

FORBES BIOLOGICAL STATION

The Past and the Promise

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Foreword

Since its establishment in 1894, the Havana research site of the Illinois Natural History Survey has been identified by a confusing array of names. It is fitting, therefore, that at the dedication of the expanded and improved facility we pay tribute to the founding genius of the Survey and of the Havana research effort as well as bring the confusion of multiple names to an end. This field station, which has been the scene of so many significant scientific investigations, is to be known henceforth as the Stephen A. Forbes Biological Station.

Forbes was a native Illinoisan, born in a log house in Silver Creek in Stephenson County on May 29, 1844. His father died when Stephen was ten, and the family experienced severe economic hardship. His academic training was sparse and fragmented—a year at Beloit College, a year at Rush Medical College, and a term at Illinois State Normal School—none of these consecutive. Yet as those who knew him and his work agreed, his attitude made life itself a school. His son Ernest was to comment after his father's death, "Either he never went to college, or he attended continuously from age fourteen to the last day of his life."

When the Civil War broke out, the seventeen-year-old Forbes borrowed the money to buy a horse and enlisted in the cavalry. Captain of his company at twenty, he was taken prisoner and maintained his morale under desperate and discouraging prison conditions by studying Greek. Later he was to comment on the educational value of his military experience: "Anyone who had kept the solitary flame of his separate intellectual life steadily burning through all the blasts and storms of war, might reasonably believe that nothing that should happen to him thereafter could possibly extinguish it; and this, as we all know, is more than can be inferred from the completion of an ordinary college course."

The keystone of Forbes' life was to become scientific research in the public service—as museum curator, professor of zoology and entomology,



State Entomologist, and founder and chief of the Natural History Survey. More than 500 library accession cards represent his sixty years of scholarship—but he is perhaps best remembered for his innovative cast of mind and his breadth of interest as a naturalist. In 1887 he anticipated the ecological era with "*The Lake as a Microcosm*," a paper in which he developed the notion of the interdependence of organisms—the community of interests. His studies included insects, crustaceans, fishes, and birds—always in the light of their relationships to the environment. His series of papers on the biology of the Illinois River helped to make that river the most investigated waterway in the world and bequeathed to us an irreplaceable historical database.

It is appropriate from time to time for organizations to reflect on their accomplishments and by so doing draw strength from the past and inspiration for the future. This publication encourages us to reflect on the achievements of a few remarkable research biologists who have had an impact on science and on natural resource policy far beyond that of any group of comparable size. The effects of their research transcend the borders of Illinois; indeed, they transcend those artificial national and international boundaries that only humans recognize.

From 1894 to 1940 a succession of scientists from the Survey were stationed in rented rooms, hotels, and boats in and around Havana. The agenda of the field station in 1894 was unique and marked the first time that a coordinated effort had been made to study a major river system. In addition, the field station differed from other

stations around the world because its emphasis was entirely on exploration and discovery. Today these activities are known as research. Since 1940, the staff has enjoyed the luxury of a permanent building on Quiver Creek.

There seems to be no record of a dedication ceremony marking the completion of that first building. My guess is that its occupants were too busy getting on with science. After all, this region was a major flyway for waterfowl that used it in numbers scarcely imaginable today. The Illinois River was a highly productive fishery and the source of a variety of desirable main courses in the finest restaurants of the East. What an extraordinary natural laboratory this was and remains. More than enough biological challenges existed to satisfy the most curious and insatiable of intellects—and satisfy them it did, in the case of some scientists for more than a half century! This river basin is a living history of the effects of European settlement. Unfortunately, it is not a history to be proud of and the Illinois is not what we believe a river system should be. Today our research efforts necessarily focus on reversing the slide toward extinction in order to be able to consider and perhaps pursue the goal of restoration.

In 1988 and 2002 additions to this research facility and renovations of the original building were completed. The 1988 construction was funded by a grant from the National Science Foundation and by the Capital Development Board of the State of Illinois in both 1988 and 2002. Together they have set the stage for the promise of tomorrow. This publication pays tribute to past achievements but it also marks a new beginning, a rededication of effort and commitment at the Stephen A. Forbes Biological Station as it moves into a third century.

Lorin I. Nevling, Chief
Illinois Natural History Survey

For almost a century and a half, the Illinois Natural History Survey has been the guardian and recorder of the biological resources of the State. Today, with a staff of more than 300 scientists and technicians, it is recognized as the premier natural history survey in the nation. Over the years, its mission has remained remarkably constant: to investigate the diversity, life histories, and ecology of the plants and animals of the State; to publish research results so that those resources can be managed wisely; and to provide information to the public in order to foster an understanding and appreciation of our natural heritage.

The Survey's reference and research collections are among the largest and oldest in North America and are used extensively by scientists throughout the world. Dating back to the 1850s, these collections have become increasingly valuable as the list of threatened and endangered species grows. Among the collections are those of fungi and vascular plants; insects, including the International Soybean Arthropod Collection; crustaceans, molluscs, and annelids; amphibians, reptiles, birds, fishes, and mammals. The insect collection alone numbers about 5,000,000 specimens, and more

“The first, indispensable requisite is a thorough knowledge of the natural order—an intelligently conducted natural history survey. Without the general knowledge which such a survey would give us, all our measures must be empirical, temporary, uncertain, and often dangerous.”

Forbes 1880

than 500,000 specimens are found in the fish collection.

The serial publications share in the remarkable history of the Survey itself. The *Bulletin*, for example, has been published continuously since 1876, and *Biological Notes* since 1933. Each issue of these research-oriented publications is mailed to over 550 scientific and educational institutions across the nation and in 51 countries, and copies are requested by ecologists, conservationists, farmers, and sportsmen throughout Illinois and the United States.

The Survey has offices and labora-

tories on the campus of the University of Illinois at Urbana-Champaign, but its research has been strengthened immeasurably by studies conducted at field stations throughout the State. The oldest of these, Stephen A. Forbes Biological Station, has operated on the Illinois River since before the turn of the century, and it is to that station this publication is dedicated.

The long tradition of biological research for which the Survey is so justly famous would not have been possible without the energy and imagination of Dr. Stephen A. Forbes. The present Natural History Survey is the direct descendant of two earlier institutions, the Illinois State Natural History Society and the Illinois State Laboratory of Natural History, and Forbes was an important figure in both of those parent organizations. He was the curator of the museum that had been provided for in the constitution of the Natural History Society, and when that collection was incorporated into the State Laboratory of Natural History in 1877, Forbes became the Laboratory's first director. At that time he also served as State Entomologist. In 1917 the General Assembly combined the State Laboratory and the Office of the State Entomolo-

1858



At the meeting of the State Teachers' Association in Decatur, Cyrus Thomas proposed the formation of the Natural History Society of Illinois. Its constitution provided that specimens be collected and deposited in the museum at Illinois State Normal University.

1876

Stephen A. Forbes initiates studies on the Illinois River.

The first issue of the *INHS Bulletin* is published, a list of Illinois crustaceans by Forbes. The *Bulletin* remains in continuous publication.



1877

The Society is incorporated into the Illinois Laboratory of Natural History and Forbes is named head.

gist, named the new institution the Illinois Natural History Survey, and granted the headship to Forbes, who was to guide the program of the Survey until 1930. Little wonder that Stephen A. Forbes has been dubbed “father of the Survey.”

As early as 1876 Forbes had begun studying the distributional records and food habits of Illinois fishes. His broad interest in aquatic biology included crustaceans, leeches, protozoans, rotifers, aquatic insects, and fishes. In 1887 he wrote *The Lake as a Microcosm*, a seminal work on the biological phenomena associated with fluctuating water levels that was to provide an important conceptual framework for his own research and that of a generation of scientists to follow.

Forbes’ devotion to the Illinois River made him an ardent spokesman for a biological station on its shores. He selected Havana as the site because the bluffs and clean, hard beaches along the eastern shores of the river and the abundance of pure, cold spring water provided good working and camping conditions. In response to his efforts, the trustees of the University of Illinois authorized field operations at Havana at their March meeting in 1894 and appropriated \$1,800. On the

“The opportunity came to us last April to establish on this stream what we know as the Illinois Biological Station, properly so entitled, perhaps, except for the fact that it was never really stationary, being actually portable and afloat, its laboratory and store-houses being boats instead of buildings.”

