M. James Allen

REGIONAL VARIATION IN THE STRUCTURE OF FISH COMMUNITIES

A major problem in identifying pollution effects on the demersal fish fauna of southern California has been the lack of knowledge of the distribution patterns of the species and the organization of their communities. Last year's annual report described some of the theoretical concepts being used to create a model of the demersal fish communities of southern California. The objective of this article is to demonstrate how the model can be used to describe the regional variation in the structure of these communities.

The structure of demersal fish communities is based upon the types of feeding roles that can coexist. The feeding role is thought to be an ecological unit above the species level that is important to an understanding of the organization of communities and one that is sensitive to nutrient-related environmental differences. Species that coexist in a given community generally perform different feeding roles, whereas species that perform the same feeding role are generally found in different communities. By examining the foraging behavior of species that are found in the same community, the basic feeding roles can be determined. Then by sorting species into feeding guilds (a guild is a set of species that perform the same feeding role) and identifying the species within a guild that are most likely to be found at a given depth, a model of the depth distribution patterns of soft-bottom fishes of southern California can be created. The structure of these communities and the fish distribution model is given in detail in a soon to be published report entitled "Functional Structure of Demersal Fish Communities of Southern California." The information developed in that paper can be used to describe the natural variation in the structure (i.e., the types of feeding roles that coexist) and composition (i.e., the species that perform each of the feeding roles) of demersal fish communities with respect to geographic regions or depths. Species with anomalous distribution patterns can also be identified and investigated to further determine their relationship to pollution.

The major feeding roles of soft-bottom fishes of southern California are shown in Figure 1. Soft-bottom fishes taken by otter trawl can be divided into two major groups- fishes that forage from the bottom and fishes that forage from the water column. In each group, there are three major feeding roles: (1) water-column feeders, (2) intermediate feeders, and (3) bottom feeders. These roles can be further divided into guilds of species that have more specialized types of foraging behavior.

The importance of these major roles to the soft-bottom fish communities can vary from one geographic region to another. In Figure 2, the abundance of each feeding role at a given depth is shown relative to that of all feeding roles at that depth; the trawl data used in the figure were collected during a synoptic survey of three geographic regions (Santa Monica Bay, Palos Verdes Peninsula, and San Pedro Bay), using the same gear and vessel (Mearns and Greene 1974).

Analysis of these data resulted in the following observations:

- Only four of the six major roles were "important" (arbitrarily defined here as representing individually 20 percent or more of the total catch at each depth in all regions): (1) Role IA, represented primarily by sanddabs; (2) Role IB, represented by sculpins; (3) Role 1C, represented primarily by turbots and soles; and (4) Role IIA, represented by water-column-feeding rockfishes. Roles IIB (bottom-feeding rockfishes) and IIC (perches and croakers) were of minor importance in all regions, although species performing Role IIC were moderately abundant at shallow depths off Palos Verdes Peninsula.
- One to three major feeding roles were important at each depth in each region; this indicates a rather simple basic structure to the soft-bottom communities in all regions.
- Santa Monica and San Pedro Bays were similar to each other in shallow and middepths in terms of the number of important roles found. Palos Verdes Peninsula differed from both in only having one major role at these depths, suggesting that the bay areas are more similar to each other than to the Palos Verdes Peninsula in community structure. All regions were different in the number of roles that were important at 140 m: Santa Monica Bay had one; Palos Verdes Peninsula had two; and San Pedro Bay had three.
- Water-column feeders (either Role 1A or IIA) were important in all regions and at all depths, suggesting that food organisms in the water column are important to demersal fishes in all regions.
- Santa Monica and San Pedro Bays differed from each other with respect to the role (other than water-column-feeding roles) that was important in shallow and middepths. In Santa Monica Bay, Role IB was important; in San Pedro Bay, Role 1C (which is more limited to bottom food than Role IB) was important. Only water-column-feeding roles were important at these depths at Palos Verdes Penisula. This suggests a difference in the general type or predictability of bottom food in the three areas.
- Fishes living in and foraging from the water column were not important in shallow water (30 m) in any region (this finding may reflect the limitations of the otter trawl as a sampling tool; for example, because of the better visibility in shallow waters, water column fishes may more easily avoid the net or, because of greater susceptibility to predation, may be more clumped and hence less frequently taken). The example above illustrates the general type of regional and depth variation in the structure of the demersal fish communities that can occur, specifically with respect to the kinds of feeding roles that coexist. The kinds of feeding roles that coexist, in general, reflect the location, abundance, availability, and predictability of the food resources utilized by demersal fishes.

In addition to identifying the major feeding roles that coexist within fish communities, the structure of the communities can also be examined in more detailed for each region. For instance, some feeding roles can often be further subdivided into guilds of species that locate their food with different sense organs (sight or touch or taste) or that feed in different manners (i.e., searchers versus polychaete-extractors). Relative abundances of each guild within a major feeding role can give a more detailed picture of regional differences in fish community structure. This can be carried further to determine whether or not a species within a guild that one would expect to find at a given depth is actually found at that depth at a given location, or whether it is replaced by another guild member. Anomalies in the distribution patterns of individual species can be determined

in this manner; in the future, certain of these species will be selected for further studies to deter-mine if pollution is affecting their distribution.

In summary, by using this model of the structure of demersal fish communities of southern California, regional and depth variation in the structure of the communities can be described, and nutrient-related alterations of this structure can be identified. The model can thus be used to identify man's effects upon these communities and to distinguish between these and natural variation in community structure. This work is being supported, in part, by a grant from tht Environmental Protection Agency

REFERENCE

Mearns, A.J., and C.S. Greene, eds. 1974. A comparative trawl survey of three areas of heavy waste discharge. Rept. TM 215, Southern California Coastal Water Research Project.

