MBL

Catalyst

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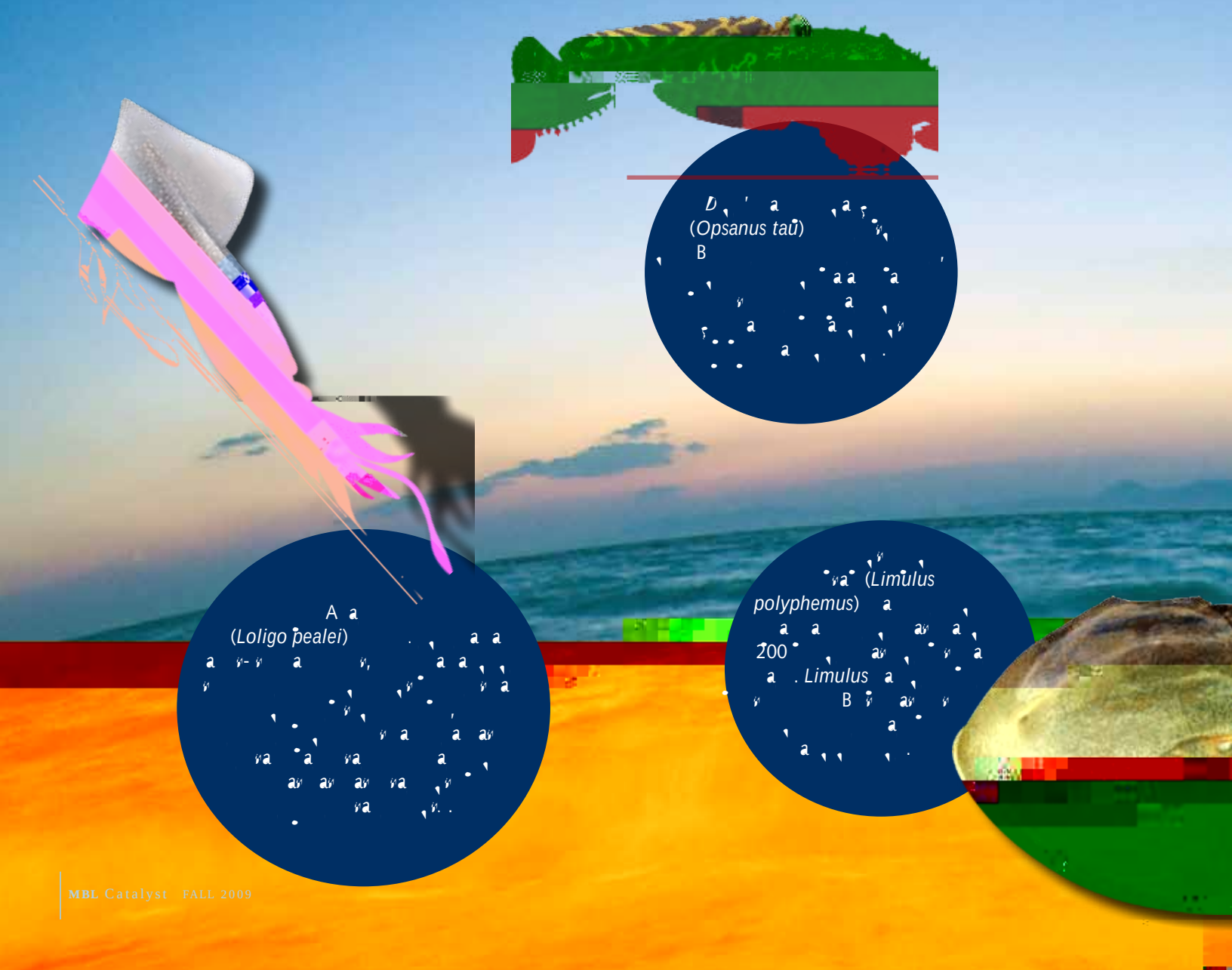
Catalyst

Departments

Creature Feature: *Why Biodiversity Matters*

To the scientist, the animal world presents a wonderful paradox. On the one hand, it contains endless and multi-faceted diversity. Each of the millions of species, from microbe to monkey, is uniquely shaped by evolution to prosper in its own planetary niche. This creates a magnificent variety of distinct features, from the signaling skin of cuttlefish to the articulate hands of human beings.

