A GRAPHICAL METHOD TO ASSESS FAUNAL DOMINANCE[a]

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Abstract: A graphical method of illustrating dominance in fish communities is presented. This procedure incorporates both numeric abundance and frequency of occurrence data and illustrates the relative dominance of each species.

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Quantitative expressions (e.g. species diversity indices, faunal homogeneity indices, and association coefficents) have been used to describe biotic assemblages in aquatic ecosystems. However, the degree of dominance, a basic component of community structure analysis, is difficult to quantify for comparative purposes. Moreover, data interpretation may be hampered when several sampling methods are used.

The simplest way to identify dominance is to rank species by numeric abundance or percentage composition. Numerical ranking for a group of samples, however, can be biased by one or more extremely large collections. To minimize this source of error, Sanders (1960) presented a Biological Index which gives equal weight to all samples by measuring the frequency of appearance of a given species as one of the 10 most abundant species in each sample. Ono (1960) graphically plotted the frequency of occurrence against the mean number of individuals per sample for each species.

The purpose of this paper is to present a quantitative method, modified from the procedures of Sanders (1960) and Ono (1960), of analyzing relative abundance and frequency of occurrence data.

MATERIALS AND METHODS

Fish data generated from the Lake Conway grass carp project were used to illustrate this graphical method of faunal dominance. Five sampling methods were used, including Wegener ring, electroshocker, gill net, 3.0 m seine, and 6.1 m seine. Two Wegener ring samples were taken monthly at each of 6 stations in shallow, heavily vegetated areas. Two seine collections accompanied Wegener ring samples at each station. One collection was taken in unvegetated habitats with the 6.1 m seine, while the other collection was taken adjacent to emergent vegetation with the 3.0 m seine. One 0.5 hour of electrofishing was undertaken monthly at each of 3 naturally vegetated and 3 branch habitats. Two 124 m gill nets were set overnight monthly at each of 2 stations. Sampling was conducted from May through September 1976.

Ono's (1960) graphical method of dominance assessment, in which he plotted the frequency of occurrence against the mean number of individuals in samples, formed the basis of the present method of analysis. The procedure of Ono was modified in 2 ways. First, since several sampling methods were used, a modification of Sanders (1960) Biological Index was used to measure numerical abundance instead of the number of individuals per sample. Second, instead of the absolute number of times each species was encountered in samples, the percentage frequency of occurrence for all gear types of each species relative to the most frequently encountered one was determined.

Sanders Biological Index measures the frequency of appearance of a given taxon as one of the 10 most abundant species. As used here, its value is obtained by assigning 10 points to the most abundant species, 9 points to the second most abundant species, and so forth to 1 point for the tenth most abundant species in pooled monthly data for each gear type. Scores for each species were then summed. Instead of using the absolute pooled numeric value as Sanders did, the relative abundance rank of each individual species as a percentage of the most abundant species was calculated.

The coordinates for each species collected were then determined and placed on a graph, where Sanders Biological Index was used on the Y axis and frequency of occurrence data were utilized for the X axis. The graph was then divided into 3 sections by dashed lines. The 20 percent and 40 percent values for both the X and Y axes were selected because they neatly separated the species clusters on the graph. The inner box encloses rare species, the middle enclosure represents common species, and the outer section depicts abundant species.

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RESULTS AND DISCUSSION

The relative dominance of species collected in Lake Conway is illustrated in Fig. 1. Thirteen species had less than 20 percentiles for both abundance and frequency and were considered rare. Eight species were defined as common. The remaining 7 species were ranked in at least 40 percentiles for either abundance or frequency.

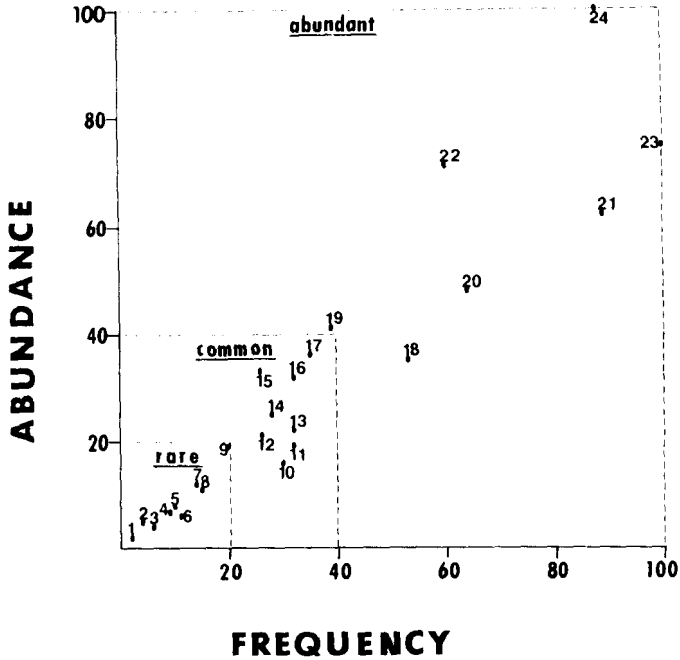

Fig. 1. Graphic assessment of dominance of species collected in Lake Conway according to percent relative abundance (Sanders Biological Index) and percent relative frequency. (1 = longnose gar, bowfin, white catfish, flagfish, and dollar sunfish; 2 = least killifish; 3 = yellow bullhead; 4 = spotted sunfish; 5 = lake chubsucker; 6 = brown bullhead; 7 = bluespotted sunfish; 8 = golden topminnow; 9 = warmouth; 10 = gizzard shad; 11 = brook silverside; 12 = gizzard shad; 13 = threadfin shad; 14 = Florida gar; 15 = golden shiner; 16 = black crappie; 17 = chain pickerel; 18 = bluefin killifish; 19 = coastal shiner; 20 = mosquitofish; 21 = Seminole killifish; 22 = readear sunfish; 23 = largemouth bass; and 24 = bluegill.

On this figure, the species became more abundant vertically and more frequent horizontally. Accordingly, the dominant species (i.e., those that occur frequently and in large numbers) appear in the upper right portion of the graph. Similarly, species located near the lower left corner are uncommon in both abundance and frequency.

Recent documentation of biotic changes associated with environmental stresses have emphasized mathematical approaches. Such analyses reduce large sets of data to a common and manageable format. The graphical depiction of faunal dominance as described above or with applicable modifications can be a valuable tool in pollution and impact studies. Construction of the previously described and illustrated graphs for different localities or time periods would permit faunal comparisons to document changes in community structure through shifts in the relative position of species.

LITERATURE CITED

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