Bioecology and Biocenology in Wildlife Education

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THE BIOECOLOGICAL APPROACH appears to be the most natural and direct method for studying wildlife and solving intricate management problems, yet bioecology as an academic course has been largely neglected in college training as a basis for the study of wildlife. The entire community of plants and animals and human beings must be considered as one united whole if the detailed aspects of wildlife populations and their complex interrelationships to the environment are to be more completely understood. Wildlife investigations are concerned as much with plants as with wild animals; management often involves manipulation of vegetation rather than direct treatment of the animals themselves. The release of pen-reared bobwhite, for example, to augment native populations has proven economically unsound; whereas, improvement of the habitat to increase food and cover for bobwhite brings results.

While most biologists will agree that the plant-animal community is the basic unit of nature, they usually claim that the bioecologic concept is too cumbersome and the biotic community too complex for practical study. Cooper (1927), recognizing the interdependence of plant and animal communities, expressed the hope that younger generations would be skilled equally in plant and animal fields.

Most of our educational institutions follow the established custom of breaking ecology into "plant" and "animal" ecology to facilitate teaching and research. A survey of ecology courses offered in 24 leading colleges and universities in the United States revealed that 20 have separate courses in plant ecology and animal ecology; four, Harvard University, University of Michigan, University of California, and Texas Agricultural and Mechanical College, of-

fer courses that are essentially bioecological in nature. Oregon State College offers a course in bioecology in addition to separate courses in plant ecology and animal ecology. Some schools offer courses titled "wildlife," "range," "forest," or "terrestrial" ecology; at least part of these subdivisions are bioecologic in content. Although the system of separating plant and animal ecology may have its advantages, the student usually conceives of plant and animal communities as separate entities and rarely develops the biotic viewpoint. Valuable concepts and ideas are thus lost; advancements in conservation are retarded. Colleges that are swinging over to bioecology and integrated courses between botany and zoology departments are aiding advancement in fundamental understanding of plants and animals in relation to each other and to their environment. The reactivated biological station at Flathead Lake under the direction of the University of Montana is contemplating ecology courses that include both plants and animals.

The trend in research and teaching has been toward overspecialization. Taylor (1936, p. 337) expresses the opinion that, "Our present practice, of turning out technical assistants who are ultraspecialists, is unfair to the young graduates, to the community, and to the natural resources for which they may be responsible." Specializations have taken place in the field of ecology to such an extreme that it is now necessary to revert toward synthesis and an understanding of the whole. Wildlife is dependent upon the understanding of entire systems of plant-animal communities and their environmental relationships. Specialization in conservation has led to antagonism, overlap, and waste of natural resources. Foresters, wildlife technicians, range specialists, and soil experts have found difficulties in working together in the past because they lacked the concept of natural resources as a whole and could not understand problems outside their special fields. Fortunately, the modern trend is toward cooperation in conservation of our wildlife, forests, grasslands, and soils. Wildlife conservationists should be well trained in wildlife, but they must also have a knowledge of related fields such as forestry, range management, soil conservation, and agriculture. They must also be experts in human relations, since their ability to convince people as well as to manage wildlife is necessary for a successful conservation program. Human beings are inseparable parts of the biotic comunities in which they exert their profound influences.

Much of the complexity and unwieldiness of bioecologic study, which seems to be the main objection of many American ecologists, may be overcome, at least in part, by: (*a*) realization that bioecology is a point of view

as well as a subject matter, (*b*) organization of the subject matter of biocenology (the science of the plant-animal community) on the basis of the European system.

Bioecology as a Point of View

That ecology is a point of view as well as a subject matter has long been recognized. A bioecologic view is as valuable to the student as any of the masses of data he may be able to assimilate from an ecology course. The proper biotic approach is essential in conservation and management of natural resources; it should be developed during college training, otherwise the concept may take a much longer period of postgraduation development, or it may not develop at all.

Bioecology considers all forms of life in relation to the environment. Plants and animals are components of an emergent entity, a bioecologic whole, or a biocenose which, as with water, may take on characteristics not found in the parts (plants and animals; hydrogen and oxygen). In other words, the whole is more than a mere sum of the parts. This holistic approach appears to be basic to an understanding of complex plant-animal communities. Courses in ecology should emphasize the emergent evolution concept (Egler, 1942) as a foundation for the extension of knowledge far beyond the individual parts of a biotic community.

Ecology emphasizes the web-of-life concept, a powerful aid in understanding interrelationships involving coactions, actions, and reactions among living things in nature. A pull or distortion at one point in the web sends a tremor throughout the whole and the entire system is affected. Grasslands, for example, cannot be overgrazed by livestock without seriously affecting the entire biocommunity, sending it through a series of retrogressive stages which may lead to ultimate destruction of the range.

Many sciences are tapped in solving complicated wildlife problems. The ecologic approach is an integrating weapon which clarifies intricate interrelations between animals, plants, soils, and climate; it extends and deepens thought, permitting more fundamental accomplishments.

