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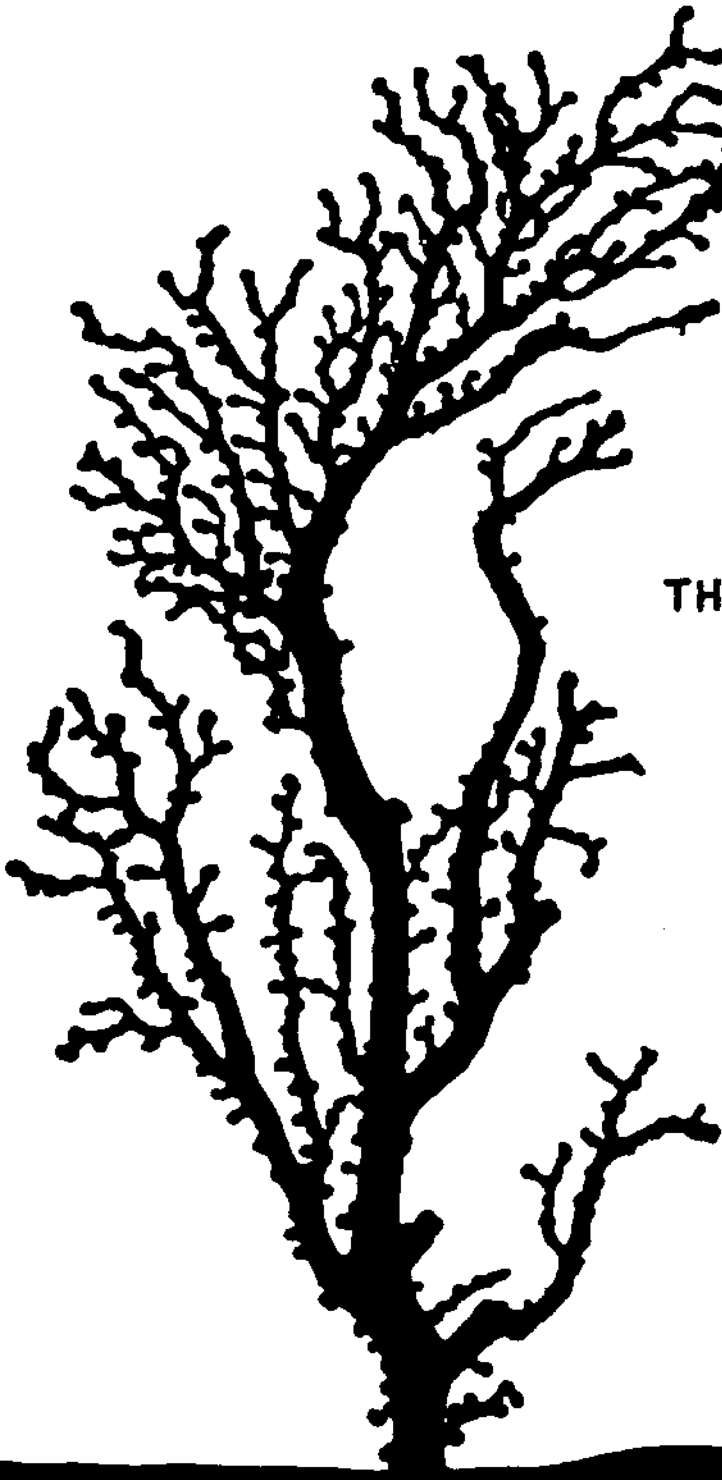

A NEW SYSTEM FOR THE COMMERCIAL HARVEST OF PRECIOUS CORAL

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ABSTRACT

A new system to harvest precious coral is described, consisting of a wire basket and cutting blade attached to the front of a submersible. The new system permits selective harvest and is more efficient than conventional methods.

