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Technical Manuscript N-119
October 1981

GUILD THEORY DEVELOPMENT AS A MECHANISM
FOR ASSESSING ENVIRONMENTAL IMPACT

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FOREWORD

This article originally appeared in the Vol. 5, No. 3 issue of Environmental Management magazine and is reprinted here with permission of Springer-Verlag New York, Inc.

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FORUM

Guild Theory Development as a Mechanism for Assessing Environmental Impact

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The following proposed procedures are designed, through the use of guild theory, to allow relatively accurate, quantifiable predictions of environmental impact, which can be aimed at both quantitative (biomass) and qualitative (diversity) aspects of the flora and fauna of the proposed area of impact. Examination of impact on plant and animal guilds should allow determination of the cause-effect relationships between the impacting activity and the environment, thus giving insight into potential mitigating procedures. I am proposing that guilds designed from an applied perspective can be used as an analytical and predictive tool in environmental decision-making procedures.

The need for such a tool arose from some of the problems faced by environmental personnel who are required to prepare environmental statements and assessments. First, the data gathering for many statements and assessments is accomplished by initially obtaining, through fieldwork or literature searches or both, exhaustive lists of organisms known or suspected to exist in the vicinity of the proposed activity. This information may then be expanded to include density, diversity, dominance, or frequency per habitat when, and if, funds are available. Representative habitats are usually inventoried as to species present, with those habitats of small acreage but significant diversity being bypassed because of lack of funds. Though exhaustive, these data are generally collected during a brief span of time. This misrepresents those species of varying seasonal occurrence, and some species, although present, are effectively unidentifiable except during certain seasons. Using this information about the area and previous experience and training, the investigator then forms an educated opinion as to the likely magnitude of the impact. This is a form of guessing, though educated, and can eventually lead to erroneous decisions.

KEY WORDS: Guild theory, Impact predictions

Second, there is a virtually complete lack of follow-up studies. Therefore, actual impact is rarely documented, a difficulty brought about by the way in which "data" for statements and assessments is provided. Groups are generally contracted to develop baseline information for regulatory purposes, and as profit-making organizations, they would receive little profit and might incur excessive losses if they were to attempt to develop original cause-effect relationships. Academia, government agencies, and other funding organizations are the institutions that should be and are looking into this aspect of environmental analyses. To develop these relationships properly is a long, expensive process and is still in its infancy. The question is: Can some useful interim procedure be developed and implemented during this period of development?

Guild theory states that organisms can be grouped by how they similarly use environmental resources (Root 1967). For use in assessing the environmental impact, this statement can be rearranged as follows: Actions that affect environmental resources will similarly affect the members of the guilds using those resources.

Once the impact on any one species in a guild is determined, the impact on every other species in that guild is known. Furthermore, this information can be applied to any ecosystem within which that guild is found. If an endangered species is contained in a guild, it is possible to predict the impact on that species without studying it specifically, which for most endangered species is virtually impossible to do anyway. Economically, the potential cost-savings are tremendous, since only a few species per guild need be studied to establish the resulting impacts on all members of the guild.

A number of steps must be carefully examined before a system or tool of this nature can be implemented. The first, and most important, is "Can guilds be delineated in such a fashion as to produce a useful tool?" Second, "Can data be gathered that would allow implementation of this method?" Finally, "Can we use this system to produce a

Figure 1. Guilds of nonmarine mammals inhabiting the continental United States. See text for discussion.

better product (Environmental Impact Assessment or Environmental Impact Statement) and a better environment?"

What are guilds? A guild by definition is a "group of species that exploit the same class of environment resources in a similar way" (Root 1967).

Is guild theory valid? Presently, it is receiving noticeable use in the literature, especially in the relationships of birds (Root 1967; Szaro and Balda 1979) and insects (Root 1973; Price 1971). It is also used, in principle, in wildlife management programs where several species are benefitted by food plot establishment and other habitat enhancement activities conducted by wildlife organizations. It is apparently reasonable to make a positive assumption as to guild theory validity.

The practical delineation of guilds suitable for use in applied studies, such as environmental analyses, presents a major obstacle. I present here a representation of mammal and bird guilds (Figs. 1 and 2, respectively). These relationships are presently being field tested in U.S. Army environmental studies. These preliminary

representations may be altered as field studies continue with different species and guilds in different ecosystems.

