nuclei. They found that *Wolbachia* tinker with the timing mechanism. In healthy wasps, both pronuclear envelopes were destroyed at the same time. But when the sperm came from an infected male, its pronuclear envelope started decaying a minute or more after the uninfected female's, preventing the enclosed chromosomes from arranging appropriately before the cell divided. The egg then divided as if it had never been fertilized, using only the chromosomes from the mother to develop into a male.

Because *Wolbachia* block an infected male's chromosomes with a simple change of timing, they can bring the process into sync with an equally simple trick. When Tram and Sullivan fertilized an infected egg with sperm from an infected male, the walls of the female's pronuclear envelope also took longer to disintegrate. As a result, both parents' chromosomes were released late, so that both became part of the embryo's genome. Such infected wasps, in turn, grow up to do their bacterial puppet masters' reproductive bidding. **–CARL ZIMMER**

Carl Zimmer is the author of *Evolution: The Triumph of an Idea.*

MICROBIOLOGY

New Method for Culturing Bacteria

The well-trained *Escherichia coli* aside, the majority of bacteria don't take to the petri dish. Pull them out of their native environments, and microbe colonies seem to wither away with a terminal case of homesickness. Now, in work reported on page 1127, researchers at Northeastern University in Boston have managed to grow in the lab several strains of previously unculturable beach-growing bacteria—an advance that may provide a new means of exploring the vast diversity of microbial species.

The key to their success: transplanting not just the organisms but their whole sandy neighborhood along with them. "If we recreate the natural conditions," says microbial ecologist and team leader Slava Epstein, "the bacteria will never know they've been moved."

The inability to culture bacteria has dampened efforts to study microbial diversity. Whereas scientists have described roughly half of plants and animals and maybe a fifth of insects, "we know only a tiny fraction of a percent of the bacterial species," says Abigail Salyers, a bacteriologist at the University of Illinois, Urbana-Champaign.

Given the difficulty of culturing most microbes, researchers have mostly explored microbial diversity secondhand by hunting for RNA signatures in the environment that signal the presence of novel active genes. Although such information can point to the existence of microbial life, it doesn't help much when it comes to identifying and characterizing the organisms. "Nothing beats actually having the organism in culture," says microbiologist Stephen Giovannoni of Oregon State University in Corvallis.

Studying the organisms in culture can not only provide new information about microbial evolution and ecology but may also yield a host of useful compounds, such as antibiotics or enzymes with unexpected properties. For example, the Taq polymerase used in the polymerase chain reaction comes from a thermophilic bacterium.

Because attempts to grow bacteria in standard lab cultures had so often failed, Epstein, microbial ecologist Tammi Kaeberlein, and molecular microbiologist Kim Lewis wanted to test their idea that a natural setting would supply the ingredients needed for the bugs to survive. To do this, the researchers collected samples of prime bacterial real estate on a sandy beach near the university's Marine Science Center on Nahant island north of Boston. The team cut blocks of sand that were 60 centimeters long, 30 cm wide, and about 15 cm deep. Although the bacteria reside on the surface, the depth was essential to maintain the same chemistry and oxygen conditions as at the beach, Kaeberlein says.

Beach colonies. Beaches harbor a wealth of microbes now being cultured in the lab. The micrograph (*inset*) shows a lab-grown colony.

Once each block of sand was in an aquarium, the team created chambers in which they hoped to mass-produce pure cultures of some bacterial strains. The chambers, which rested on the sand and were covered with seawater, had walls consisting of permeable membranes that allowed nutrients and other environmental chemicals to enter the chamber but prevented the bacteria from escaping.

Bacteria in these chambers thrived, forming 300 times the number of colonies produced in conventional lab culture dishes. At least 20% of the organisms placed in the chambers formed colonies, compared to much less than 1% in the culture dishes, Epstein says. Using this technique, the researchers so far have isolated two previously unknown microbes, called MSC1 and MSC2 (MSC for Marine Science Center), and are investigating nine more.

