MARINE CENSUS

Grants Kick Off Ambitious Count of All Ocean Life

Scientists around the world take on a grand challenge to dramatize the need for more marine research

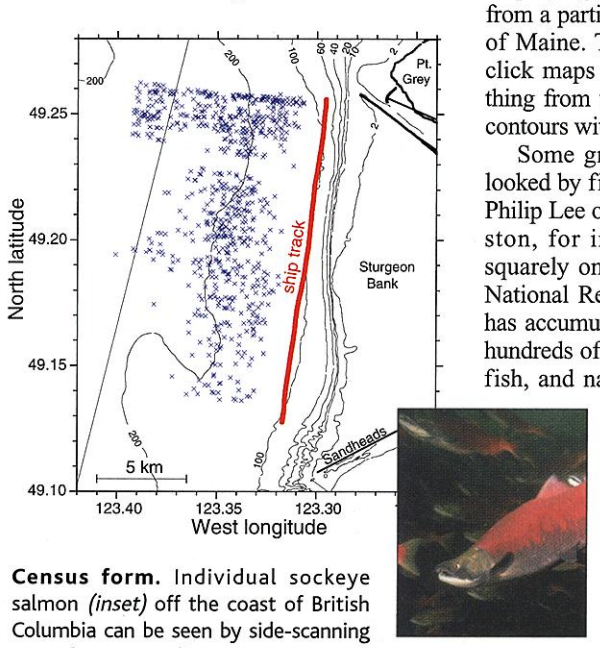
J. Frederick Grassle believes in the power of numbers. A marine biologist at Rutgers University in Camden, New Jersey, Grassle has spent years advocating more research on life in the world's oceans. During a conversation a few years ago with Jesse Ausubel, a program officer with the Alfred P. Sloan Foundation in New York City, the pair hit upon a promising idea for igniting the public's passion for marine research: What about counting all the living creatures in the vast deep?

Last week the idea, a "Census of Marine Life," took a big step toward reality when eight research groups were awarded $3.7 million to develop model Internet atlases that display everything from the distribution of squids to the DNA sequences of tiny zooplankton. The projects, administered by the Washington, D.C.–based National Oceanographic Partnership Program, kick off what could become a 10-year, billion-dollar effort to use everything from dip nets to airborne lasers to enumerate and map marine life. "The census is driven by three questions," says Ausubel: "What did, what does, and what will live in the ocean?"

Answering the trio of questions, he admits, is a "grand challenge." Although researchers have described some 15,000 kinds of marine fish, for instance, they estimate that at least 5000 more species, along with countless crustaceans, shellfish, and worms, have eluded detection. And often the numbers and distribution of even known species are sketchy.

The census aims to reduce such uncertainty by making existing data more accessible and useful to researchers, and by creating computerized libraries that can accommodate a flood of new numbers from studies of selected ocean patches. By applying new technologies for identifying marine species from afar, census planners also hope to give conservationists and regulators better tools to estimate marine populations, and provide the public with a global snapshot of marine diversity. Some environmentalists worry that identifying hidden populations could unintentionally hasten their exploitation. But researchers say that the potential conservation benefits outweigh the risk. "One reason we've done a woeful job of conserving marine biodiversity is that we lack an understanding of what and where it is," says Elliott Norse of the Marine Conservation Biology Institute in Redmond, Washington.

A grand challenge. Like many big ideas, the Census of Marine Life was born partly of frustration. Despite increased public concern about threats to global biodiversity, financial support for marine biology has lagged. The antidote that Ausubel and Grassle proposed in 1997 was a "census of the fishes." But it morphed into a census of all marine life after protests from biologists working on scaleless creatures.



Census form. Individual sockeye salmon *(inset)* off the coast of British Columbia can be seen by side-scanning sonar from great distances.

Many scientists were initially skeptical that a census would be technically feasible—let alone affordable. But after attending workshop presentations on the rapid advances in a wide range of sensing technologies, from plankton-spotting satellites to biomolecular tests that can sniff out an organism's chemical signature, many were won over to the cause. Environmentalists, however, tempered their support with concern that governments might be unable to prevent a rush to exploit any new populations uncovered by the census.

Keeping such concerns in mind, Grassle assembled a team of researchers from the United States, Canada, Europe, and Japan to sketch out an action plan. Although a complete draft won't be ready until later this year, the group agreed that its first step would be "to take the best data we already have—which is often in some researcher's notebook—and make it widely available in a standard format," says Grassle. Researchers dubbed this concept the global ocean biogeographic information system (OBIS).