Precious coral (Genus *Corallium*) has been used for jewelry since prehistoric times (Tescione 1968). Since the first century A.D., dredging has been the principal method for commercially harvesting precious coral (Tressler 1923; Bauer 1969). With the exception of the fishery in the Mediterranean Sea where divers have traditionally collected small amounts of red coral, the distribution of all major known coral beds is below the depth range of conventional SCUBA. In the Western Pacific Ocean where 95 percent of the world's annual catch is harvested, coral beds exist at depths between 90 and 450 meters (Kitahara 1904; Grigg 1971). Coral in the Orient is collected by dredging with weighted tangle nets. This method is both destructive and inefficient and because the world supply of precious coral has been declining in recent years (Grigg 1971), a means of harvesting coral selectively is needed. This paper describes a new system to selectively harvest precious coral by utilizing a submersible and compares dredging and submersible catch data.

Description of coral harvesting system

The coral harvesting system consists of a steel reinforced wire basket attached to the front of a small two-man submersible (Figs. 1 and 2). At the front of the basket is a notched steel plate equipped with a cutting blade that can be rotated across the notch. To harvest coral, the pilot maneuvers the submersible just off the bottom to a point where the base of a colony of precious coral is situated within the notch. The cutting blade is then actuated hydraulically to shear off the coral at its base. Catch plates around the notch minimize the incidence of coral falling out of the basket. A manipulator (arm and claw) with four degrees of freedom, which is operated hydraulically, can be used to pick up colonies which do not fall into the basket. The arm is also used periodically to "pack" colonies into the basket so they do not interfere with visibility or operation of the cutter. Payload of the basket is 75 Kg.

The cutting blade is capable of exerting a pressure of 175 Kg/cm^2 minus ambient pressure which must be subtracted because it acts on the opposite side of the hydraulic cylinder and has to be overcome by the pressure of the hydraulic pump (Fig. 2). After the oil has passed through the hydraulic cylinder, it collects in an external pliable plastic reservoir (exposed to ambient pressure), which obviates the need for a return line and hull penetration.