The work also provided an intriguing hint about why some microbes don't grow well. When Kaeberlein was cleaning out the refrigerator, she noticed that one supposedly pure bacterial strain that had surprisingly thrived in a culture dish wasn't pure after all. "There was more than one type of organism growing in there," she says.

When the researchers investigated, they found that MSC1 and MSC2 would grow in the petri dish only when both strains were present. Because the growth didn't seem to depend on the food supply, the team suggests that the bacteria may signal each other in the environment, transmitting some sort of "all's well" call that certain species need to hear before they'll proliferate. Such signals have been detected in the biofilms formed by many bacteria.

Marine microbiologist Edward DeLong of Monterey Bay Aquarium Research Institute in Moss Landing, California, points out that the new method isn't going to solve all bacterial culture problems; many environmental niches aren't compatible with the diffusion-chamber format. Even so, he says, any advance in culturing microbes will help put more microbe species on the map.

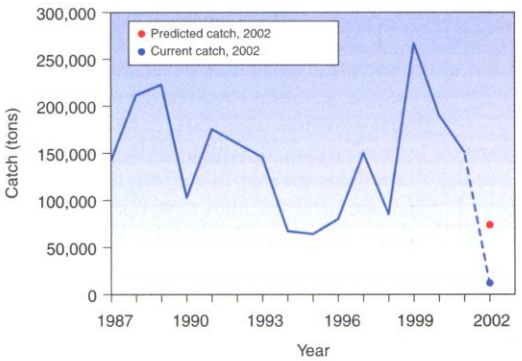
–KATIE GREENE

FISHERIES RESEARCH

No More Surprises From Evanescent Squid

CAMBRIDGE, U.K.—In a good year, fishing boats can haul almost 300,000 tons of squid out of the South Atlantic ocean. But this spring, many are returning virtually empty. In fact, 2002 is shaping up to be the poorest year for one of the world's largest squid fisheries —worth up to $1 billion in good years— since record keeping began in 1987. That's dismal news for squid fishers and calamari

CREDITS: T. KAEBERLEIN



Here today ... Researchers can now predict the ups and downs of the Argentinean flying squid.

aficionados but no surprise to a team here at the British Antarctic Survey (BAS). Using a model based on ocean temperatures and currents, BAS researchers predicted the dearth of squid off the Falkland Islands.

In contrast to many other fish stocks that are reeling, overfishing is not to blame for this year's pathetic catch of the Argentinean flying squid. The culprit is poor hatching and nursery conditions last year, says BAS biologist Paul Rodhouse, who developed the model with BAS's Claire Waluda. The model's success may help gird the industry for future off years, and it may serve as a template for predicting catches of other short-lived species, such as anchovies, in the South Atlantic and elsewhere.

A key hurdle the researchers had to overcome in modeling the flying squid is its short life-span: only 1 year. The larvae hatch near the River Plate estuary off the coast of Argentina in July and then, after maturing, swim several hundred kilometers south to cooler, plankton-rich waters near the Falkland Islands. There they are caught by international fishing vessels using lines between February and June. Those that elude capture attempt to return to their breeding grounds, where they spawn and die. The fact that the population goes from larvae—"no squid at all"—to fully grown adults in only a few months makes sampling and predictions based on the previous year's catch difficult, says Robin Cook, a modeling expert at the Fisheries Research Services in Aberdeen, U.K. Indeed, last year's catch is mostly irrelevant, says Rodhouse, who compares the squid to the desert locust: "It doesn't make any difference how many you kill. When the environmental conditions are right, they return as a plague."

Rodhouse and Waluda zeroed in on sea temperature in the nursery area in July to predict the catch 8 months later. Last July, temperatures were 1.5° Celsius warmer than average, driving a shift in currents that swept larvae into the open ocean. "While they are small, they are at the mercy of the currents," says Waluda.

