TEMPORAL VARIATION IN THE SPECIES DIVERSITY OF A WOODLAND CADDISFLY FAUNA FROM CENTRAL ILLINOIS

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ABSTRACT.—The species diversity as measured by H of the adult caddisfly fauna of the Nettie Hart Woodland Memorial near Mahomet, Illinois, was calculated for one night a week from May 26 to September 18, 1966. The calculated diversity values were much less variable than the population levels of the individual species as measured by the coefficient of variation. The coefficient of variation of the H values was .3201, but the range of the coefficients of the individual species was from .5876 to 1.7060. It is hypothesized that this indicates that some organization exists in the community such that a change in the population level of one species is not independent of the populations of the other species. Their was no significant correlation between commonness and variability in the ten commonest species.

An important question in the measurement of species diversity in natural communities is whether diversity measures reflect an inherent organization of the community or only a random assemblage of species. If the species diversity of a group of organisms is less variable than that of the populations of the component species, it is possible that a degree of organization is present, smoothing over differences caused by changes in the densities of individual species.

METHODS

A study was made of the adult caddisfly community in the Nettie Hart Woodland Memorial near Mahomet, Illinois. An ultraviolet, 15-watt, black-light trap was run every night for one year along the Sangamon River by Dr. Milton W. Sanderson of the Illinois Natural History Survey. The trap was located in the woods between the bank of the river and a small tributary stream. The catch from each night was preserved in 70 percent alcohol and stored. Catches from 17 nights, taken at approximately weekly intervals from May 26 to September 18, 1966, were sorted and all of the adult caddisflies of the families Hydropsychidae, Psycomiidae, Leptoceridae, and Rhyacophilidae were identified. The Hydropsychidae, Psycomiidae, Leptoceridae, and Rhyacophilidae are roughly of the same size grouping and make up about 95 percent of the caddisfly fauna at this location.

The diversity index used was H (information theoretical) and was calculated using the formula

$$H = \frac{c}{N} (\log_{10} N! - \log_{10} n_i!)$$

and the tables given in Lloyd *et al.* (1968). H rather than H′ was used because the samples were not taken randomly (Pielou, 1966), and the sample had to be considered as a population unto itself. The parameter c in this case equals 2.302585

and is used for conversion of logarithms from the base 10 to the base e. The total number of individuals is represented by N, and the number of individuals per species by n_i. The calculated diversity for each of the 17 nights is given in Table 1. Diversity as measured by H is influenced by three factors: the number of species in the sample, the number of individuals, and a component measuring the shape of the distribution of individuals to species. This second component has been termed "evenness" by Pielou (1966).

TABLE 1.—Summarized data for each of the 17 night's catches from May 26 to September 18, 1966.

	Individuals	Species	Males	Females	H
May 26	114	5	53	61	.4576
June 3	196	8	116	80	1.0348
June 12	974	14	442	532	1.5535
June 17	157	12	75	82	1.6742
June 23	521	13	278	243	1.8702
June 30	668	14	323	345	1.7250
July 6	712	15	244	468	1.9601
July 14	1,305	8	333	972	1.1401
July 22	667	11	258	409	1.5311
July 26	801	15	321	480	1.6531
August 4	175	9	92	83	1.4828
August 12	264	10	102	162	1.6640
August 19	324	13	91	233	1.8487
August 25	772	10	413	359	1.4206
September 4	441	11	253	188	1.3254
September 8	326	11	232	94	1.1884
September 18	70	6	41	29	1.2304

RESULTS AND DISCUSSION

The hypothesis was that the temporal variability of H was the same as that of the species in the community. The percentage of each species in a single night's catch was computed and averaged over all 17 nights. It is not possible to make generalizations about the true abundance of each species because the number of caddisflies caught any night is dependent on weather. The standard deviation of each species' frequency was also computed. Using these two statistics, the coefficient of variation for the 10 commonest species was computed, an analysis suggested by Dr. Monte Lloyd of the University of Chicago. Similarly the mean and standard deviation of H for the period of 17 nights was calculated. The antilogarithms to the base e of the calculated H values were taken before calculating the coefficient of variation, because H is on the log scale and not directly comparable to the coefficients of variation of the species.

The coefficient of variation for the H measure is .3201 and falls well below the range of the component species (Table 2), indicating that the variation of diversity as measured by H is less than that of the component species.

TABLE 2.—Coefficients of variation and total number of individuals of the 10 commonest caddisfly species.

	Total Individuals	Coefficient of Variation
Cheumatopsyche analis	2,258	.7436
Hydropsyche orris	2,237	.6303
Potaymia flava	1,807	1.2560
Ocestis inconspicua	666	.5876
Leptocella candida	357	1.4211
Polycentropus cinereus	350	.9675
Hydropsyche betteni	272	1.1725
Aithripsodes transversus	256	1.2541
Trianodes aba	65	1.7060
Nyctiophylax vestitus	53	1.1332

The data suggested that the populations of the commoner species in the community fluctuated less than the rarer species. A correlation coefficient (r) was calculated using the log total number of individuals of each of the 10 commonest species as the x variable and the coefficient of variation as the y variable. The calculated r was .3371 and is not significant. Prior to the beginning of the study, it was also hypothesized that there would be significant correlations between the population fluctuations of the three commonest species and the fluctuation of H. A regression analysis of the population levels of each of the three commonest species against H were calculated, but none of the three was significant.

The possible implication of this study is that organization, as measured by H, probably exists in natural communities, and the fluctuations of species populations are not entirely random with respect to other related members of the community. The possibility of the lower variation of H being a statistical artifact cannot, as yet, be ruled out.

ACKNOWLEDGMENTS

I wish to express my appreciation to Dr. Richard B. Root of Cornell University for reading and commenting on this paper. I also wish to thank Dr. Philip W. Smith of the Illinois Natural History Survey and my wife Beverly for their help with the writing of the paper.

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Manuscript received May 21, 1970