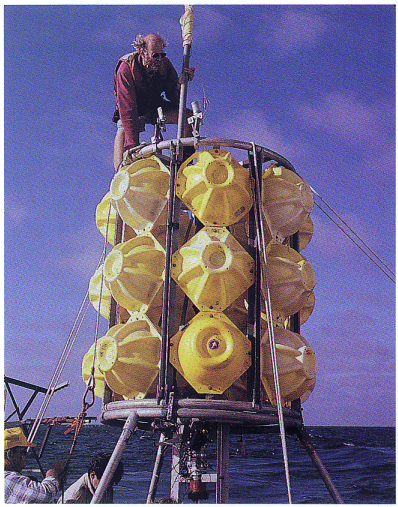
Seasons without Light

Why life's got rhythm even at great depth.



Oceanographer Ken Smith readies an instrument that measures respiration of animals embedded in sea-bottom mud.

In the deep sea, neither day length nor temperature changes. So why is reproduction cyclical and coordinated there? How can there be "seasons" at the bottom of the sea?

Sunlight does not penetrate below 100 meters in the ocean, in some places far less. Except for the light given off by certain animals (there are no plants where sunlight is unknown) and the rare instances of thermoluminescence (the glow of molten lava, for example), the deep sea is dark.

But how can temperature not change? This has to do with water's density at various temperatures. The solid form of most compounds is more dense than the liquid state; thus, an iron bar sinks in a vat of molten iron. But the solid form of water is less dense than the liquid, which is why an ice cube floats. In fact, water *does* become denser as it cools — but only down to 4 degrees centigrade. Consequently, water in ocean deeps stays at that temperature. Warmer or cooler water rises.

Marine biologists have had to theorize about deep-sea seasonality because of the difficulty of studying that part of our globe directly. How hard is it to work the depths? Imagine deep-ocean sampling techniques applied to the organisms on the surface of the Earth: What if, hoping to examine those organisms, you were forced to work blindfolded using a bucket dangling from a balloon floating two miles up?

But things are changing. Now humans can visit the depths in submersibles and perform assays by means of remotely operated vehicles equipped with high-resolution video and sensitive manipulator arms.

We can ask questions of the animals themselves. They are telling us that there is a pronounced rhythm to life at depth.

Ken Smith, of the Scripps Institution of Oceanography, is studying seasonality on the sea floor at a site 4,000 meters off the coast of central California. From samples he collects several times a year, I have found that all sea anemones of one species spawn together, in the spring. The spawning occurs at the same time as that of brittle stars studied by other marine biologists. The stars spawn every spring, the anemones don't. Yet in neither species is reproduction continuous or erratic, the likely result if there were no "seasons."

Reproduction is coordinated, but how?

With few exceptions, deep sea animals, like those elsewhere, depend on plants. Most marine plants are microscopic and float free on the surface, where sunlight is available. As they and the animals that feed on them die, all sink bottomward.

Animals in the deep harvest this marine "snow" as it drifts down.

The supply of this material is governed by surface temperature and light, with levels highest in spring and lowest in winter, in California. The pulse of surface productivity is propagated — with some attenuation and time lag — to the sea floor, serving as a signal to the animals living there. Deep sea animals reproduce in times of relative plenty, just as many land animals do. This is the more remarkable because they lack other cues — temperature and light change — to help them know the time of year.

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