

# Leading the Way to Salmon Recovery

## Spotlight on Research



Northwest Fisheries Science Center

National Marine Fisheries Service

National Oceanic and Atmospheric  
Administration

U.S. Department of Commerce

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Flash back to a young Usha Varanasi, passionate about chemistry, math, science and physics (and quite adept at solving the mysteries laid out in Perry Mason and Agatha Christie books). Varanasi was vexed. The other schoolgirls whose interests ran more towards arts than sciences were teasing her, calling her "bookworm."

"My grandmother was quite a forward-thinking person," Varanasi says. "She used to say 'You have to make a decision in life, whether you want to be among the 5 percent about whom people talk, or do you want to be among the 95 percent who talk about that 5 percent? You've got to decide... You've got to learn very early in life you can't be too soft about criticism.' And, somehow, that stuck with me."

Back to the present with a middle-aged Varanasi, director of the National Marine Fisheries Service's Science Center in Seattle, which has been criticized as an "arrogant" agency that has "politicized" science.

The challenges faced by the beleaguered agency are myriad -- insufficient funding; the wildcard of global climate, which can, with a subtle shift of a few degrees in water temperature, weaken the health of the salmon the agency seeks to protect; legal challenges and vocal opposition by landowners, environmentalists and farmers to NMFS regulations.

The scientists working under Varanasi's direction will need fortitude and endurance, she says, as they carry out large-scale experiments to demonstrate that their recovery suggestions will improve salmon health.

"They're going to be challenged because their science is going to affect so many people. (Scientists) are going to say where the risks are. They are also going to have so much uncertainty that they're going to be challenged continuously," Varanasi says.

Varanasi has felt such challenges first-person, as she blazed a series of new trails in the nascent field of pollution's effect on marine life.

Nearly 20 years ago, her work showed that marine oil spills had a measurable and significant impact on fish health. Hydrocarbons concentrated in fish livers and were excreted by their gall bladders, leaving few traces in their flesh.

Within days of the Exxon Valdez oil spill, Varanasi's group was able to use screening techniques to answer a pressing question from 13 tribes that relied on subsistence fishing: Was it still safe to eat halibut and herring?

And, Varanasi and collaborators were able to detect DNA damage to fish livers caused by a short exposure to contaminants stored in the sediments of urban estuaries.

The methodology of her work that showed damage to juvenile salmon passing through polluted Puget Sound waterways also was used for the winter run of endangered Chinook salmon in San Francisco Bay.

In the contaminant field, tens of thousands of chemicals interact with the water, air and animals. Taking pieces of the puzzle, looking for relationships, changing parameters and seeing the same statistical correlations gave her team confidence that "a" was causing "b."

Seeing the same effects in the lab gave corroboration. Testing their methods with a large-scale natural disaster, such as the Valdez spill, gave instant validation of their techniques.

For salmon, similar large-scale experiments are about to begin in a 160,000-square-mile area that stretches across Washington, Oregon, Idaho and California. Salmon declines can be blamed on multiple risk factors: adverse ocean climate, habitat degradation, outdated harvest practices that haven't tracked with the stocks' reproduction rates. The agency's scientists have pinpointed certain qualities and characteristics of habitat that contribute to salmon mortality. And they've



Dr. Usha Varanasi, director

identified the key times in the salmon's life cycle — the first year of life in the estuary and the first few months in the ocean — that the economically and emotionally valuable fish are most vulnerable. Fix those key sections of the habitat before those key times

in the life cycle and salmon health should begin to rebound.

"The salmon stocks have not only been declining for a long time. But now, many of them are listed as endangered species... So, the theories are what are the causes for (salmon) decline? And the test that will come now is as we provide scientific certainties to what would work for recovery," she said. "Our hypotheses and our restoration practices are just about to go into the testing mode."

As a teen-ager, when Varanasi first discovered a love for science, she never dreamed the passion would lead to directing one of the agency's nine major field installations across the nation. For middle-class East Indian children, pursuing a quality education was simply what you did. Thoughts of a career came separately and later.

Varanasi hadn't even pondered school in the United States -- she hadn't ever traveled alone -- until a few neighborhood boys got accepted to college in Chicago. With a history of good grades, a handful of recommendation letters, a bit of pluck and a heaping dose of naivete, she wrote to the nation's top colleges to gain admission and -- when her father blanched at the expense -- asked for financial assistance.

"I wrote to all of these deans without ever realizing that's not the way you do it. I just wrote ... saying I want to come. And I'd like a scholarship. I can't come without it," she said.

She followed a master's degree in organic chemistry from the California Institute of Technology with a Ph.D. in organic chemistry from the University of Washington. She began working at the Science Center, in a temporary position, as a post-doc.

Finding concrete clues to solve chemical mysteries was reassuring. But chemistry, alone, was empty. Only when the chemistry married the biology to explain -- for instance, that porpoises use masses of fat in their foreheads with acoustic qualities to hear their way through the world, echolocating with rapid-fire clicks or demonstrating that oil

leaks from oil exploration had the potential to harm fish -- did Varanasi feel she was answering scientific questions that mattered.

After "growing up" at the Center, Varanasi took over its leadership in 1994 and implemented a few key changes in recent years:

- Rather than waiting for various groups to develop a salmon recovery plan then reviewing it for scientific merit, the Center has put its scientists and scientists from various agencies on the frontline to develop a recovery plan that says "This is what is needed to improve. That gives a scientific underpinning to recovery efforts for the Puget Sound and Lower Columbia", she said.
- Because they anticipated challenges, the agency drew together a panel of independent scientists -- much like the National Academy of Sciences -- to ensure as each recovery team was developing scientific principles along the West Coast for the various, unique watersheds, that those principles were subjected to rigorous scientific scrutiny.
- Rather than simply looking at the "4 Hs" of salmon separately, the Center has begun a systems ecology approach. The detailed study of habitat, hatcheries, harvesting and hydropower continues. But there's also an overlay: a group of scientists whose duty is to take all the separate parts and start connecting them.

And she's been leading by example.

"I have an attachment to young scientists who really care to answer the scientific questions that matter and have enthusiasm for it," she said. "You've got to do the work you love and then when what you love makes a difference is really where I want this science center to be."

--Diedtra Henderson

### Usha Varanasi, career at a glance

1964 -- Master's degree in organic chemistry from California Institute of Technology

1968 -- Ph.D. in organic chemistry from University of Washington

1981 -- National Marine Fisheries Service Outstanding Employee of the Year

1988, 1991 -- National Oceanic and Atmospheric Administration Unusually Outstanding Performance Award Winner

1993 -- Department of Commerce Gold Medal Winner

1994 -- Named director of the National Marine Fisheries Service's Northwest Fisheries Science Center.

1999 -- Finalist, Executive Excellence Award

**Coming Next: Salmon Restoration, 101**

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