Ecology—Hub of the Pure and Applied Natural Sciences

RALPH W. DEXTER
Kent State University, Kent, Ohio

There are no fish in Northbranch Creek. Once they were abundant, and Northbranch Creek was locally famous as a site for wholesome recreation. But why are there no fish there today? Why have many attempts to restock the stream failed? An investigation was begun to find the answer to these questions. A seining sample taken in that investigation showed that not only were game fish absent, but practically all forage fish were absent as well. Little wonder that black bass, perch, and pike were not present! If forage fish are gone, the absence of fish life cannot be due to overfishing. Bottom samples produced meager indications of animal life. Some of the water was strained, but it did not yield much plankton. Without small animal life and plankton there was little food for the forage fish and the young game fish. The invisible animal life feeds on tiny water plants, the algae; but algae were very scarce. Algae are green and need sunlight to manufacture food. But Northbranch Creek has changed: No longer is the water clear; now it runs muddy. Sunlight cannot penetrate the silt-laden water. So the investigation next turned on the origin of this sediment. Upstream it was found that drainage was carrying silt into the stream. The land was eroding; the topsoil was being washed away; gullies were forming. The land was losing its fertility and a desert was slowly taking shape. With every rain a torrent of muddy water washed over the land and spilled into the overburdened stream flooding the countryside. Now it was remembered that this barren waste had once been a dense forest—a favorite hunting ground of the early settlers. No one seemed to realize that when the forest was leveled, the game would disappear, rainwater would not soak into the ground, the soil would wash away, the stream would fluctuate between flood water and dry stream, the muddy water would not get enough sunshine for algae to live, there would be no small animal life to feed the forage fish, and game fish would vanish from the stream. It is a long chain from the fish to the forest, but there it can be traced, giving a fine illustration of the interrelationships of all natural resources.

The study of these interrelationships of living things with each other and with their environment is the science of ecology. Ecology is at once analytical and synthetic in its approach. It analyzes a natural phenomenon such as the disappearance of fish from Northbranch Creek to determine the component factors responsible for a whole chain of events. Then the pieces are put together like those of a picture puzzle to make possible an understanding of the whole complex situation as a unit of nature.

Many basic sciences contribute foundation stones to the science of ecology. Through chemistry, analyses are made of soil and water to determine salt content, acidity, organic content. Instruments borrowed from the physics laboratory are used to measure temperature; water velocity and pressure; the quality,

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intensity, and penetration of light. Mathematics contributes statistical methods, quantitative techniques of sampling populations, and the basis for surveying the landscape. Geology, through its branches of physiography and soil science, gives an understanding of soils—their structure, nature, and origin, and the forces which are acting upon them. Petrology and physical geology explain the nature of the bedrocks while historical geology traces the history of a region. Hydrography explores the physical and chemical properties of bodies of water. Climatology, another branch of the natural sciences, focuses attention on the relation of the atmosphere to living things on the earth. Descriptive climatology pictures atmospheric conditions in terms of precipitation, temperature relations, humidity, movements of air masses. Factors of macro- and micro-climates are measured and recorded. On and within these great masses of earth, water, and atmosphere live the plants and animals which are the concern of botany and zoology. The classification of these living organisms, their physiological requirements and adjustments, their structural adaptations to a manner of living, their behavior and diseases and their inherent characteristics are all special subsciences of biology. The synthesis of all—the living organisms, their coactions with each other, and their reactions to the physical surroundings—is the special province of ecology. The chief contribution which ecology makes to science is the integration of all basic sciences for the understanding of natural phenomena. Studies of food cycles, population numbers and their fluctuations, community dynamics, distribution of plants and animals and its causes weld together the fundamental sciences into a unified problem. Ecology borrows from all sciences, requires the cooperation of all scientists, and gives in return an overview concept of nature. Ecology is the hub of the natural sciences.

