A PORTRAIT OF RIVER BASIN STUDIES IN THE SOUTHEAST

Prepared as a Supplement to Paper Presented by Dr. Wendell L. Johnson, Chief, Fishery Section, Branch of River Basin Studies, Bureau of Sport Fisheries and Wildlife, at the 13th Annual Conference of the Southeastern Association of Game and Fish Commissioners, Baltimore, Maryland, October 27, 1959

ORGANIZATION

River Basin Studies, as a specific activity of the Fish and Wildlife Service, assumed official identity in the Southeast Region (Region 4) with the employment of two biologists August 19, 1945. With little previous experience in this field and virtually no guidelines, this small crew was assigned the task of studying every Federal water-development project in a 10-State (now 12) area.

The first study undertaken was in relation to the Corps of Engineers' comprehensive plan for the White River Basin, Missouri, Arkansas. Soon after, problems reported upon in widely separated areas were Cross Florida Barge Canal, Florida; Santee Hydroelectric project, South Carolina; Yazoo Backwater area, Mississippi; Allatoona Dam and Reservoir project, Georgia; and Falmouth project, Kentucky.

To save travel time and encourage closer liaison with the planning and construction agencies, field offices were established as funds became available. The first was set up in Vicksburg, Mississippi, July, 1948. Its area of responsibility is the lower Mississippi Valley. Corps of Engineers projects studied are under the jurisdiction of the District Engineer in Little Rock, Memphis, Vicksburg, and New Orleans. In addition, the Vicksburg field office has been responsible for wetlands, small watersheds, and FPC studies in Arkansas, Louisiana and Mississippi. Of its many activities, the most significant perhaps, is the Mississippi River and Tributaries project review.

The Vero Beach Office, Florida, was established shortly after assignment of a field biologist to full-time study of Central and Southern Florida flood control project, February, 1955. Its program is a good example of concerted effort. The Florida Game and Fresh Water Fish Commission and the Department of Conservation both have men working in close cooperation with our field staff. The former agency established a river basins program with field headquarters in Vero Beach. The latter is conducting research in problem areas. The University of Miami, through its marine laboratory, also is conducting research which is yielding valuable information with respect to the ecology of estuarine waters. The State Wildlife Federation is very active and has assisted much in local educational programs.

The Raleigh Office, North Carolina, was established December, 1955, to serve the States of Maryland, Virginia, North Carolina and South Carolina. There are six district offices of the Corps of Engineers in this field area, three of which are in the North Atlantic Division and three in the South Atlantic Division. Other Federal agencies with which the Raleigh Office works closely are the Geological Survey, Public Health Service, National Park Service, Soil Conservation Service, Agricultural Stabilization and Conservation Committee. Contacts with State government units are not cited here but they include agencies concerned with public health, water-pollution control, recreation, water resources, game and inland fisheries, and commercial fisheries.

Studies are in progress on the Potomac and James Rivers; Kerr, Hartwell, Wilksboro, and Salem-Church Reservoirs; and Princess Anne County Watershed project, Virginia. The office is also cooperating in special studies of salt marsh mosquito control and ecological problems of Back Bay-Currituck Sound, Virginia and North Carolina.

The Decatur, Alabama, office was established in 1957 to initiate detailed planning for replacement of Kentucky Woodlands National Wildlife Refuge which will be partially inundated by the Barkley Reservoir on the lower Cumberland River, Kentucky and Tennessee. In the authorization of this project,

Congress made provision that lands for wildlife purposes be acquired. It was the first special authorization of this type in the Southeast.

Other studies which rapidly assumed importance with establishment of the Decatur Field Office were Jackson Lock and Dam project on the Tombigbee River, Tennessee-Tombigbee Waterway, and numerous reservoirs under construction or consideration in the Ohio River drainage.

The Decatur Office works closely with the Mobile District Office, Corps of Engineers, within the South Atlantic Division, and the Huntington, Louisville, and Nashville Districts in the Ohio River Division. This office also conducts special investigations similar to those described for the other field areas.

