THE USE OF INFORMATION THEORY IN THE STUDY OF THE DIVERSITY OF BIOLOGICAL POPULATIONS

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1. Introduction

Any natural assemblage of animals or plants usually contains several species of organisms. It may therefore be described as diverse. Only in the unlikely event that all the organisms in a collection belonged to the same species could one say that its diversity was zero.

Diversity is thus a characteristic of biological collections. Whether the object of study be a natural community of plants, a collection of insects caught in a light trap, the microarthropods in soil samples, a population of breeding pairs of forest birds, or the plankton organisms in a sample of sea water, it will almost always exhibit diversity. A biologist will therefore wish to assign some numerical value to this property of the collection he is studying.

Various methods of measuring diversity have been used in the past, the simplest being merely to count the number of species present. More precise measures take account of the fact that diversity has two quite distinct aspects. Thus, besides knowing the number of species in a collection, it is also necessary to consider how the individual organisms are apportioned among them. For a given number of species, a collection in which the species are fairly evenly represented has high diversity; whereas, if the bulk of the collection is made up of only a few of the species, while the remaining species are poorly represented, the diversity is lower.

Before describing in detail a way in which diversity may be measured, it is worth while considering why the diversity of populations is of interest to theoretical biologists. The diversities of numerous populations have been measured in various ways and facts such as the following have emerged: tropical communities are more diverse than those of high latitudes [1]; the communities of continental land masses are more diverse than those of isolated oceanic islands [1]; well established communities that have been undisturbed for long periods of time are more diverse than immature ones; communities of short lived organisms that show great seasonal variation in numbers (such as Lepidoptera in temperate latitudes) have high diversity in midsummer and low diversity in spring and fall [2]; sea floor animals living in shallow water form more diverse