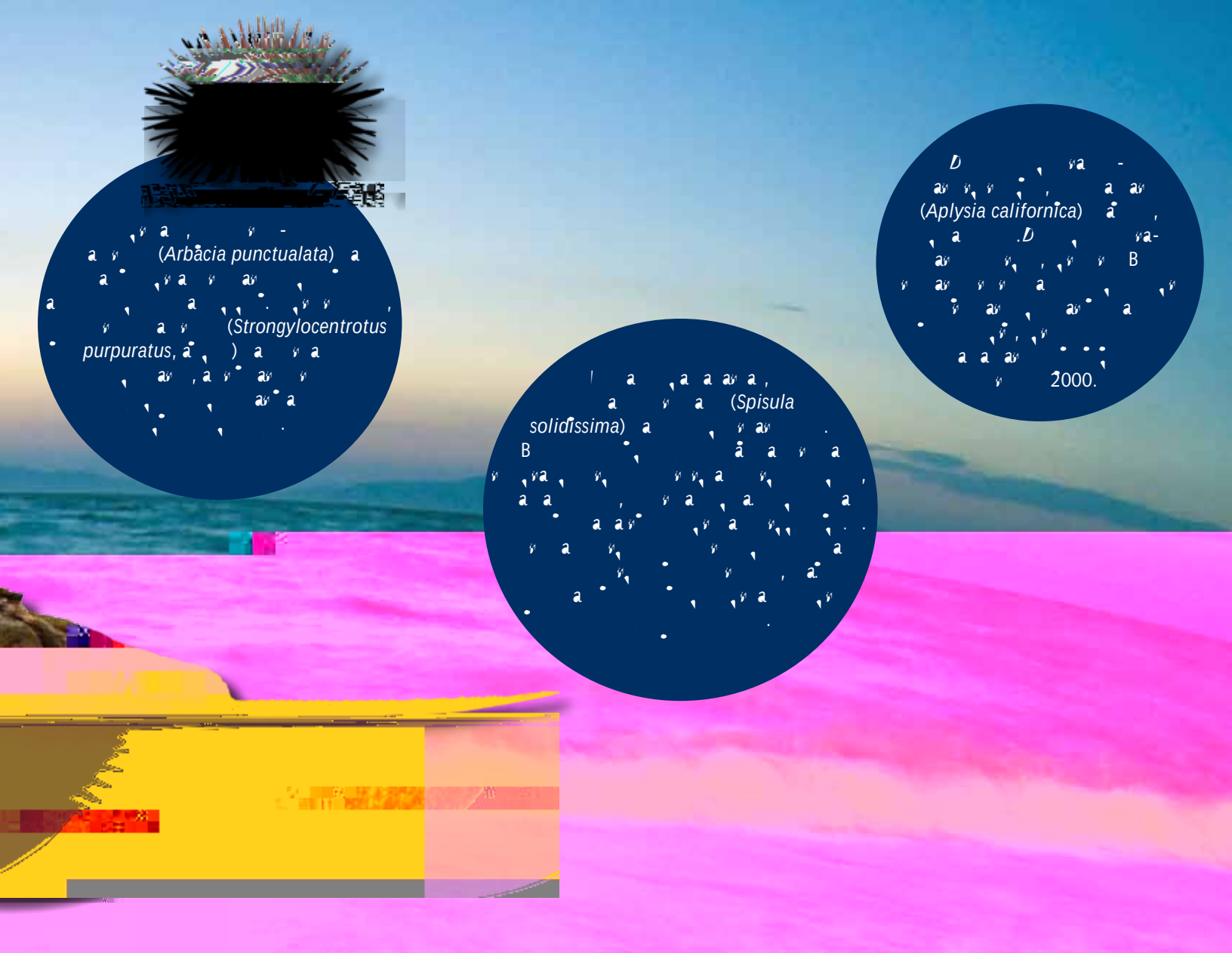
From this diversity in the animal world, the concept of a model organism in science arose: "For a large number of (biological) problems, there will be some animal of choice on which it can be most conveniently studied," wrote MBL investigator August Krogh in 1929. A scientist interested in fertilization, for instance, will make faster progress studying the prolific sea urchin, which releases thousands of eggs each summer, than a slowly reproducing mammal.



