire. "A lot of the issues that the commissions talked about came true with Hurricane Katrina: wetlands loss, lack of planning, inadequate infrastructure, risk from natural hazards, continued fragmentation of ocean policy, major damage to fisheries in the [Gulf of Mexico]," he says. "We need a lead ocean agency to take a new direction internally and to cooperate with other agencies to consolidate and focus programs."

Initially, government leaders responded positively to the two commission reports, a response that earned an A– on the report card. In December 2004, Bush released an action plan that included the creation of a committee to oversee ocean policies (this committee will release a priorities plan and implementation strategy at the end of 2006). Congress and state governors also acknowledged the major recommendations of both commissions.

But momentum has stalled since then. Congress and the Bush administration have not done enough to create a national ocean policy and to strengthen NOAA to the point that it can serve as the lead ocean agency, according to the report card, which gives leaders a D+ in the category of national ocean governance reform.

Policy makers, moreover, receive an F in new funding for ocean policy and programs. The U.S. Commission on Ocean Policy called for a doubling over five years of ocean-related research funding. But federal ocean research received level funding in fiscal year 2006, and Bush's 2007 budget proposal would reduce NOAA's oceanic and atmospheric research support by 9%, to \$338 million. Important ocean programs such as the six NOAA Undersea Research Centers were severely cut for 2006 and would not be fully restored under the 2007 budget.

"We are very disappointed in the president's budget request for NOAA," says Ted Morton, federal policy director of the international nonprofit Oceana. "We were expecting to see more increases for critical ocean and coastal programs. The commissions were clear that significant increases were necessary to restore ocean health."

The report card gives government a C+ for fisheries management reform, noting the Senate's establishment of bipartisan support in an effort to reauthorize the 1976 Magnuson-Stevens Fisheries Conservation and Management Act, the primary federal law governing fisheries management.

Another bright spot is the ongoing reform of ocean management occurring in some states and regions. Among the most notable are efforts in California, Puget Sound, and the Gulf of Maine. These management efforts, which earned a B–, are using a broad ecosystem approach and include government at all levels. The idea is to work toward regional cooperation and across jurisdictional lines in new and existing programs. In the Pacific Northwest, for example, the Northwest Straits Commission addresses marine conservation in the region, the Shared Strategy for Puget Sound addresses salmon recovery in that water body, and the Puget Sound/Georgia Basin International Task Force addresses environmental problems associated with population growth. —John Tibbetts



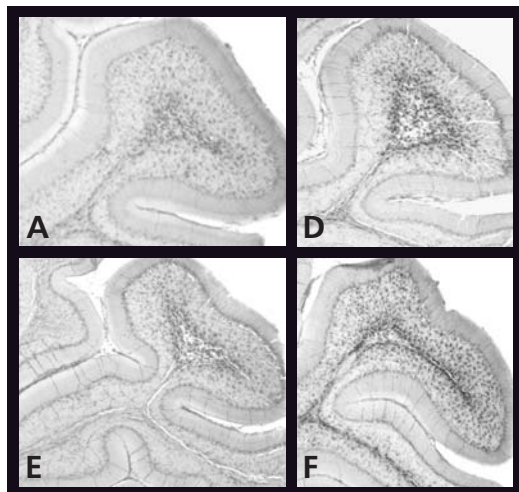
**Bright spot in a dim picture.** Although some regions such as Puget Sound (above) are earning good marks for ocean management, overall the United States is failing miserably when it comes to the nation's ocean policies, according to a recent report by the Joint Ocean Commission Initiative

## ENDOCRINE DISRUPTORS

## Bisphenol A and the Brain

Estrogens are known to trigger rapid cellular responses, including hormone secretion and cell permeability changes, in tissues as diverse as the pancreas, the pituitary gland, and the brain. Two studies published in the December 2005 issue of *Endocrinology* now present an intricate picture of how estradiol, the body's primary endogenous estrogen, acts in the cerebellum, with one study building on the other and including another layer of complexity: the addition of the xenoestrogen bisphenol A to the system.