The application or the art of ecology is the very essence of what is called conservation. The management of aquatic resources—crabs, shrimps, shellfish, fish—depends upon a knowledge of the life histories of these organisms. Temperature and salinity tolerances; seasons and habitats required for propagation; the food, enemies, and parasites of each must be known for effective management. Likewise, the life histories of game animals, their cycles of abundance, their requirements for an optimum population which will be in harmony with other resources to insure a continued supply, must be the basis for a successful game management program. Forestry now recognizes the importance of the relation of a forest stand to other resources, and the need of providing for the forest's own perpetuation through selective cutting; the leaving of seed trees; reforestation; and the protection of the forest against the dangers of fire, erosion, and insect pests.

Determining the carrying capacity of range lands to insure maximum utilization without destroying the grasses and allowing the invasion of weeds is a common sense measure as well as an application of ecology. Enemies of pests must not be destroyed to prevent an outbreak of vermin; yet many range lands have been turned into deserts by rodents before the lesson was learned that carnivores are needed to keep the rodents in check. Land planning is based upon a knowledge of the physical nature of the landscape, soil and climate, and the requirements of various crops and domestic animals. Land not suitable for one use may be ideal for another, but many farmers have tried to eke out an

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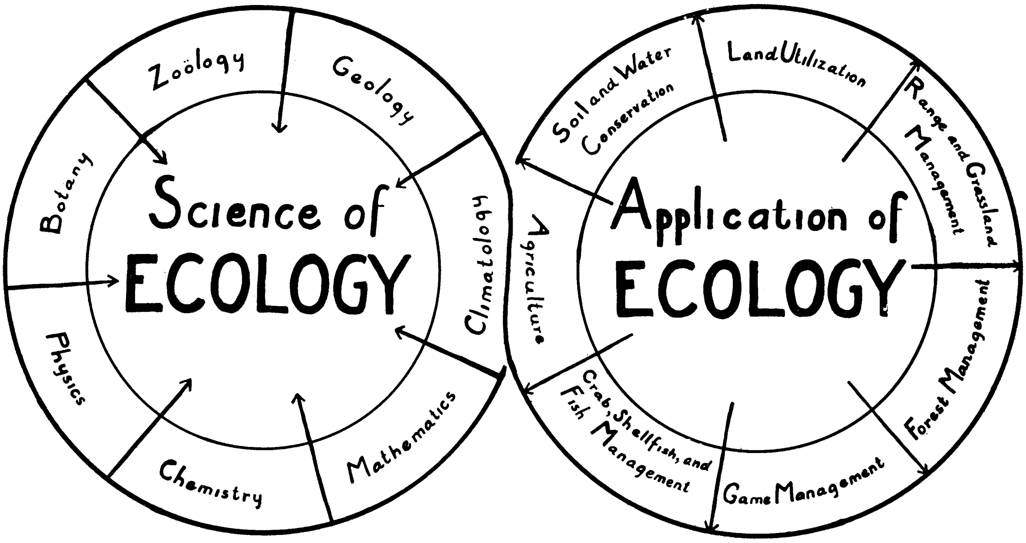

existence cultivating land which was better suited for use as a pasture or woodlot. The introduction of domestic animals into new areas is hazardous without a study of the climatic differences which the animals will have to endure, especially during the breeding season. Plant introductions have failed because of the lack of proper insects for pollination. The failure to introduce red clover into Australia without importing bees at the same time is a classic example. Pests introduced, on the other hand, such as the Japanese beetle, oriental fruit moth, Norway rat, or English sparrow, have demonstrated how an organism can get out of control in a new region in the absence of natural enemies and upset the balance of nature to an alarming degree. Control measures for insect pests involve a knowledge of the life history of the insect and its relations to the environment. The conservation of fertile topsoil and the maintenance of a uniform water cycle not only assure the preservation of the basic resources, but hold the key for managing all of the renewable resources.

The management and utilization of all natural resources is a matter of applying ecological knowledge, principles, and methods to the problems of maintaining and protecting a balance of nature favorable to the economic welfare of man.