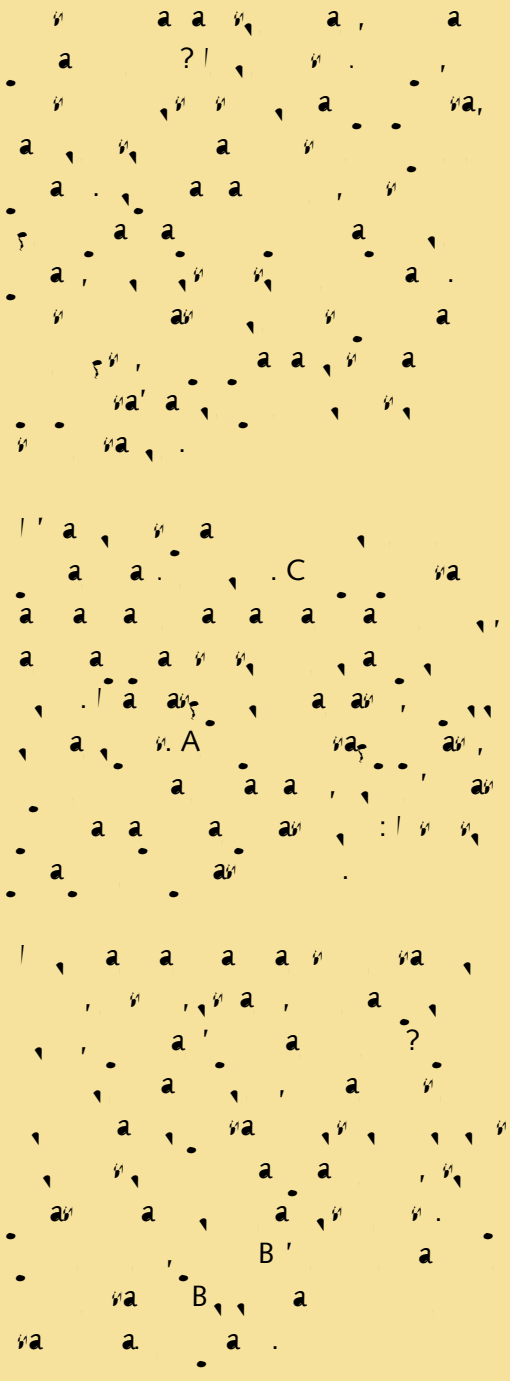
Below the boundless diversity in the animal world lies an astonishing degree of commonality at the genetic level.

But here also lies the paradox. How can insight gleaned from simple animals in any way translate to cures for human disease and disorders? The answer lies in the genes. Below the boundless diversity in the animal world lies an astonishing degree of commonality at the genetic level. The genes that control cell division or hormone release—or any aspect of growth, disease, or aging—are essentially the same in the worm and the fish and the mouse and the human.

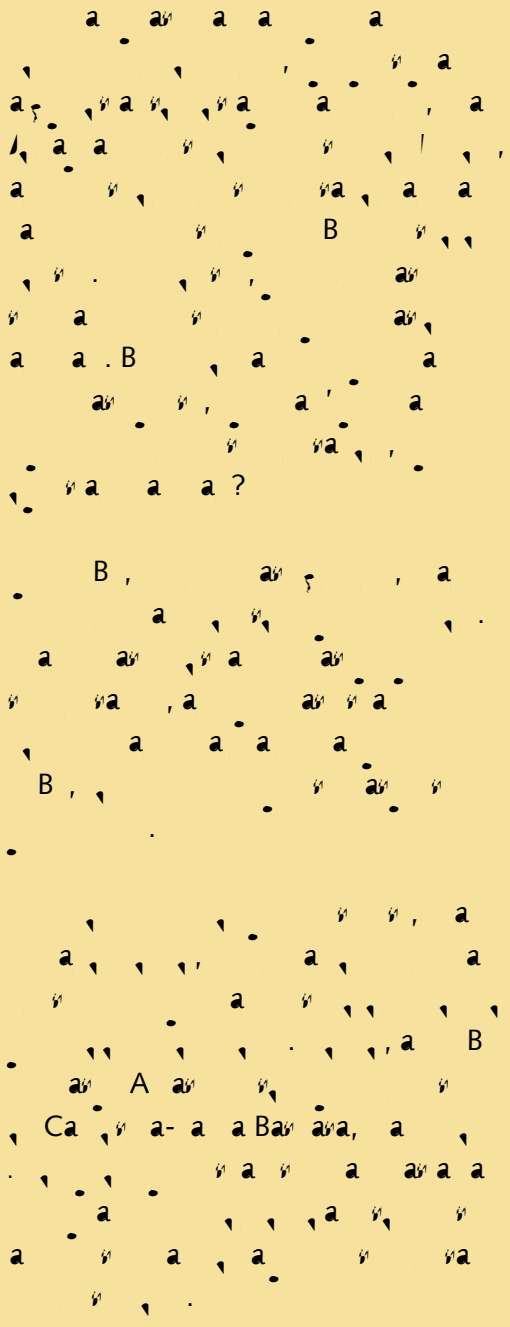
As this issue of *MBL Catalyst* celebrates, scientists at the MBL study animals at all levels of organization—from the single gene in a fish that may explain autism in a child; to the communities of microbes that power our planet; to the entire kingdom in the Encyclopedia of Life. Much of the animal world remains unexplored, yet discovering and preserving biodiversity is key to advances in medicine, as well as the protection of life on Earth. Read on, and see what the animals are telling us.

