

FISHERY MANAGEMENT

## Can Science Keep Alaska's Bering Sea Pollock Fishery Healthy?

The pollock fishery in the chill waters of the eastern Bering Sea is said to be the best managed in the world. But a surprising decline in numbers has scientists worried

Every January along the continental shelf in the eastern Bering Sea, a great mass of spawning, olive-green fish surge through the nutrient-rich waters. These are walleye pollock (*Theragra chalcogramma*), social fish that tip the scales at 700 grams when mature. The pollock spawn in waters north of the Aleutian Islands, where the bounty serves as food for marine mammals, seabirds, fish—and humans: The eastern Bering Sea pollock fishery is the largest and most lucrative in North America. Each year it brings in \$1 billion and supplies millions of meals in the form of fish sticks, fast-food fish fillets, imitation crabmeat, and roe.

The fishery is remarkable not only for its size but also, to date, for its sustainability: It's certified as sustainable by the London-based Marine Stewardship Council, and catch limits are recommended by scientists who judge the state of the fishery with surveys and state-of-the-art models; there's even a major ecosystem study funded by the U.S. National Science Foundation (NSF).

This year's data are sparking concern, however. Previous predictions of a sizable uptick in pollock numbers weren't borne out by recent surveys. Instead, there are dramatically fewer pollock than scientists had estimated just a year ago. The stock is at its lowest level since 1980, and Greenpeace has put the fishery on its red list of unsustainable harvests.

Last week in Seattle, Washington, responding to the lower numbers, scientists advising the North Pacific Fishery Manage-

ment Council (NPFMC) recommended that the catch, rather than being raised from this year's low as expected, stay low again in 2010. Given the uncertainty, some argue that the harvest should be cut even further. The council itself will vote on the recommendation next week. "This time last year we said the stock was going up," says marine biologist Lowell Fritz of the Alaska Fisheries Science Center (AFSC) in Seattle, who argued for a lower quota. "But it didn't. And that is cause for concern."

Fritz and others say that the revised estimates and dwindling numbers raise questions about how well-managed the fishery really is, and whether the researchers' reams of data and calculations can produce what all parties want: a long-term sustainable fishery in a healthy ecosystem. "It's tricky," says Douglas DeMaster, science and research director of AFSC, who's based in Juneau. "How far can we knock down a single species before impacting the ecosystem? We don't know yet." But even though the fishery is at a low point, "it is not overfished," he says. "And we're working hard to make sure it never is."

### The big haul

Pollock are found across the North Pacific from Puget Sound to the Sea of Japan. But they are especially abundant in the waters of the Bering Sea's continental shelf. Once regarded as commercially worthless, pollock gained value after Japanese trawlers developed a process for reducing its white meat into a protein paste called surimi. And after

**Plentiful pollock?** The Bering Sea fishery is America's largest.

the North Atlantic cod fishery collapsed in the 1990s, pollock fishing surged. The Bering Sea pollock fishery is now the world's largest single-species fishery, averaging more than 1 million metric tons annually. But pollock are not immune to overfishing: Other formerly abundant pollock fisheries in the region, including an exceptionally rich one called the Donut Hole (see graph, p. 1341), were heavily fished in the 1980s and 1990s and have never recovered.

In the eastern Bering Sea, fishing boats hauled up an average of 1.33 million metric tons of pollock each year between 2001 and 2007. In 2007, however, surveys showed that pollock numbers were down. So scientists

recommended—and fishers abided by—a reduced quota of 1 million metric tons in 2008. NPFMC reduced the 2009 catch by another 18% to 815,000 metric tons.

But the scientists' models predicted better news ahead, and last fall they estimated that in 2010 the stock could sustain a catch close to previous levels. To assess the health of the pollock population, AFSC researchers gather data about the sex, size, weight, and condition of the fish from scientist-observers aboard the fishing vessels and take abundance data from annual bottom-trawl and acoustic midwater-trawl surveys. The scientists track the fish in age classes. Pollock reproduce prolifically, live nearly 11 years, and are mostly fished beginning at age 4, as many fishing vessels selectively target areas preferred by older, larger, and more valuable fish.