Forbes 1914

first of April, Forbes opened the station for the “continuous investigation of the aquatic life of the Illinois River and its dependent waters.” The station consisted of three rented rooms in Havana, a working library of 120 volumes, and a chartered cabin boat stationed on Quiver Lake about two and a half miles north of town. Fieldwork on the Illinois River was conducted from the boat equipped with seines, dredges, surface nets, plankton apparatus, and other collecting equipment. It also carried microscopes, preservation reagents, a number of breeding cages for aquatic insects, and aquaria. Somehow it also managed to provide a kitchen and sleeping accommodations for four. Thus, the Havana Station became the first inland aquatic biological station in America equipped for continuous investigation and the first in the world to undertake the serious study of the biology of a river system.

Forbes immediately set about establishing objectives for the new station. Among these were his desire “to contribute largely to a thoroughgo-

ing scientific knowledge of the whole system of life existing in the waters of this State, with a view to economic as well as educational applications, and especially with reference to the improvement of fish culture and to the prevention of a progressive pollution of our streams and lakes,” and his hope that the station might someday “occupy a rich and promising field of original biological investigation hitherto largely overlooked or neglected not only in America but throughout the world.”

His plans for the station were extensive: “It has for its field the entire system of life in the Illinois River and connected lakes and other adjacent waters, and it is my intention to extend work as rapidly as possible to the Mississippi River system, thus making a beginning on a comprehensive and very thoroughgoing work in the general field of the aquatic life of the Mississippi Valley, in all its relations,

1887

Forbes publishes *The Lake as a Microcosm*.



1894

The University of Illinois establishes a biological station near Havana with Forbes as the founder and Frank Smith director. Early staff included William Shafer, Hatcher Brown, Frank Smith and Miles Newberry. The Havana Station becomes the first inland aquatic biological station in the world to undertake the serious study of the biology of a river system.



1895

Charles A. Kofoid begins his study of the plankton of the Illinois River. Based upon his collections over the next five years, he was to publish nearly 1,000 pages on the plankton of this area.

scientific and economic.” Forbes believed that “by such studies one gets a vivid idea of the individuality of a river as an organism, and of the complexity of its structure and sensitiveness of its physiological reactions.”

At the biennial session in 1895, the Illinois legislature appropriated \$2,500 for further equipping the station and \$3,000 per annum for its expenses. With these funds, a 60-foot house-boat was built in Havana from plans drawn under Forbes’ direction. This floating biological laboratory was brought to the station in September of 1896. With no power of its own, it was towed by a 25-foot steamer, the Illini. The houseboat proved to be a comfortable and efficient laboratory for as many as fifteen workers and had the very great advantage of mobility. Thus according to Forbes, the “station differs from most American freshwater stations, in the fact that its equipment is all afloat, and readily movable from place to place; that it is devoted to investigation only, and not to teaching; that it is in operation throughout the year instead of being limited to the vacation season; that it is devoted to a study of the biology of a river system instead of a lake; and that it is supported directly by appropriations from the treasury of the State.”

The original staff of the station had a wide variety of research specialties. Frank Smith was principally interested in aquatic worms, and Adolph Hempel worked on protozoans and

“Not many years ago biological instruction in American colleges was mostly derived from books: of late it has been largely obtained in laboratories instead: but several years’ experience of the output of the zoological college-laboratory has firmly convinced me that the mere bookworm is hardly narrower and more mechanical than the mere laboratory grub. Both have suffered, and almost equally, from a lack of opportunity to study nature alive.”

Forbes 1894

rotifers. Dora Smith served as micro-technician, and Miles Newberry was overseer of the cabin boat and acted as general field assistant. Charles A. Hart, entomologist and curator of collections for the State Laboratory, made frequent collecting trips to the field station and Ernest B. Forbes, son of Stephen Forbes, came for six weeks of general collecting. Professor Thomas J. Burrill and other members of the Botany Department of the University of Illinois collected aquatic plants, and Assistant Professor Henry E. Summers of the Physiology Department photographed the region. Lydia M. Hart, an exceptionally fine artist, illustrated faunistic publications as well as early publications on the aquatic life of the Illinois River.

Forbes believed strongly that classroom and laboratory work should be integrated, and his feeling on

this point may have influenced the University of Illinois to require field experience at a biological station before granting a graduate degree in zoology. In addition, summer school biology students at the University were required to spend ten days of fieldwork in zoology, botany, and entomology at the Havana Station. In 1896, the station hosted a class of seventeen biology students from high schools and colleges, including Charles C. Adams and James G. Needham, for the first Summer School of Biology at Havana. In 1897 Forbes’ daughter, Bertha, a high school teacher, participated in a summer program.

Forbes believed that both field and laboratory work should be mandatory at the station. “It is, in fact,” Forbes wrote, “the biological station, wisely and liberally managed, which is to restore to us what was best in the



1896

A 60-foot houseboat is built in Havana under Forbes’ direction and launched as a floating biological laboratory.

1900

A significant diversion of Lake Michigan water into the Illinois River begins,

1903

Robert E. Richardson arrives at the Havana Station, becomes its director, and remains on the staff for the next thirty years.

naturalist of the old school, united to what is best in the laboratory student in the new.” And what a place Forbes chose for his approach. He described the scene of the Illinois River near the field station in 1896: “The forest itself, beginning at water’s edge with a billowy belt of pale green willows, is an untamed tract of primitive wilderness. Elms and pecans and sycamores tower overhead. The shallow lakes and swamps are glorious in their season with the American lotus and the white water lily. Waterfowl abound, and fish lie in the shallows, basking in the summer sun. The microscopic life in a cubic meter of water is at certain times far in excess of the amount recorded for any other situation in the world.”

Water samples were collected regularly from six points on the Illinois River and three points on connecting lakes and analyzed by Professor Arthur W. Palmer in conjunction with the State Water Survey, which had been founded in 1895. Much of Palmer’s work at the Havana site was the result of a wide-spread typhoid epidemic in 1893 and the belief that it originated in contaminated water supplies. Significant increases in pollution of the river were reported in 1888 and 1889. Chicago sewage was being dumped into the Illinois and Michigan Canal, and Peoria, Pekin, and other small towns along the river were contributing to the problem. Although Palmer’s work had

significant impact on sewage disposal in small towns, pollution from sewage in the Illinois River was to increase for another two decades.

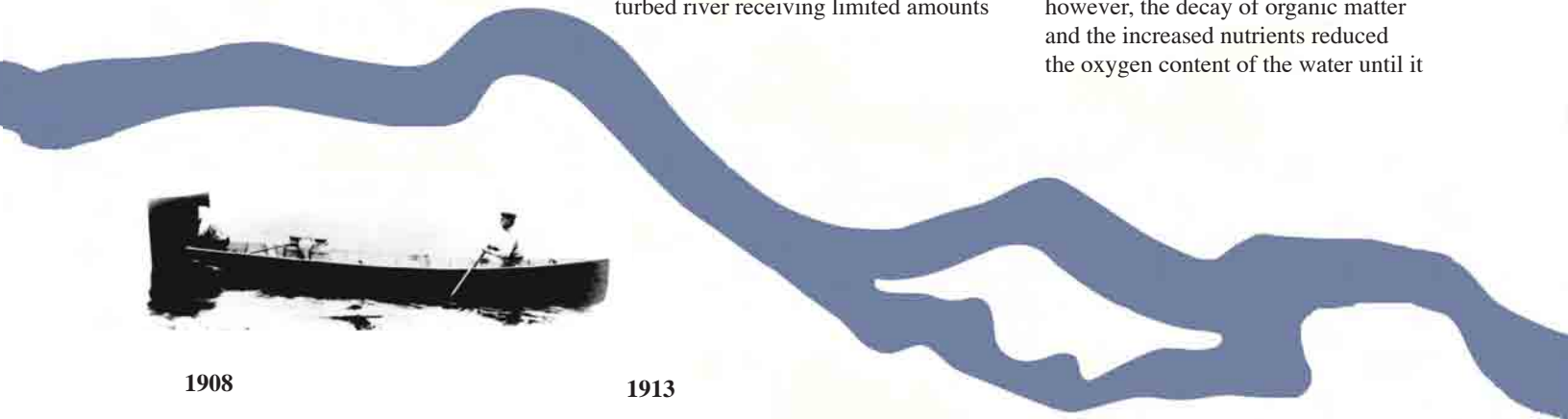
Charles A. Kofoid, director of the Havana Station from July of 1895 through December of 1900, had as his major area of investigation the plankton of the Illinois River. All together he published nearly 1,000 pages on the subject.

