M. James Allen

ALTERNATIVE METHODS FOR ASSESSING FISH POPULATIONS

In the past, most of our studies of demersal fish communities of southern California have been based upon samples of fish collected by small otter trawls, a collecting method that can be used only on the soft-bottom habitats and one that probably catches smaller bottom fishes more effectively than larger, more active fishes. The objective of this study is to determine what information on demersal fish species and communities can be obtained by using sampling methods other than small otter trawls.

Two additional techniques were used this year to sample demersal fishes: (1) photographic "sampling" along discharge pipes by divers aboard submersibles or using scuba gear and (2) hook-and-line sampling along otter trawl stations. Both techniques were used in Santa Monica Bay. In addition, television cameras were towed along the bottom and attached to otter trawls to identify organisms not effectively sampled by the trawl

Photographs of marine organisms were taken along the Hyperion 5-mile effluent and 7-mile sludge discharge pipes to identify the species of marine organisms found on and around the pipes, an area not sampled by otter trawls. This study was initiated by the Coastal Water Project and the City of Los Angeles and was conducted by Mr. Harry Pecorelli of Aqua Contractors and Oceanographies, Inc., during June and July 1974. Photographs were taken at seven stations in three depth zones along the pipes—at a shallow station (10 to 30 m) on each pipe, at a middepth station (40 to 50 m) on each pipe, and at three deep stations, one on each of the two diffuser legs (60 m) of the 5-mile pipe and one (60 to 100 m) on the 7-mile pipe. Shallow stations were photographed by scuba divers, and middepth and deep stations were photographed from a two-man submersible. Almost 400 color photographs of marine life living on and around the pipe were taken, and species distribution patterns were determined. This information is presented in a paper, "Marine Organisms Associated with Waste Discharge Pipes in Santa Monica Bay, California," by James Alien, Harry Pecorelli, and Jack Word, soon to be published in the Journal of the Water Pollution Control Federation.

Hook-and-line sampling of marine organisms in Santa Monica Bay was conducted by Jon B. Isaacs during April and May 1975. Two methods of hook-and-line sampling were utilized. A 100-hook setline was laid across the bottom to catch the species within the vertical range of the trawl that might avoid the net. In addition, schools of fish located by sonar in the general vicinity of the trawl stations were fished with rod and reel to collect species that either dwell in the water column above the vertical range of the trawl or are highly clumped and there-fore might be frequently missed by the trawl. We thought that large predators missed by the trawls might occur more frequently in the hook-and-line catches; we also felt that there might be differences in the frequency of disease (particularly fin erosion disease, which affects swimming abilities) in otter trawl and hook-and-line catches. Three transects were sampled, each including stations at four depths (20, 60, 100, and 190 m) corresponding to previously trawled sites. Additional

hook-and-line sampling is currently being done along discharge pipes and in deep rocky areas to identify species living in these untrawlable areas.

Television cameras were attached to the small (7.6-ni head-rope) otter trawls during surveys at Santa Catalina Island during July and September 1974; the television monitor and video tapes allowed us to directly observe the behavior of fishes and invertebrates with respect to the otter trawl.

Thirty-one species of fishes were observed in photographs of the discharge pipes (Table 1). Rod-and-reel sampling yielded 15 species, and setline sampling yielded 11 species. A total of 23 species were taken by both hook-and-line methods, with only four species in common between the two methods: spiny dogfish (*Squalus acanthias*), sablefish (*Anoptopoma fimbria*), white croaker (*Genyonemus lineatus*), and Pacific sanddab (*Citharicthys sordidus*). In contrast, 87 species have been taken in Santa Monica Bay by otter trawl surveys conducted by the Coastal Water Project. Photographic and hook-and-line methods yielded only two species that were not taken by otter trawl in this area: Pacific hagfish (*Eptatretus stouti*) , taken by setline, and an unidentified ronquil (*Rathbunella* sp.) observed in the photographs. Both species have been taken by otter trawl elsewhere.