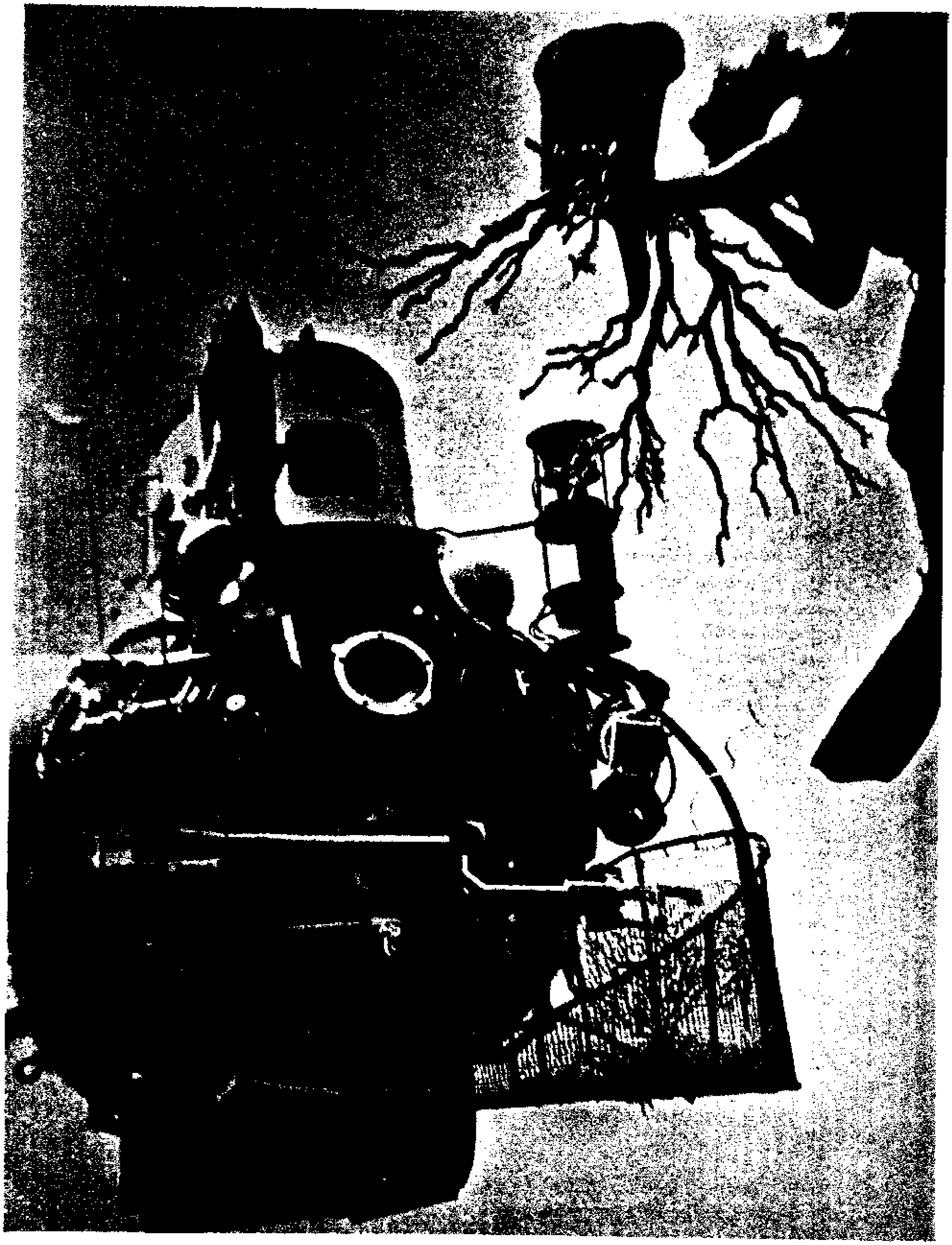

Figure 1. A diver just below the surface retrieves a large branch of gold coral from the basket of the 2-man submersible Star II at the completion of a dive to 1200 feet. Launch and recovery of the submersible is accomplished underwater with the use of a stable platform which can be submerged to 60 feet (Estabrook and Horn, 1972).