A station in Slidell, Louisiana, was our last move to decentralize regional office activities. This action in 1958 was taken to coordinate studies related to the Mississippi River-Gulf Outlet project. Of all the studies being undertaken, this is our most intensive. Surveys will continue over a three-year period with a view toward determining measures necessary to protect valuable fish and wildlife resources in the marshes and coastal waters southeast of New Orleans. Assisting us in this survey is the Texas A & M Research Foundation, the Louisiana Wildlife and Fisheries Commission, and the Bureau of Commercial Fisheries. In addition to providing information on which to recommend conservation measures, our studies will reflect ecological changes characteristic of projects of this type.

Thus, the organization has grown from a two-man staff in 1945 to a complement of 22 technical men constituting some of the best talent available in the field of wildlife, freshwater fishery and marine biology. It is yet a young organization, but its leadership is seasoned and the personnel prepared.

THE REGION 4 APPROACH

The overall objective of the River Basin Studies program of the Bureau of Sport Fisheries and Wildlife is the conservation and development of fish and wildlife resources in connection with water resource projects. The field survey and report are the basic means by which facts are obtained and recommendations coordinated with cooperating agencies. Basic procedures in this respect are similar throughout the United States.

The job is not completed, however, until the measures recommended have been implemented and evaluated. This requires the adoption of an approach designed to overcome the many problems associated with each project. Since the problems also vary greatly from one region to another, so does the regional approach.

The Region 4 approach, from the beginning, has been positive. Definite plans of fish and wildlife conservation for almost every drainage and project area studied have been formulated. In this task, the capabilities of each area are appraised, related to man's most pressing needs, and a fish and wildlife plan fitted into the scheme of things.

We have sought management measures which are compatible with other project uses; but, where it has been necessary to push single-purpose fish and wildlife projects to achieve balance, we have done so.

The best illustration of the Region 4 approach is the Mississippi River and Tributaries project, a review of which was directed by Congress in a resolution dated June 12, 1954.

The first phase of this review consisted of a series of 12 public hearings conducted by the District Engineers, Corps of Engineers, with the assistance of the Regional Director, Bureau of Sport Fisheries and Wildlife. These hearings, which were well attended, provided local people an opportunity to express their views with respect to the need for fish and wildlife conservation, as well as for flood control and drainage.

The second phase involved surveys and planning by the Corps of Engineers and the Branch of River Basin Studies as the basis for determining any modifications in the overall project deemed necessary and justifiable.

The third phase involved a series of coordination meetings with the Corps of Engineers and with local interests as the basis for arriving at a mutually acceptable plan for each sub-basin. These meetings are in progress at the present time.

The fourth phase is review by higher authority, Congressional action, and construction of those projects authorized and for which funds are appropriated.

While we do not expect the Corps of Engineers to fully concur in all of our recommendations, we are encouraged by the outcome of our jointly prepared plan for the White River Backwater area, a segment of the MRT project, which was authorized by the Congress in 1958. This was the first instance in Region 4 where fish and wildlife conservation was recognized as a collateral purpose to flood control with specific provision for project operation in conformance with a plan agreed upon by the Corps of Engineers, this Bureau, and local drainage interests.

We also are encouraged by public interest in our program as demonstrated during a meeting in Manila, Arkansas, June, 1959. While the people had expressed a desire for fish, wildlife, and drainage, too, of the approximately 500 persons present, 496 favored the proposals made by this Bureau for restoring Big Lake.

PROGRESS

The progress of the River Basins program cannot be measured in strictly physical terms. Much that will be accomplished is now on the planning table, or in the minds of the field personnel.

Much has been accomplished, however, which may be charted by the discovery and application of effective conservation measures.

The Subimpoundment. One of the first measures to be applied that had popular appeal was the subimpoundment. In theory it was generally assumed that reservoirs with widely fluctuating water levels could not afford good fishing. It was also assumed that the practical solution to this problem would be to build auxiliary dams on one or more arms of the main reservoir, whereby pools could be created with stable levels.

