Sea Grant Oregon

Economic Leadership

Researcher probes secrets of rockfish reproduction, sustainability

Groundfish populations appear to be losing mature fishes that may be most capable of sustaining its numbers.

Sometimes, a researcher has to be the bearer of bad news. But bad news now may save a fishery from even worse news later, especially if it helps a species to recover to sustainable harvest levels.

For decades, Pacific fishermen have hauled in groundfish from large banks on the mid- and outer continental shelf, banks which were home to a seemingly endless supply of rockfish, black cod, ling cod, halibut, flounder, and other species. The commercial fishery, first fully established during World War II, took on added importance in the 1980s with the sharp decline of much of the region's salmon fishery.

But by the mid-1990s, fisheries managers were starting to see signs that groundfish, too, might be in danger of collapsing, as its Atlantic counterparts had done.

In a perfect world, fishery managers would know how many fish could be taken without damaging a species' ability to reproduce itself. But all kinds of factors influence fish numbers: initial stock numbers, food supply, mortality rates, disease, predation, and such large-scale climatic factors as El Niño or changing currents.

That's where research can help, by providing the kind of solid data managers need to make the best possible decisions for the resource, the economy, and the people who are caught in the middle. Sea Grant has been trying to provide some of that information by supporting a variety of fisheries research projects. Piece by piece, scientists are beginning to assemble the puzzle—but it's a slow process, and one that can produce as many questions as answers.

Some of those questions have Steve Berkeley worried. A researcher at OSU's Hatfield Marine Science Center (HMSC), Berkeley has spent years trying to answer the question of whether fish get better at reproducing as they age—not only in terms of how many offspring they produce, but in how well those offspring survive. Since larger, older fish are much sought-after by fishermen, it's critical to know if continuing to harvest such mature specimens might accelerate the fishery's decline.

Berkeley had a hunch that the long life cycles of a particular species—rockfish, some of which can live to be 100 years-old—might serve some evolutionary purpose. But he was surprised to discover that there didn't seem to be enough fish of sufficient age to prove his hypothesis. And that has him worried.

Black rockfish are relative youngsters, as rockfish go, but even they can live into their 30s. It takes the fish five years or more to become sexually mature, at which point females spawn hundreds of thousands of tiny, translucent live young that spend their first weeks in the plankton layer near the

surface of the ocean, later settling out into bays, estuaries, and near shore reefs.

But Berkeley found "a phenomenally high mortality rate for the larvae"—and the rate seemed to be highest among the offspring of younger adults.

Prior to the spawning season, Berkeley and his graduate students bought mature female black rockfish carcasses from charter boats and docks up and down the Oregon coast—about 1,000 fish over three years. They analyzed growth rings in the fishes' ear bones, or otoliths, to determine their ages and examined their ovaries to determine when they would have spawned that spring. They found that older fish had spawned both earlier and over a longer period of time than the younger adults.

Early data indicated that the offspring of older fish were more likely to survive to become juveniles. But when Berkeley sought to confirm that likelihood by examining even older fish—15, 20, even 25 years-old—he was stunned to discover that none of the specimens he had collected was older than 9.

"The point of the experiment was to compare the offspring of old fish, and we had none," he said. He went back to his carcass data, and discovered that the proportion of older females had been dropping steadily and sharply, in each of the three years. "It indicated to me that there may be a problem developing in the fishery," Berkeley said. A subsequent Oregon Fish and Wildlife Department survey found the same age pattern in both lightly and heavily fished reefs.

Traditional species management wisdom allows a take of roughly 65 percent of the estimated spawning population, by weight, leaving from 35 to 40 percent to reproduce, Berkeley said. But if his early results about age distribution, reproductive success, and spawning season hold true, the reproductive potential of the species has been reduced further—and faster—than expected. And Berkeley fears the population may be losing precisely those fish most capable of sustaining its numbers.

Now, Berkeley has received additional Sea Grant funding to compare the rockfish he's analyzed from Oregon waters to similar fish caught off Vancouver, British Columbia. "We're going to see if we can locate a population with significantly older age structures than what we've found down here," he said.

Berkeley has shared his research results with the Oregon Department of Fish and Wildlife (ODFW), which regulates the nearshore rockfish catch. He hopes information like his will prompt regulators to conduct a formal stock assessment for this population of fish, something that has not yet been done.

"The data suggest there's something going wrong, but we need to know if it's a local thing or more widespread," he said. "This is an important fishery—if this one collapses, there's not much left."

Other Sea Grant researchers have tackled other aspects of the fisheries management puzzle, providing important information to those charged with regulating the resource. They include:

- NOAA geophysicist Robert Embley is developing high-resolution maps of the sea floor of Heceta Bank, the largest and possibly most important fishing bank off Oregon. In a project jointly funded by NOAA Fisheries, Embley is processing data collected in 1998 by a research vessel equipped with a state-of-the-art SIMRAD EM300 sonar system capable of unusually high resolution scanning.
- Zoologist Mark Hixon, meanwhile, is working with Embley and geosciences researcher Dawn Wright to compile data from previous research on Heceta Bank, including a series of OSU/ODFW submersible dives in the 1980s and early 1990s, with the new scans going into a single database. Their objective is to create a GIS that combines the new, highly detailed maps with historic observations of fish distribution and abundance, permitting scientists and managers for the first time to understand exactly where fish live and breed.
- David Sampson, a fisheries and wildlife researcher at HMSC, has had Sea Grant support for several years for his efforts to help fishery managers improve their stock assessments by gaining access to more, and more reliable, data, including the information gathered by fishermen as part of their required logbooks.

The projects mentioned in this report were funded by the NOAA Office of Sea Grant and Extramural Programs, U.S. Department of Commerce, under grant numbers NA36RG0451 and NA76RG0476, project numbers R/OPF-46, R/OPF-50, R/OPF-39, M/A-2, and by appropriations made by the Oregon State legislature.