
M G KERCKHOFF MARINE LABORATORY - CALIFORNIA INSTITUTE

HELP FOR KELP

Wheeler North is a marine biologist with a mission

One thing you can say for certain about California's kelp forests: They have a friend in Wheeler North. A marine biologist, a dedicated diver, and a Caltech professor of environmental science, North enjoys kelp as a magnificent plant and appreciates its vital role in the ecology of the ocean and the economy of the state. For almost 20 years he has been working to make sure that it thrives.

The waters along the Pacific coast once had dense marine forests that extended for a mile or so offshore all the way from San Diego to Alaska. But infestations of hungry sea urchins and an unprecedented rise in ocean temperatures in the late 1950's almost wiped them out. Identifying the culprits was North's first step toward preserving the remaining forests. The second was to start eliminating the urchins. As a third move, he has been experimenting with ways of planting new kelp in denuded areas where it once flourished.

Mature kelp plants release billions of spores each season, so North began by removing adult plants from still verdant forests and implanting them in areas where kelp once grew. But the low survival rate of the spores in nature makes transplanting full-grown plants pretty inefficient, so North worked out a method of culturing billions of kelp embryos in his laboratory for large-scale dispersals in the sea.

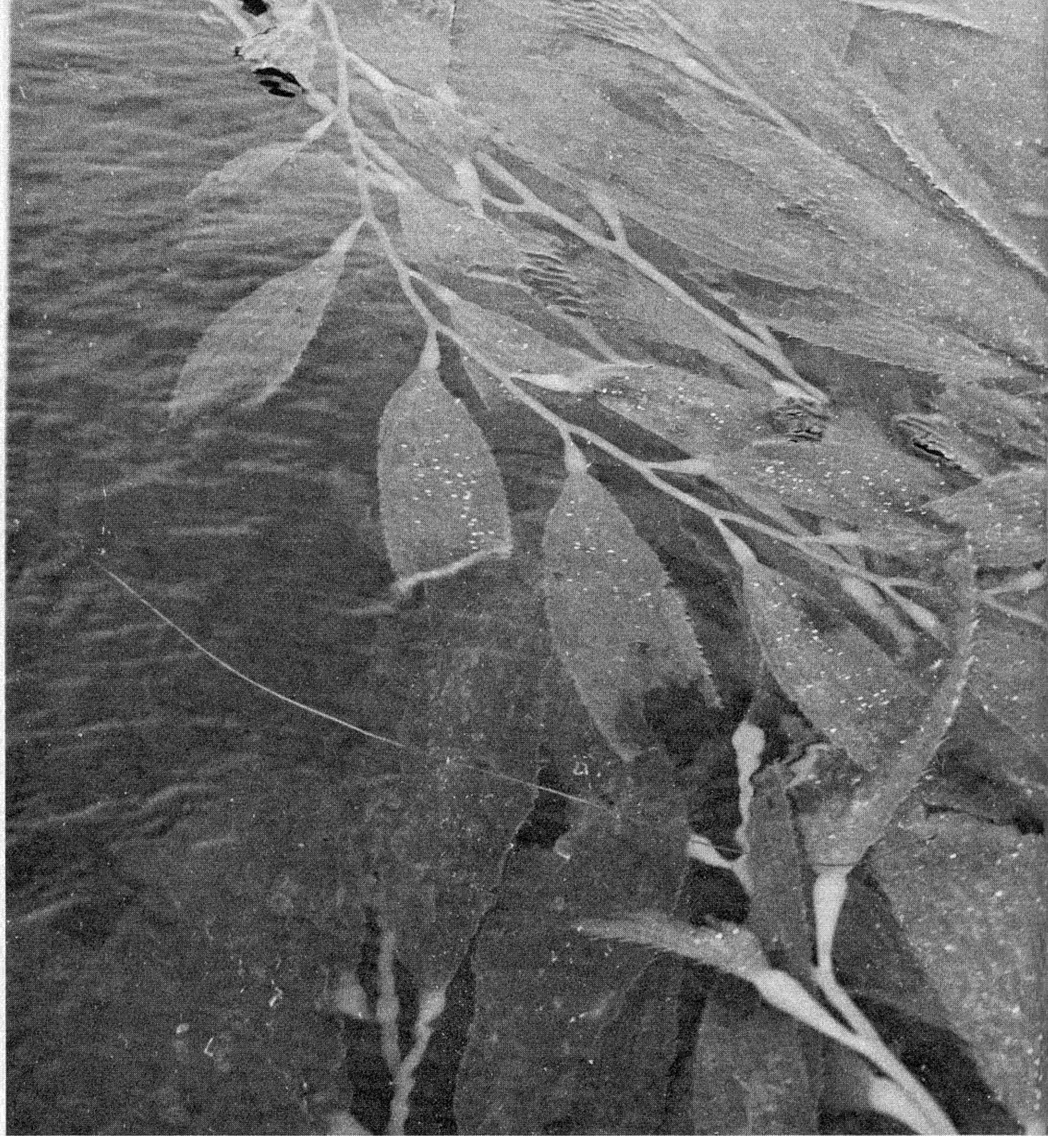
He has now developed two methods for getting plantings started in the ocean: tying small plants to styrofoam buoys which are anchored with a heavy chain to the sea floor; and scraping billions of embryos from a substrate at the planting site.