The Acworth Dam and Subimpoundment, erected in 1950 on Allatoona Creek, an arm of the Allatoona Reservoir, Georgia, is the first example of such a project recommended in our reports. It has proven very beneficial, although the fishing afforded in this stable-level pool is little better and in some ways not as good as in the main impoundment. Similar results, incidentally, were experienced with the construction of subimpoundments on TVA reservoirs.

The Acworth Subimpoundment, however, has provided over 600 acres of fishing water which otherwise would have been a mud flat during the autumn and winter months. Furthermore, it has provided a beautiful setting for a State park; a major highway crosses the dam connecting the city of Acworth with super highway 41; and it has greatly enhanced property value around the shoreline.

The impoundment continues to be an important element in the plans for many projects although its purpose and mode of operation have radically changed as we shall describe.

Water Level Management. Our interest in water level management stemmed from the realization that if we were to develop the fisheries of large impoundments, we would have to work with fluctuations in pool stages. There are virtually no stable-level reservoir projects in the Southeast. Furthermore, with alternate storage and drawdown for flood control, water supply, power, navigation, and other purposes, the degree and pattern of fluctuation varies from one impoundment to another, and, in the same impoundment, from year to year.

In our search for a practical tool we were well aware of the effectiveness of water-level manipulation in waterfowl management, also in mosquito control. We were also familiar with the excellent fishing afforded by many oxbow lakes in the lower Mississippi River Valley which are overflowed each winter and spring by rising river stages.

The correlation of these observations with other experience gave us a valuable clue in fashioning a plan for the fish and wildlife management of impounded waters based on the manipulation of water levels. This plan and our concept with respect to its use were first described at the annual meeting of the American Fisheries Society in Denver, on September 11, 1947.

Meanwhile, we had publicly declared that fishing in Blue Mountain Reservoir, a flood-control project on the Petit Jean River, Arkansas, would be favored by extreme water level fluctuations. Our statement, recorded by the Corps of Engineers at a public hearing in the village of Blue Mountain, was widely distributed. There was, of course, some national reaction to this revolutionary point of view. In time, however, the principles of water-level management have become better known and while the application of this measure is still in the experimental stage, excellent results are being obtained in a number of instances. The best example, from a fishery standpoint, is the management of water levels in Nimrod Reservoir, Arkansas, as reported by A. H. Hulsey.

Another example—Conservation Area 1, Central and Southern Florida flood control project. In this area, a seasonal fluctuation of water levels between elevations 14.0 and 17.0 has been approved by the Corps of Engineers. The primary objective—to preserve and restore desirable aquatic vegetation in this portion of the Everglades. Fishing, however, has been greatly improved, and environmental conditions are more favorable for the production of frogs, one of the principal economic resources.

A similar operation is planned for Conservation Areas 2 and 3 which are being developed by the Florida Game and Fresh Water Fish Commission, cooperating with the Central and Southern Florida Flood Control District.

The authorized White River Backwater project provides for seasonal inundation of lowlands for fish and wildlife purposes. A similar plan has been given favorable consideration by the Corps of Engineers with respect to the Red River Backwater, Louisiana, and the Yazoo Backwater area, Mississippi. In the latter, water-level management as proposed, will bring 43,000 acres into extensive production.

In addition to providing a valuable management tool, special studies with respect to water-level fluctuations have greatly advanced our understanding of the ecology and biology of water and wetlands in natural overflow areas. Continuously, we are confronted with a desire on the part of many people, including conservationists, to stabilize water levels in some of our best fishing lakes. For example, agricultural interests, hotel operators, and concessionaires around Reelfoot Lake, Tennessee, have repeatedly requested that the lake levels be stabilized. Only after long and sustained effort, have we been able to secure even partial understanding as to the significance of the backwater in maintaining desirable fishing conditions in the lake.

Selective Clearing. The bleak, monotonous shoreline of many reservoirs in the Southeast, as contrasted to the cypress-rimmed lakes of the Mississippi lowlands, prompted us to seek some practical means of diversifying the habitat of large impoundments. One means which affords some promise of success is selective rather than complete clearing of the pools.