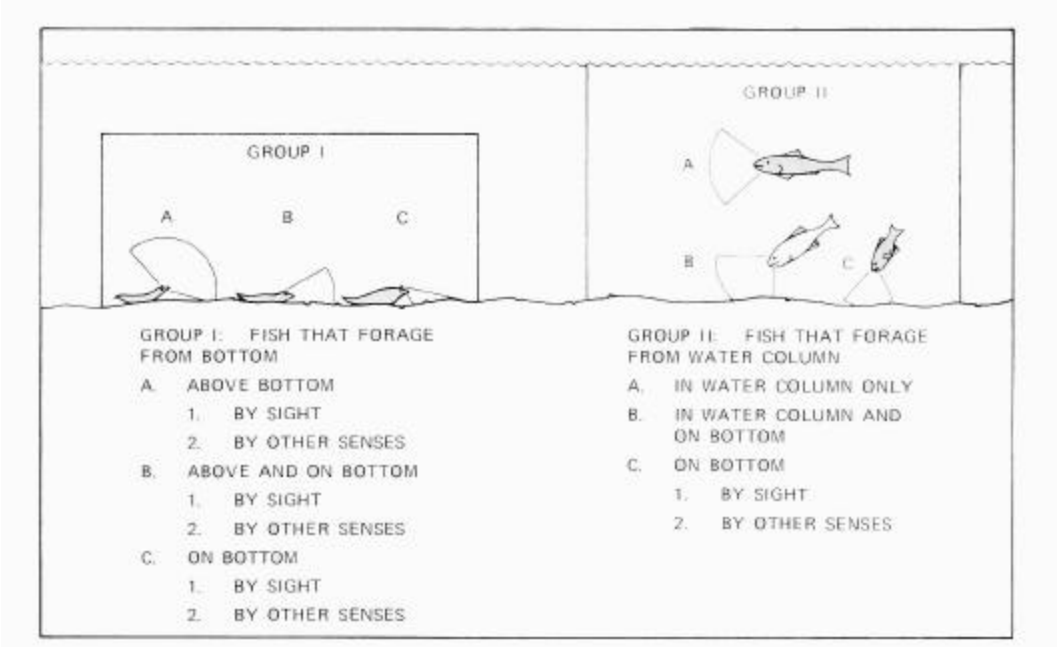

Figure 1. General types of demersal fish foraging behavior

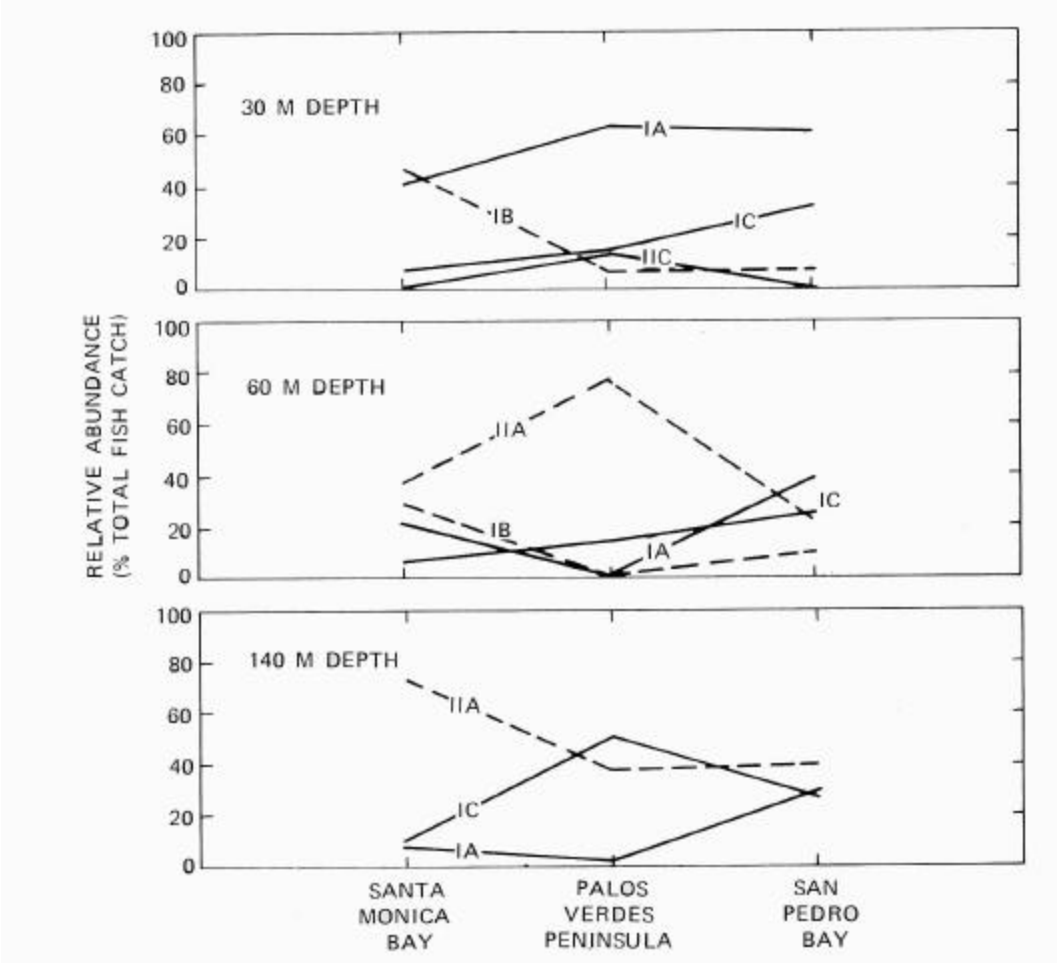

Figure 2. Relative abundance of demersal fish feeding roles in each of three geographic regions in southern California.