Even with these techniques now fairly well established, North is a long way from just doing underwater gardening. For instance, he is experimenting to determine the best season for planting, the best substrate for growing embryos, and the maximum depth at which the divers can work. Each new area he goes into has its surprises, and he has to adjust to them. And what he learns extends the hypotheses for further work.

Currently, North is trying to reestablish two former kelp beds—one at Imperial Beach at the Mexican border and one at Palos Verdes in Los Angeles County. The project at Imperial Beach is doing well; at Palos Verdes the going is rough. He wants to know why.

In the 100-mile-long stretch of coastline between Imperial Beach and Palos Verdes, North and his colleagues have by now reestablished about 50 percent of the extinct kelp beds. One of the most verdant and productive is at Point Loma, where kelp is again plentiful enough that it can be commercially harvested. What is even more important to North, the underwater world is ecologically in balance, and exciting and beautiful to explore—which he does periodically to make sure everything is in order in the kelp forest.

Home base for North's kelp studies is Catech's William G. Kerckhoff Marine Laboratory in Corona del Mar. In culture chambers there he grows enough embryonic kelp plants to make a jungle of the whole ocean. In nature, though, only three or four out of 1,000 billion embryos survive long enough to become visible plants, and still fewer ever grow up. But North manages to better the odds considerably. The embryos grown in the lab have a 100 percent rate of survival, and when they are released in selected areas in the ocean, their chances are 1 in 100,000.



Kelp forests are an important part of the natural environment of southern California and a highly valuable asset economically. They provide both homes and food for many varieties of fish and crustaceans, which in turn provide both food and sport for man. Kelp also yields a chemical called algin which, by binding oily and watery fluids together, is useful as an emulsifier in foods like salad dressings. As a suspender, algin keeps pigment particles mixed with a carrying liquid in products like paints, pharmaceuticals, and cosmetics; and ice creams are smoother and packaged cake icings stiffer because of its ability to control viscosity.

The giant kelp, *Macrocystis pyrifera,* grows only along the Pacific coast from Baja California to Alaska in the northern hemisphere. One of the fastest growing of all plants—up to two feet a day—it eventually becomes one of the longest—up to 200 feet.

It may look like Caltech's answer to Vassar's daisy chain, but it's actually an important part of a serious kelp transplanting project. Small kelp plants are tied to styrofoam buoys attached to a heavy chain, which is transported by boat to an area slated for planting. Laid on the ocean bottom, the chain acts as an anchor until the kelp can take hold. It takes a lab crew several months to prepare a mile of chain, and a whole summer to process and plant 5,000 buoys. This system for reforestation of the sea is used in areas where there are large populations of kelp-grazing fish and a plant needs as much head start as possible.