Most of the reservoirs which had been constructed by private interests for power purposes in the early 1900's were not cleared of timber. The first Corps of Engineers projects in this region, however, were completly cleared. Dale Hollow Reservoir, for example, was cleared for a distance of five feet vertically above the power pool in direct response to the demand for mosquito control.

In view of the rigid clearing regulations and lack of understanding with respect to our program, we concluded that the most we could hope for would be the establishment of a few tree tops or fish attractors in selected reservoirs. Our first recommendation in this respect was in connection with the Allatoona Reservoir, Georgia, the construction of which had been initiated when our report was released in 1949. The Corps of Engineers was very cooperative and, with the assistance of the clearing contractors, erected over 90 fish attractors in conformance with specifications drawn up by the Branch of River Basin Studies.

In later studies, we recommended that instead of felling trees and tying them with cable to hold them in place, groups or stands of trees be left standing in selected sites. This was accomplished concurrently with the clearing of Clark Hill Reservoir on the Savannah River and Buford Reservoir on the Chattahoochee River.

Surveys of Jim Woodruff and Demopolis Reservoirs in the lowlands of Alabama, Georgia, and Florida revealed water-tolerant trees in the reservoir basins. With a view toward simulating the waterscapes of Reelfoot Lake, Tennessee, or Cypress Gardens, Florida, we recommended that the cypress and tupelo gum trees which grew along the stream banks, around the ponds, and in the swales be left standing. Here again, the Corps was cooperative and following coordination with the State Health Departments of Georgia, Florida, and Alabama, our recommendations were carried out. In consequence, not only were our objectives generally obtained, but savings in clearing costs were substantial.

Then in some parts of the region, the pendulum began to swing too far, and the general public became alarmed at the prospect of living with lakes filled with dead and decaying timber. So great was the alarm in the case of Table Rock Reservoir in the Ozark Mountains that the Corps held a public hearing in Branson, Missouri. Townspeople, including many ardent fishermen, came to that hearing with a view toward forcing the Little Rock District Engineer to completely reverse his stand. Realizing the stake that fish and wildlife interests had in this matter, we appealed for understanding as did the Missouri Department of Conservation. Subsequent to the hearing, we assisted the Corps in explaining the principles of selective clearing whereby a satisfactory compromise was reached.

Our most recent experiences with respect to selective clearing concern Jackson Lock and Dam project (Corps of Engineers) and Weiss Reservoir project (licensed under FPC), Alabama. Our studies of the latter were undertaken with funds made available by the Alabama Power Company whose interest in our program was first aroused by knowledge of our work in this field. Clearing plans for each have been completed and coordinated with construction agencies and with health authorities. We are in agreement as to detail. This is another milestone in the progress of our program in the Southeast.

In retrospect we also are disturbed by the lack of systematic studies conducted by this Bureau or any other agency whereby we may accurately evaluate the effect of selective clearing and thereby refine our recommendations. Some work is being initiated, and we have made some general observations, but as of this date our chief support is still the veteran fisherman who for many years has felled trees into his favorite lakes to improve his catch. In the lower Mississippi Valley, for example, the oxbow fisherman through trial and error, knows which of the tops are the most productive and, for reference purposes, he calls them each by name.

The results of selective clearing within reservoirs which we have planned have been generally favorable. While we do not know the exact effects of fish attractors on fish or upon fishing success, we do know that they have an appeal to the angler. Furthermore, we have found that selective clearing affords one of the few practical means by which portions of reservoirs may be zoned for exclusive fishing use.

In future studies we shall be seeking maximum public benefit at minimum expense commensurate with public health, safety, and efficient project operation. And we shall be guided by the point of view that we must plan and substantiate our recommendations with respect to areas to be cleared.

Stream Flow Regulations. The regulation of stream flows has been a much desired tool in fishery management, but under experienced conditions, it has not been as effective as we would like.