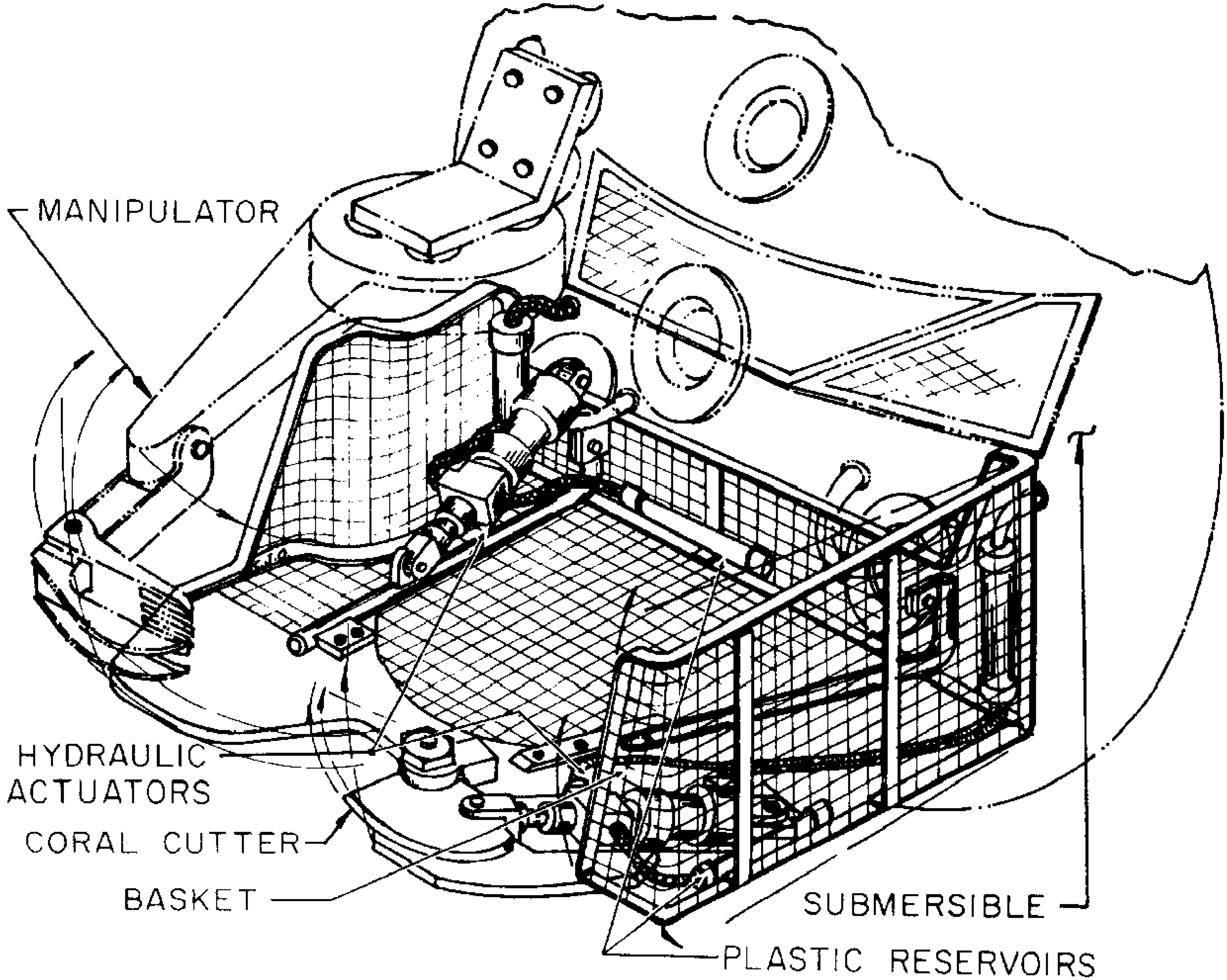

Figure 2. The coral harvesting system includes a coral cutter, basket, hydraulic actuators and manipulator.

At the depth limit of the submersible (380 meters), the net pressure on the blade is slightly more than 135 Kg/cm^2, which is more than sufficient to cut the largest colonies of coral. An additional advantage of this design is that, at the end of the cutting stroke, ambient pressure serves to push the blade back into an open position, eliminating the need for an additional hydraulic actuator.

At the end of the dive, the entire basket assembly is rotated upward 30° by a second hydraulic actuator, designed identically to the first (Fig. 2). A lid is tripped and falls to close the top and front of the basket. The manipulator is then positioned above the lid and prevents opening during ascent and surfacing.

This system was developed at Makai Range, Inc. in Hawaii and is currently being used to harvest precious coral commercially at depths between 350 and 380 meters. Previous trials to harvest coral using only the manipulator and basket proved to be unfeasible economically because too much time was required in handling each colony.

Catch data

To compare tangle net and submersible catch data, all collections were taken in the same area (157°32.3W x 21°18.4N). The tangle nets used consist of four hanks (1 Kg each) of nylon netting (mesh size: 10 cm square) attached to cement-filled steel cylinders (40 cm long x 25 cm diameter). When dragged across the bottom the weighted nets break and entangle coral indiscriminately.

Data given in Figure 3 are based on pooled values representing seven dredge hauls and three submarine dives. Because considerable breakage occurs with both methods of collecting, the maximum diameters of fragments rather than lengths or widths were compared. Pieces of coral smaller than 10 mm in diameter were lumped and weighed collectively.

The precious coral collected with the submersible was both qualitatively and quantitatively superior to dredge haul collections. The size-frequency distribution of coral collected with the submersible was characterized by considerably larger fragments than coral collected by dredging (Fig. 3). In dredge hauls, no fragments larger than 30 mm in diameter were found and only 13 percent were larger than 20 mm in diameter. Fifty-five percent of the coral in the dredges was less than 10 mm in diameter. In contrast, the largest coral collected with the submersible was between 40 and 45 mm in diameter and 38 percent was greater than 20 mm. Only 39 percent of the coral collected by the submersible was less than 10 mm.

The average quantity of precious coral collected per dredge haul, which lasted on the average one hour, was 1.7 Kg. Eight hauls per day, a reasonable maximum, would therefore yield on the average 13.6 Kg of precious coral. The average catch by the submersible, limited by power to about four hours on the bottom, was 36.6 Kg/day, or about 2.7 times the average daily dredge haul catch. However, because the submersible catch contained significantly larger coral, its actual value was closer to 10 times the value of the dredged coral. Although more expensive to operate than conventional surface vessels, commercial harvest of precious coral by submersible has proven to be a profitable operation. Not only is it significantly more efficient than dredging, but it also allows selective harvest at a rate that does not exceed natural replacement rates.