Thanks to North, California's kelp is in good condition

Hitting urchins with a hammer, North works to clear a safe area for kelp to take hold and grow—leaving no more than one urchin per square yard. Last summer hundreds of volunteer divers had such one-to-one encounters with hundreds of thousands of sea urchins, and thus gave trillions of embryonic kelp plants a bigger chance to survive. (In the process they also provided a lot of hungry fish with free meals.)

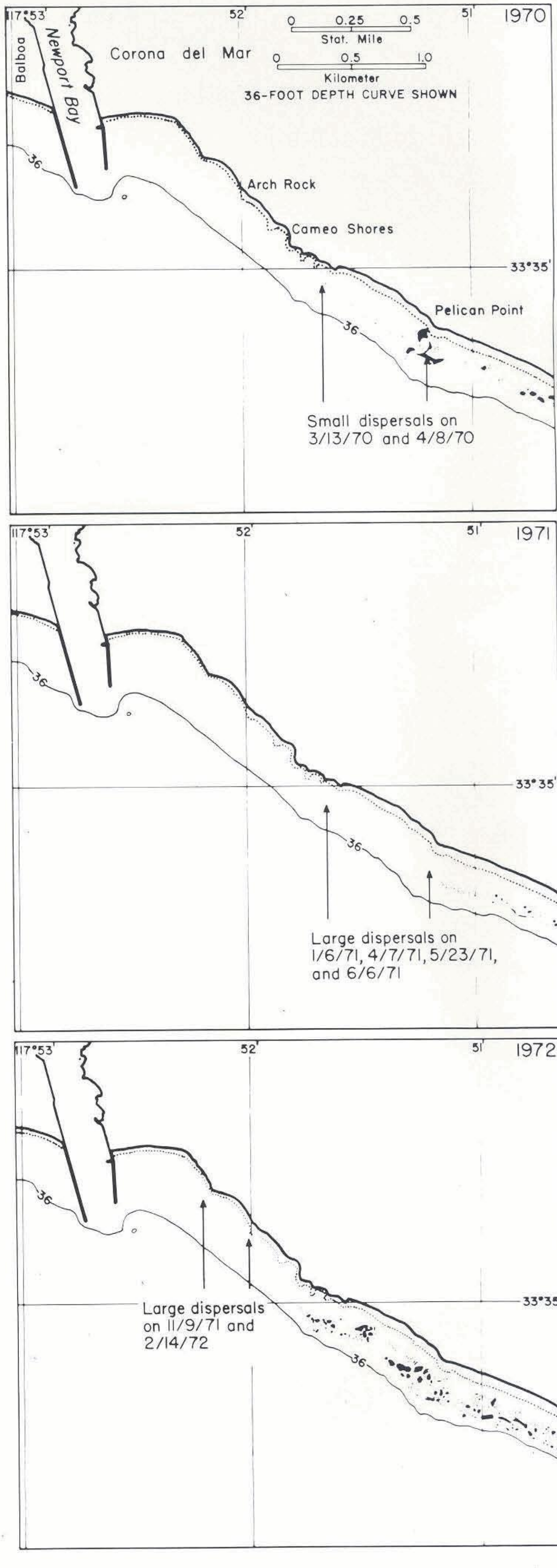
Another method North has developed to kill the urchins is to dump quicklime into the sea above them. The quicklime particles settle on some urchins, burning and killing them. And the presence of the chemical suspended in the water causes untouched urchins to release their holds on the bottom, leaving them prey to the ocean currents.