In the White River Basin, Missouri and Arkansas, for example, the pattern of flow and quality of water were radically changed with construction and operation of Bull Shoals and Norfolk Dam for flood control and power purposes. Flooding was reduced in the middle reaches of the river to the extent that the natural production of commercial fishes has sharply declined. Furthermore,

minimum stream flow immediately below the dams was reduced almost to zero as a result of intermittent power generation. Of greater significance, the withdrawal of cold water from deep strata of the reservoirs virtually eliminated sport fishing for warm water species for a distance of almost 200 miles downstream.

In anticipation of these changes, the Branch of River Basin Studies, cooperating with the Arkansas Game and Fish Commission, recommended that favorable pattern of flow be maintained in the upper as well as the lower portions of the valley by controlled release of water from the headwater reservoirs.

To replace the loss of the warm water fishery, it was recommended that a trout hatchery be constructed below Norfolk Dam for the purpose of rearing fingerling stock for annual introduction into the cold waters of the upper White River. This also has been accomplished with outstanding results for a distance of about 35 miles below Bull Shoals Dam. From the mouth of the Buffalo River to Calico Rock, fishing has been less spectacular and is inconsequential from Calico Rock to Batesville, although prevailing water temperatures are favorable.

Similar problems were revealed in the Obey River below Dale Hollow Dam, Tennessee, and in the Cumberland River below Wolf Dam, Kentucky, by cooperative studies undertaken by the Tennessee Game and Fish Commission, Kentucky Department of Fish and Wildlife Resources, and the U. S. Bureau of Sport Fisheries and Wildlife. Subsequently an excellent trout fishery was established in the Obey River by annual stocking and by controlled release of cold water during the weekend periods, in accordance with minimum requirements, determined by the Tennessee Game and Fish Commission.

Cooperative effort in Kentucky, however, has failed to establish a trout fishery of importance in the Cumberland River. This stream, as well as many others in the Southeast, including the Chattahoochee River below Buford Dam in Georgia, is not conducive to a trout fishery although water temperatures appear favorable.

We do not fully understand the limiting factors. Successful trout programs are limited to streams located in limestone valleys, with beds composed of fractured rock and rubble, with medium fall or gradients broken by long riffles and rocky shoals, and with deep pools which carry little suspended sediment.

The problem has been further complicated in some instances by alternate periods of cold and warm water releases. In Greers Ferry, Arkansas, for example, the cold winter-stored water probably will be completely withdrawn from the power pool by September; whereupon, it will be followed by the release of warm water until the autumn overturn. In such event, the Little Red River below Greers Ferry Dam will be suitable for neither cold nor warm water fishes. Such a situation has prevailed for many years below Cherokee Reservoir, Tennessee.

In all, there are about 25 dams discharging cold water which affects the warm water fishery of more than 600 miles of large streams in the Southeast. Additional ones are being planned, some of which, fortunately, will be designed and operated in such manner that water can be released from any strata regardless of reservoir stage, and stream temperatures obtained below the dam which are optimum for desired species of fish.

The first project in the Southeast with specific provision for water quality control was the Roanoke Rapids Dam and Reservoir on the Roanoke River, North Carolina. Before this project was constructed by the Virginia Electric Power Company, the probable effects of cold water discharge and oxygen deficiency on the striped bass fishery of this stream had been called to the attention of the Federal Power Commission.

Meanwhile, special studies were initiated by State and Federal agencies and on the basis of agreement VEPCO constructed a weir or "curtainwall"a short distance upstream from the dam and power intakes. Since the crest of the "curtainwall" is about 25 feet below the level of the power pool, the cold and

sometimes oxygen-deficient waters are entrapped, and the warm-surface waters are withdrawn.

More recently, the Corps of Engineers has favorably considered our recommendations that the dams to be located on Nolin River, Barren River, Little Sandy River, and Little Tygarts Creek in the Ohio River drainage be equipped with means for warm water discharge. The Nolin Dam will have a multivented intake which will permit the withdrawal of water from 4 levels. The lowest intake will permit water to be taken from the bottom of the reservoir, while the upper three will permit water to be taken from different strata near the surface. By experimental operation of this structure, we hope to determine optimum conditions for either cold or warm water fishes; also to establish the effects which variable discharge may have upon the reservoir fishery.