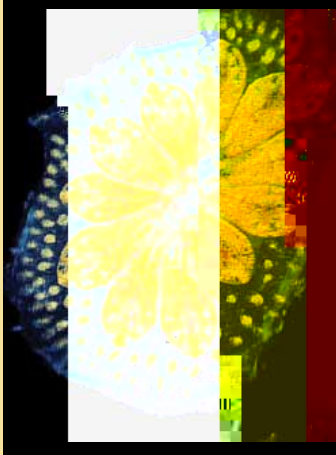


It’s Back!



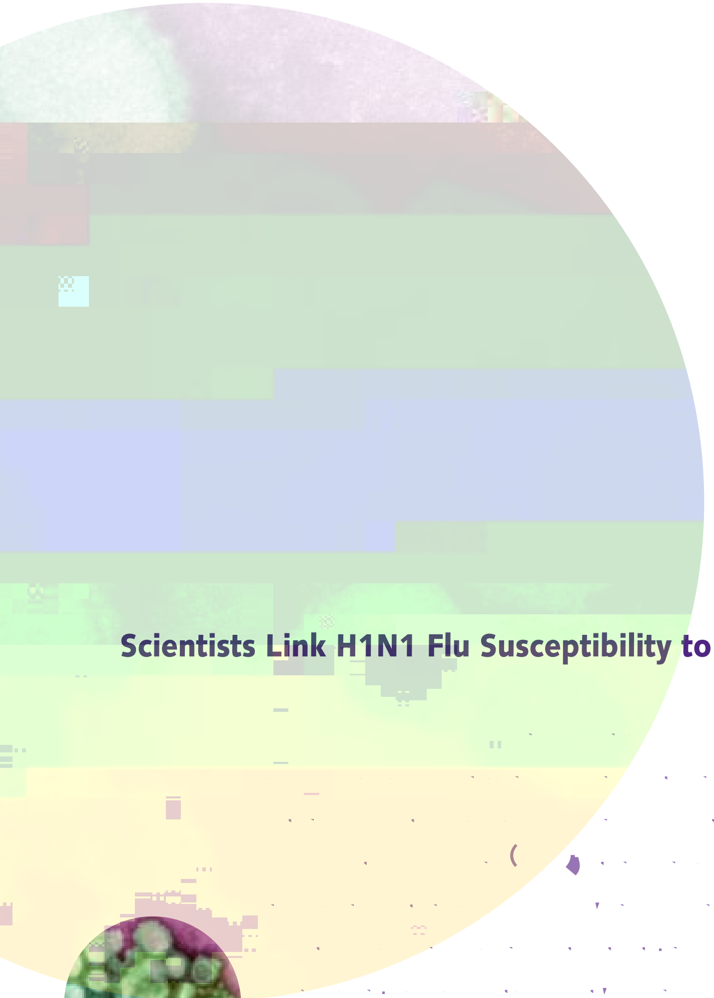
If so many animals





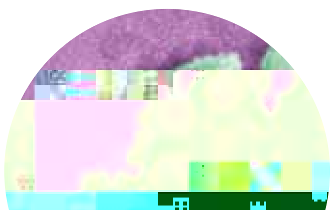
News & Notes

MBL Scientist Spearheads White House Climate Change Report



Scientists Link H1N1 Flu Susceptibility to Common Levels of Arsenic Exposure

(*Environmental Health Perspectives*

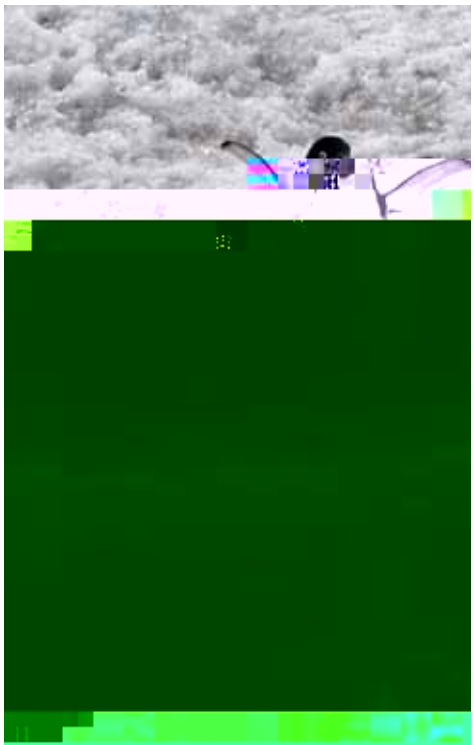


2008 B *Science* C *C. elegans*,

(*Science* 324, 1729-1732, 2009)

Science 80 30

(*Science* 323: 1470-1473, 2009)



Steward of the Seas

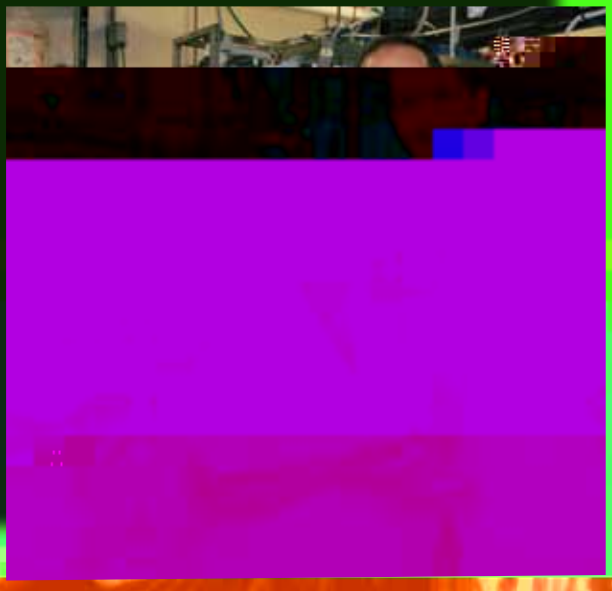
MBL alumna Jane Lubchenco takes a holistic approach to ocean policy as NOAA's new head

"Our focus is very much on having healthy, productive, resilient ocean systems," she says. "There is a common commitment to be good stewards, to work together as partners. And that is pretty remarkable and exciting to be a part of!"

Vital Statistics

One Fish, Many

Zebrafish swim to the fore



Hats

MBL Moment

The Big Picture

. . . with

Jesse Ausubel
Vice President, Programs
Alfred P. Sloan Foundation

Jesse Ausubel is vice president at the Alfred P. Sloan Foundation, where he directs programs in basic science and technology. Ausubel also directs the Program for the Human Environment at The Rockefeller University; and is an adjunct faculty member at Woods Hole Oceanographic Institution. Associated from 1977 to 1988 with the National Academy complex in Washington, D.C., he was one of the principal organizers of the first U.N. World Climate Conference in 1979 and has authored and edited more than 150 publications on technology and environment.

