FOREST-PRAIRIE TRANSITIONS AND THE ADMIXTURE OF BUTTERFLY FAUNAS

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Terms referring to general types of ecological communities, such as *forest, prairie, tundra,* or *montane* communities, are used by ecologists to describe or categorize the character of environments. Likewise, they are used in description of types of species inhabiting such areas. Terms such as *prairie butterfly,* or *forest butterfly,* though sometimes vague in meaning, are common descriptive terms in Lepidopterology.

Transitions from prairie communities to forest communities differ in degree of abruptness from place to place. The escarpment affords a wide area of interspersement of these types of communities, while an abruptly rising mountain range may leave only a small amount of margin between forest and grassland. It seems obvious that the degree of interspersement of forest and prairie has a counterpart in the extent of *forest, prairie,* or *forest-prairie* types of species making up an area's faunal admixture.

Recent studies of butterfly faunas in escarpments along the western edges of the Great Plains, where forested areas are interspersed with prairie (Johnson and Nixon, 1967; Johnson, 1971) suggest extensive sympatry of butterfly species from various type of ecological communities. Hence, an investigation into the effect of forest-prairie interspersement on faunal admixtures seemed invited.

I therefore created a scheme by which types of species indicating the forest, prairie, or forest-prairie ecology might be designated and their percentage composition in various faunas analyzed.

Materials and Methods

It was deemed important to conduct the study in areas representing intergradations between two extremes. Hence, I selected the Bighorn Mountains of Wyoming (an area where transition from grassland to forest is abrupt), the scantily forested escarpments of the Long Pine Recreation Area in north-central Nebraska, and several areas between them. The latter included the Laramie Mountains of Wyoming, the Front Range of Colorado, the Black Hills of South Dakota, the Pine Ridge of Nebraska, and the escarpments along the Niobrara River cuttage in Nebraska. The location of these study areas is presented in Figure 1. Since nearly all of these areas have had recent specific faunal studies, a list of species for each area was conveniently obtained within the criteria cited concerning

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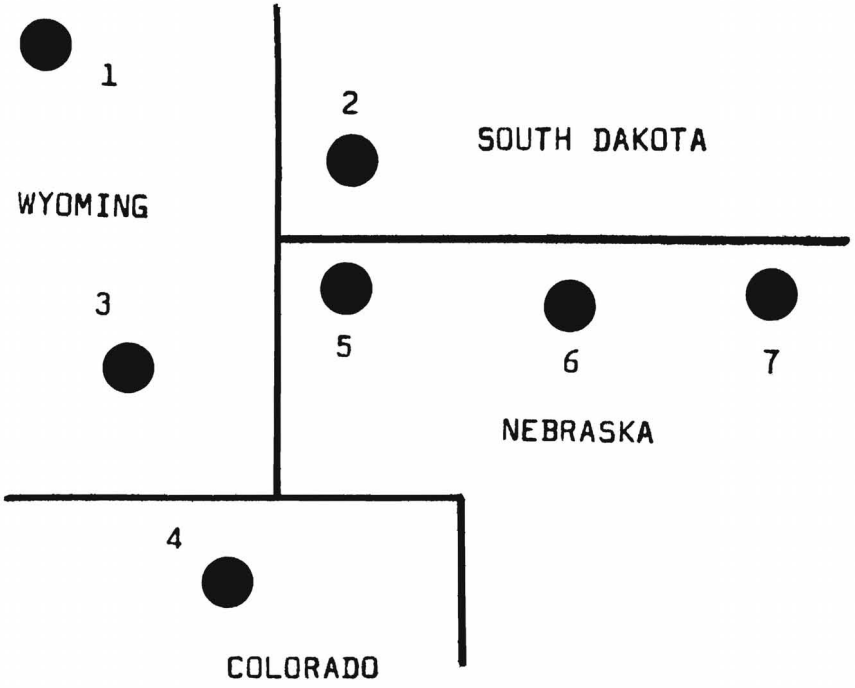

Fig. 1. Locations of the seven study areas. 1, Bighorn Mountains; 2, Black Hills; 3, Laramie Mountains; 4, Front Range; 5, Pine Ridge; 6, Niobrara River cuttage; 7, Long Pine Recreation Area.

them. Because the faunas of these separate areas are not unknown to lepidopterists and because the lists were compiled from a variety of sources, it was not deemed important to the study to include them, except to note that the species were organized according to dos Passos (1964). The number of species in each fauna is listed below each column on the dendrogram. The sources of the faunal lists are summarized below.

