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PLANKTON COMMUNITY STRUCTURE: EVALUATION OF
ANALYTICAL METHODS USING MODEL COMMUNITIES

Annual Progress Report

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Yearly Progress Report

Contract AT(38-1)-852

Willis B. Hayes, P.I.

I. Work Completed, 15 June, 1974 - 15 March, 1975

Work during the first nine months of the grant period has followed, in general outline, the procedures discussed in the original grant proposal. This work has concentrated in two main areas: (1) the programming and testing of procedures to determine various sorts of affinity indices for plankton communities, and (2) the evaluation of factors needed to construct a plankton community model, which will be used to evaluate the affinity tests.

The first affinity test studied was the "recurrent group" procedure of Fager (Fager, 1957; Fager and McGowan, 1963; Venrick, 1971; etc.), since it has been used by a number of investigators for analyzing plankton. After a number of programming difficulties were overcome, a series of Fager's programs were combined with some written by the author to (a) calculate the recurrent group distribution in a series of plankton samples, (b) establish the physical locations of the groups, (c) calculate inter-group relationships, and (d) set an objective level for the recurrent group index, using a Monte Carlo procedure.

The second test investigated was Orloci's "sums of squares" method (Orloci, 1967), an "agglomerative" test as opposed to Fager's "divisive" one (Pielou, 1969). The Orloci procedure has been used primarily in terrestrial vegetation analysis (e.g. Stanek and Orloci, 1973), but it is adaptable to plankton. The programming is not as formidable as Fager's method. A program for this procedure is now working in BASIC, and is in the process of being converted to FORTRAN IV.

A third procedure of interest was the "probabilistic similarity index" developed by Goodall (1966). At the time the original proposal was written, an application of this index to plankton was not known, but a recent study (Legendre, 1973) has in fact done this, with promising results. Preliminary tests indicate that the method may be applicable to a wider variety of sample types than the previous ones, although its precision remains untested. A FORTRAN program of this procedure is in progress.

The generalized community-distribution model has been approached as described in the first proposal. The first approximation to the model was a static distribution pattern based on a transect chain (e.g., a series of vertical plankton tows made along a particular course). Several factors were experimented with at this level:

a) Species number. For ease in debugging the program, only 20 species were used, distributed over a 500-compartment transect chain. This will later be expanded, hopefully to about 100 species, to make a more realistic match with actual plankton collections studied (e.g. Strickland, et al., 1968).

b) Patchiness. Plankton patchiness appears to occur on three general scales: small-scale (centimeters to meters in extent), mid-scale (tens of meters to kilometers), and large-scale (kilometers to hundreds of kilometers). This study has thus far concentrated on the middle range, with the compartments of the transect line representing homogeneous blocks of 10 x 10 meters, and the chain extending for 5 km. Studies by the author have shown that community structure in nearshore plankton can undergo striking changes in distances of this order.

Patchiness of various degrees was simulated by breaking the chain into either uniform or random-length blocks, then inserting given fractions of the

different species at random into the compartments of each block. Patchiness could be quantified by a mean-square procedure (e.g. Kershaw, 1958). Some species were assumed to be random in distribution (Poisson), rather than patchy, and some common species were put into almost all of the compartments.

c) Species-area distribution. Diversity patterns enter into the analysis through the necessity of considering the distribution of species occurrences. Analysis of actual plankton samples by the author has produced occurrence (presence-absence) data as in Table 1.

Table 1. Nearshore phytoplankton and microzooplankton collected off La Jolla, California, April-September, 1967; 69 samples at 3 sampling stations, 158 spp. "Octave" notation after Preston (1948).

<u>Octave</u>	<u>No. of occurrences</u>	<u>No. of species</u>
1	1	13
2	2-3	16
3	4-7	18
4	8-15	44
5	16-31	42
6	32-63	25

Such data strongly suggest lognormal distributions, which were incorporated into the model. The relationship between number of occurrences and number of individuals is now being studied; it appears to be dependent on sampling methodology.