

of the Vienna University of Technology, one of the authors of the paper. The researchers shined a strong beam of laser light at a volume of neon gas to produce x-ray photons



**Don't blink.** Viennese researchers Reinhard Kienberger and Michael Hentschel work on a beam line that carries attosecond pulses.

of different frequencies. For the most part, the frequencies canceled each other out through destructive interference, leaving a spike where they added up. Because the laser flash lasted only a few wave cycles, Krausz and his colleagues were able to obtain a single spike instead of a train of spikes, something that a group of French and Dutch researchers achieved earlier this year (*Science*, 1 June, p. 1627).

Measuring the duration of this pulse posed a bigger challenge. The researchers shot the pulse, along with the laser beam used to create it, into a chamber of krypton gas. The x-ray pulse ionized the krypton, causing electrons to fly out of their parent atoms with a certain kinetic energy. The electric field of the laser beam then subtly changed the kinetic energy of the electrons by amounts that depended on which point in its rising-and-falling cycle the field had reached at the instant the pulse knocked the electrons loose. Changing the birth moment of the photoelectrons—that is, the time the x-ray pulse struck the krypton atoms—determined how much the laser beam altered the electrons' kinetic energies.

Shooting the x-ray pulse into the gas at various points in the laser cycle, Krausz's group observed that the change in kinetic energy rose or fell in a wavelike pattern, or modulation. The appearance of the modulation in the spectrum proved that the time of the krypton's ionization—and hence the duration of the x-ray pulse—fell within a window of time less than half the 1.2-femtosecond period of the laser cycle. "If the pulse were longer, it would not be possible to see the changing influence of the laser field as it goes through one cycle. The modulation would be smeared out," Krausz explains.

From the modulation, the researchers calculated that the x-ray pulse lasted a fleeting 650 attoseconds and that the krypton atoms released their electrons in less than 150 attoseconds. The modulation also gave information about the oscillating laser field. By combining it with the intensity of the laser beam, the researchers traced the beam's changing electric field over the course of one cycle—in effect, sketching the curve of a wave of light.

It's only a matter of time, Krausz says, before the technique they have demonstrated is applied to meaningful attosecond experiments. One is the study of inner-shell relaxation—the filling up of vacancies in shells close to the nucleus by electrons jumping in from outer orbits. Attophysics is here, says Krausz; now for snapshots of the atomic interior.

—YUDHIJIT BHATTACHARJEE

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## CONSERVATION BIOLOGY

### When Is a Coho Salmon Not a Coho Salmon?

Should hand-reared fish be counted in efforts to save wild, imperiled salmon? A U.S. federal judge has said yes, and the U.S. government earlier this month decided not to challenge the ruling. As a result, up to two dozen West Coast salmon runs could be stripped from the endangered species list. These developments have outraged conservationists, who say counting hatchery fish is

like tallying zoo animals when deciding whether their wild brethren are threatened with extinction. "It just doesn't make sense," says Bill Bakke of the Native Fish Society in Portland, Oregon.

For more than a century, the government has used hatcheries to bolster commercially valuable salmon runs, often to make up for spawning habitat lost to dams. The fish are dumped into rivers while they're still juveniles, then they swim out to sea and spend several years in the ocean maturing before returning to the hatchery. But although the pampered hatchery fish are the same species as their wild kin, they don't always act the same way: Behaviors and traits that help hatchery fish do well in captivity differ from those needed to survive in the wild.

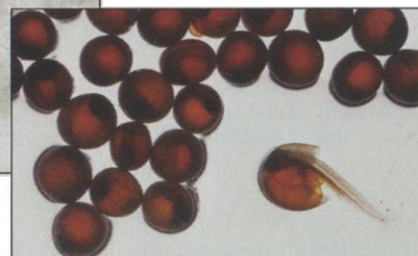
The National Marine Fisheries Service (NMFS), as a result, has ignored the hatchery fish when deciding whether a "distinct" salmon population—such as one that uses a specific river or coastal area—needs protection under the Endangered Species Act (ESA). In 1998, for instance, when NMFS listed the wild Oregon coast coho salmon as endangered, it did not take the hatchery fish into account because biologists said they weren't essential to the long-term survival of the struggling wild population.