In view of the importance of this problem, we have made an eleventh hour appeal for modification of the Greers Ferry Dam in the interest of preserving existing and potential warm water fisheries in the Little Red River. Since the cost of modifying structures in high, multiple-purpose dams of this type will be much greater than in low or single-purpose dams, our recommendations must be adequately justified.

The Corps of Engineers also has given favorable consideration to our recommendations that fish and wildlife pools be included in Rough River, Nolin, and Buckhorn Reservoirs, Kentucky. In effect, these pools would provide for storage of waters above the conservation-pool levels in late spring for withdrawal during the summer and autumn. Benefits would be two-fold. A larger reservoir would be available to the public during April-June, the peak period of recreational activity; minimum stream flow would be increased from July-October, thereby improving fish habitat during the critical dry period.

Our first major effort to reduce maximum rates of flow was with respect to the regulated discharge of water from Lake Okeechobee into the Gulf of Mexico via the Caloosahatchee River and from Lake Okeechobee into the Atlantic Ocean via the St. Lucie Canal. The problem which involves sedimentation of the estuaries, high-water turbidity, reduced salinities, reduced fishing success, loss of revenue, and possibly red tide outbreaks is too complex to describe here. We have been working in cooperation with State and local agencies on a set of criteria for use by the Corps in scheduling releases of surplus flood waters.

Another measure concerning the volume and manner in which water is released through or over a control structure was first described in our report on Fort Gaines Lock and Dam Project, Georgia and Alabama, May, 1956. In this report, we pointed out that fishes moving upstream from lower segments of the river or downstream through the turbines, locks or spillway would concentrate in the tailwaters; also that bank fishing would be best during sustained flows of large volume and poorest during erratic flows of low volume.

We also explained that while fishing success would be very good in these tailwaters, it would be influenced by the location of the operating power units and the order in which they are placed in operation. Observation of other projects disclosed that fast moving water along tailwater banks is essential for maximum harvest. Thus, we recommended that the turbine of the Fort Gaines Powerhouse nearest the shore be utilized when single-unit operation coincides with the periods of heavy fishing intensity. We also recommended that at such times when the one-unit step operation is initiated, the unit nearest the bank be started first.

The Corps of Engineers has not agreed to this recommendation on Fort Gaines project for the reason that these tailwaters will be too hazardous for fishing. We are convinced, however, that the measure merits serious consideration in the Southeast.

Drainage Improvement and Flood Control. The clearing and snagging of streams, conversion of natural channels into deep open ditches by realignment and enlargement, and the diversion of flows, all in the name of improved drainage and flood control, are among the most destructive practices with which

we have been confronted. And they usually offer the least opportunity for applied fish and wildlife conservation.

For example, in their natural state the streams of the Mississippi River Delta have deep meandering channels for distribution of overflow and drainage of backwater from the bottomlands. They are flanked by extensive hardwood forests, the foliage of which contributes much to the organic enrichment of the alluvial soils. They are enriched too by frequent deposition of sediments derived from fertile lands upstream and by the death and decay of a vast store of living organisms. Under such conditions, the backwaters are clear and productive of fish life.

This was changed, of course, in most basins with the construction of levees and clearing of the forests for agriculture. With their water supply severed many of the streams ceased to flow in summer. The situation was aggravated by silt-laden waters draining from the agricultural land directly into the sloughs and bayous and then into the major creeks. Then, many of the streams which had formerly provided adequate drainage were now filled with willows and sediment and had to be opened up if the farmers were to survive.

The simplest and most economical method of obtaining relief was by the clearing and removing of willows and debris from the stream. This proved very efficient where siltation had not far advanced. Clearing, as accomplished by the early settler, had little or no effect on the fish and wildlife economy. But with modern equipment in the hands of indiscriminative contractors, not only were the willows and snags removed from the channel, but virtually all trees and shrubby vegetation was cut and burned with devasting effects on fish and wildlife resources.