CREDITS: (TOP TO BOTTOM) SOURCE: BAS; C. GILBERT/BAS; ROBERT F. BUKATY/AP

The duo predicted a catch of 73,000 tons this year, near the bottom of an annual catch that fluctuates wildly between 60,000 and 290,000 tons a year. With only a few weeks to go this season, the haul has barely reached 10,000 tons—a severe economic loss considering that the squid fetches $3000 per ton.

The model's success may help fishery managers cope with future disastrous years by suggesting, for example, how many vessels should be licensed. In addition, this type of model could work for other fisheries—such as a squid fishery off the coast of South Africa—that are susceptible to the vagaries of currents, says Jean-Paul Robin, an expert on cephalopod fisheries at the University of Caen, France. In the meantime, managers at the South Atlantic squid fisheries are steeling themselves to this coming July's readings—and the omen they will offer. **–ADAM BOSTANCI**

SCIENTIFIC COMMUNITY

U.S. Science Academy Elects New Members

The U.S. National Academy of Sciences last week elected 72 new members—11 women and 61 men. Among them was J. Craig Venter, the controversial leader of a private venture that last year completed a rough draft of the human genome. Some members were prepared for a challenge to Venter's election, but none materialized. The new members and their affiliations at the time of election* are:

Harvey J. Alter, National Institutes of Health (NIH); **Boris L. Altshuler**, NEC Research Institute and Princeton University; **Kathryn V. Anderson**, Cornell University and Sloan-Kettering Institute; **Barry C. Barish**, California Institute of Technology (Caltech); **Jacqueline K. Barton**, Caltech; **Adriaan Bax**, NIH; **Zdenek P. Bazant**, Northwestern University; **Philip A. Beachy**, Howard Hughes Medical Institute (HHMI) and Johns Hopkins University School of Medicine; **Manuel Blum**, Carnegie Mellon University; **John Bongaarts**, The Population Council; **Patrick O. Brown**, HHMI and Stanford University School of Medicine; **Carlos J. Bustamante**, HHMI and University of California (UC), Berkeley; **William C. Campbell**, Drew University; **Harvey**

* For more details, go to www.national-academies.org.

ScienceScope

Neutron Plans Unveiled European researchers will make their case next week for a powerful accelerator designed to produce neutrons to probe the structure of proteins and designer materials. On 16 and 17 May, leaders of the European Spallation Source (ESS) project will meet in Bonn, Germany, to unveil their plan to the research community, the media, and—most importantly—politicians who will decide whether to fund the long-discussed facility. "It's like a motor show where we'll pull the sheet off our wonderful new model, and we want to hear the audience gasp," says Robert Cywinski, a physicist at the University of Leeds, U.K., and chair of the European Neutron Scattering Association.

An expert commission gave ESS its blessing in 1996 (*Science*, 9 May 1997, p. 891), but political support was slow to follow. Since then, planners have redesigned the machine so that it would leapfrog over two sources under construction in the United States and Japan. ESS "would allow [Europe] to keep [its] position on the world stage for 30 to 40 years," Cywinski says.

But ESS backers first need to find an estimated $1.5 billion. Construction could begin in 2004, with completion set for 2011. Five sites are competing for the project: Yorkshire and the Rutherford-Appleton site near Oxford, U.K., Lund in Sweden, and Jülich and Halle in Germany.

Mouse Tale at End? It's official: Mice, rats, and birds used in laboratory research are no longer animals—at least according to a major federal animal welfare law. In a big win for the biomedical research community, Congress this week approved a massive farm bill that includes language exempting the animals from regulation under the Animal Welfare Act. President George W. Bush is expected to sign the bill, ending a decade-old struggle by animal activists to force the U.S. Department of Agriculture to regulate the use of the most common laboratory animals (*Science*, 22 February, p. 1439). The bill also orders the National Academy of Sciences to conduct a 1-year study of the use and regulation of mice, rats, and birds in research.

Animal advocates, however, say they will carry the fight to a new arena: the states. John McArdle of the Alternatives Research and Development Foundation in Eden Prairie, Minnesota, says activists will work to pass state laws that require researchers to consider alternatives to animals in experiments and to treat all animals humanely.