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JA As a small child, I loved almanacs, encyclopedias, and atlases; by age 10 I had memorized the New York City subway system. I identify with the 18th century vision of science, of exploration and discovery and documentation. So naturally, I liked the idea of appreciating all life in the sea, or creating an encyclopedia of all species.

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JA In about 1990, I asked, "How much land could 10 billion people spare for nature?" Conventional wisdom projected that more people on Earth would leave less land for nature, while I was interested in the chance of a great restoration of wild nature. Clearly, sparing the sea equals sparing terrestrial habitat in importance. I was shocked to learn how little we know about what lives in the ocean. In marine biology, the models were better than the data. In seminars at Woods Hole Oceanographic Institution and MBL, researchers would present sophisticated mathematical simulations of ecosystems with very few measurements at the level of species, whether tuna or jellies. In fact, the expert consensus was that about 90 percent of the ocean was unexplored and poorly documented biologically.

In 1996, Fred Grassle, a benthic ecologist formerly at WHOI, and I began talking about this lack of observation of marine biodiversity. Something big needed to be done to generate more information on all life in the oceans, top to bottom, to generate more understanding and eventually more beneficence. From the World Climate Program and other early career experiences, I knew how to organize cooperative international scientific programs. After lots of consultations, many on summer days on Water Street in Woods Hole, the Census officially kicked off in May 2000.