We observed and reported upon the effects of this type of clearing operation with respect to the Corps of Engineers project for Steele Bayou, Mississippi. In reporting upon a similar project for the Tensas River, Louisiana and the Little Missouri River, Arkansas, we recommended certain modifications which we believed would not only conserve fish and wildlife resources but reduce the cost of project maintenance.

We recommended, for example, that snags and fallen timber which lay in the main channel below the average low water grade and which did not materially retard flood flows be undisturbed. These obstacles usually afford good fishing sites since they offer cover and in places cause the stream to scour deep holes in the channel.

We also recommended that all live, firmly rooted trees, with the exception of willows, having a minimum diameter of 6 inches 5 feet above the ground be left standing. In substantiation, we described how the forest canopy in addition to providing shade for fish and fisherman, retards the reproduction of shrubby plants. A dense understory offers far more resistance to the flow of water than the trunks of a few, large trees.

The results achieved from the plan as recommended for these two areas has been very gratifying both to the Corps and to this Bureau.

Channelization. When the removal of willows and snags from streams was not enough to provide the desired drainage, it was necessary to enlarge the channel. Since the early settler could do little more than open up a few constrictions on the lands which he owned, his efforts had only local effect. With the organization of drainage districts, however, the work was begun on a much larger scale with specialized equipment; and the efforts were widespread.

The usual procedure was to excavate a channel along a straight line, following the natural stream course as much as possible to reduce the cost of excavation. This often required cutting across bendways, lakes and swamps, or other natural depressions.

With the completion of the major outlets, the stage was set for the excavation of secondary ditches whereby the drainage of every acre within a given watershed could be accomplished. This type drainage is perhaps best illustrated in the Little River Basin of southeast Missouri and northeast Arkansas where the only remaining wetland habitat is Big Lake and vicinity. Even here, the

natural productivity of the streams and lakes concerned has been greatly reduced by the inflow of silt-laden water.

The maintenance of the drainage systems, however, is not without problems, a fact which has made it possible for us to obtain some consideration in planning future channelization works. For example, in addition to the continuous fight on the part of local drainage districts to keep the ditches free of willows, too much drainage in some areas has reduced the water table to such an extent that during periods of drought, production of crops has been greatly reduced.

One of the simplest conservation measures which came to mind as we were studying the Plum Bayou drainage project, Arkansas, was the installation of a series of weirs with crest elevation about 4 to 6 feet above the ditch bottom. In effect, their function would be comparable to natural shoal areas in streams which are responsible for pool formation. Direct benefits anticipated would be (1) the creation of permanent pools for the propagation of fish; (2) control of willow reproduction; (3) creation of sumps for irrigation purposes, and (4) conservation of soil moisture.

Our recommendations for Plum Bayou have not been carried out since the Corps has not initiated construction of this project. The Corps, however, has installed such weirs in the canals and drainage ditches excavated within Boeuf-Tensas River Basin, Arkansas and Louisiana, and in connection with the auxiliary channel, Yazoo Headwater Project, Mississippi, as well as in other project areas of this valley.

As for the benefits obtained, some fishing has been provided by the pools and below the weirs. A comparison of benefits to cost, however, must await detailed appraisal.

Flood Flow Diversions. As a substitute for channel enlargement we have advocated the construction of floodways and auxiliary channels designed to bypass or divert only those flows in excess of specified volumes or stages. In the Cache River Basin, Arkansas, for example, the Corps of Engineers has tentatively approved our recommendation that flood flows on the Cache River be diverted at a point near Pitts into a single ditch to be constructed down Bayou De View. This action will save approximately 108 miles of Cache River which under the authorized plan, would have been dredged throughout its entire length.

Cutoffs equipped with low-water weirs also provide a practical means of diverting flood flows without the usual deterioration of old bendways. In the Little Missouri River, Arkansas, for example, cutoffs across the necks of several river bends were excavated, with bottom elevations several feet above the natural stream bed level. All low flows and a part of the flood flows are still discharged down the natural channel.

The Holly Bluff cutoff, Yazoo River, Mississippi, was equipped with a permanent sill to prevent degrading of this diversion channel.