The studies, conducted by researchers led by Scott Belcher at the University of Cincinnati College of Medicine, investigated an estrogen-mediated extracellular signal-regulated kinase system in developing rat cerebella neurons. The first study, conducted *in vitro*, identified the individual steps in a



**Are U surprised?** Compared to the control (A), bisphenol A exhibits a U-shaped dose-response curve in the rat cerebellum, increasing immunopositive cell numbers at low and high doses (D, F, respectively), but not intermediate doses (E).

cascade of cellular responses triggered by estradiol. The second study focused on this response following injection of estradiol and bisphenol A, alone and in combination, into rat cerebella. Effects were seen at very low doses of  $10^{-12}$  to  $10^{-10}$  moles per liter (M) and at higher doses of  $10^{-7}$  to  $10^{-6}$  M, but not at intermediate doses of  $10^{-9}$  to  $10^{-8}$  M. Paradoxically, when bisphenol A was injected alone, it mimicked estradiol; when injected with estradiol, however, it blocked estradiol action.

Bisphenol A is a known endocrine-active chemical. Low-level human exposure is widespread due to the chemical's presence in

polycarbonate plastic and epoxy resins, but understanding long-term consequences of exposure will be challenging. As illustrated in the *Endocrinology* papers, bisphenol A exerts an effect through a complex system at a concentration range that has not been evaluated in traditional risk assessment.

"It is a fundamental part of endocrinology, and it is beautifully demonstrated [in these papers], that stimulation at [the cerebellar] cell surface receptor is able to cause effects at doses below a part per trillion," says Frederick vom Saal, a professor of biology at the University of Missouri-Columbia. Not only are the doses many magnitudes lower than those considered in classic high-dose toxicity studies, but at extremely low doses both estradiol and bisphenol A demonstrate a response that disappears as the dose increases. "This absolutely challenges the fundamental assumption of risk assessment that once you start increasing dose you always see an increase in response," says vom Saal.

According to Belcher, an assistant professor of pharmacology and cell biophysics, labeling the effects observed in his group's studies as harmful or negative is not possible. "With the way it's been looked at, you can't say whether the observed actions are safe or harmful, but it is clear that the issue needs to be looked at more carefully and seriously," he says.

Although the plastics manufacturing industry, represented by the American Plastics Council in Arlington, Virginia, generally questions several aspects of bisphenol A research, they do agree that translating findings such as those in the *Endocrinology* papers to the sphere of risk assessment won't be easy. "It's not so straightforward to figure out what the results mean for human health, even if you take the results that are published at face value," says Steve Hentges, executive director of the American Plastics Council polycarbonate business unit. "Even to develop a testable hypothesis is not very simple at all. It's very complex systems that they're looking at. The mechanism is a long way from any kind of an adverse effect."

Belcher, too, believes that extending his work into risk assessment is premature. "You can't make a conclusion whether bisphenol A is going to be safe or harmful with current risk assessment models at these low doses," he says. Further, as shown by the paradoxical reaction to bisphenol A, responses to an estrogenic compound can depend on what else is in the system. —Julia R. Barrett

## PFOA to Be Eliminated

In January 2006, eight companies agreed to an EPA agreement to eliminate perfluorooctanoic acid (PFOA) from consumer products within the next decade. PFOA, used to make nonstick and stain-resistant materials, has been linked with cancer and birth defects in animals. The chemical has been detected in the blood of 95% of Americans and in marine organisms and polar bears. Currently, PFOA can be found in a wide variety of consumer products, including food packaging, nonstick cookware, and fabrics. Under the terms of the pact, companies will have to reduce manufacturing emissions of PFOA and trace amounts of the compound in consumer products by 95% by no later than 2010. PFOA should be completely eliminated by 2015.