The eight 2-year grants—ranging from $350,000 to $500,000 and involving 63 institutions in 15 nations—are designed to jumpstart OBIS. A team led by Edward Wiley of the University of Kansas's Natural History Museum in Lawrence, for example, hopes to link 21 databases holding information on 39 million fish specimens through FISHNET, a Web-based archive. Others, such as Dale Kiefer of the University of Southern California in Los Angeles, will develop tools for displaying and manipulating information from a particular region, in his case the Gulf of Maine. The eventual goal is point-and-click maps that can display data on everything from water temperature to sea bottom contours within a particular swath of ocean.

Some grants tackle species often overlooked by fisheries biologists. A team led by Philip Lee of the University of Texas, Galveston, for instance, hopes to put squids squarely on the map. His world-renowned National Resource Center for Cephalopods has accumulated more than 5000 slides and hundreds of hours of video of squids, cuttlefish, and nautiloids over the last 25 years, and is eager to share them over the Internet. Deborah Steinberg of the Bermuda Biological Station for Research in Ferry Reach has a different task in mind for her partners: counting minute crustaceans called copepods. Since 1988, her Bermuda Atlantic Time-Series Study has collected millions of pieces of data—including zooplankton samples that may contain as many as 1000 species, including 150 types of copepods—from a site in the Sargasso Sea. With help from experts from Russia and the United States, she will now identify the critters, giving the database even more depth.

Technological fixes. Steinberg's work will rely on some of the technologies that the census is counting on for success, including silhouette-recognition software that can identify zooplankton species from photos. By 2003, planners hope to begin pilot projects that will "test how far we can push" other technologies for both mapping and identifying species, says Grassle. Surface-layer–piercing airborne lasers that combine the speed of light with the range of an airplane, for instance, "have opened up the possibility of quickly surveying much larger areas" than

CREDITS (TOP TO BOTTOM): SOURCE: DAVID FARMER; STUART WESTMORLAND/CORBIS

once considered possible, notes steering panel member David Farmer of the Institute for Ocean Sciences in Vancouver, British Columbia. Farmer's own work with side-scanning sonar (see graphic) has shown that it is possible to identify individual fish from up to 10 kilometers away. Such sensors, mounted on seagoing "tollgates" installed along migratory routes, could provide valuable insights into population movements.

One major problem for the census takers will be deciding where to deploy such relatively expensive technologies. "The question is how many cleverly designed projects you'll need to put together a good global picture," says Ausubel. Possible targets for the next phase of the census include poorly understood environments, such as sea mounts and deep-sea vents, and heavily fished regions, such as the Gulf of Maine or the Alaskan coast.

The census has won support from biologists involved in policy-making, such as Mike Sissenwine of the National Marine Fisheries Service in Woods Hole, Massachusetts. "It's a wonderful grassroots scientific effort, and the spin-offs will be tremendous," he predicts. Grassle hopes the census will also revive such fields as systematics and biogeography. "They used to be central themes in marine science, but they've become peripheral," he says. "We want to bring them back to the center."

Achieving that will require money, and Ausubel and others are optimistic that the United States, Japan, and European nations will help foot the bill, along with private foundations. At the same time, the organizers are careful not to promise too much. "We're still developing exactly what we mean by census," says Grassle, whose working definition is "not counting everything, but doing a much better job of surveying ocean life." Such an effort would still represent a compelling opportunity, says Ausubel: "Even if the full census is never realized, this is something that will be very useful."