When Forbes looked back on the research conducted at the station from its genesis to 1903, he noted that more than 6,000 collections had been made—about 500 were fishes, some 2,000 were plankton collections, and a variety of aquatic forms accounted for another 3,500. Weekly water samples had been analyzed for a consecutive period of three and a half years. In addition to local collections, boatside samples had been taken from longitudinal sections that totaled 450 miles on the Illinois River and 316 miles on the Mississippi between St. Louis and Quincy.

In 1903 Robert E. Richardson, an aquatic biologist, joined the staff of the State Laboratory and was asked to take charge of the station at Havana and the fish collections. He was to remain a part of the staff for the next thirty years, conducting extensive studies of the bottom fauna of the Illinois River during a period that coincided with severe changes in the biology of the river. Before the turn of the century, the Illinois had been a relatively undisturbed river receiving limited amounts

of organic pollution from a few towns along its banks. By 1900, however, Chicago was growing rapidly, and disposal of sewage and organic waste materials had become a problem. In 1900 the flow of the Chicago River was reversed, and water from Lake Michigan was sent southward to transport sewage and organic wastes through a diversion channel into the Des Plaines River, a headwater stream of the Illinois. Consequently, the Illinois River began to receive a heavy load of organic pollutants and up to 10,000 cubic feet per second of Lake Michigan water, including lake water that had been withdrawn for industrial and municipal purposes and was now being discharged. During the same period about half of its 400,000-acre floodplain was being leveed, cleared, and drained for agricultural purposes.

Forbes and Richardson had collected bottom fauna in the Illinois River prior to 1900, and Richardson continued to do so after the Lake Michigan diversion. With his assistant, Henry C. Allen, Richardson virtually lived afloat during 1909 and 1910, intensively studying breeding grounds to learn the fate of fish eggs and fry. At Chillicothe and Hennepin, the river appeared nearly normal, but pollution upriver became progressively worse. Because the organic pollutants served as fertilizer to plant life, the fish yield from the lower Illinois increased from 11.5 million to 24 million pounds from 1900 to 1908. In the upper Illinois, however, the decay of organic matter and the increased nutrients reduced the oxygen content of the water until it



1908

Stephen A. Forbes and Robert E. Richardson publish their classic *The Fishes of Illinois* with color plates by Lydia Hart. Over 200,000 specimens

1913

Robert E. Richardson begins his study of the bottom fauna of the Illinois River, work that was to stretch over fifteen years and document deleterious changes brought about by the dumping

1915–1920

The Illinois River suffers the worst effects of organic pollution, and fish yields plummet.

“Our recent work shows that the productivity of a stream is dependent upon the extent and condition of its backwaters and the period of its overflow, a fact which makes drainage district operations on the river bottoms a menace to its productiveness.”

Forbes 1912

was unsuitable for fish and the organisms on which they feed. Organic waste from Chicago continued to increase, and maximum pollution occurred between 1915 and 1920. Based upon his studies of bottom fauna, Richardson calculated a reduction of 34.5 million pounds in the weight of bottom organisms from Chillicothe to LaGrange. Fish yield declined to 4 million pounds by 1921, a result of increased pollution and the extensive leveeing and drainage of bottomland lakes.

Between 1913 and 1918 Richardson, sometimes in collaboration with Forbes, published a series of articles based on his opportunistic studies of changes in the Illinois River. Continuous collections at the station also made possible the first edition of *The Fishes of Illinois* in 1908. This book, a joint endeavor by Forbes and Richardson, had been conceptualized by Forbes back in 1876, before the station opened. A second edition was issued in 1920, and the book remained a unique publication for more than forty years.

During the early 1920s aquatic investigations of the Illinois River continued from the houseboat laboratory. By 1927 the staff of the Survey had published twenty articles, more

than 1,850 pages, on the biology of the Illinois River. These benchmark publications had a profound effect on the study of aquatic biology throughout the nation, and similar investigations were initiated at other sites.

In 1923 David H. “Doc” Thompson was employed as a zoologist by the Natural History Survey. After Richardson’s death in 1935, the aquatic staff consisted of Thompson, assistant F. D. Hunt, and several graduate students under Thompson’s direction.

In 1935 the Survey gained access to the *Anax*. This 48-foot cabin boat, named after a genus of dragonfly, had been purchased by the State for cooperative fishery studies with Iowa and Missouri on the Mississippi River. A completely equipped floating laboratory, the *Anax* was used until the mid-1940s in a number of research undertakings on the Illinois River. Among these was Thompson’s 1942 fish survey of the river from Channahon to Grafton, in which he examined 34,000 fishes to determine physical abnormalities and species.

Thompson’s interest in fish management grew, and his studies expanded to areas throughout Illinois. He found that such “fine” fish as crappies amounted to about fifty pounds per acre in Lake Senachwine, regardless of the number of fish or the area of the lake. Thompson concluded that the

food resources and carrying capacity (the standing crop or total weight of fishes at “saturation”) of a body of water remained fairly constant but that the number of fishes could vary widely.

In July of 1948 William C. Starrett was hired by the Survey to continue aquatic studies of the Illinois and Mississippi rivers. One of his responsibilities was to analyze and publish the Mississippi fishery data that had been collected by others. In 1949 Starrett was placed in charge of the Havana Station and began a study of Lake Chautauqua, a shallow floodplain lake of about 3,500 acres. The lake had once been leveed to keep out the river and pumped dry for farming. When the levees broke in the flood of 1926, the Levee District declared bankruptcy and the land was acquired by the federal government as a wildlife refuge. Starrett and others at the station investigated the economic value of Lake Chautauqua and other bottomland lakes in the Illinois Valley for recreational duck hunting, for commercial and sport fishing, and for fur and timber. These figures were then compared to the value as cropland of drained and leveed bottomland lakes. When price supports for the crops produced and the costs of constructing and maintaining levees were factored in, recreational values clearly out-weighted agricultural worth. The economic logic of reflooding drained and leveed land was clear in the 1950s and remains so today.



1917

The Illinois Laboratory of Natural History and the Office of the State Entomologist are merged by the General Assembly and named the Illinois Natural History Survey. Forbes becomes the first chief of the Survey and remains in that position until 1930.



1923

David H. “Doc” Thompson joins the Survey.

1927

The biology of the Illinois River is now documented by 1,856 printed pages.

In April of 1953 William Starrett was one of the thirteen charter members of the Midwest Benthological Society founded at the Havana Field Station. Since then, the society has achieved national status as the North American Benthological Society with a membership of more than 2,000.

During the 1960s Starrett and his assistants conducted surveys on six navigation pools on the Illinois River. One method of study was to note the number of mussels. From 1966 to 1969 Starrett found only 24 kinds of mussels as opposed to 49 kinds reported prior to 1900. Water pollution from sewage and industrial wastes was found to be the major cause of the reduction in species. In 1971 he published his classic study, *A Survey of the Mussels (Unionacea) of the Illinois River: A Polluted Stream*.

One of the most important studies implemented by Starrett was an annual electrofishing survey of the Illinois River. Begun in 1959 the survey continues to be updated. This long-term monitoring of the fish populations in the Illinois River has provided a baseline for documenting changes in number, distribution, and species of fish as the river system continually sustains changes brought about by natural processes and human activity.

Wildlife research at the Survey began in the 1870s when Forbes investigated the food habits of birds. His

“By diking and drainage operations the Illinois River is being robbed of the haunts of its water birds, and corn will presently be growing every year on some 200,000 acres of forest, marsh, and lake over which its waters spread a few years ago in time of flood.”

Forbes 1919

insightful ideas concerning predation, density dependent and density independent factors in wildlife populations, census techniques, and population management were consistent with many of the principles that came to be associated with modern wildlife biology. Not until the 1930s, however, was wildlife research fully recognized in the Survey’s program. Theodore H. Frison, who replaced Forbes as Chief of the Survey in 1930, established the Section of Game Research and Management in 1934. Frison also initiated the Midwest Fish and Wildlife Conference, which celebrated its sixtieth conference in 1998. Its first meeting was held in Urbana in December of 1935, with a field trip to Lake Chautauqua

near Havana, where such distinguished scientists as Aldo Leopold, Paul Errington, Miles Pirnie, and Harry Ruhl viewed the waterfowl populations.