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MAJOR DENNIS R. WILLIAMS, Field Service Officer, Army Pictorial Service Signal Corps, has rejoined Encyclopaedia Britannica Films, Inc. as Educational Field Supervisor after serving four years in the Army in Film Utilization work in the United States and later throughout the world in Army Combat Training Centers.

Prior to entering the Army, Major Williams was District Manager for Erpi Classroom Films, Inc., which has been absorbed by Encyclopaedia Britannica Films, Inc. Major Williams will headquarter in Chicago at the film company's home office.

IT IS NOT TOO LATE to submit brief items for the *Visual Aids* special issue to the guest editor, Addison Lee, Austin High School, Austin, Texas. Since the issue is tentatively scheduled for April, such items should reach Mr. Lee before February 10.

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Among the new developments of the Chicago meeting was a plan for a series of calendar pages for THE AMERICAN BIOLOGY TEACHER. The plan was in part an outgrowth of the Nature Calendar developed last year by Dr. Agersborg and sponsored by the Association.

The calendar page project was turned over to the Conservation Committee, headed by Dr. Palmer. Each issue will carry the calendar for the following month, since the journal is mailed about the fifteenth of the month of issue. In future issues, the space occupied by this announcement will be used for a photograph, drawing, map or other device appropriate to the season.

In the space for each day will be an item of biological interest; while in the present issue nearly all of these are birthdays, no doubt future issues will see the appearance of an increasing number of other types of items. Opposite each printed item will be a blank space in which the reader may make such notes as interest him—temperature and weather records, appearance and disappearance of migrant birds, personal appointments.

Please let the committee know what you think of this idea. Do you want it continued? Does it make the journal more useful? What suggestions have you for improvement. Send your comments to the chairman of the Conservation Committee, DR. E. LAURENCE PALMER, *Cornell University, Ithaca, New York.*

JANUARY 1946

1.	Clarence Cottam, Wildlifer, born 1899		17.	Theodore Frison, Naturalist, born 1895	
2.	James Croll, Scientist, born 1821		18.	Edward Franklin, Chemist, born 1825	
3.	George W. Crary, Dermatologist, b. 1864		19.	E. S. Burgess, Botanist, born 1855	
4.	Louis de Morveau, Chemist, born 1737		20.	H. M. Lefroy, Entomologist, b. 1877	
5.	See note below.		21.	Waldo Lee McAtee, Biologist, born 1883	
6.	Gilbert M. Smith, Algologist, born 1885		22.	Francis Bacon, Philosopher, b. 1561	
7.	Johann C. Fabricius, Entomologist, b. 1745		23.	Daniel W. Coquillett, Entomologist, b. 1856	
8.	Alfred Russell Wallace, Naturalist, born 1823		24.	Frederick Julius Cohn, Botanist, born 1828	
9.	Frederick V. Coville, Botanist, died 1937		25.	William McGillivray, Naturalist, born 1796	
10.	Herbert William Conn, Bacteriologist, b. 1859		26.	George F. Atkinson, Botanist, born 1854	
11.	Aldo Leopold, Wildlifer, born 1887		27.	William Crocker, Botanist, born 1876	
12.	O. B. Howard, Mammalogist, b. 1863		28.	John Merton Aldrich, Entomologist, b. 1866	
13.	Sir Davis Ferrier, Neurologist, b. 1843		29.	William Tufts Brigham, Museum Director, died 1926	
14.	Edward F. Bigelow, Nature Teacher, b. 1860		30.	Franz Hauer, Geologist, born 1822	
15.	Nathaniel Lord Britton, Botanist, born 1859		31.	Harold C. Bryant, Park Naturalist, b. 1886	
16.	Antonio Jose Cavanilles, Botanist, born 1745				

NOTE: For best suggestions for January 5, sent to E. Laurence Palmer, Cornell University, Ithaca, New York, a set of twelve different identification charts will be sent; for best suggestion for any date in remainder of the year, a complete twig chart. How many of the above can you identify?

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