## Mold Genomics

The 22 December 2005 issue of *Nature* featured information on the latest genomes to be cracked: *Aspergillus fumigatus*, the most common infection-causing mold; *A. oryzae*, a nonpathogenic mold that has been used for 2,000 years to make sake, miso, and soy sauce; and *A. nidulans*, widely used as a laboratory model organism. The work to sequence these mold genomes was an international effort, spanning three continents. Scientists working on the project hope their investment will yield insight into the workings of *A. fumigatus*, which could in turn lead to better treatments for serious asthma, allergies, and other conditions in which the fungus is implicated.

## Ahoy There, EPA!

In December 2005, the EPA formally introduced its new Ocean Survey Vessel *Bold*. A converted Navy vessel, the 224-foot ship is a floating scientific laboratory stocked with state-of-the-art equipment to support the EPA's ocean monitoring and educational tasks, and can accommodate 20 scientists. The EPA began using the *Bold*, its only coastal and ocean monitoring vessel, in August; by September the ship was involved in conducting water quality assessments in the Gulf of Mexico following Hurricane Katrina.

The *Bold* will also support enforcement and survey efforts, and function as a nautical classroom, where tours and demonstration events will educate the public about ocean and coastal environmental issues.





## AIR POLLUTION

## The Plaque of the Matter

Particulate matter measuring less than 2.5 microns ( $PM_{2.5}$ ) has been widely linked to heart disease. These tiny particles of dust, soot, and smoke accompany emissions from power plants and vehicle exhaust, and lead to an estimated 60,000 premature deaths per year in the United States. EPA standards limit average human exposure of  $PM_{2.5}$  to a maximum of 15 micrograms per cubic meter. Now a study published in the 21 December 2005 issue of *JAMA* shows that long-term exposure to  $PM_{2.5}$  even at levels within federal standards accelerates the development of atherosclerosis in laboratory mice by increasing plaque development, especially when the mice are also fed a high-fat diet.

Mice do not naturally develop plaque, a fatty deposit on the inner lining of arteries; the 28 mice used in the study were genetically modified to do so. The animals were divided into two subgroups, one fed a normal diet, the other a high-fat diet. Those subgroups were then divided again, with half breathing air containing concentrated  $PM_{2.5}$  at levels equivalent to 15.2 micrograms per cubic meter and the other half breathing particle-free filtered air. The air pollution group was exposed for six hours per day, five days per week, for six months.

Researchers found measurable changes in the extent and severity of plaque formation in the aorta as well as artery inflammation and reduced function of the arterial lining. In animals that breathed

polluted air and ate a high-fat diet, 41.5% of the arterial interior measured was filled with plaque, compared to 13.2% in animals that breathed filtered air and ate a normal diet.

In humans, high plaque levels can lead to heart attacks and strokes. “These results can be very applicable to the human population, especially in urban environments,” says coauthor Lung Chi Chen, an associate professor of environmental medicine at the New York University School of Medicine. “We found that the combination of air pollution and diet had a dramatic effect on plaque formation, leading to inflammation and heart disease.”

“It was surprising in this study to see the impact of exposure to a relatively low PM concentration on plaque development,” says Kevin Dreher, a principal investigator studying the cardiovascular effects of air pollution within the EPA’s National Health and Environmental Effects Research Laboratory. “While both dietary groups developed plaque when exposed to polluted air, the high-fat diet led to more consistent and statistically significant increase alterations of plaque development. Fat in the diet appears to be an important effect modifier when coupled with exposure to air particulate pollution.”