For centuries the valley of the Illinois River had provided a major migration route for waterfowl. Mallards and other species funneled through the bottomlands in impressive numbers, and the valley became a famous shooting ground in the late 1800s. After the turn of the century, however, hunting was increasingly regulated by the federal government because continental waterfowl populations were dwindling. In the Illinois Valley the situation was exacerbated by the increased degradation of the river, which contributed to an even further decline in the number of waterfowl that used the valley. The days of spring hunting, unrestricted bag limits, baiting, live decoys, hunting for a commercial market, and unlimited gauge and shells were over, but the drought of the 1930s dealt waterfowl a further blow. In recognition of the importance of waterfowl to Illinois, the Survey employed Arthur S. Hawkins and Frank C. Bellrose to initiate a waterfowl research program in 1938.

For two years Hawkins and Bellrose traveled the Illinois Valley, observing waterfowl and examining habitat. Their investigations included a survey of duck foods, a study of the kill during the 1938 duck hunting season, an evaluation of experimental

1933

The first issue of *INHS Biological Notes* is published, a study of the migration of Illinois fishes by D.H. Thompson. *Biological Notes* remains in continuous publication.



1935

The *Anax*, a 48-foot cabin boat, is acquired by the Survey and used as a floating laboratory for aquatic studies until the mid-1940s.



1935

Theodore H. Frison of the Survey instigates the Midwest Fish and Wildlife Conference. Its first meeting is held in Urbana with a field trip to Chautauqua Lake to view waterfowl populations.

1938

Arthur S. Hawkins and Frank C. Bellrose begin their studies of duck food in the Illinois Valley and Bellrose launches the waterfowl inventory during the fall migration.

plantings of aquatic plants, the mapping of aquatic vegetation, and—with Harry G. Anderson—a major study of the food habits of waterfowl.

Wood duck studies were also begun in 1938 with the collection of preliminary information on nesting biology. In 1939 the first successful nesting box for the wood duck was constructed from rough-cut lumber, thus beginning the nesting box studies that would continue as part of the Survey's waterfowl program. In 1942 a box was designed to exclude the raccoons that preyed upon the hens and their eggs, and in 1950 a cylindrical, galvanized metal house was developed to exclude the fox squirrel as well. Bellrose's latest model, a plastic box, was designed for Ducks Unlimited in 1987. More than 10,000 boxes were sold in the first six weeks of sales.

In 1938 Bellrose had attempted to inventory ducks at the confluence of the Illinois and Mississippi rivers near Grafton. The area was rich in bottomland sloughs interspersed among forests, but his difficulties there, along with Hawkins' insistence, convinced Survey administrators that the proposed building for the field station should be constructed in the Havana area rather than near Grafton.

During the depression years of the late 1930s, the federal government established work programs that made possible a variety of construction projects. The Survey made use of that opportunity to construct a building to house the Havana Station. In May of 1939 the Bureau of Biological Survey

“A permanent institution—a stationary station.”

Forbes 1914

of the U.S. Department of Agriculture granted the Survey a special use permit on the Chautauqua Refuge. This 99-year permit was the first to grant a nonfederal agency occupancy on a federal refuge. Construction of the building and an access road began during the summer of 1939. The frame structure of the first permanent building for the Havana Station was completed in early 1940, a mile or so from the site on Quiver Lake where Forbes had established the Biological Station in 1894. Until an addition was built in 1988, this building housed up to twenty full-time and seasonal employees.

In January of 1940 Hawkins, Bellrose, and John M. “Frosty” Anderson moved into the newly completed building to begin what would become one of the most productive waterfowl research programs ever conducted at a field station. The next year Jessop B. Low joined the waterfowl staff, and studies of ducks in the Illinois Valley proliferated. In spite of World War II, a number of benchmark studies in the biology of waterfowl were produced, and their findings did much to advance the art of waterfowl management. Bellrose and Anderson's study of the relative

value of moist-soil and aquatic plants to ducks was the first in which food habits of waterfowl were related to the availability of food. Fellow worker Harry G. Anderson documented the diet of seventeen species of waterfowl in Illinois, and Bellrose suggested how research findings could be used to establish Illinois duck seasons.

The program to band waterfowl begun by “Frosty” Anderson in the fall of 1939 expanded rapidly and continued through 1952. More than 75,000 ducks, mostly mallards, were banded at four localities in Illinois. These bandings generated important information about migration behavior, the mortality of ducks, and the reporting rates on banded ducks.

One of the best wildlife data sets ever compiled in North America had its genesis in 1938 when Bellrose inventoried waterfowl during the fall migration in selected bottomland lakes in the Illinois Valley. Ground counts were continued by Bellrose during the early 1940s, including a remarkable weekly observation period in late November and early December of 1944 when he counted more than 3.6 million mallards in parts of the Illinois Valley. In 1946 ground counts were expanded to include areas of the Mississippi River. When planes, pilots, and fuel became available after World War II, the logistics of counting ducks were greatly simplified. Aerial inventories

1939

The Bureau of Biological Survey of the U. S. Department of Agriculture issues a special use permit that allows the Survey to occupy a site at the Chautauqua Refuge—the first ever issued to a nonfederal agency on a federal refuge.



1939

Waterfowl banding studies are begun by John M. “Frosty” Anderson. They continue through 1952 with more than 75,000 ducks banded at four Illinois localities.



1940

The first permanent structure for the field station is completed, just a mile or two from the site where Forbes established the Biological Station in 1894.

of the Illinois River floodplain from Spring Valley southward to Grafton and the Mississippi River floodplain from Alton northward to Rock Island were begun by Bellrose in the fall of 1948. Winter and spring inventories of those areas were added in 1955. Beginning in 1972 and in subsequent years, the periodic aerial inventories were expanded to cover selected wetlands, rivers, reservoirs, and cooling lakes at power plants throughout Illinois and

“No one can interest himself in a study of the nature, distribution, and directions of the energy of a dynamic system without an immediate and overpowering desire for quantitative data.”

Forbes 1908

additional segments of the Illinois and Mississippi rivers. Robert D. “Tud” Crompton, who began working at the Havana Station in 1948, assumed responsibility for the aerial inventories in 1970 in addition to his work on the wood duck project. Michelle M. (Georgi) Horath joined the staff in 1982 and, along with her many other research responsibilities, began conducting the aerial inventories in 1990. The massive amount of data provided by years of

inventorying has vastly improved our understanding of the chronology of migration, the effects of refuges, the value of wetlands, and the distribution of waterfowl in Illinois.

Following an extensive die-off of mallards in January of 1947 and another the following year, the Survey began an investigation of the effects of lead shot on waterfowl that was to span a period of more than fifty years. Bellrose was joined by James S. Jordan, and the pair conducted a series of physiological studies that demonstrated that diet, amount of shot ingested, sex and age of ducks, and other variables had significant influence on the severity of lead poisoning in mallards. In 1959 Bellrose published his impressive work on the disease, *Lead Poisoning as a Mortality Factor in Waterfowl Populations*. In this study the incidence of ingested lead shot in migrating waterfowl was determined through the fluoroscopic examination of live-trapped ducks and the duck gizzards collected from hunters and through a painstaking compilation of data from other investigators who had examined waterfowl gizzards. Ultimately, data on ingested lead shot from 39,610 giz-

zards of eleven species of waterfowl collected from 1938 to 1954 were used in the study. From this massive amount of information, Bellrose concluded that approximately four percent of the mallards in the Mississippi Flyway died each year as a result of lead poisoning. He further estimated that the annual loss from lead poisoning for all waterfowl species in North America fell between two and three percent. This and subsequent studies conducted at the Havana Station were instrumental in developing a federal program for the elimination of lead shot in the sport hunting of waterfowl, a program that was implemented nationwide in the 1991–1992 hunting season.

Another landmark in Bellrose’s career was the publication of *Ducks, Geese and Swans of North America*, an updated edition of the 1942 classic by Francis H. Kortwright. Bellrose’s edition sold 300,000 copies and was recognized by The Wildlife Society as the best book publication of 1977.