The mammals inhabiting North America are here divided into 30 guilds (Fig. 1). The first separation is based on size, as size approximately reflects the magnitude of home range, territory, and food resource requirements of each member of a guild. The second level of separation is based on the major mammalian feeding strategies; and subsequent separations are based on minor feeding strategies, habitat preferences, behavior patterns, or a combination of the three.

The birds inhabiting the United States were separated into 31 groups (Fig. 2) or guilds based on factors generally attributable to their feeding habits. Initial separation was based on the major feeding strategies (herbivorous, insectivorous, carnivorous, piscivorous, ground invertebrate eaters, and omnivorous). Later separation points varied, with combinations of size, feeding habit, more specific food type, or method of feeding being used. For each of the 31 guilds delineated, examples are given in the right-hand column.

The usefulness of guilds as an environmental analysis tool and in determining cause-effect relationships relies on the principle that, if the theory of guilds applies in reality and if guilds are properly delineated, actions

though the species composition of these areas is very different.

To show how this approach to guild theory could be of use, we have prepared an example from some prelim-

Figure 2. Guilds of predominantly land-dwelling birds inhabiting the contiguous United States.

The usefulness of guilds as an environmental analysis tool and in determining cause-effect relationships relies on the principle that, if the theory of guilds applies in reality and if guilds are properly delineated, actions impacting one member of a guild should impact the other members of that guild in a similar way. For example, actions that impact most species of voles, lemmings, and cotton rats (all considered members of one guild) in the grasslands of the southwestern United States should impact members of this same guild in a similar manner in the grasslands of the central United States, northeastern United States, or Alaska, even

though the species composition of these areas is very different.

To show how this approach to guild theory could be of use, we have prepared an example from some preliminary data gathered on a tracked-vehicle training area. We are dealing with four guilds and six species (Table 1). A 23% reduction in total small mammal biomass occurred following short-term use (woodland clearing and a brief period of training) as compared to a 66% loss after long-term (35 years) training. Examination of the guilds showed a variable impact. Guild No. 7 showed a 90% and 72% loss for short-term and long-term impact areas, No.

Table 1. Guild biomass

Guild	Species	Biomass control (g)	(% change)	
			Short-term	Long-term
7	Prairie vole, pine vole	158.9	15.8 (-90.0)	43.9 (-72.4)
2	Short-tailed shrew	58.2	5.4 (-90.7)	0 (-100.0)
9	Chipmunks	349.3	107.3 (-69.3)	0 (-100.0)
12	White-footed mouse, house mouse	9.4	314.9 (+3350.0)	154.5 (1643.0)
Total		575.8	443.4 (-23.0)	198.4 (-65.5)

2 was down by 91% and 100%, No. 9 was down by 69% and 100%, but No. 12 showed a 34-fold and 16-fold increase. These results appear to delineate some of the cause and effect relationships between this type of training and small mammal populations when the characteristics of each guild are examined. Shrews and voles (Nos. 2 and 7) are exclusively surface runway dwellers, inhabiting nests or dens either on the surface under the duff or below ground but close to the surface. Chipmunks (No. 9) are somewhat similar, preferring to stay on the ground, although they will climb occasionally. All three guilds suffered severe loss to their preferred habitat and moderate loss of food resources, with loss of food to the grass-eating voles being the most severe. On the other hand, mice (No. 12) showed a distinct increase, since their preference for climbing and seeds allowed them to effectively replace the vole and chipmunk guilds.

It is acknowledged that threatened and endangered species will continue to deserve individual recognition. Economically important or controversial taxa probably constitute other exceptions to the universality of guild analysis. Even with these species, predictions of degradation of habitat by guild could provide a far more accurate picture of true post-projects impacts than do current estimation methods.

The initial problem of misrepresentation of species presence can be solved by requiring that baseline ecological surveys be conducted during the different seasons of the year. This would be expensive and may not be reflected in regulations in the near future. This difficulty can be reduced if those species whose presence was not documented as a result of seasonal problems are assigned to guilds whose presence was documented. If the effects of the proposed activity are analyzed, then effects on undocumented species are also predictable and can be discussed.

The second problem of lack of follow-up studies can be

solved only over time but can be reduced in magnitude in the interim. As cause-effect relationships are developed for one activity versus one species, these relationships may be extrapolated to other species in the same guild, even though extensive studies may not have been conducted. Such relationships can then be extended to different, but related, activities such as land-clearing operations for commercial or housing developments and non-military off-road vehicle activity.

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