–DAVID MALAKOFF

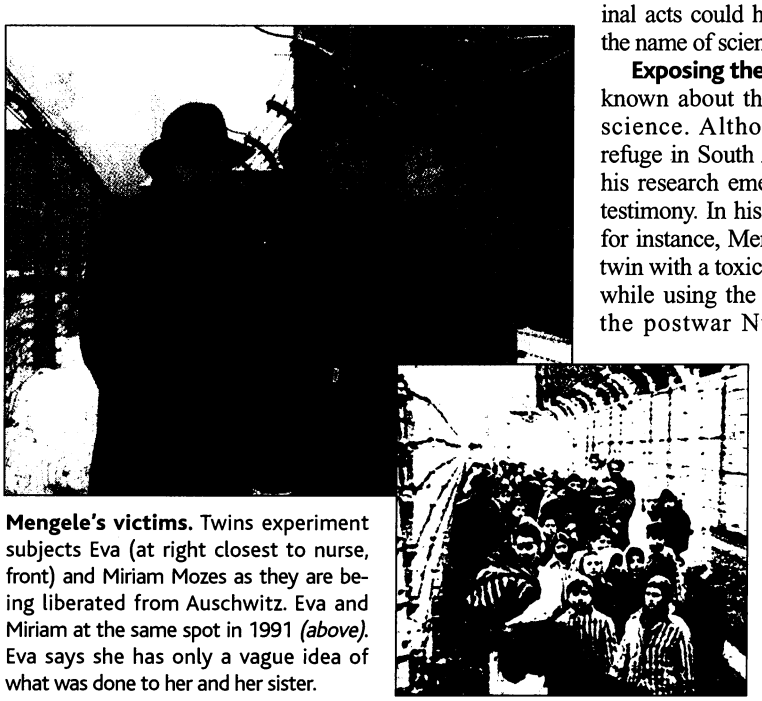
NAZI RESEARCH

Reopening the Darkest Chapter in German Science

As historians dig up disturbing new details about the complicity of German researchers in Nazi-era crimes, officials are calling for full disclosure

BERLIN—More than a half-century after it happened to her, Eva Mozes Kor can still recall the mysterious injections, the frequent blood tests, and the dark-haired young man with a hawklike brow who hovered over her bed one day, waiting for her to die. Kor would disappoint her tormentor: Neither she nor her twin sister, Miriam, succumbed to Nazi physician Josef Mengele and his World War II experiments on prisoners, mostly Jews, at the Auschwitz-Birkenau concentration camp. But the sisters did not emerge unscathed. To this day, Kor says she agonizes over not knowing what Mengele injected into her and Miriam, and for what nefarious purposes their blood was used. And she has waited in vain for an apology from any scientific institution whose Nazi-era predecessors had used Mengele's results. An apology, says Kor, who lives in Terre Haute, Indiana, "would mean a great deal to survivors. Why can't they do this simple thing?"

That question reverberates through the modern-day German scientific community, which regards Mengele as a murderous maverick but is now focused on the complicity of more legitimate researchers. Last month, at a meeting* here sponsored by the country's main science granting agency, DFG president Ernst-Ludwig Winnacker acknowledged that the wartime DFG "had allowed itself to be made into an instrument of a criminal regime. As part of Hitler's state, it allowed crimes against humanity under the guise of science." And new evidence involving Nobel laureate Adolf Butenandt, wartime director of the biochemistry institute of the prestigious Kaiser Wilhelm Society, suggests that the cover-up of certain Nazi-era abuses, and the postwar scientific community's embrace of dozens of tainted researchers, was more widespread than previously imagined.



Mengele's victims. Twins experiment subjects Eva (at right closest to nurse, front) and Miriam Mozes as they are being liberated from Auschwitz. Eva and Miriam at the same spot in 1991 *(above)*. Eva says she has only a vague idea of what was done to her and her sister.

CREDITS: COURTESY EVA MOZES KOR/C.A.N.D.L.E.S. HOLOCAUST MUSEUM AND EDUCATION CENTER

With the past appearing in an ever more sinister light, both Winnacker and Hubert Markl, president of the Kaiser Wilhelm's postwar successor, the Max Planck Society, contend that a public apology would be a hollow gesture. Instead, they have launched separate historical inquiries into the abuses of the Kaiser Wilhelm institutes and the DFG during the Nazi era and postwar years. "We need to do this not only for the victims but for future generations of scientists," Markl says. "We must make clear how murders and other criminal acts could have been conducted in the name of science in Germany."

Exposing the past. Much is already known about the horrors of Nazi-era science. Although Mengele found refuge in South America, details about his research emerged from eyewitness testimony. In his infamous twins study, for instance, Mengele would inject one twin with a toxic substance or pathogen while using the other as a control. At the postwar Nuremberg "doctors' trial"—which ended in 1947 with the conviction of 15 defendants, seven of whom were hanged—prosecutors outlined a series of cruel experiments to test the limits of endurance. Prisoners were exposed to everything from mustard gas and malaria to freezing-cold seawater and high-altitude conditions of low pressure and scarce oxygen. The evidence also shows how the Kaiser Wilhelm Institute of Psychiatry exploited Nazi pogroms to obtain the brains of mentally ill people for

* "Science and Science Policy: Interactions, Continuities, and Inconsistencies From the Late Empire to the Early German Federal Republic/Democratic Republic," 18 to 20 May.