The faunal list of the Pine Ridge in Nebraska came from Johnson and Nixon (1967). That of the Niobrara River cuttage and Long Pine Recreation Area from Johnson's *The Butterflies of Nebraska* (1971). The Wyoming lists were obtained from the literature (DeFoliart, 1956; Nabokov, 1953) and the extensive personal research of Richard Hardesty (Douglas, Wyoming) and John S. Nordin (Webster, South Dakota). Hardesty and Nordin also assisted in compiling the faunal list of the Black Hills of South Dakota. The Colorado list was culled from county records in Brown (1957).

Since it is difficult to construct an exact criterion to designate which

species are found "within" any physiographic area, a consistent decision was made to define mountain areas as all parts which rose above the lowlands, that is, having a higher elevation than the surrounding plains. Similarly, regarding river cuttages, this criterion included all areas below the surrounding plains, and in escarpment situations, that transition between surrounding lowlands and table lands above. Although criteria of this type cannot be completely exact, the amount of variation within the definitions seem not too dangerous, since it leaves the amount of general interspersement of forest and prairie dependent on the abruptness of the transition between dominance of forest or prairie. In this study these criteria grouped the study areas into three general categories: escarpments, with complete interspersement (Pine Ridge, Niobrara cuttage, Long Pine Rec. Ar.), areas of moderate transition (Black Hills, Front Range, Laramie Mts.) and an area of abrupt transition (Bighorn Mts.). That the abruptness of transition affects consistently the types of species present is the important thesis of this investigation.

The second problem was developing definitions for *forest* butterfly, *prairie* butterfly, and *forest-prairie* butterfly. It was most important that the technique be clear and as unbiased as possible. To satisfy this, Mr. Hardesty and I separately gave each species one of three labels: forest, prairie, or forest-prairie. The criteria used were based upon questions: "Must one go to the forest (or prairie, or either) to find the species?" and if this could not be definitive, "In what environ does the foodplant grow?" The success of this method is evident since Hardesty and I disagreed on the designation in only a few cases. In these I made the redesignation on the grounds of further consideration of the original criteria. With lists of all the resident Papilionoidea defined into these three categories for each study area, the percentage of each category in each fauna was computed. Results are summarized in Figure 2, which presents dendrograms of the percentage composition of each fauna.

To facilitate the accuracy of sampling, the Hesperiidae were omitted since they are poorly known in some of the collection areas. It should be noted, however, that this omission tends to depress the percentage of prairie species in the admixture since many of the skippers are of that type. Also omitted were any tundra forms inhabiting a study area. The use of general categories like *forest* or *prairie* as defined in this study seems to allow for this. To give the Colorado list a realistic "Front Range" integrity, the list from that area was limited to Larimer and Boulder Counties. Also, nowhere were the faunal resemblances *between* the faunas involved (these are calculable after Long, 1963), nor was the type of forest (deciduous or coniferous) designated.

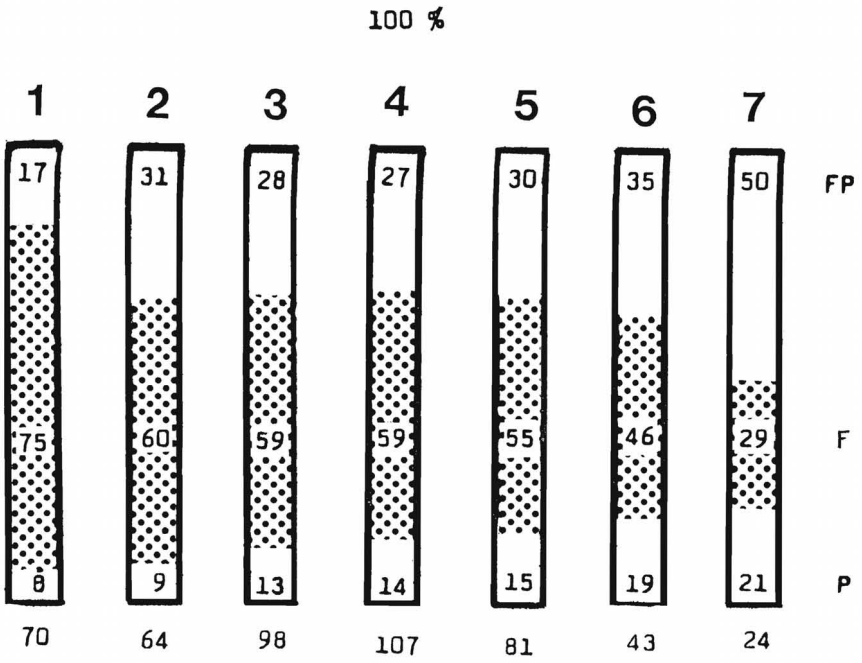

Fig. 2. Graphic representation of faunal admixture in each study area. Forest-prairie taxa (FP) illustrated above, clear; Forest taxa (F) represented in middle, stipled; Prairie taxa (P) represented below, clear. 1, Bighorn Mountains; 2, Black Hills; 3, Laramie Mountains; 4, Front Range; 5, Pine Ridge; 6, Niobrara River cuttage; 7, Long Pine Recreation Area.

