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DANIEL PAULY PROFILE:

Going to the Edge to Protect the Sea

David Malakoff

Fisheries biologist Daniel Pauly has carved out a colorful--and controversial--career with fresh and frank insights into marine fisheries

Daniel Pauly still remembers his youthful encounter 30 years ago with what he calls "the living papers." A graduate student in Germany, Pauly watched the field's royalty with awe at his first major fisheries conference. "Names I knew only from the literature were suddenly parading before me like kings," he recalls. "I was terrified."

These days, the 55-year-old Pauly--tall and graying--is a bit of a living paper himself. A professor at the University of British Columbia (UBC) in Vancouver, he is arguably the world's most prolific and widely cited living fisheries scientist, with recent headline-grabbing papers in *Science* and *Nature*. He's also an architect of a leading fish database and a popular ecological modeling program.

Despite these accomplishments, Pauly remains something of an outsider. His offbeat approach to the science is part of the reason. Whereas colleagues have built careers by using complex mathematics to crunch massive data sets, Pauly has worked mostly in data-deprived developing nations, and he says he can't stomach "enormous equations."

His irreverence is another factor. In a field marked by caution, Pauly has become an outspoken and often controversial critic of modern fishing practices. He's suggested that marine fishers will leave little but jellyfish for future generations to eat, and he has blamed the Chinese government for inflating fish catch statistics and helping obscure a global overfishing crisis. The industry, he says in a sonorous accent that hints at a globe-trotting life, "has acted like a terrible tenant who trashes their rental." Some colleagues are also uneasy about his close ties to the Pew Charitable Trusts--an unabashed advocate for marine conservation (see sidebar) that has given him nearly \$4 million.

But even opponents say Pauly is a valued foe. "[Pauly] is an immensely charismatic, articulate, big-picture guy in a science that tends to produce little-picture guys," says veteran fisheries biologist Ray Hilborn, a friend and sometime critic at the University of Washington, Seattle. "For better or worse,

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he's probably had a greater impact on the field than any member of his generation."

A difficult start

Pauly has always stood out from the crowd. The child of a French mother and an African-American father, he recalls a "difficult" childhood in Switzerland being raised by another family. A church-related job working with the disabled led to a scholarship to attend Germany's University of Kiel, where he chose fisheries science. "I wanted to find an applied way to help people," he says. He also wanted to travel. "I sometimes felt odd in Europe, so I thought I might blend in a little more" in the developing world.



Earning his stripes. Daniel Pauly displays a professional interest in a Washington, D.C., fish market.

CREDIT: RICK KOZAK

In 1974, he got his chance, spending 2 years helping aid officials develop new fisheries in Indonesia. The experience led to his first big scientific hit: the "Pauly equation." It's a relatively simple formula that enables researchers in data-poor tropical nations to estimate the natural mortality of fish, a key measure needed to calculate sustainable catches. Traditional methods, he notes, were mostly devised to survey relatively homogeneous northern fish stocks, not diverse tropical schools, and depend on reams of technical information churned out by well-equipped labs.

Bent on finding simpler methods, Pauly mined the literature for the mortality, growth rates, and habitat temperatures of 175 types of fish. His goal was to use the well-documented species to predict the mortality of unstudied varieties living in similar habitats. Success would allow researchers to use a pocket calculator to crunch easily gathered numbers, such as fish lengths culled from local markets.

The mathematical product of Pauly's labors appeared in 1980 [*ICES Journal of Marine Science* **39** (3), 175-192] and the paper has become the most cited of his more than 400 publications. Its tally of 313 citations, as compiled by the Institute for Scientific Information in Philadelphia, Pennsylvania, is 16 times the norm.

The formula has also become a celebrated part of Pauly's professional persona. When Hilborn wrote a parody a few years ago comparing fisheries research to a priesthood, he dubbed Pauly "the Prophet Daniel, ... a heretic" who had been exiled to "the lower regions, the hot places. Daniel must toil in infernal heat ... armed only with a thermometer."

Today, researchers still debate the robustness of Pauly's equation. "It doesn't always give the right answers," says Ransom Myers of Dalhousie University in Halifax, Nova Scotia, "but it got people thinking about better ways." Pauly is self-deprecating: "The equation gets lots of citations. But half of them probably say, 'It's crap--but there is nothing else to use.' "

Career move

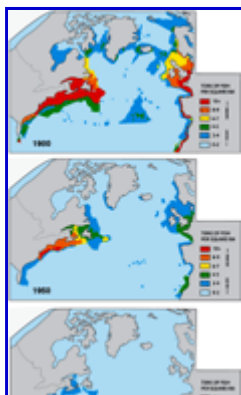
Armed with his doctorate, Pauly moved to the Philippines in 1979 for what became a 15-year stint at the International Center for Living Aquatic Resources Management (ICLARM) in Manila. A training ground for researchers from developing nations, ICLARM offered Pauly a bully pulpit as well as backing for two major projects that would raise his profile.

One was FishBase, a global database now packed with information on more than 26,000 species of fish (<http://www.fishbase.org/>). As a student, Pauly was inspired by Walter Fischer, a biologist with the United Nations Food and Agriculture Organization (FAO), who cajoled colleagues into assembling fact sheets on thousands of economically important fin- and shellfish. The personal computer seemed like a natural extension, and in 1989, FAO and ICLARM joined forces to create FishBase, with Pauly and Rainer Froese, a German computer expert, running the show. After several false starts, FishBase now boasts of more than 3 million hits a month. "It may end up as [Pauly's] most lasting contribution," says Serge Garcia, a biologist with FAO in Rome, Italy.