So when the next season opens in January 2010, fish that hatched in 2006 will be included in the catch. And it is this 2006 class that has surprised and disappointed scientists. As 1-year-olds and 2-year-olds, this age group appeared particularly plentiful. "It looked like an above-average class," says James Ianelli, an AFSC fisheries biologist in Seattle who heads the modeling team and is lead author of the pollock assessment report released on 17 November. But this year's bottom-trawl survey found fewer fish, and the midwater acoustic trawl was even worse, down 30% from last year's estimate. "There were fewer 3-year-olds than our model predicted," says Ianelli, and older fish were largely absent.

Why were 3-year-old pollock relatively scarce? “It could be they had poor survival rates as 1-year-olds, or maybe they are staying more toward the bottom. We’ve also had 4 years of record-cold bottom temperatures,” which could affect the fish’s distribution, says Ianelli.

Whatever the reason, the discrepancy between the previous and the most recent surveys, coupled with the continuing decline, has set off alarm bells. “It surprised people because we [scientists] almost always get the trend right,” says Fritz. “But we really missed this one; we were off by 30%. And that makes me think we’re in new territory.”

In November 2008, scientists had estimated that the population could sustain a catch of 1.23 million metric tons in 2010. But last week the 15 members of the NPFMC Bering Sea Groundfish Plan Team, after much debate, voted instead for a catch of 813,000 metric tons. The vote was split, with seven scientists recommending a further cut to 738,000 metric tons.

### Driving the system

Despite the lower number, Ianelli and DeMaster say the fishery remains healthy. There’s enough of a buffer built into the model to assure that the spawning stock never drops below 20% of its estimated unfished numbers, says DeMaster. “It’s a conservative approach,” he says, meant to ensure that enough young fish will be produced every year to replace those caught. This year’s stock is at 27%.

To better understand the pollock’s cycles, and what factors in the ecosystem affect them, scientists are busy incorporating more data about the ecosystem—on ocean temperature, zooplankton production, pollock predators, and climate—into their models. “We’re in the third year of our Bering Sea Project,” says marine biologist Mike Sigler at AFSC in Juneau, referring to a 6-year, \$52 million NSF and North Pacific Research Board-funded study of the eastern Bering Sea’s ecosystem. “It’s already helping us understand these changes in pollock.”

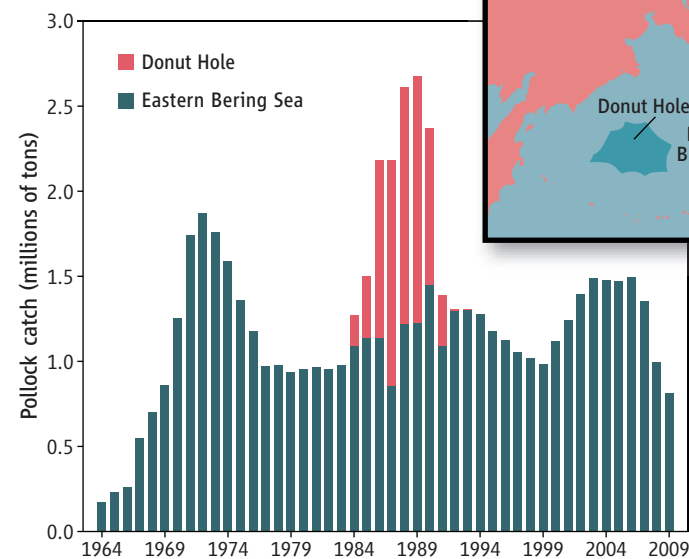
Researchers have found that many poor age-class years seem to be tied to less sea ice and warmer ocean waters. “That’s the pattern for the [pollock] classes from 2001 to 2005,” says Sigler. However, the drop in the 2006 class remains puzzling, because there was plenty of sea ice and colder water that year. Sigler hopes to have an explanation by 2012, when the project ends.