Figures below each bar represent number of species in each fauna.

Results

The results are summarized in Figure 2. Each bar of the graph is arranged to illustrate change in number of prairie taxa (below, clear), forest-prairie taxa (above, clear), and forest taxa (middle bar, stipled).

The order of the graphs corresponds with the degree of transition ecologically proceeding from the most abrupt (Bighorn Mts., 1) to the most gradual (the Long Pine Rec. Ar., 7). Note that both the Front Range sample and Laramie Mountains sample are represented though they reflect no real difference in abruptness. This serves to illustrate similarity in types of admixture in two very similar ecological situations.

The portions of each graph representing percentages of species indicating certain types of ecological situations show a consistent pattern relative to the abruptness of the ecological transition from prairie to forest. The general correlations are as follows:

Increase in abruptness, corresponding with less interspersement of prairie and forest, results in:

1. increase in forest indicative species
2. decrease in prairie indicative species
3. decrease in forest-prairie indicative species

Decrease in abruptness, corresponding with more interspersement of prairie and forest, has the opposite result in all cases.

Consistent with the general ecological concept that ecotones often harbor a major portion of the species of biota in an area, results indicate that the complete interspersement of forest and prairie biomes in the escarpments promotes a dominance of those areas by forest-prairie types of species (see Long Pine Rec. Ar., 7). In fact, with decrease in abruptness of transition the amount of forest-prairie species increases at a greater rate than purely prairie taxa, indicating the pressure of the marginal ecology on the faunal admixture. Discussion of the relative roles of prairie and forest in the margin is very difficult, but it appears that the factor of forest may dominate an area. This is illustrated by the fact that even a semblance of woodland, such as the scattered stands of trees in the Long Pine area affords large numbers of forest species a habitat, probably by its affording the general flora of the area a divergence. This conforms to the observation that food-plant diversity in the forest and especially in the ecotonal areas is usually greater than on the surrounding mixed-prairie. The role of the Pine Ridge forests in influencing the admixture of the Nebraska butterfly fauna (Johnson, 1971) is an example of this on a large scale. The relationship of types of species and the habitats they utilize invites new thinking into problems of taxonomic and distributional evolution.

Conclusions

The study illustrates that when types of species indicating certain ecological conditions are designated realistically, their percent admixture in a fauna varies consistently with degrees of spatial transition in an areas ecology.

Though the general assumption is simple, the analysis of it seems justified since the assumption is usually made without any thought to the parameters or criteria for its having meaning.

Hence, an effort was made to give definition to categories that are usually general or non-definitive. The paper points out that such a definitive study can be made, and hopefully offers criteria on which similar questions can be investigated.

Acknowledgments

I am grateful to Dr. C. A. Long (Wisconsin State University, Stevens Point) for his suggestions concerning the project, and to Mr. Richard Hardesty (Douglas, Wyoming) and Dr. John S. Nordin (Webster, South Dakota) for their aid in compiling the faunal lists.

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BOOK REVIEW

MOTHS AND HOW TO REAR THEM, by Paul Villiard. 1969, 242 pp. + i–xiii, profusely illustrated with half tones. Funk and Wagnalls, 380 Madison Avenue, New York. Price $10.00 U.S.

This is a volume that everyone interested in rearing the larger moths, particularly the sphingids and saturniids, should have on his reference shelf. One hundred and seventy-seven species are discussed under the headings of family [name], popular name, range, availability, preferred foodplant, diapause [stage], ova, larvae, rearing requirements, cocoon and adult. The adult, the mature larva, the cocoon or pupa, and usually the egg of each of the native and exotic species discussed are illustrated in half-tone reproduction.

Although an introductory section is devoted to a detailed description of the spreading procedure, some of the adults illustrated have not been spread with any great skill and many of these appear to have become wet and matted at some stage. The author-photographer seems to have a penchant for dark backgrounds in his illustrations and in the case of dark specimens or those with translucent wings results are not pleasing. The usage of generic names is often not current but this causes no difficulty.

The book is a highly enjoyable one and I thoroughly recommend it to all interested in the natural histories of the larger moths.

D. F. HARDWICK, *Editor.*