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NASA TECH BRIEF

A Mathematical Model of the Effect of a Predator on Species Diversity

One of the striking features of terrestrial soils is the presence of a diversity of microbial species, many of which have overlapping nutritional requirements. Even a partial overlap in nutrient needs, between two microbes, predator and consumer, challenges the competitive exclusion principle—an ecological generalization that no two species can coexist indefinitely when they require a common limiting resource.

A mathematical model has been developed to determine what occurs when a predator is introduced, which has the normally successful microbe competitor as the sole nutrient resource. The conclusions derived from this model can be applied to other, more advanced ecological problems, e.g., wildlife population control.

The analysis of the interactions of the predator and consumer populations and their resources is considered in two parts: first, the development of a basic set of differential equations which describe the interactions with the specific growth rates (treated as undefined variables); second, a description of the specific growth rates as they are affected by population density and nutrient concentration.

Based upon the assumptions and the general test conditions, there is a theoretical expectation that (1) the level of resource concentration rises when the consumer population is reduced by predation, and (2) an additional consumer can coexist with the originai consumer utilizing the resources released by predation. These two conclusions are in full agreement with previous conclusions cited in the literature. Moreover, from this model it is found that the presence of the second consumer stabilizes a predator-prey association which otherwise might oscillate.

These conclusions suggest that predators play an important role in maintaining species diversity, since predators reduce the number of individual prey organisms in a population to the level where they cannot fully exploit their potential resources. It can be reasoned that resources never limit population growth in the presence of the predators. The further implication is that another species which would have been excluded in competition for the resource may enter the environment and exist on an unexploited residue of resource.

Note:

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Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price $3.00
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NASA-CR-101669 (N69-30085), A Mathematical Model of the Effect of a Predator on Species Diversity

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