'You can see the whole ecosystem'

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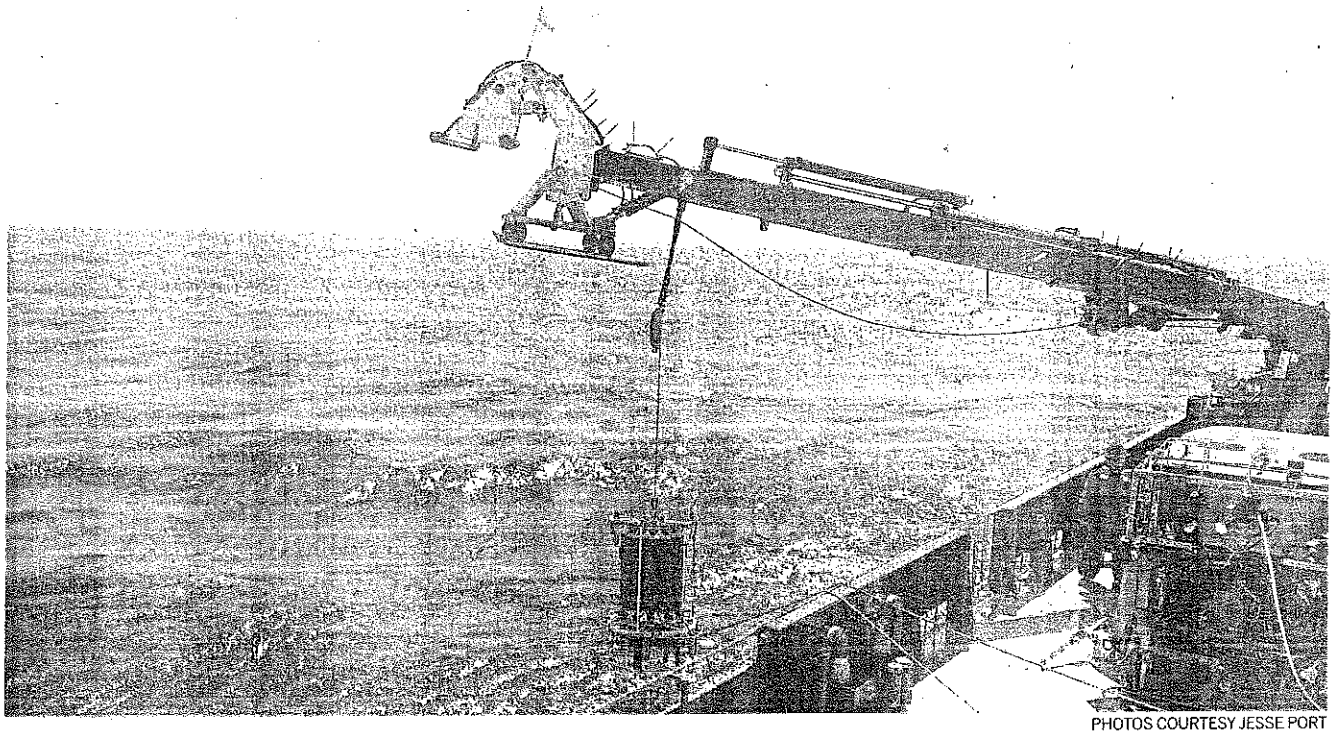
Probing waters to track life



PHOTOS COURTESY JESSE PORT

Teams from Stanford and the Monterey Bay Aquarium Research Institute collect water for eDNA analysis in Monterey Bay.

Sampling eDNA promises to help scientists keep an eye on area's rare, endangered marine species

By Emily Benson
Staff writer

Police officers solve crimes with it. Doctors use it to predict the risk of certain cancers. Dog lovers find out the breeds of their mutts with it.

Now, scientists are using DNA to identify fish and other marine creatures by scrutinizing the DNA flecks they leave in their wake. The new technique — the analysis of genetic material in the environment, dubbed eDNA — promises to help scientists keep better track of rare or endangered marine species.

Sampling for eDNA can be as simple as dipping a jar into the ocean. So it's often safer, faster

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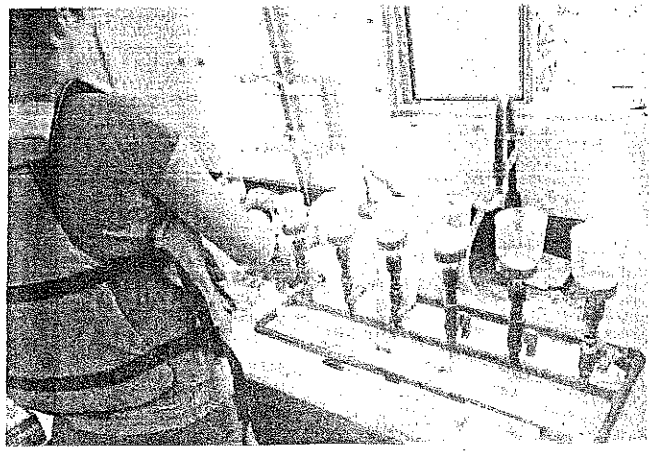

A researcher filters seawater that was collected to track environmental DNA while on a boat in Monterey Bay.