Chen and his group are now gathering results on heart rate and blood pressure changes in these same mice. In ongoing studies, they are also examining specific mechanisms that could link air pollution, diet, and heart disease. In particular, they are trying to better define which components in  $PM_{2.5}$  most likely promote plaque formation and atherosclerosis. —Rebecca Clay Haynes

## FOOD SAFETY

## Adding Up to No Good?

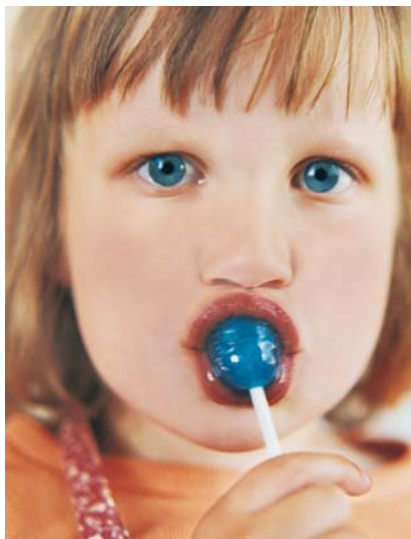
The safety of food additives is usually examined by varying the dose of a single additive administered to animal models or cell cultures. However, British researchers at the University of Liverpool and the University of Ulster report in the March 2006 issue of *Toxicological Sciences* that combinations of additives can produce neurotoxic effects at dosages that are safe when each additive is tested alone.

The authors examined four common food additives: Quinoline Yellow (FD&C Yellow No. 10), Brilliant Blue (FD&C Blue No. 1), L-glutamate (the major constituent of monosodium glutamate, or MSG), and aspartame. Quinoline Yellow is banned from foods in the United States, Japan, and Norway; Brilliant Blue was banned from foods in most European countries but has since been reapproved. Coauthor Karen Lau, a doctoral student, says these additives were tested because they are commonly used in foods targeted for consumption by children.

Neurotoxicity was measured by the relative growth of neurites from mouse NB2a neuroblastoma cells after exposure to the additives. Two combinations of additives stunted neurite growth: Quinoline Yellow paired with aspartame, and Brilliant Blue paired with L-glutamic acid. Other

pairings showed no effect. Lau hypothesizes that ingestion of the well-established neurotoxicants aspartic acid and L-glutamic acid as additives could lead to a high enough body burden to kill neurons by a mechanism called excitotoxicity.

Lau says young children may be especially at risk for the type of toxicity observed in the nerve-cell cultures, because effects were seen at concentrations of additives she says are theoretically achievable in plasma by eating foods and drinks typically consumed by children—for example, a snack of corn



**Food blues?** Certain food additives including common dyes may combine to cause toxic effects.

chips, which may contain MSG, and a fruit juice drink, which may contain aspartame.

Scientists at the U.K. Food Standards Agency (FSA) question whether these results are relevant to the human consumption of these additives. “[The Lau study assumes] that both MSG and aspartame are absorbed one hundred percent in the gut, but [other studies] show that this does not seem to be the case,” says FSA senior press officer Shaun Whelan. “It is . . . extremely unlikely that the plasma levels predicted by the authors of this study accurately reflect the actual situations *in vivo*.”

Whelan says glutamic acid and aspartic acid occur naturally in many foods, and there is no evidence that they are treated differently in the body when they are ingested as food additives. Lau counters, however, that consumption of glutamic acid in its free form or as MSG has a more dramatic effect on plasma levels than that of glutamic acid in protein, and can lead to high concentrations in the body. More research is needed to clarify these effects.

Other studies have suggested that non-nutritive food additives are associated with behavioral disorders such as attention deficit/hyperactivity disorder. These effects are controversial, but Lau’s team believes their results warrant further investigation of such possibilities. Whelan says the FSA is currently funding research on the effects of ingested chemical mixtures, including color additives, on the behavior of young children. —Michael Szpir

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## International Maritime Organization

In 1948 an international conference in Geneva adopted a convention formally establishing what is today called the International Maritime Organization (IMO). The IMO initially worked mainly to ensure maritime safety, but after a 1967 spill of 100,000 tons of crude oil off the southern coast of England, the organization began focusing attention on alleviating the environmental impacts of the shipping industry. Today the IMO has devoted a section of its website at <http://www.imo.org/home.asp> to these environmental programs.