Two years ago, the Pacific Legal Foundation, a property rights group in Sacramento, California, that is critical of the ESA, challenged that omission in federal court. On 10 September a U.S. district judge agreed, ruling that NMFS had been "arbitrary" in distinguishing between "two genetically identical" salmon "in the same stream." On 9 November, NMFS's parent agency—the National Oceanic and Atmospheric Administration—threw in the towel. It declined to appeal the ruling, signaling a change in policy. "It's time to stop fighting and start fixing" salmon runs, says Robert Lohn, NMFS Northwest Region administrator.

But critics fear the decision will result in less protection for endangered salmon, because including hatchery fish will likely boost some populations beyond the threshold for protection. The agency must immediately delist the Oregon coast coho salmon, they note, and it must also consider re-



**Hatching a dispute.** Coho salmon raised from eggs in hatcheries may look the same as their wild cousins, but biologists say they act differently.



CREDITS: (TOP) F. KRAUSZ/VIENNA UNIVERSITY OF TECHNOLOGY; (COHO SALMON AND EGGS) NATALIE FOREBYCORBIS

moving from the list 23 other endangered salmon and steelhead populations that share waters with hatchery fish.

The decision runs counter to salmon science, according to many biologists. "A whole sheaf of scientific studies" from the past 20 years suggests that hatcheries cause problems for wild fish, says Robin Waples of the NMFS Northwest Fisheries Science Center in Seattle. Hand-reared fish may be genetically similar to their wild cousins, for instance, but they often aren't as skilled at foraging or avoiding predators. As a result, interbreeding between hatchery and wild fish can produce less fit mongrels.

Waples and other NMFS scientists hope to hash out the biological significance of these differences by next September, when the agency plans to release a new policy on the role that hatcheries should play in salmon restoration and then decide whether to delist some of the imperiled populations. NMFS will ponder whether hatcheries could help save wild populations, for instance, by rearing only eggs taken directly from wild fish. Waples says the agency will also consider whether seemingly plentiful runs that are composed largely of hatchery fish would survive on their own, as the ESA requires.

—JOCELYN KAISER

## MARINE CONSERVATION

### Reserves Found to Aid Fisheries

When California officials began holding public meetings last year on a controversial state plan to ban fishing in some coastal waters, some anglers raised a stink. Their anger, which included flinging dead fish at one session, stemmed in part from what they said was insufficient evidence that closing some fishing grounds would actually help boost catches in nearby areas.

New findings presented on page 1920 could help clear the air. An international team of marine scientists reports marked increases in commercial catches and the number of trophy fish caught by sport anglers in and around small reserves in the Caribbean and off Florida. The authors say the results confirm the validity of their models and, more importantly, lend credence to global efforts to establish new reserves. The findings "will help remove a major logjam in the debate," says lead author Callum Roberts, a biologist at the University of York, U.K.

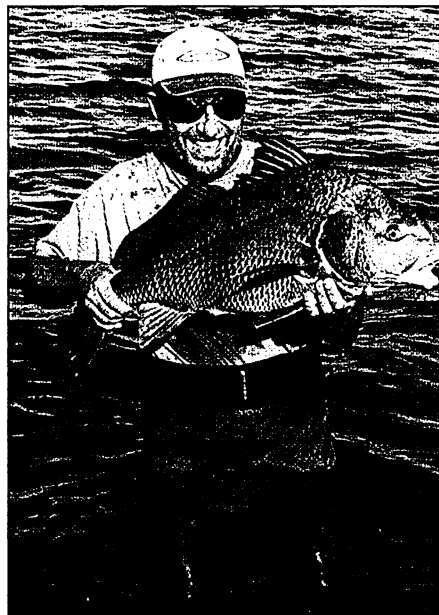
Some scientists, however, caution that closing off some areas won't be enough to restore healthy fisheries. And some influential fishing groups and politicians remain on the offensive, saying that reserves in U.S. waters threaten public access to the seas.

