

## UNDERWATER COLOR PHOTOGRAPHY

High-quality color photographs of bottom conditions contain a great amount of ecological information in a readily understandable form. Somehow, the evidence of one's eyes is usually more convincing, and is often better remembered, than abstract tabulations of other forms of data. Therefore, we have made a special effort to document the appearance of the outfall pipes and the surrounding soft bottoms and reefs with color photographs.

The outfall discharges and most of the affected zones are well below ordinary diver depth so we use an automatic or remotely triggered camera. Because no person is present to aim the camera at the desired subject we sometimes use a television camera with its real-time images as a viewfinder. The alternative is to place the camera on a tripod in the area of interest and use bait to attract fish to the field of view, or to move the camera periodically and hope that a few of many photos will be of the desired subject.

Our system is built around a 35-mm Minolta SRT 101 camera equipped with either a standard 36-exposure pack or a special magazine that holds enough film for 250 exposures. The camera is electrically driven (12 volts), and it automatically transports the film and recocks itself after each exposure. The timing circuit, made by Microtonics Digilay, can be set to fire at evenly-spaced intervals of 45 seconds to 29 hours.

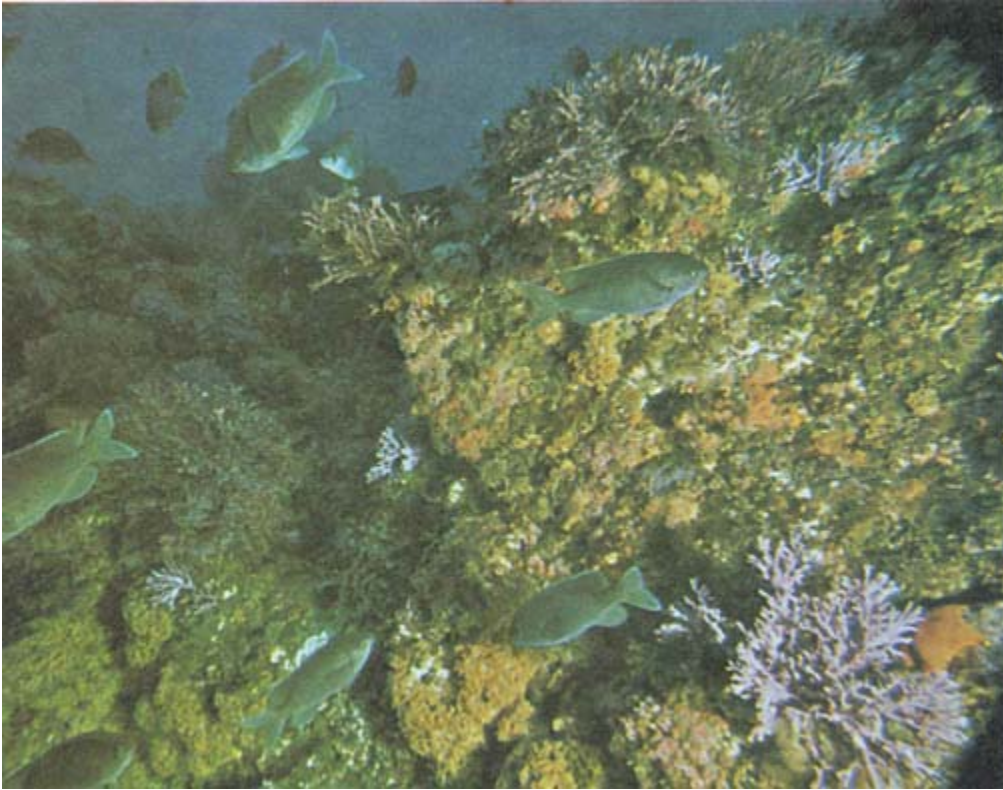
The lens is a 21-mm (wide angle) with a maximum aperture of f2.8, but we never use the camera at the lower f-stops. The secret of getting high definition pictures is to use high f-stops, high levels of light, and relatively fast film (usually Ektachrome, ASA 64).

The strobe lights are two FT 118 GE bulbs that flash for 1,200 microseconds with an output of 8,400 lumen-seconds. These lights are powered by 12-volt gel-cell batteries that charge condensers with 2,100-microfarad capacitance at 450 volts. This flash is equivalent to 250 watt-seconds and permits us to make color photos to a distance of 8 meters at f8. The condenser recycling time is about 20 seconds. To minimize the problems of connectors, external cables, and synchronization between the strobe equipment and the camera, all are installed in the same pressure case. This case is a cylinder 21 by 92 cm that has slight negative buoyancy in seawater.

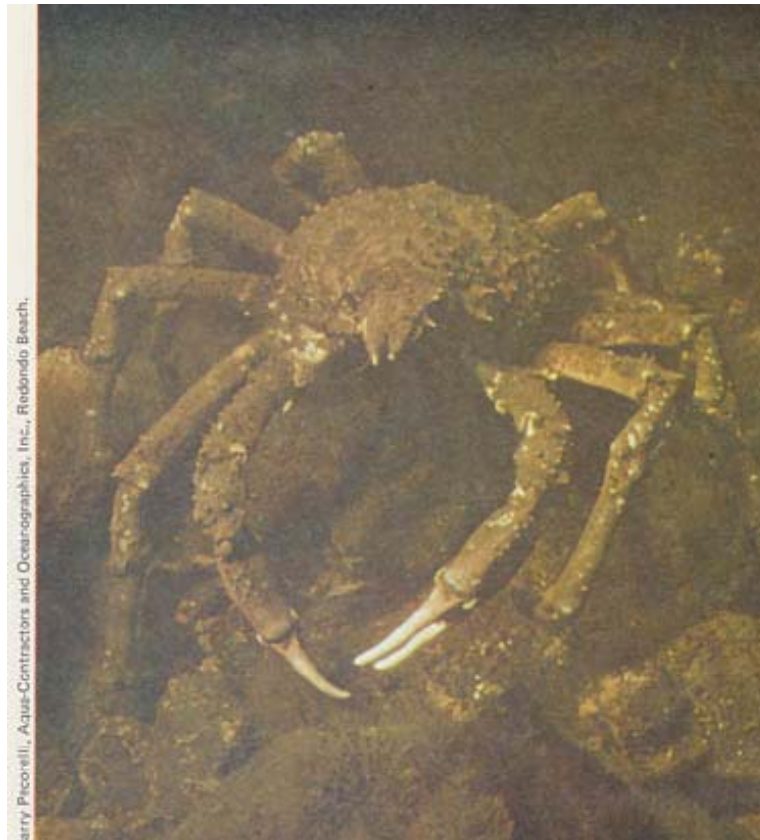
Because the deepest water we are likely to encounter in our research is the 1,000-m depth of the San Pedro Basin, the camera housing is designed for the pressures at that depth (about 100 atmospheres).

All of the above equipment was designed, bought or built, and assembled by Jack Mardesich of the Project. As with the television equipment, the camera system requires reasonable clear water to be effective. However the clarity around the outfall diffusers and over the adjacent bottom is usually good enough that objects 3 meters away can be photographed; often the effective range is several times greater.

**Farnsworth Bank, a rocky control site well offshore. At a depth of 60 meters, life is diverse and abundant.**



**A crab (*Loxorynchus grandis*) on the ballast stones of Hyperion outfall. After 15 years of discharge, the absence of sedimentation is evident.**



**A mid-depth on Oil Platform Hilda, a juvenile rockfish (*Sebastes auriculatus*) peers out from a mass of *Corynactis californica* at its prickly bedfellows, *Strongylocentrotus purpuratus*.**