Those who feel that plants and animals exist together rather than independently develop a critical attitude toward a subdivision of ecology into "plant" and "animal" phases. Phillips (1931), a strong proponent of the biotic community, says "The consideration of plant communities and

animal communities as separate entities does violence to the facts presented in Nature, and what is more, acts adversely in that it obscures the fundamental relation between plants and animals." Phillips (1931), Taylor (1935), Carpenter (1939), and Clements and Shelford (1939, pp. 5–10) have traced the historical development of the concept of bioecology. To accept the bioecologic viewpoint precludes consideration of animals as biotic factors in the study of vegetation or of plants as a part of the environment of animal communities. Plants and animals must be considered as interrelated, coacting constituents of the biotic community.

Leopold (1947) and Taylor (1948) make pleas for an ecological conscience. Vogt (1948) stresses the importance of proper ecological orientation throughout his book, *Road to Survival.* The biotic viewpoint is indispensable if we are to develop an ecological conscience, a conservation conscience, or true ecological orientation.

A new school of conservation has been inaugurated at Cornell University. The University of Michigan has a school of forestry and conservation; Utah State Agricultural College has a school of forestry, range, and wildlife management. The trend toward schools of conservation is obvious at other institutions. Courses in bioecology are basic at such schools and the ecologic viewpoint should permeate throughout the entire conservation curriculum.

The bioecologic viewpoint is essential in big-game management. Attention must be given to range conditions produced by livestock and big game, as well as to number of animals, productivity, and kill limits of the big-game herds. Fortunately in many western states the ranges are being given as much attention today as population statistics; sound management is based on keeping the herds within the carrying capacity of the range and in harmony with livestock interests.

Organization of Subject Matter (Biocenology)

Egler (1942, p. 256) has pointed out that the seven fundamental points of view employed by European scientists in the investigation of the natural sciences have rarely been applied in our country. He also presents the system as applied to the study of vegetation science. If we accept the biocommunity as the basic unit of nature, the system logically applies to plant-animal entities as well as vegetation. The seven points of view in relation to the subject matter of biology are shown in Table 1. The system presented here includes

Table 1.—Subdivisions of biology, showing relationships to flora, fauna, and biocenoses

Point of View	Subject Matter		
	Flora	Fauna	Biocenose (plant-animal community)
Composition	Study of speciation	Study of speciation	Composition of the biocenose
Form and structure	Floristic morphology	Faunistic morphology	Morphology of the biocenose
Function and processes	Floristic physiology	Faunistic physiology	Physiology of the biocenose
Distribution in space	Floristic geography	Faunistic geography	Chorology of the biocenose
Distribution in time	Paleobotany	Paleozoology	Chronology of the biocenose
Relation to environment	Autecology	Autecology	Ecology of the biocenose (bioecology)
Classification	Floristic taxonomy	Faunistic taxonomy	Taxonomy of the biocenose
	Floristic botany	Faunistic zoology	Biocenology
	Study of flora	Study of fauna	Study of biotic communities

the study of flora, the study of fauna, and the study of biotic communities or biocenology. This organization should facilitate teaching and research in biocenology; it should also clarify the relationships between point of view and subject matter in an otherwise less coherent mass of knowledge. The position of bioecology, which in its restricted sense includes only the relations of the biocommunity to the environment, is clearly indicated.

It may be argued that, (*a*) plant-animal communities are less definitive than so-called plant communities or vegetation, (*b*) some animals, such as migratory birds, elk, and mule deer, are influents in various communities at different seasons of the year, (*c*) birds are often dependent upon life forms (habitats) rather than particular kinds of plants and animals, and (*d*) the biocenose cannot be studied as a concise entity defined by specific composition, constant morphology, and precise geographic distribution. In applying the seven points of view no attempt should be made to force plants and animals into rigid, artificial communities. Various degrees of integration are found among biocenoses: some are well-developed, as a plankton community, while others are loosely formed, as an old-field community. There is, moreover, a blending in varying degrees from one community to another: geographic demarcations of communities may be sharp, as the biotic zonation in the northern Rocky Mountain region, or they may be indistinct as in some of the eastern hardwood forests. Vegetation itself, if considered alone, also exhibits variation in degree of integration and geographic definition. The important thing is to recognize the biocommunity; it may be studied in its variability in seasons, its distribution, its composition, and its organization, as well as in its other characteristics.

Is biocenology at the present time a definite organized science? Perhaps the best answer is that it is now in incipient stages of development. As yet, there are no courses offered in this subject matter in our universities; there are no textbooks. If we were to organize and classify available knowledge on the subject of biocenology, however, we would have an excellent beginning for a new science. Much work has already been accomplished in the United States and in foreign countries, particularly Russia, in bioecology and in chorology, composition, morphology, and physiology of biocenoses. The various phases of the work have not been organized and arranged from the point of view of biocenology.

Biocenology is obviously a basic science in wildlife education. Just as it is important to study individual plants and animals, their morphology, physiology, distribution, and ecology, so it is also essential that we study the plant-animal community as a whole from the seven different points of view. The parts (plants and animals) have little meaning in wildlife management except in their relation to the entire community and to the environment. Numbers of deer and elk have little meaning except in relation to the carrying capacity of the range vegetation.

Integrations between plant and animal studies through biocenology should lead to greater potentialities in wildlife investigations and in the conservation of natural resources in general. New horizons are appearing in the science of the biotic community; wildlife conservation and management are fundamentally dependent upon the developments in this new science. It may be anticipated that ultimately biocenology will appear in conservation curricula throughout the country.

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