Studies have shown that closing swaths

of the sea to human activity can produce sizeable ecological benefits within the reserve, from more diverse sea life to bigger schools of fish. But "whether reserves have spillover benefits is one of the most hotly debated and least studied issues in marine reserve research," says Karen Garrison, a reserve advocate with the Natural Resources Defense Council in San Francisco, California. Such studies are difficult, she notes, because researchers must find areas where they can compare catches before and after a reserve was established, and monitor all the relevant variables, from how long fishers work to changing ocean conditions.

In their study, Roberts and colleagues from the U.S. National Marine Fisheries Service and the University of the West Indies, Barbados, focused on a 5-year-old network of reserves off the Caribbean island of St. Lucia and an area off NASA's Cape Canaveral rocket launching site in Florida that had been closed for nearly 40 years. In St. Lucia, the researchers concluded that the reserves, which cover about one-third of a long-used coral reef fishing ground, increased catches in nearby areas by up to 90%, compared to prereserve numbers. Off Florida, they found that sport anglers fishing around a 40-square-kilometer area closed in 1962 for security reasons have landed a disproportionate number of world- and state-record fish from three species. Since 1985, for instance, most Florida record red and black drum came from the area.

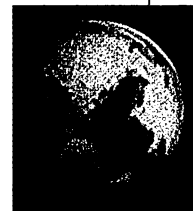
The study confirms that reserves can serve as sheltered nurseries for surrounding waters, say the researchers. And although the studied reserves were small, Roberts says the findings—when combined with



**Drum roll.** Researchers say that a Florida reserve helps produce trophy fish like this black drum.

## ScienceScope

**Rocky Missions** Returning a Mars soil sample to Earth is an enticing prospect—and an expensive one, given its \$2 billion price tag. NASA tentatively plans a 2011 launch with a 2014 return. Now a National Academy of Sciences panel argues that the agency should conduct not one, but 10, sample-return missions. In a Mars science report released 26 November, the panel, chaired by John Wood of the Harvard-Smithsonian Center for Astrophysics, concludes that one sample won't be enough to "unlock all of the planet's secrets." Instead, the first mission should be a "trail-blazer" for a more extensive program. That expensive vision, however, is unlikely to win support from the Bush Administration.



**Preemptive Strike?** After years of resisting change, the Russian Academy of Sciences (RAS) earlier this month approved a new charter that trims the number of its divisions from 18 to 10. That will eliminate several plum positions in RAS's governing presidium. In true Soviet fashion, however, academy members reelected the only candidate on the ballot—President Yuri Osipov—to an unprecedented third term (*Science*, 2 November, p. 974).

More substantial changes may be afoot for the 325-odd RAS institutes. "We must find out which are effective and which are not," says former science minister Vladimir Fortov. That would enable the academy to funnel scarce resources to worthy institutes. Observers expect the academy to unveil other specific reforms by May.

**New Chief** Developmental biologist Peter Gruss has been elected president of Germany's Max Planck Society, the nation's major science group. Gruss, 52, is currently head of the department of molecular cell biology at the Max Planck Institute (MPI) for Biophysical Chemistry in Göttingen. He will take over next June from biologist Hubert Markl, who plans to return to research at the University of Konstanz after leading the society for 6 years. Although he lacks Markl's administrative experience, Gruss should bring "a fresh perspective," says Tobias Bonhoeffer, director of the MPI for Neurobiology in Martinsried. Like Markl, Gruss favors allowing research on human embryonic stem cells in Germany—an issue the government is still debating.

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