Regardless of the cause, the spawning mass has declined, and AFSC’s harvest rules have in turn limited the catch, says fisheries scientist Steven Martell of the University of

British Columbia, Vancouver, in Canada. “There’s been a 45% reduction in catches over the last 4 years,” he says. But if those reductions aren’t sufficient and the stock doesn’t recover as projected in the next few years, he warns that the fishery “will certainly be in trouble” and could be closed.

Others think that the catch should be reduced even further now. “The pollock fishery is the most valuable fishery in the U.S.,” says Jeremy Jackson, a marine ecologist at the Scripps Institution of Oceanography in San Diego, California. “More is known about it than any other fishery in the world. Yet despite all the wonderful data and fancy models, they’ve failed to protect the pollock or the Bering Sea ecosystem. We need to call ‘Time out!’”

Jackson says that although including ecosystem effects in pollock management is worthwhile, the researchers also need to look at “the effects of pollock fishing on the



**Ups and downs.** After a few big years, the Donut Hole pollock fishery collapsed; to avoid such collapse in the Eastern Bering Sea, the catch is restricted.

ecosystem.” He notes that pollock is a staple for northern fur seals and endangered Steller sea lions, both of which are struggling (*Science*, 4 April 2008, p. 44).

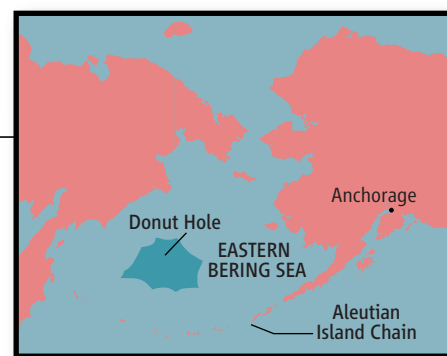
Critics say worries about the fishery stem from a fundamental issue: It’s managed primarily to get the maximum sustainable yield from a single species. “It can’t make a legitimate claim to [being] an ecosystem-based fishery, as long as it maintains this single-species focus,” says Timothy Ragen, director of the Marine Mammal Commission in Bethesda, Maryland.

Jackson and others say that when faced with questionable data, as scientists were this year, it would be better to reduce the quota

even further. Fritz says he tried to persuade the Plan Team to do that but failed. “Can we recognize the danger signals and react appropriately and in time, if the fishery is really in trouble?” he asks.

But the fishery is required by law to also consider the socioeconomic effects of its decisions. The pollock fishery is one of Alaska’s largest employers, and former Alaska Senator Ted Stevens once brought the entire U.S. government to a halt to protest (and eventually overturn) restrictions upon it. “There’s a lot of policy in this process,” says DeMaster. “It’s not entirely science.”

Still, many say that the pollock fishery continues to be one of the best-managed in the world, largely because the Fishery Council, unlike some other big fisheries,



follows scientists’ guidance. “The North Pacific Fishery Council relies the most on science,” says fisheries biologist Daniel Pauly of the University of British Columbia, Vancouver. That’s “in stark contrast” to other councils or governing bodies such as

the European Commission, he says, where fisheries sometimes ignore scientific advice and adopt high quotas, “and the stocks [such as bluefin tuna] suffer accordingly.”

So when fishing-fleet representatives and others gather in Anchorage next week at the Fishery Council’s meeting to set next year’s quotas, the scientists’ recommendations likely will be adopted. “We know the scientists are concerned,” says Donna Parker of the Seattle-based fishing firm, Arctic Storm Management Group. “They treat our fishery like a cultivated field, and we expect they will manage it well into the future.”

—VIRGINIA MORELL