Fish

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and cheaper than mounting a dive expedition, the current gold standard for counting the number of ocean creatures in a given area, experts say.

"It's remarkable what you can get out of a glass of water," said marine ecologist Ryan Kelly of the University of Washington in Seattle. "You can see the whole ecosystem in there."

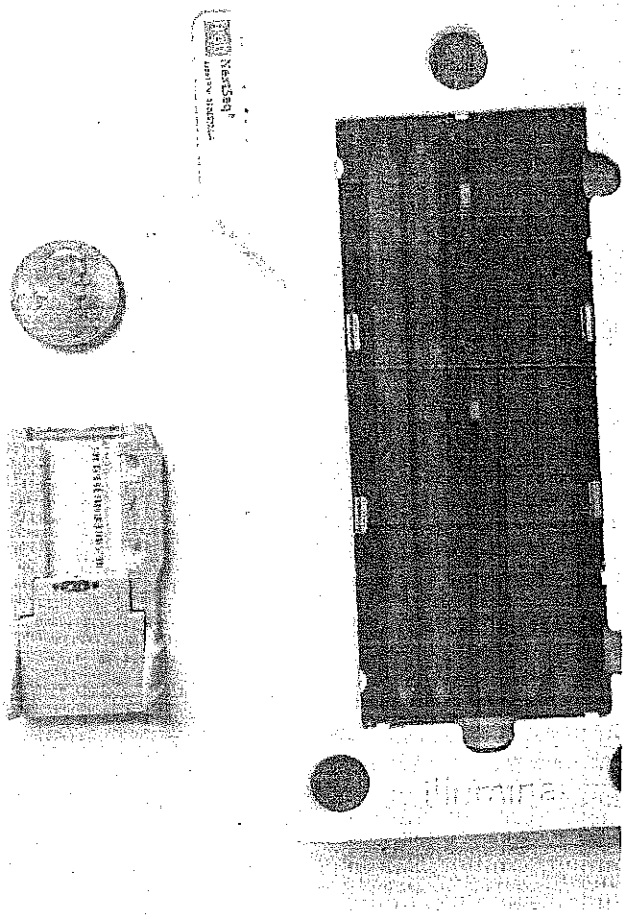
Kelly and other scientists took stock of the marine mammals and fish in Monterey Bay in a recently released study designed to show how eDNA stacks up against traditional dive surveys.

The scientists found that eDNA assessments picked up almost all the organisms scuba divers spied underwater— plus many more that human eyes missed.

"The idea behind eDNA is that we're all shedding DNA all the time; dandruff is a form of eDNA," said biologist Christopher Jerde of the University of Nevada, Reno, who wasn't involved with the Monterey Bay study. "In the marine environment, it gets suspended in the water and you can grab it with just a simple water sample."

This type of monitoring is crucial for keeping an eye on the health of places such as the Monterey Bay National Marine Sanctuary, said Andrew DeVogelaere, the head of the sanctuary's research program.

The sanctuary includes thousands of square miles of ocean. At its deepest, it extends more than 2 miles to the seafloor. With such a large area, including places where it's not safe to dive, eDNA could transform how researchers survey the sanctuary, DeVogelaere said.



COURTESY JESSE PORT

An Illumina flow cell can be used to sequence DNA from seawater that is captured by researchers.

"With the eDNA water samples, you can cover much larger areas in a much faster time period," he said.

It works like this: After scientists collect water samples, they filter genetic material out of them and then match those snippets to a database of DNA from marine organisms.

The research technique has skyrocketed within the past decade, as genetic analysis has gotten cheaper and easier. But, scientists say, the technique is still being refined.

The Monterey Bay study was published in the journal Molecular Ecology. Scientists took water samples and sent divers down to four types of habitats: sea grass beds, kelp forest, sandy areas and rocky reefs. Environmental DNA analysis of the water picked up 11 of the 12 fish and marine mammals that the divers observed — and also identified 18 additional animals the divers missed.

The scientists were also curious to know how much the sea swirls up eDNA.

"We didn't know what to expect. We thought we might find everything everywhere," said lead author Jesse Port, an environmental geneticist and fellow at Stanford University at the time of the study. "Where we're seeing the fish, is the fish's DNA showing up?"

In fact, waves and tides don't stir fragments of DNA into a meaningless stew of genetic information: The eDNA the researchers found in different habitats matched what the divers saw.

Despite the promise of eDNA, water samples aren't going to completely replace divers anytime soon. Indeed, divers can gather some information — such as the number of a particular species in a specific spot — that eDNA cannot provide.

In addition, environmental DNA samples are easily contaminated — Port and his colleagues found human, chicken and turkey DNA in the Monterey Bay samples. And current eDNA techniques can tell scientists only if a particular species recently swam by, but not how many of them were there.

Researchers are still refining the technology, but even with those limitations they say eDNA has the potential to help regulators decide things like where to put a marine reserve or allow trawling by revealing the presence of rare and threatened species.

"I think it's the wave of the future," DeVogelaere said. "Fifteen years from now, people are going to wonder: 'How did they make decisions without it in the past?'"

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