SAMPLING MIDWATER FISH USING THE TEN-FOOT ISAACS-KIDD MIDWATER TRAWL AND THE COBB PELAGIC TRAWL

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INTRODUCTION

In order to study the general ecology of midwater nekton, an efficient method of obtaining samples representative of the biota of the sampling area must be employed. Ordinary plankton samplers (meter nets, etc.) do not catch nekton, probably because they are too small and too slow. A fish has adequate time to sense the pressure wave of the towed net and only a short distance to swim to avoid it. There are two obvious ways to overcome avoidance by nekton: make the trawls bigger, or tow them faster. The two choices are exclusive because drag forces on a large net restrict towing speed.

With few exceptions, scientists have used a slightly larger trawl towed at high speeds--the Isaacs-Kidd midwater trawl. This trawl has a slight advantage in size over a plankton net and a great advantage in speed. A few have built larger, otter-type trawls. These trawls are expensive, hard to handle, and require a research vessel especially equipped with double drum winches to operate them. Although the size of these trawls limits towing speed, it also presents such a large opening that all but the largest fish would be captured.

To this point, no one knows if a large trawl is really worthwhile. Perhaps the smaller, faster trawls do as good a job of sampling nekton as the larger, slower trawls. McGowan and Fraundorf (1966) give a detailed account of the effect of increased net diameter on sampling ability, i.e. abundance and diversity estimates of zooplankton. They found that species diversity and abundance increased for the most part with increased net diameter, the amount of water filtered being equal in all cases. Cailliet (personal communication), working with nekton, compared the six-foot and ten-foot Isaacs-Kidd midwater trawls. For

both fish and decapods, preliminary results indicate the ten-foot trawl caught over twice as many organisms per volume but the species diversity for both trawls was approximately the same. The ratio of mouth areas for the two trawls is approximately 1:3.

Aron and Collard (1969) studied the problem of sampler speed on catch. Using a modified six-foot Isaacs-Kidd midwater trawl, they found that the effect of increased net speed on catch was species dependent. Length frequency diagrams of high-speed tows show an increase in both numbers and mean size in some species (speed dependent) and an increase in only numbers in others (speed independent).

According to Barkley (1964), there is an optimum net size such that the minimum swimming velocity, a function of trawl speed and distance required to swim from the midpoint of the trawl mouth to the edge, needed to escape an oncoming net is as large as possible. Too large a net requires a low towing speed which reduces an organism's minimum escape velocity. Too small a net allows higher towing speeds, but the small diameter also reduces an organism's minimum escape velocity. The most efficient net would be one large enough to minimize reaction distance but small enough to gain high speed without radically reducing the minimum escape velocity (Barkley, 1964). Barkley does not, unfortunately, give a size for this ideal net.

If a trawl is towed with sufficient speed, there will be no chance for avoidance; if a trawl is big enough, the avoidance behavior need never be evoked (Harrisson, 1967). Harrisson makes the initial comparison between smaller, faster trawls and larger, slower trawls but analyzes the problem only to a limited extent. He suggests that the larger trawls

might be capable of catching larger fishes; but, because the comparison data are from different cruises, no precise comparison could be made.

This study considered a series of samples taken with a ten-foot Isaacs-Kidd midwater trawl and a slower, larger otter-type midwater trawl. I shall compare the two trawls' estimates of abundance, diversity, and population size frequencies, and consider the relationship of any differences due to patchiness and avoidance. I hope particularly to determine to what extent a larger trawl is a better sampling device, and whether larger trawls should be used more frequently in studies of the species composition and general ecology of midwater fishes.