ECOLOGY

Survival of the Smallest

RETURNING THE BIG ONES TO KEEP FISHERIES HEALTHY **BY SARAH SIMPSON**

Any commercial fisher or weekend angler knows to "throw the little ones back." The idea is to give small fish time to grow up and make babies. But that strategy may actually be harming fish stocks.

Ongoing experiments on captive fish reveal that harvesting only the largest individuals can actually force a species to evolve undesirable characteristics that diminish an overfished stock's ability to recover, says David O. Conover, director of the Marine Sciences Research Center at Stony Brook University. The results may explain why many of the world's most depleted stocks do not rebound as quickly as expected.

SHRINK-FIT: Harvesting the largest fish drives fifth-generation Atlantic silversides to be smaller (*left third*) than fish from populations that were harvested at random (*middle third*) or from which only small fish were harvested (*right third*).

STEPHAN MUNCH *Stony Brook University*

The genetic effects appeared in Atlantic silversides, a small, usually fast-growing fish. Conover brought a batch of wild silversides to his laboratory in 1998. He and his students then reared six generations, each time removing the largest 90 percent from one group, the smallest 90 percent from another group, and a random 90 percent from a third.

By 2002 it was plain to see that killing off the largest fish had a dramatic effect. Individuals in that group were only about 70 percent the average weight of their randomly harvested counterparts; they were only 55 percent the weight of survivors in the group where only the largest individuals were spared. Because the compared fish were the same age, the scientists could attribute the shrinkage to selection of genes for slower growth.

Even more alarming, the slower growth came with a suite of deficiencies. Detailed examinations of the fifth- and sixth-generation fish, led by Matthew R. Walsh, now a doctoral student at the University of California, Riverside, revealed that members of the large-harvested group were less willing to forage for food and less able to outwit predators. They also produced smaller and fewer eggs, and a lesser portion of those eggs grew into healthy offspring.

These results are not entirely a surprise, Walsh notes. Historical records confirm that cod and other popular food fishes were bigger in the past, and "it is well known in many fish species that fecundity increases with body size," he says. Now, though, human-induced evolution will be more difficult for biologists and fisheries managers to ignore. "This work is a good example of how evolution can work against the long-term fitness of the population—and against our interests," says U.C.R. fish biologist David N. Reznick.

Whether weaker fish are making it to the dinner table now is not at all clear, Conover admits. But letting some big fish go along with the little ones is probably a smart strategy nonetheless. Meanwhile Conover's team has halted all size-selective harvesting and is waiting to see whether subsequent generations will recuperate—and how long it takes to do so.

NANOTECH

Crystal Steer

SAPPHIRE PLAYS SUPPORTING ROLE FOR NANOTUBES **BY CHARLES Q. CHOI**

Carbon nanotubes would make ideal connecting wires in advanced circuits if not for the painstaking effort required to line up each tiny, sticky, floppy strand. Now scientists have found that crystalline sapphire can automatically help guide nanotubes into the patterns needed to build transistors and to make flexible electronics.

Electrical signals can flow more quickly through carbon nanotubes than through silicon, which in principle could lead to faster computers, explains Chongwu Zhou, an electrical engineer at the University of Southern California. Moreover, nanotubes