From 1972 to 1982 Bellrose served as director of the Havana Station. In 1974 he received an honorary



1940

Arthur S. Hawkins, Frank C. Bellrose, and John M. Anderson occupy the newly constructed field station and continue research that was later to be known as one of the most productive waterfowl programs ever conducted at a field station.



1941

Jessop B. Low joins the waterfowl staff at the station.

1944



Bellrose continues his ground counts of waterfowl during fall migrations. During a remarkable weekly observation period in 1944, he counts over 3.6 million mallards in parts of the Illinois Valley.

1947

Following spectacular die-offs of mallards, Bellrose and James S. Jordan initiate a series of physiological studies to investigate poisoning from ingested lead shot.

doctorate from Western Illinois University, and in 1981 he was granted the highest rank of the Survey—Principal Scientist. The capstone of Bellrose's remarkable career came in 1985 when The Wildlife Society awarded him its highest honor—the Aldo Leopold Medal. In recognition of Bellrose's dedication to the waterfowl of Illinois, Governor James R. Thompson "caused the great seal of the State of Illinois to be affixed" to a proclamation declaring February 1, 1988 "Frank Bellrose Day in Illinois." Although semi-retired since 1982, Bellrose and colleague Daniel J. Holm completed a book in 1994 based upon Frank's lifetime work on the wood duck. *The Ecology and Management of the Wood Duck* was awarded The Wildlife Society's best book publication of 1994. Since then, Frank has devoted his efforts toward a revision of *Ducks, Geese, and Swans of North America*.

Bellrose, like Forbes before him, contributed over half a century of service to the Havana Station. His career, like that of Forbes, developed from a deep and tenacious sense that out of the understanding of a place comes the best natural science. Site and science are inseparable in the work of both men.

In July of 1972 Richard E. "Rip" Sparks joined the Survey and was stationed at Havana until he accepted

"The children must be drawn towards and not away from the woods and fields and waters and must be led to see more clearly that ... a man cut off from fellowship with the creatures of the open air is like a tree deprived of all its lateral roots and trimmed to a single branch. He may grow down and up, but he cannot grow out. His resources of enjoyment are so narrowed that he is often an object of pity when seen away from the city street."

Forbes 1891

a position with the Illinois Water Resources Center at the University in October 1998. At his suggestion, the River Research Laboratory was established as a unit of the Havana Station and a number of grant-supported studies were attracted to it. Sparks and his assistants conducted studies on the toxicity of contaminants to bivalves and fishes in the Mississippi and Illinois rivers, studies on the effects of commercial navigation on aquatic flora and fauna, and a series of

studies concerning the status, disease, harvest, and management of mussels in the Illinois and Mississippi rivers. Other studies investigated interactions between mussels and sport fishes, movement patterns and habitat utilization of radio-tagged channel catfish in the Illinois River, and various aspects concerning the biology of the exotic zebra mussel.

In 1981 the station and its study areas along the Illinois and Mississippi rivers were designated as an Experimental Ecological Reserve by the Institute of Ecology and the National Science Foundation. To qualify for that designation, a field site must represent an important natural system dedicated to long-term experimental research. From 1982 to 1989 the River Research Laboratory was one of eighteen sites representing major ecosystems of the United States funded by the National Science Foundation under the program for Long-term Ecological Research (LTER). Sparks was the principal investigator of the LTER project for the interinstitutional study of the biological structure and function of the Illinois and Mississippi rivers.

The Large River LTER encompassed Forbes' vision to a remarkable

1948

Bellrose begins the aerial inventories of waterfowl in the Illinois River floodplain. In expanded form, these continue today.

1953

The Midwest Benthological Society is founded at the Havana Station with Starrett as one of its thirteen charter members. Now numbering over 2,000 members, the organization is known as the North American Benthological Society.

1948

William C. Starrett arrives and becomes director of the station the following year.



1955

Bellrose expands the aerial inventories to include wintering waterfowl and bald eagles.



“The special subject which I have fixed upon as the point of direction toward which all our studies shall tend, is the effect on the aquatic plant and animal life of this region produced by the periodical overflow and gradual recession of the waters of these great rivers—phenomena of which the Illinois and Mississippi rivers afford excellent and strongly marked examples.”

Forbes 1908

degree. It extended field research to the upper Mississippi River and treated the Illinois and Mississippi rivers and their associated floodplains, backwaters, and lakes as components of river-floodplain systems in which biological productivity is governed by the annual advance and recession of floods, a novel subject expressed by Forbes and Kofoid. The importance of the flood pulse was supported by the historical data sets that allowed researchers to compare each river system before and after major changes induced by human activity and by a present-day comparison of the highly perturbed Illinois River with the less disturbed upper Mississippi and the relatively pristine Amazon. Comparing the relatively small (in terms of flow) Illinois with the other two rivers demonstrated that biological productivity depends not on the absolute volume of flow but on characteristics of the floodplain and on the extent, timing,

and duration of the flood.

Because the annual flood is a predictable and reoccurring phenomenon, many organisms have evolved adaptations that enable them to exploit the seasonally expanded habitat and food supply associated with the flood. But the period of low flow is just as important as the flood. Low flow concentrates the annual production of fish into shallow pools where herons and egrets obtain food for their nestlings; it exposes mudflats where moist-soil plants grow and produce seeds sought by waterfowl; it allows soils to drain and aerate, thereby speeding the processes of decomposition and recycling.

In addition to the further support their data gave to the concept presented by Forbes and Kofoid of the importance of periodic overflow and recession of river waters within floodplains, LTER investigators made two impor-

tant discoveries about the Illinois and Mississippi rivers. The first was that localized concentrations of fingernail clams and mud-burrowing mayflies were almost always adjacent to beds of aquatic plants. The concentrations of invertebrates in turn attracted bottom-feeding fish and diving ducks—the proverbial “hot spots” of the fisherman and duck hunter. The second discovery was a mechanism whereby nutritious organic matter could be moved from the plant beds, where it was probably produced, offshore to the clams and mayflies, where it was consumed. Although invertebrates require nutritious detritus, they cannot live within the plant beds where there is little current and where the water near the bottom lacks oxygen because of the decay of organic matter. Instead, invertebrates depend on large-scale eddies that provide a slow circulation that entrains organic matter from the plant beds and distributes it offshore over the clam and mayfly beds. These same eddies retain and recirculate organic matter locally so that it is not lost downstream in the main current. Such eddies occur wherever tributary deltas or wing dams deflect the main current away from the shore.

Both discoveries have important

1959

Bellrose publishes *Lead Poisoning as a Mortality Factor in Waterfowl Populations*.



1959

The electrofishing survey of the Illinois River that continues today is initiated by Starrett.

1969

Starrett discovers that only 24 kinds of mussels remain in six navigation pools on the Illinois compared with 49 kinds reported prior to 1900. Pollution from industrial wastes and sewage is found to be the major cause of the dwindling number of species.

1971

A Survey of the Mussels (Unionacea) of the Illinois River: A Polluted Stream is published by Starrett.



1972

Frank C. Bellrose is appointed director of the Havana Station.

implications for the maintenance of species diversity in floodplain-river systems and for the management of those systems for sport and commercial fisheries and for migratory birds. Because most of the biological activity in floodplain-river systems occurs in lateral areas and depends on the flood pulse, management practices will logically require that habitat in those areas be conserved or rehabilitated and that the duration, seasonal timing, and extent of the flood be preserved or restored.

Stephen P. Havera joined the wildlife staff of the Survey in 1972 where he studied eastern cottontails and tree squirrels. He transferred to the Havana Station in 1978 to participate in a major study regarding the diversion of water from Lake Michigan into the Illinois Waterway.

During the 1980s Havera directed his energies toward compiling materials for an extensive book, *Waterfowl of Illinois: Status and Management*, published in 1999. A field guide was prepared as a companion volume to the book. The book and field guide were

recipients of The Wildlife Society's outstanding book publication for 2000. With the help of assistants, a number of studies for the book were completed: a comparison of the food habits of Illinois waterfowl today with those recorded in the 1930s, a waterfowl habitat inventory of selected

"From the consequent human interferences with the established system of things, numerous disturbances arise—many of them full of danger, others fruitful of positive evil. Oscillations of species appear not less injurious to man than to the plants and animals more directly involved."