The other high-profile project enhanced an ecosystem-modeling program called Ecopath. Traditional techniques that treated each fish stock separately had failed to grasp the messy world of marine ecosystems, and Pauly saw new possibilities in Ecopath, a little-known model for estimating biomass changes along coral reefs that was first developed by Jeffrey Polovina of the U.S. National Marine Fisheries Service. "I took it and tweaked it," says Pauly, incorporating an array of information on fish habitats and life histories that allows researchers to predict how populations might respond to various pressures. As with FishBase, he also recruited savvy partners, notably Danish biologist and software wizard Villy Christensen, and used training workshops to spread the gospel.

Today, Ecopath and its offshoots are widely used. But like Pauly's equation, it is often reviled as too simplistic. "It's useful but still a work in progress," believes ecologist Stuart Pimm of Columbia University in New York City. Dalhousie's Myers agrees but says Pauly's team "almost single-handedly brought ecosystem approaches back to life."

In 1994, after a management shakeup at ICLARM, Pauly moved to Vancouver to become a tenured professor. He arrived in academia just as collapsing fisheries sent shock waves around the world, and he quickly adopted a bolder stance toward conservation. The result was a burst of provocative papers.



Bye-bye biomass. Pauly's team has documented a sharp decline in North Atlantic table fish over the last century.

CREDIT: (MAP IMAGING) JONAH SACHS/FREE RANGE GRAPHICS, (MAP DATA) R. WATSON, V. CHRISTENSEN, D. PAULY/OCEANA

The first two are already minor classics. In the 16 March 1995 issue of *Nature*, Pauly and Christensen took aim at the idea that the sea is so fertile that humans haven't yet fully tapped its potential as a source of food. Earlier estimates, the pair noted, suggested that humans exploited fisheries that used just 2% of the globe's aquatic "primary production," leaving room to enhance catches. But the real take is at least 8% of primary production, the pair calculated, and up to 40% in key fishing grounds. Those numbers suggest that humans already claim a lion's share of the sea's accessible wealth.

In the second paper, published in the October 1995 issue of *Trends in Ecology & Evolution*, Pauly railed against "shifting baseline syndrome." Young biologists, he wrote, often failed to become outraged over the collapse of once-teeming fish stocks because they couldn't quantify--or didn't believe--anecdotes about immense past catches. As a result, "each generation ... accepts as a baseline the stock size and species composition that occurred at the beginning of their careers," producing ever-shrinking expectations of what a fishery should look like. "It was an idea that was floating around at the time, and I just put a name on it," says Pauly.

Independence day

Such concerns eventually brought him together with marine conservation advocates at a fisheries meeting in 1995. "It was my declaration of independence," he says. "I ceased seeing myself as servicing government fisheries departments and the industry," he says, although some colleagues call it "an act of betrayal."

Two years later, Pauly met Josh Reichert, head of Pew's \$45 million environmental program. At Reichert's invitation, Pauly floated a grand global vision, describing how Ecopath-like software, FishBase, and regional catch statistics could be combined to produce a portrait of the state of the world's fisheries. Although half a dozen prominent researchers predicted it would fail, Reichert says, "we took a chance anyway."

The \$4 million investment paid quick returns. A year later, Pauly's team--many plucked from ICLARM--scored again with a paper (*Science*, 6 February 1998, p. [860](#)) that analyzed world catch data. It argued that fishers had systematically overfished larger, more valuable predatory fish, such as cod and groupers, forcing them to shift to less desirable species lower on the food chain. This "fishing down the food web," Pauly said, would eventually leave people with a diet of "jellyfish and plankton soup."

Such hyperbole, and the statistical gyrations of Pauly's team, drew groans from some colleagues. FAO staff argued that Pauly had skewed their data to make his case (*Science*, 20 November 1998, p. [1383](#)). In response, Pauly's team said that FAO's suggested corrections--such as accounting for aquaculture--only made the trend worse.

A similar exchange followed a recent *Nature* paper (29 November 2001) with UBC colleague Reg Watson that suggested that China had intentionally inflated its catch statistics to match its economic targets. The reality, Watson and Pauly found by comparing the claims with the fish-producing capacity of Chinese waters, was that China's overblown numbers had masked a slight decline in FAO's global catch estimates.



Mr. Pauly goes to Washington. The researcher briefs congressional staff on fisheries issues.

CREDIT: RICK KOZAK

In a lengthy response (www.fao.org/fi/statist/nature_china/30jan02.asp), FAO researchers noted--accurately--that they had long ago asked China to correct the problem. And they decried press suggestions that they had intentionally fudged data to hide fisheries problems. "We welcome efforts to improve the accuracy of our data," says Richard Grainger, FAO's fisheries chief. "That's why we've worked hard to make it available to researchers such as [Pauly]."

Both papers "put FAO in a very difficult spot," says Andrew Rosenberg, dean of life sciences at the University of New Hampshire, Durham, and the former top U.S. fisheries biologist. "Some people may [already] have known these things. But [Pauly] puts them together in a way that makes sense."

Pauly's notoriety has generated a flood of speaking invitations and helped attract a publisher for a long-planned volume called *Darwin's Fishes*. The title is a play on Darwin's famous finches, although Pauly says, "Darwin actually wrote far more about fish." Being a celebrity is like hanging onto the side of a fast boat, he remarks: "It's nice to talk to the waves, but it's dangerous as hell."

Still, Pauly seems incapable of staying away from the edge. In recent speeches, he's told fisheries biologists that they need to win over the public--or else. "If fisheries science doesn't consummate a marriage with conservation," he says, his discipline--and the oceans--will suffer.

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