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The Biosystematic Problem

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The new approach to taxonomy, variously called "The New Systematics", "Experimental Taxonomy", or Biosystematics", is now a recognized branch of biology. The growth of this new approach during the past three decades has not only renewed interest in taxonomy among taxonomists, but has also demonstrated to the other disciplines of biological science the implications of taxonomic research to their work. The purpose of the present paper is to review briefly the methods and purposes of the biosystematists in the hope that study of this kind may be encouraged in the Southwest. In this region, problems of species that lend themselves to this type of investigation are practically untouched.

Essentially, biosystematics utilizes cytology, genetics, ecology, physiology, paleontology, and biometry, as well as traditional comparative morphology. The goal of biosystematics is the delimitation of natural biotic units, using a system of nomenclature (ecotype, ecospecies, etc.) meant to convey precise data regarding species; especially in terms of interspecific relationships, variability, population-structure, and evolution. The working hypothesis is that species are not particular kinds of organisms, but rather particular kind of populations (Camp 1951; cf. Camp and Gilly 1943).

Plant systematists have become more aware of the importance of cytology in species problems, due to occurrence of widespread polyploidy and apomixis. The orthodox taxonomist, whose chief concerns were naming and describing species, formerly would too frequently ignore variations; or, even worse, describe the variations with new names, thus further burdening the nomenclature. He seldom made any attempt really to understand the cytogenetic and ecological causes of the variation. Often this apathy was due to a fundamental disbelief in the actual existence of natural biotic units, e.g., species.

The biosystematist not only makes full use of cytology, but draws freely from the field of genetics. Hybridization experiments often demonstrate the presence or absence of internal sterility barriers, and indicate to what extent the characters are correlated — both of which are of great taxonomic significance. Crossing studies should be attempted, no matter how absurd the cross might appear on morphological grounds.

Ecological data are very useful and should be gathered in connection with revisions. Information on habitat preferences, phenology, seasonal changes, variations in habit, etc., are especially helpful. Turrill (1929) reports cases where amalgamation of two species into one polymorphic species occurred, because of the breakdown of ecological barriers to interbreeding. Other like situations could be cited. Ecological isolating-mechanisms are no doubt as effective as genetical and cytological ones; probably they are among the first kinds of isolating-mechanisms developed by plants and animals (cf. Mayr 1942).

Biosystematic studies usually involve three correlated approaches to taxonomic problems: (1) the study of natural populations (comparative morphology, ecology, biometry); (2) cytogenetic investigations (cytology, genetics); (3) examination of herbarium or museum material (comparative morphology, biometry).

(1) *The Study of Natural Populations.* — Sampling and analysis of natural populations are important aspects of biosystematic studies. Many useful data can be gathered concerning population structure and ecological relationships by employing standard techniques of mass collection, with field observations and subsequent analyses. If hybridization is suspected as the cause of increased variation, it is most desirable to have information regarding natural populations.

Anderson (1941) has described for botanists the technique of collecting samples of natural populations for use in statistical analysis. This usually involves random collection of from 25-50 individuals from each population. Measurements and observations may be taken on the living plants, or more conveniently, on pressed plants studied in the laboratory. Graphic representations of the results of these studies can be made, using the hybrid-index procedure and frequency-distribution histograms (Anderson 1936).

(2) *Cytogenetic Investigations.* — The recent emphasis

placed in plant taxonomy on transplant studies and artificial hybridization experiments is well illustrated by the elaborate studies of Clausen, Keck, & Heisey (1939, followed by individual papers). They have shown that many species are comprised of races adapted to various ecological conditions existing in their range, each race separated from the others by partial discontinuities in the over-all variation pattern. Clausen (1951) has redefined the categories that are applied to such species, using the terms of Turreson (1922) "ecotype", "ecospecies", and "cenospecies".

Growing-plants in a garden facilitate experiments in crossing various races and species, and make readily available, material for chromosome study. The investigator of garden-plants can also study their characters in nearly controlled environmental conditions, can determine sterility-barriers, and the degree of character-correlation. But, as botanists well know, a classification based entirely on sterility as its criterion in delimiting species is of little real value (cf. Turrill 1942). Best of all, experimental gardens permit the student more intimate association with the plants he is studying.

(3) *Examination of Herbarium or Museum Material.*— Taxonomic studies traditionally are based on the close examination of as many herbarium or museum specimens as possible to detect key-characters for separating taxa. Camp (1943) emphasizes the continuing need of adequate herbarium study in revisions by biosystematists. The great importance of this phase of taxonomy is that it permits the study of plants or animals over their entire range. In some cases biometric analysis can be made on these specimens (Anderson & Turrill 1935).

The information derived from these three approaches to basic taxonomic problems makes possible a more significant delimitation of natural biotic units. It is to be expected that the interpretations of orthodox taxonomy and those of biosystematics will agree in many groups, and in others, not at all. The genus *Rubus* offers a classical example of different approaches and interpretations. In *Rubus,* polyploidy and apomixis confuse the taxonomic picture that orthodox taxonomy attempted to clarify by a large number of meaningless binomials. A more realistic nomenclature will emerge when taxonomists fully acknowledge that species do not possess the same amount of genetic variability. Keys to species-identification should make allowances for occasional exceedingly-wide variation; and hybrids ought to be included if natural hybridization occurs.

Biosystematics has certainly elucidated problems of species in many cases. The science of taxonomy is becoming a true life-science to the great satisfaction of co-workers in other disciplines of biological science. Taxonomy, ideally a meeting-ground for all the various branches of biology, can be such a focus only if taxonomy attempts to keep abreast of developments in other disciplines.

Texas offers practically untouched regions for really contributory pieces of biosystematic study, as very little (if any) work of this kind has been done by Texas systematists, at least in the area of plant science.

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How the Mud-Puppies Were Named

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The many names under which the mud-puppies have been described or cited have caused some confusion. At least 33 'common" names and 29 scientific names have been given them at one time or another, not considering the names that have been applied to the species described since 1924.

Perhaps the fact that the mud-puppies are largely nocturnal in their aquatic habitats accounts in part for the failure to accumulate information about them and to standardize their names. While they may be locally abundant, they become evident only to those who seek them. It is perhaps not surprising that the occasional mud-puppy that turned up in water supply lines or on fishermen's hooks