"How do you understand the relatedness of all 200,000 forms of marine life? Or longevity across many taxa? Or the effects of climate change on the diversity of life in ecosystems? For such questions, science needs macroscopes, and happily the MBL and its sister institutions are creating them."

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JA In late 2005, at a meeting in Frankfurt, the Census scientists raised the issue of how to standardize and provide access to the fast-growing information on the 200,000 or so named marine species. Would each Census team need to create its own software and user interfaces, its own species Web pages? This would be extremely inefficient, and bewildering for users of the information. The Census community emphatically asked me, as a manager of the program, for a convenient, open-access, open-source informatics framework.

A few weeks later, in a happy convergence, the president of the MacArthur Foundation, Jonathan Fanton, contacted me. Jonathan had received a one-page letter from Ed (E.O.) Wilson at Harvard about his concept for an online Encyclopedia of Life. Jonathan invited me to lead a feasibility study on the EOL for MacArthur, which I did in 2006 and 2007. We concluded that advances in software, including some developed in the MBLWHOI Library and in Mitchell Sogin's lab at the MBL, meant the EOL could happen fast and economically. Moreover, the Marine Census illustrated the demand for an EOL, both from researchers and the general public.

In practice, the EOL is a godsend, and not just for the Census. If every expert had to create the software that the EOL's Biodiversity Informatics Group has created, most species would never have pages. The growth of the EOL has been incredible. Within a year of Ed Wilson's letter to MacArthur, the MBL and other cornerstone institutions involved in the project had funding commitments for $45 million. With the leadership of MBL scientist David Patterson, the EOL site went public a year later, and now it contains more than 150,000 species pages with vetted content that have benefited about two million unique visitors. No other project in my career has moved as fast.

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JA Many marine species already have good pages, and by the crescendo of the Census in October of 2010, a large fraction of marine species will be vividly present in EOL. The Census is also working with Google Earth and National Geographic to share information through maps and new forms of visualization. The biodiversity community is moving toward a much more integrated vision of services, an "e-Biosphere" in which users will navigate seamlessly from species names to DNA sequences to historical literature to maps and images.

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JA "Macroscopes" are joining microscopes as premiere tools for 21st century biology. For centuries, biology discovered by zooming into smaller and smaller things. Now, projects including the Census and the EOL enable us to discover and appreciate patterns and phenomena that before were too big to see. How do you understand the relatedness of all 200,000 forms of marine life? Or longevity across many taxa? Or the effects of climate change on the diversity of life in ecosystems? For such questions, science needs macroscopes, and happily the MBL and its sister institutions are creating them. •

Signals from the Squid

Scott T. Brady is professor and head of the department of Anatomy and Cell Biology at the University of Illinois College of Medicine in Chicago. He has been conducting research at the MBL since the early 1980s. During

TREASURES FROM THE MBL'S ARCHIVES

From the Deep

Prince Albert I of Monaco was an avid oceanographer. He arranged many scientific campaigns on his four yachts, and the biologists aboard made hundreds of drawings of the organisms they encountered. This culminated in *Resultats des Campagnes Scientifiques* (1900), a massive, multi-volume work devoted to marine organisms, such as the rare deep-sea octopi in this colorized print. Now, for the first time, the *Resultats* have been scanned by the MBLWHOI Library and are available online through the Biodiversity Heritage Library (www.biodiversitylibrary.org). The BHL is a consortium of more than 40 libraries in the United States, Europe, and Asia that is digitizing tens of thousands of volumes of biodiversity literature. This trove is a magnificent resource for the Encyclopedia of Life (www.eol.org), which is creating an authoritative Web page for every species on Earth. Prints like this one, of graceful octopi, are vital for taxonomists who are tracking how species names—and even distributions—have changed since Albert I, "Prince of the Sea," sailed the Atlantic over a century ago. • — JD

From Joubin, Louis (1900) "Fascicule XVII: Cephalopodes provenant des campagnes de la Princesse-Alice (1891-1897)," in a Ca a ; A , a a A , a . III. The octopi are now known as , (top), B , (bottom), and a a (side diagrams).

Powerful Partnerships

On its own, the MBL is a world leader in biological research and education. Together with its partners, it is a powerful force for social change. In the next issue of *MBL Catalyst*, we profile some of the dynamic people and organizations that ally with the MBL to solve some of the pressing medical and environmental issues facing society today.

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