Forbes 1880

areas of the State, the nesting history of waterfowl in Illinois, examination of the statewide waterfowl harvest, a review of the history of duck clubs in the Illinois Valley, and an analysis of all bands returned for eleven species of ducks tagged in Illinois. The largest of these studies, an examination of the data collected during aerial inventories since 1948, took several years for

data entry and computer analysis. As companion pieces for the investigations on food habits, Havera undertook nutrition studies with mallards. Of particular interest were the findings that game-farm and wild strains of mallards differ markedly in their ability to digest and assimilate foods and that some of the foods used in duck management, corn for example, are nutritionally deficient in essential elements.

In 1982 Havera became director of the Havana Station, and in the mid-eighties he combined forces with Richard E. Warner of the Survey to investigate the effect of farming practices on the amount of waste grain left in the field and thereby available to wildlife. Their work also included the relationship between soil erosion and farming practices. Havera initiated a series of studies on diving ducks at Keokuk Pool, considered then to be the most important inland migration area for diving ducks in North America, and continued numerous studies of the effects of the ingestion of lead shot on waterfowl.

The continental number of bald eagles was increasing, and wildlife specialists took note. The increase coincided with the establishment of nongame wildlife programs in Illinois and other states, an expanding appreciation of endangered species, and a growing awareness of the danger of lead poisoning to eagles that eat waterfowl crippled by hunters using lead shot or made ill from ingested shot. Studies conducted by Havera and his assistants in 1985 investigated the distribution and secondary lead poisoning of bald eagles in Illinois and resulted in the publication *Distribution and Abundance of Winter Populations of Bald Eagles in Illinois*. In the 1990s,



1972

Richard E. "Rip" Sparks joins the Survey and is stationed at Havana.

1976

Bellrose completes *Ducks, Geese and Swans of North America*. Destined to sell 300,000 copies, the book is recognized by The Wildlife Society as the book of the year in 1977.

1978

Stephen P. Havera transfers from the Champaign Survey to the Havana Station.

1981

The station is designated an Experimental Ecological Reserve by the Institute of Ecology and the National Science Foundation.

Havera's investigations included the importance of natural cavities to wood ducks nesting in the bottomland forests of the Illinois River valley, the feasibility of using helicopters to inventory populations of breeding wood ducks, the nesting biology of mallards in Illinois, and moist-soil plant seed production. His research experiences and knowledge were solicited for many local, state, regional and national committees where often he could provide insights into solving biological problems of the Illinois and Mississippi rivers while promoting their importance. During this period, Havera served on the Board of Directors of the American Institute of Biological Sciences, as Chairman of the Environmental Issues Committee of the Mississippi Flyway Technical Section, President of the Organization of Biological Field Stations, and President of the North Central Section of The Wildlife Society.

Like Bellrose and Starrett, Havera grew up in a town along the Illinois River. That early bond with the river runs deep, and when the Norris Farm, at that time the largest farm in the state, near Havana was put up for sale in 1986, Havera and his colleagues convinced the Illinois Department of Conservation and the U.S. Fish and Wildlife Service to consider the merits of restoring Thompson Lake, the once fabulous adjunct to the Illinois River that was declared public property in 1915 but was drained in 1923 to create

"And now of recent years there has come on another still more disturbing factor, that of the reclamation and improvement of the rich river bottomlands and the drainage of many lakes whose beds are now fields of corn. The process leaves the Illinois River much as Samson was left when shorn of his locks by the self-seeking Delilah."

Forbes 1919

the farm property. Although the Norris Farm was sold to other agricultural interests in 1988 and again in 1991, the feasibility study proved useful as the value of wetlands and the need for their restoration became increasingly clear. As a result, the Emiquon National Wildlife Refuge was established in 1993 in the vicinity of the historic Thompson Lake. Acreage was added during the next decade with the ultimate goal of incorporating more than 11,000 acres into the refuge, including the former basins of Thompson and Flag lakes, which were purchased by The Nature Conservancy in 2000.

During recent decades, the companion laboratories at the Forbes Biological Station have on occasion joined forces in interdisciplinary undertakings. In one such study, members of the Waterfowl Research Laboratory and the River Research Laboratory set about to evaluate the effect on fish and wildlife of the nine-foot navigation channel constructed in the Illinois River. The major impact of

that channel proved to be an increase in sedimentation rate brought about by a reduction in the current of the river. The degradation of aquatic environments is irrevocably linked to increased sedimentation.

A second joint investigation considered the probable effects on the environment of a proposed increase in the diversion of water from Lake Michigan to the Illinois Waterway. The rate of diversion, a controversial topic since 1900 when diversion in appreciable volume was initiated with the completion of the Chicago Sanitary and Ship Canal, has ranged from 2,900 cubic feet per second in 1900 to 10,245 in 1927. In 1938 a U.S. Supreme Court decree set the rate at 1,500 cubic feet per second, but a second decree raised the rate to 3,200 in 1961. When a threefold increase in the diversion



1982

Stephen P. Havera becomes the director of the Havana Station.

1982

The station is named one of eighteen sites representing major ecosystems of the United States to be funded by the National Science Foundation under the program for Long-term Ecological Research (LTER). Richard E. Sparks is appointed principal investigator of the LTER project for the inter-institutional study of the biological structure and function of the Illinois and Mississippi rivers.

1983

Bellrose, Havera, Paveglio, and Steffek publish *The Fate of Lakes in the Illinois River Valley*.



1985

Robert D. Crompton returns a female wood duck to a nesting box at Nauvoo. The first successful nesting box for the wood duck was constructed in 1939. A plastic model was designed for Ducks Unlimited in 1987.

rate was proposed in 1976 in an effort to improve water quality in the Illinois Waterway and reduce shoreline damage along the Great Lakes, the Havana Station, along with a number of other state and federal agencies, was funded to study the effects of such an increase. The staff of both laboratories concurred: changes in seasonal water regimes and increased flooding of terrestrial habitats would have negative effects on the environment and its associated species. Water levels at Havana might be as much as three feet higher during summer low-flow conditions. A substantial increase in the rate of diversion could lead to a reduction in species diversity and to poorer quality and decreased resiliency of all affected ecosystems.

A third interdisciplinary study returned to the problem of sedimentation in the Illinois River. Sedimentation is at present the worst pollutant of the Illinois, as it is of all our nation's waterways that drain agricultural areas. In 1983 Bellrose, Havera, and associates published *The Fate of Lakes in the Illinois River Valley*, in which they predicted that most of those lakes would remain biologically viable for only 24 to 127 years. Peoria Lake, the largest lake in the Illinois Valley, was projected to lose half of its remaining depth of three feet by the year 2000, a projection that unfortunately became true. Taken together, the various sedimentation studies made at the station indicate that the once diverse bottoms of the lakes along the Illinois River have been changed to uniformly shallow, concave accumulations of loosely coagulated silt. The structural diversity of those bottoms has been lost, blanketed with thick and ever increasing layers of sediment. By the late 1970s, the average depth of bottomland lakes

“To the experienced student of river biology, the river system itself comes to have the aspect of a huge, complex, sensitive, active living organism, of telescopic size and microscopic composition; with its periods of origin, of growth, of development, and of transformation; its peculiarities of structure as related to its environment; its powers of appropriation, metabolism and excretion; its laws of physiological action and of personal behavior; its conditions of health and of disease; its beneficent and its malevolent relations to the welfare of man; and the more completely one succeeds in unraveling the structure and analyzing the activities of this living leviathan, the more clearly he sees that it must be studied as a whole for an understanding of any of its parts, and studied in each of its parts for an adequate understanding of the whole.”

Forbes 1914

along the Illinois was only two feet, and the problem was aggravated by the presence of such toxic substances as ammonia and heavy metals that preclude reestablishment of the benthic community.

June of 1987 saw the station once again afloat. The sister surveys—the Water Survey, the Geological Survey, and the Natural History Survey—jointly purchased two houseboats with Build Illinois funds. Christened the *William C. Starrett* and the *Robert E. Richardson*, the two vessels were equipped with a variety of monitoring devices. During that year the Havana Station was expanding its facilities on land as well. In 1986 the National Science Foundation awarded \$50,000 to the station toward the construction of an addition, a grant made as part of a program to offer facility and equipment support to field stations with productive scientific histories. Once matching funds were obtained

from the Illinois Capital Development Board, the addition was under way. Offices, workrooms, a library, a computer room, and a secretarial area were added. The original building was renovated to include offices, workrooms, a conference room, a basement workshop, and storage areas. In September 1988 the addition became fully operational, and a formal dedication was held in May of 1989, the fiftieth anniversary of the original building. As part of that rededication of the building and in honor of the man whose energy and vision were responsible for the founding of the station in 1894, the station was officially designated the Stephen A. Forbes Biological Station. Two research units were defined to encompass current activities at the station—the Waterfowl Research Laboratory and the River Research Laboratory.