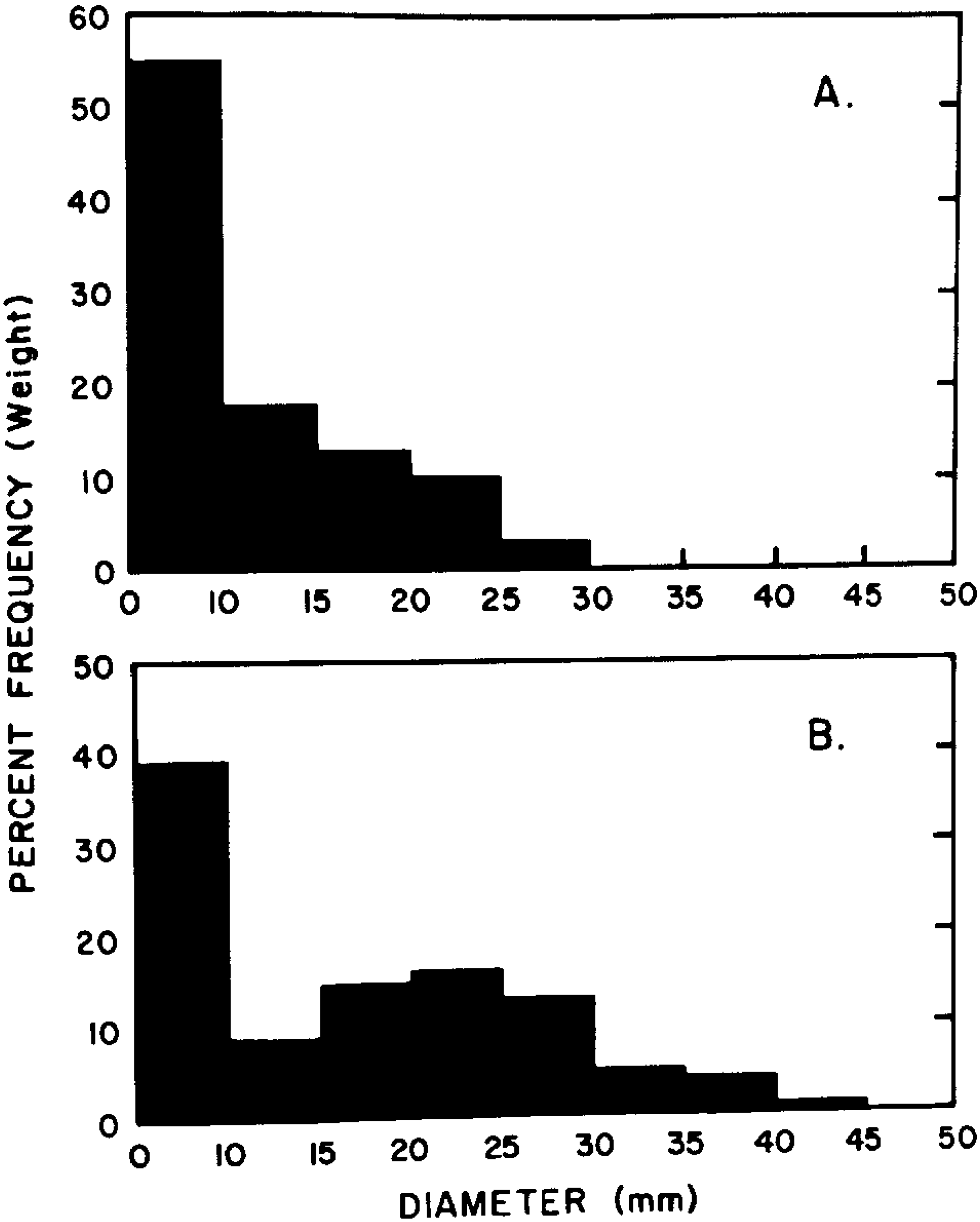

Figure 3. Size-frequency distribution of precious coral collected with tangle nets (A) and the submersible (B).

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