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trients from the ocean's depths and sunlight — for phytoplankton to grow explosively. In peak conditions, diatoms, a common kind of phytoplankton, can double twice a day and turn the water green. Oceanographers call this a diatom "bloom."

The cold water brings up plenty of some essential nutrients but not, it turns out, enough trace metals for diatoms to thrive. The trace metals do not come from deep within the ocean; they come with the mud that runs off the continent after winter floods.

But winter floods are out of phase with the coastal upflow. Luckily, broad continental shelves along much of our coast trap the trace metals, and keep the levels of metals like iron and zinc high enough off the coast through the summer so that all the requirements are in place during the warm months for "phenomenal blooms," Bruland said.

"Around Santa Cruz and up north we have a nice, broad continental shelf," Bruland said. In contrast, off the coast of Big Sur, though the upwelling occurs just as elsewhere, the area has fewer rivers and the continental shelf is less than a mile wide. So, the ocean there stores less iron, Bruland says.

Bruland and Hutchins, who was a graduate student with Bruland until 1994, sailed off the central California coast to collect water samples and measure its chemistry and the abundance of diatoms. In water collected off Big Sur, the pair found that diatoms grew little. "But if we just added iron, they bloomed like crazy," Bruland said.

Off the coast of Santa Cruz, Año Nuevo and near San Francisco, Hutchins and Bruland found that diatoms already were growing at peak rates. Adding iron to that water did not affect plankton growth.

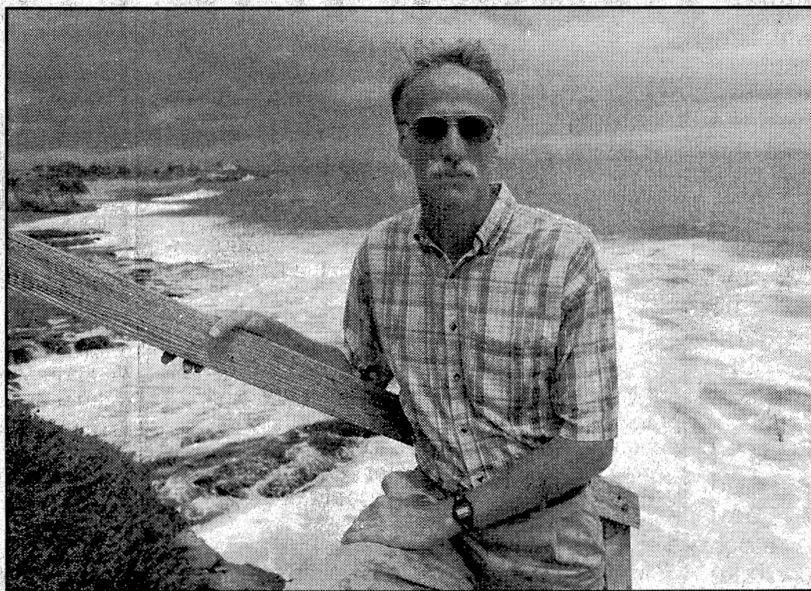
Other scientists have "seeded" patches of remote ocean with iron and seen that the added metal provokes phytoplankton blooms. Kenneth Coale conducted some of the open ocean experiments. "Micronutrients were not thought to be important before near coastal regions," he said. "Much of the open ocean is iron deficient. Now this shows that even coastal systems can be limited by iron."

The coastal regions are unique in the abundance of life they support and also in the extent that human behavior can damage them. "In the last 50 or so years, we've seen a decline in off shore productivity as measured by plankton levels. The decline has coincided with the damming of 50 percent of coastal rivers," Coale said.

In most of the open ocean, small animal plankton graze on small plant plankton. To go from phytoplankton to a tuna fish requires about six layers in the food chain, with about 10 percent efficiency in the conversion among layers, Bruland explained. To get a pound of tuna requires 10 pounds of small fish and 10,000 pounds of phytoplankton.

In contrast, iron-rich coastal waters are so productive the fish can directly eat the plankton.

"Marine mammals come here because of that, all this food," Bruland said. The shortened food chains based on the blooms of large diatoms also attract humans who want fish to our coast.



Dan Coyro/Sentinel

UC Santa Cruz oceanographer Ken Bruland says small changes in iron concentration off our coast can lead to big differences in what kind of life thrives there.

"Top predators — like whales and people on commercial fishing boats — are a common sight in the iron rich waters along California, such as Monterey Bay," Hutchins said. "You see very few in the iron poor waters near Big Sur though."

Along with human action, year-to-year weather variations can affect iron levels.

"This El Niño year is anomalous. It's no problem getting iron out in the ocean this year," Bruland said.

Hutchins and Bruland also report in their paper that iron levels control how other nutrients are stripped from the water, and may affect how well carbon dioxide — a "greenhouse effect" gas — is absorbed in the ocean. The oceans are

believed to store 60 to 80 times more carbon dioxide than found in the atmosphere.

"I personally don't think we know enough about the subtleties to even consider planetary engineering, or purposeful alterations of the environment. I think it's superarrogant to consider purposefully attempting planetary engineering such as adding iron to counteract a human induced carbon dioxide increase," Bruland said.

Coale agrees.

"It would be ill advised and irresponsible to do one kind of global manipulation to counteract another kind of manipulation. I don't know any scientists who advocate it," he said.

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National Marine Fisheries Service.

On the road leading to the lab, Sierra Club activists rallied and held up signs urging federal officials to protect California shores and marine wildlife from oil spills. The Sierra Club announced earlier in the day they were expecting Vice President Al Gore to attend the groundbreaking, which he did not.

The rally was partially spurred by a letter dated Wednesday from Gov. Pete Wilson to President Clinton asking, among other things, for the administration to permanently ban offshore oil drilling in federal waters off California.

Regarding the environmentalist concerns and Wilson's letter, McGinty said the governor had been invited to take part in the National Ocean Conference taking place today and Friday in Monterey, but declined.

"This is really the kick-off to the National Ocean Conference,"

McGinty said. "It's very fitting because this research facility points out the challenges and the opportunities."

The new lab facility is scheduled to be completed by 2000. Its ultimate aim, if funding is available, will be to perform annual fisheries surveys for the entire West Coast, said Rolland Schmitt, director of the Fisheries Service.

University officials were smiling about the new lab, since it complements their own facilities.

"This is going to make for a very happy companionship," said UCSC chancellor M.R.C. Greenwood. Such cooperative arrangements between federal, state and privately endowed institutions are the best arrangement for conducting research in the future, she said.

All the dignitaries made a point of crediting congressman Sam Farr, D-Carmel, for getting the funding for new lab passed through legislature and off the drawing board.