1985



Bellrose receives the Aldo Leopold Medal, the highest honor given by The Wildlife Society.

1986

Federal legislation prohibits the use of lead shot for waterfowl hunting in corridors along the Illinois and Mississippi rivers and in selected counties, and a nationwide ban was implemented in the 1991–1992 hunting season. This regulation is based largely upon the research findings of the staff at the Havana Station and the Survey.

1987



The 42-foot *William C. Starrett* and the 35-foot *Robert E. Richardson* are launched at Havana.

Shortly thereafter, the River Research Laboratory assumed responsibility for a federally-funded program to monitor the various parameters of the Illinois River, The Long Term Research Monitoring Program. Aquatic staff and equipment for this project gradually moved to a rented facility in Havana and that site became the Illinois River Biological Station in 2001. In July 1995 the Natural History Survey was brought into the Illinois Department of Natural Resources. Another milestone occurred in May 1997 when the waterfowl component of the Forbes Station was officially designated the Frank C. Bellrose Waterfowl Research Center and an endowment campaign was created for its research program with the assistance of the Illinois Conservation Foundation.

The foresight of Stephen A. Forbes in establishing a biological station on the Illinois River has made possible many significant contributions to an understanding of the river ecosystem. Forbes' goals for the station included "a comparison of present conditions with those of the former time." He intended "to study the river as a unit with special reference to its economic and hygienic protection and improvement; to work out the details of its biological regimen, by a separate study of special problems; and to carry on comparative studies between the Illinois, the Mississippi, and the

Missouri, all readily accessible from the station." These goals remain valid today.

The staff at the Forbes Biological Station plan to expand work in three areas of demonstrated competence: river ecology and restoration, population studies of waterbirds and aquatic organisms, and toxicological studies to determine why certain populations have declined. In addition, they hope to make significant contributions in two areas that are currently receiving [national and international attention:](#)

"The time is surely at hand when the people of Illinois will learn to appreciate and develop this great gift of nature in the various directions in which it may be made to serve their interests and their pleasures."

Forbes 1919

the function and value of wetlands and a holistic or ecosystem approach to ecology.

During recent decades the River Research Laboratory has set two long-range goals. The first is to seek

explanatory principles through the comparative study of large floodplain rivers and by comparing rivers with other types of ecosystems. The second is to apply those principles and the techniques of aquatic toxicology to the restoration of degraded rivers and the conservation and management of less disturbed rivers. The latter may well require the higher priority if any fully functional river systems or portions of river systems are to remain. The river borders of Illinois total 880 miles; 570 of them are accounted for by the Mississippi, 180 by the Wabash, and 130 by the Ohio. In addition, four large rivers traverse the State: the Illinois, the Rock, the Kaskaskia, and the Big Muddy. Those river highways played a major role in the history and development of Illinois. Much remains to be learned about them and their management if they are to play an equally significant role in the State's future.

Because of unstable and often declining continental populations of waterfowl, the long-range goals of the Bellrose Waterfowl Research Center will focus on both migration and winter habitat. Research will address such

1988

Governor James R. Thompson declares February 1, 1988 Frank Bellrose Day in Illinois.



1988

With funds from a National Science Foundation grant and from the Illinois Capital Development Fund, a 3,500-square-foot addition to the original field station is completed.

1989

"The Flood Pulse Concept in River-floodplain Systems" is published in the *Canadian Journal of Fisheries and Aquatic Sciences*.



1989

On the occasion of the ninety-fifth anniversary of the Havana Station, the new addition is dedicated. In honor of its founder, the station is officially named the Stephen A. Forbes Biological Station.

topics as the nutritional, nesting, and habitat requirements of various waterfowl species; the distribution, quality, and quantity of waterbird habitat; and the management of waterbird habitat and populations. Monitoring via aerial inventories will continue as an element of the research program.

In the spring of 2002 a major facility improvement program for the station was completed. Funded by the state Capital Development Board, the original office building was renovated and a new laboratory was added. A storage/garage building was erected and the parking area was resurfaced and expanded. These improvements provided the most advanced physical facilities for the station since construction of the permanent office structure in 1939. Unfortunately, funding was inadequate to replace the suspension bridge that spanned Quiver Creek since 1940 and served as a unique landmark. The rustic bridge, in a state of disrepair, swayed in the breeze over the creek for the last time on 30 October 2001.

The staff of the Forbes Biological Station is dedicated to the investigation of the properties and functions of the Illinois and Mississippi rivers and the plants and animals associated with and dependent upon them. The staff's mission is to document the changes in those rivers, the reasons

for those changes, and the results of those changes. Their most challenging aspiration is to restore a part of the Illinois Valley to some semblance of its pristine condition as one of the most remarkable, beautiful, and productive river systems in North America, to give back to the river at least part of the floodplain that was taken from it. After ascending the Illinois River with Louis Joliet in 1673, Pere Marquette wrote, "We have seen nothing like this river that we enter, as regards to its fertility of soil, its prairies and woods; its cattle, elk, deer, wildcats, bustards, swans, parroquets, and even beaver. There are many small lakes and rivers. That on which we sailed is wide, deep, and still, for 65 leagues."

Stephen Forbes and Charles Kofoid were able to study this river in its essentially unblemished condition until 1900. Just after the turn of the century Robert Richardson would observe to two lads as they sat on the river ridge between the Illinois and what was then Thompson Lake, "I probably won't see it, but you boys will, when the Illinois River will be ... just a sewer and navigation canal." The successors to this trio—Thompson, Bellrose, Starrett, Sparks, and Havera—have documented the abuse caused by pollution, navigation, drainage, sedimentation, and diversion and the demise of

one of our nation's greatest resources. The fervent wish of the present staff at the Forbes Biological Station is not only to document change and its effect on the Illinois Valley but to use this information to restore part of this once magnificent waterway so that future generations can witness and appreciate what Forbes saw in 1894 when his studies at the station began.

1991

The exotic zebra mussel (*Dreissena polymorpha*) is found for the first time in the Illinois River.



1992

Aaron P. Yetter ascends a tree as extensive studies of the use of natural cavities for the nesting by wood ducks and helicopter inventories of breeding populations of wood ducks are undertaken in the bottomlands of the Illinois Valley.

1993

The Great Flood of 1993 inundates the floodplains of the Illinois and Mississippi rivers.

1994

Frank C. Bellrose and Daniel J. Holm publish the *Ecology and Management of the Wood Duck*, which was awarded The Wildlife Society's best book publication award.

Milestones in Pictures and Print

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Wildlife researchers Aaron P. Yetter, Michelle M. (Georgi) Horath, Christopher S. Hine, and Stephen P. Havera pause on the east levee of the Thompson Lake Drainage and Levee District near where the staff was photographed on the sandy shores of the lake 100 years before (see page 3).

1995

The Illinois Natural History Survey becomes a member of the Department of Natural Resources.

1997

Brent Manning, Director of the Illinois Department of Natural Resources, establishes the Frank C. Bellrose Waterfowl Research Center as a component of the Forbes Biological Station and announces the formation of the Bellrose Waterfowl Research Endowment through the Illinois Conservation Foundation.