The Marine Environment section, accessible through the menu at the top of the IMO homepage, provides an overview of how the IMO works to regulate and prevent marine pollution by ships, with links to in-depth information on the applicable international treaties. The first such treaty is the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), which was adopted in 1973 and modified in 1978. This treaty governs accidental and operational oil pollution as well as pollution by chemicals, packaged goods, sewage, garbage, and air pollution. The 1990 International Convention on Oil Pollution Preparedness, Response and Co-operation calls on parties to establish measures for reporting and handling oil pollution incidents. The IMO also serves as secretariat for the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, which was adopted in 1972.

A list of links on the Marine Environment page leads to other topics of interest. The Ship Recycling page has a detailed overview of the IMO's moves to govern the disassembly and recycling of ships. Although the organization adopted recommended guidelines on ship recycling in 2003, the IMO's senior technical body agreed in 2005 to develop legally binding regulations for the design, construction, operation, and preparation of ships to enable safer and more environmentally sound recycling, along with rules for enforcing the instrument. The Ship Recycling page also has links to an IMO article on ship recycling, to pages on the current guidelines for ship recycling, and to the website for the joint IMO/International Labour Organization/Basel Convention Working Group on Ship Scrapping.

The Prevention of Pollution section has links to pages on specific forms of pollution covered by the conventions that the IMO is responsible for (such as oil pollution, chemical pollution, sewage, and air pollution). These pages provide information on the specific protocols that govern each area, background on the pollution source and the problems it can cause, and details about how the treaties came about. Within this section there is also a page about shipboard pollution prevention equipment required under MARPOL 73/78.

The Ballast Water Management section includes information on the International Convention for the Control and Management of Ships' Ballast Water and Sediments, which was adopted in February 2004, as well as information in seven languages on other IMO guidelines covering this subject. There is also an external link to the site for the Global Ballast Water Management Programme, a partnership between the IMO, the UN Development Programme, and the Global Environment Facility that seeks to help developing countries understand the problem of ballast contamination and prepare to implement the convention. —Erin E. Dooley

## Zayed Prize Winners

In December the Zayed Prize Higher Committee announced the 2005 winners of this recently established international prize for environmental work. UN Secretary General Kofi Annan was honored for his efforts to catalyze global support for sustainable

development. The members of the expert panel of the Millennium Ecosystem Assessment were honored for cataloging the status of the world's ecosystems and the life-sustaining services they provide. Angela Cropper, co-president of the Cropper Foundation of Trinidad and Tobago, and Emil Salim, the former Indonesian State Minister for Population and Environment, were honored for their efforts to effect actual change in environmental policy. The prizes, worth \$1 million apiece, are awarded every two years.



## Testing New Mothers for Toxicants

In fall 2005, the North American Commission for Environmental Cooperation began a continentwide testing program to analyze the blood of 500 first-time mothers for environmental contaminants including dioxins, furans, PCBs, DDT, chlordane, lindane, arsenic, lead, and mercury. The study will give scientists a profile of population exposure to these pollutants and allow them to assess baseline values and potential areas of concern in Mexico. The testing, which is partially funded by the World Bank, will be conducted at 15 sites in Mexico and Canada; pre-existing data will be used for the United States. A report outlining the results of the study is expected in 2006.

## Breathing Easier at School

Now that many state laws allow students to carry asthma and anaphylaxis medications to school and administer these drugs to themselves, the Allergy & Asthma Network

Mothers of Asthmatics has launched a campaign to educate students, parents, health care providers, and school staff about these new laws and to help students

better manage their conditions. The campaign homepage at <http://www.BreatheAtSchool.org/> offers an interactive U.S. map showing state laws on permitting these medications in schools. Visitors can also download free educational materials such as the Allergies and Asthma at School Kit, which guides students and parents in talking to school staff about allergies and asthma.