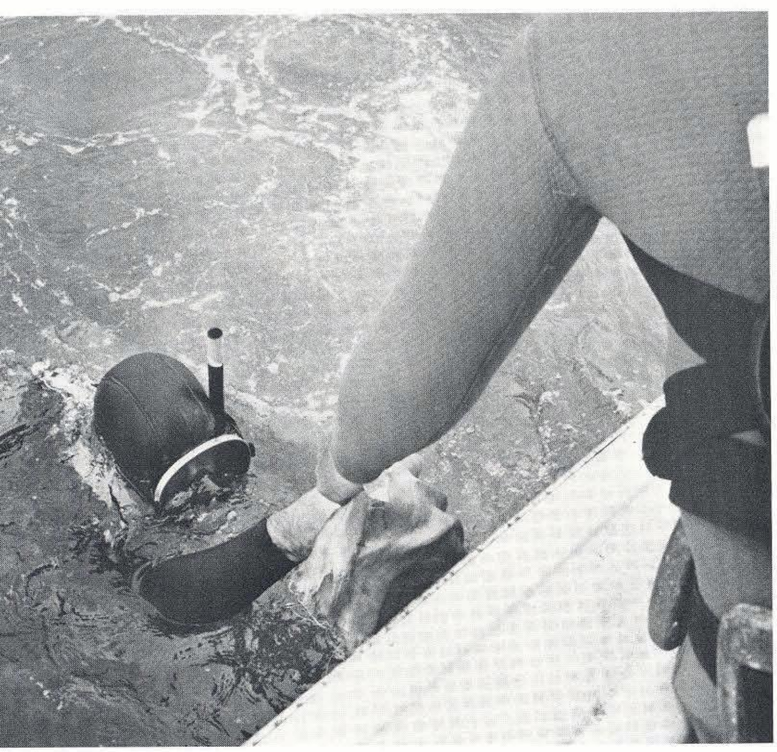
Nature's own agent for keeping the underwater kelp-urchin ecological balance is the sea otter, which finds the urchins a gourmet delight. But sea otters have been hunted almost to extinction, and though they are now protected throughout California, only in areas like Monterey Bay are the herds large enough to keep the sea urchin population under control.

A horde of spiny, beautiful—and voracious—sea urchins attack a tagged kelp plant. The urchins (moving across the sea floor at about 30 feet per month) chew through the "holdfast" at the base of the kelp. Eating only an ounce or two and moving on, they cut loose up to 300 pounds of plant, which drifts away and dies. And the area over which the urchins have grazed becomes an underwater desert.

North is making scientific farming of the ocean a reality

One way to keep track of the outcome of kelp planting experiments is to map both the dispersal areas and the location and density of the resulting beds. In 1970, North and his group made two small dispersals of kelp embryos off Cameo Shores and Pelican Point in Orange County, leading to some minor reappearance of kelp where there had been none since 1958. Kelp needs water that gets no warmer than 65 degrees Fahrenheit to thrive, and unusually warm surface water temperature in the summer of 1971 reduced survival rates among these young plants—though the spores at first took hold and grew as expected in the comfortably cool water on the bottom of the sea. For the last year a combination of large-scale dispersals and favorable water temperatures has created a vigorous forest of kelp, visible on the surface as a canopy of leaves. And embryos released off Arch Rock and Cameo Shores in the early spring of 1972 have resulted in enormous numbers of small plants on the ocean floor.





On his way to the bottom of the sea, North takes along a billion potential kelp plants growing on a folded fiberglass cloth, which acts as a substrate for a kelp culture. Cloths like these are laid on the bottom of still-water tanks in the lab, where they catch and hold spores from specially treated bottom leaves of kelp plants (sporophylls). In a few weeks the spores develop into embryos with sticky surfaces and are ready for transplanting. Then a diver takes the cloths to a favorable underwater location and scrapes them off with a plexiglas rod.

Part of a marine biologist's underwater activity is making species lists of plants growing in any area he is investigating. Graduate student Joe Devinny lays out what he has just collected—and instructor North brings up a few more items that might possibly have been overlooked.