More species were taken per station by otter trawl (10.4 ± 0.4) than by rod and reel (3.6 ± 0.5) and set-line (2.3 ± 0.7) methods, although time spent on the station varied considerably (otter trawl, 10 min.; rod-and-reel, 4 hr; and setline, 1 hr).

Setlines were most effective at sampling wide-ranging species that forage on the bottom; the setline did not sample rockfish populations. Rod-and-reel fishing into schools located by sonar was effective at catching species such as rockfishes that range higher off the bottom and are generally clumped. Otter trawls were most effective at sampling small bottom fishes such as flatfishes, sculpins, and small rockfishes.

Although we caught a proportionately greater number of large fishes with the hook-and-line methods than with the otter trawl, hook-and-line catches usually fell within the size ranges sampled by otter trawl. The hook-and-line catches showed that more large bottom-feeding fish (mostly spiny dogfish) occurred in shallow water than was indicated by otter trawling. Fin erosion was not encountered in the white croaker caught by hook and line (the white croaker was the only species abundant in this survey that is frequently diseased in otter trawl surveys). However, white croaker taken by otter trawl in this area at the same time also did not have eroded fins. Thus, we still have not determined whether or not healthy fish escape the trawl more frequently than diseased fish.

Photographic sampling was effective at showing the species (particularly invertebrates that cannot be taken by hook-and-line) found on hard substrate areas (such as out-fall pipes) that cannot be trawled. This method was also very useful in showing where the organisms are living-information of this sort is almost always lost by remote sampling techniques. The disadvantages of photographic sampling include the difficulty in making accurate identification of organisms observed and in getting size estimates on some species.

Video tapes of otter trawls in action suggested that many of the fishes and invertebrates encountered escape the nets. Larger fish species (such as the Pacific angel shark, Squatina californica) have been observed to swim into the net, become entangled and later swim out before the net was retrieved. Water-column species often swim up and over the net. Smaller bottom species (such as speckled sanddabs, *Citharichthys stigmaeus*) swim slightly off the bottom in front of the net, trying to outrun it. Turbots (*Pleuronichthys* sp.), which are often buried, jump vertically from the bottom when the net approaches, only to fall within it. Sea pens and tube-dwelling polychaetes, which have a certain degree of attachment to the bottom, are not well sampled.

Of the three general methods (otter trawl, hook-and-line, and photographs), otter trawls are probably the best method of sampling small bottom fishes on soft-bottom areas—the trawls yield the greatest number of species and numbers of individuals from which additional measurements can be made. Small otter trawls probably do not efficiently sample large, fast-swimming species or species that burrow in the sediment. Large species found over soft-bottoms are often more effectively taken by hook-and-line techniques. Of these, setlines more effectively sample large, wide-ranging bottom feeders, which may escape the net; fishing by rod and reel in schools located by sonar is a more effective way to catch the highly clumped rockfishes that may be missed by chance in a trawl. Photographic and hook-and-line methods are both effective at sampling rocky bottom areas.

Sampling methods such as otter trawl or hook-and-line fishing allow accurate identification of specimens and measurement of size and disease states, although they give little information as to the behavior of the organisms in their natural environment. Photographic sampling gives more information on the behavior of the species in their natural environment, but identifications can be less accurate, and fewer measurable data are gathered.

The use of these additional methods has not substantially altered our viewpoint of the organization of demersal fish communities as indicated by small otter trawls, although they have provided useful information and insight for a better description of these communities. Each collecting method is selective for different species or sizes of species—only by using a variety of methods can a comprehensive picture of demersal fish communities be developed.

Table 1. Fish collecting methods used by the Coastal Water Project in Santa Monica Bay.

		Hook and Line		
	Otter Trawl	Rod and Reel	Setline	Submersible Photographs
Total Samples	124	16	13	399
Depth Range (m)	20 – 190	20 – 190	20 – 190	10 – 100
Habitat	Soft	Soft	Soft	Pipe
Time spent on Station	10 min.	4 hr	1 hr	–
Total Species	87	15	11	31
Species/Station (Mean ± Std. Error)	10.4 ± 0.4	3.6 ± 0.5	2.3 ± 0.7	–