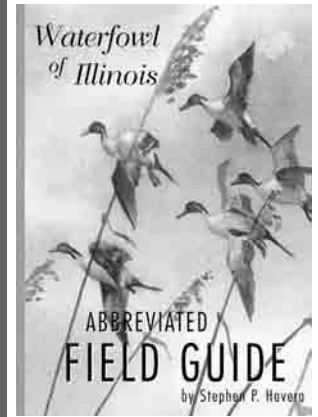
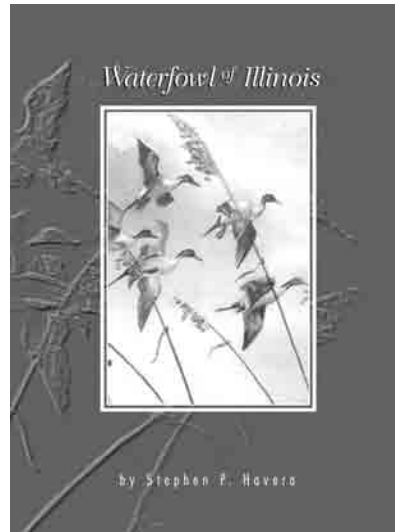
1998

Michelle M. (Georgi) Horath marks the 50th year of the aerial inventories of waterfowl populations in the Illinois and Mississippi river floodplains.



1998

Christopher S. Hine captures a hen mallard for a radio-telemetry study of the nesting biology of mallards in central Illinois.



1999

Havera and staff publish the compendium *Waterfowl of Illinois: Status and Management* along with a companion field guide. These books received The Wildlife Society's Outstanding Book Publication Award for 2000.

2002

The Forbes Biological Station research program conducts investigations into a third century as the physical facilities are enhanced and expanded.



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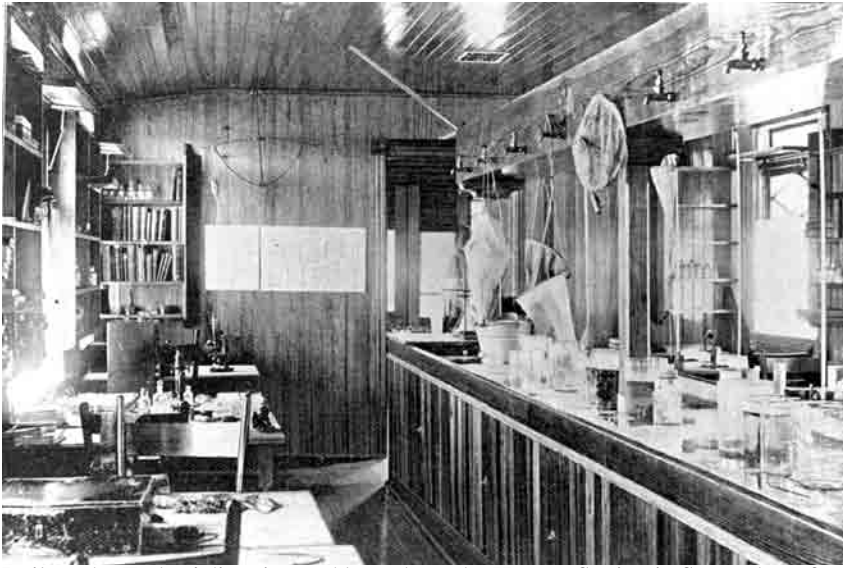
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Built under Forbes' direction and brought to the Havana Station in September of 1896, the 60-foot floating biological laboratory had no power of its own and was towed from site to site by the 25-foot steamer *Illini*. The fully equipped houseboat accommodated as many as fifteen workers and proved to be a comfortable and efficient working arrangement with the very great advantage of mobility. This floating laboratory was often established for months at a time at various points along the Illinois River. It remained in use until 1935.



The *Anax*, named after a genus of dragonfly, on the Illinois River at Havana on April 8, 1935. For a decade this 48-foot cabin boat served as the station's floating laboratory.



The interior of the *Anax*. Retractable beds suspended from the ceiling permitted nighttime quarters to double as laboratory and living space during the day.

Robert E. Richardson and Henry C. Allen on the Illinois River in 1910. As Forbes put it in 1911 when he reported on the biological investigations on the Illinois River, "Two men—Mr. R.E. Richardson, with Mr. H.C. Allen as his assistant—who have fairly lived in a boat, going over the grounds where fishes were depositing their eggs, where the fry were hatched, and from which the fry must escape if they were to survive. Their object was to learn everything possible with regard to the whole process, and also to determine what was the fate of the egg and what was the fate of the fry."



David H. Thompson spent a good many days aboard the *Anax* as he surveyed the fishes of the Illinois River from Channahon to Grafton. In the process he examined some 34,000 fishes for physical abnormalities and species composition.



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During the depression years of the 1930s, the federal government established work programs that made possible a variety of construction projects. The Survey made use of that opportunity to construct a building to house the Havana Station. The frame structure was completed in 1940, a mile or so from the site on Quiver Lake where Forbes had established the station in 1894.



Founders of the Midwest Benthological Society. In the front row are Eugene Surber, Robert Schiffman, George Wimmer, R. Weldon Larimore, and Paul G. Barnickol; in the back row are Morris L. Brehmer, Alvin Lopinot, Troy Dorris, Kenneth MacKenthun, and William C. Starrett. Founded at the Havana Station in April of 1953, the society has since achieved national stature as the North American Benthological Society with a membership of more than 2,000. Three of the founding members are not pictured above: Donald F. Hansen, Bruce Muench, and Andreas Paloumpis.



William C. Starrett became the director of the Havana Station in 1949. His survey of dwindling species of mussels in the Illinois River remains a classic. Starrett also initiated the annual electrofishing survey of the Illinois River that continues to be updated. Here Starrett tests water samples from the Illinois River.

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One of the best wildlife data sets ever compiled in North America had its genesis in 1938 when Frank Bellrose inventoried waterfowl during the fall migration in selected bottomland lakes in the Illinois Valley. On the left, Jessop B. Low uses a spotting scope to observe waterfowl near Turner's Lake in October of 1942. In the center, John M. Anderson observes geese along the Mississippi River from a sandbar in Alexander County, Illinois, February 1941. On the right, Arthur S. Hawkins positions himself in a goose hunter's pit to watch waterfowl near Horseshoe Lake in February of 1941.



Following an extensive die-off of mallards in January of 1947, the Survey began an investigation of the effects of lead shot on waterfowl that was to span a period of fifty years. Physiological studies conducted by Frank C. Bellrose and James S. Jordan demonstrated that diet, amount of shot ingested, and sex and age of ducks had significant influence on the severity of lead poisoning in mallards. Here Jordan and Bellrose band a mallard in the Havana area in 1948.



In 1959 Frank C. Bellrose published his impressive work, *Lead Poisoning as a Mortality Factor in Waterfowl Populations*. Data from 39,610 gizzards of eleven species of waterfowl collected from 1938 to 1954 were used in the study. This and subsequent studies were instrumental in developing a federal project for the elimination of lead shot in the sport hunting of waterfowl, a program implemented nationwide in the 1991–1992 hunting season. Here Bellrose examines a lead poisoning die-off at Rice Lake in March of 1972.



Stephen P. Havera joined the Survey in 1972 and transferred to the Havana Station in 1978. He became its director in 1982.

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Over the past sixty years, the slow but insidious process of soil erosion has filled in the bottomland lakes of the Illinois Valley, eliminating aquatic vegetation, reducing the number of species of fish by over 60 percent, and cutting the number of mallards that use the flyway by more than 80 percent. Here Stephen Havera and Richard Sparks use contour maps to study floodplain elevations in the Illinois River valley.



In 1986, the National Science Foundation awarded \$50,000 to the station toward the construction of an addition, a grant made under a program to offer facility and equipment support to field stations with productive scientific histories. With matching funds from the Illinois Capital Development Board, the addition became fully operational in September of 1988. As part of the fiftieth anniversary of the original building, the station was officially designated the Stephen A. Forbes Biological Station in May of 1989. Two research units were defined to encompass current activities at the station—the Waterfowl Research Laboratory and the River Research Laboratory.

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In this aerial view, Lake Chautauqua and the Illinois River stretch out behind the Forbes Biological Station (bottom center) in the mid-1980s.



The Forbes Biological Station situated on Chautauqua National Wildlife Refuge, fall 2002.



The task set for themselves by the present staff is not only to document change and its effect on the Illinois Valley but to use this information to restore part of this once magnificent waterway so that future generations can witness and appreciate what Forbes saw in 1894 when his studies at the station began. The dedicatory stone, an unpolished glacial boulder taken from the Illinois River floodplain, is a tangible reminder of that commitment. It honors the memory of Stephen A. Forbes, namesake of the station, but it also marks a new beginning.

Illinois Natural History Survey, David L. Thomas, Chief
A division of the Illinois Department of Natural Resources, Brent Manning, Director

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