Similar action was taken by the Corps in response to our recommendation that a sill be constructed at the head of the Amite River diversion in southern Louisiana. While this structure will permit flood flows to be discharged directly into the Gulf of Mexico, all moderate and low flows will continue to meander through extensive swamp lands, thereby maintaining favorable conditions for an abundance of fish and wildlife.

In the preliminary planning stage is a proposal that surplus waters stored in Lake Okeechobee, Florida, be discharged southward into the Everglades National Park by means of a floodway rather than into the Gulf of Mexico and the Atlantic Ocean as presently accomplished. Traditionally, overflow from the lake region filled the Everglades to a shallow depth and slowly moved to the southwestern tip of the Florida peninsula. Under present conditions, water supplies of the Everglades are far from adequate—on the other hand discharge into St. Lucie estuary on the east coast and the Caloosahatchee estuary on the west coast has aroused public indignation.

Low Flow Diversion. In other instances we have recommended the excavation of diversion ditches designed to carry flows of less than specified volume or stages. In the Big Lake Area, Arkansas and Missouri, for example, we

have proposed that the existing floodway ditch be enlarged so as to convey all flows of 4,000 c.f.s. or less, except when water is needed for seasonal inundation of the State public hunting and fishing area on the east and the Big Lake National Wildlife Refuge on the west. By this means, we hope to bypass during the summer months those waters which are silt laden and which have been largely responsible for the deterioration of the aquatic habitat in Big Lake.

A similar recommendation has been made for the improvement of Lake Chicot in the Boeuf-Tensas Basin of southeast Arkansas. While each of these fish and wildlife proposals has met with public acceptance, further coordination with the Corps will be required before we can expect favorable action.

Land Acquisition. Acquisition of lands for fish and wildlife purposes in conjunction with water development projects is essential to providing maximum public benefits. This includes lands that are necessary for (1) public access and use, and (2) the preservation of existing or potential fish and wildlife values.

Availability of lands around the margins of reservoir projects, in the interest of public use and access, was no problem in the early years of the River Basin Studies program.

For example, over 27,300 acres of land were purchased in fee title above the 11,900-acre power pool of Allatoona Reservoir. This is a little more than two acres of marginal land to one acre of permanent water. Most of this land lies within one-quarter mile of the shoreline. There are several large tracts, however, occupying prominent pninsulas which have proven admirably suited for public use areas. Two were developed as State parks and a third was zoned as a wilderness area and later leased to the Georgia Game and Fish Commission.

In addition to these State-administered projects are the usual boat-launching ramps, concessions, parking areas, overlooks, grounds, group camps, and day use areas. Similar use and development are characteristic of most of the early reservoir projects constructed by the Corps. On Kerr, Clark Hill, Center Hill, and other project lands have been made available to various groups interested in providing outdoor recreation.

Other projects wherein lands have been made available to the State Game and Fish Departments for Wildlife purposes are Bull Shoals, Nimrod, and Blue Mountain Reservoirs, Arkansas; Bodcau Reservoir, Louisiana; Arkabutla and Sardis Reservoirs, Mississippi; Old Hickory and Cheatham Reservoirs, Tennessee; Demopolis Reservoir, Alabama; Jim Woodruff Reservoir, Florida; and Clark Hill Reservoir, Georgia and South Carolina.

Two State projects, one in Georgia and one in Alabama, were jeopardized by the enactment of legislation which directed the Corps to revest lands not needed for public purposes. In the case of the Jim Woodruff Reservoir project, the Corps held up execution of a General Plan on the grounds that fish and wildlife management did not constitute public purpose. After many months of debate, the lands were made available and are under development by the Florida Game and Fresh Water Fish Commission.

Another battle for the transfer of lands preceded establishment of the Holla Bend National Wildlife Refuge on the Arkansas River. With the excavation of a cutoff across this horseshoe bend, an island of approximately 5,000 acres was formed. The lands so severed were purchased by the Crops since the cost of acquisition was less than the cost of providing access.

Later these lands were declared surplus to project needs and turned over to General Services Administration for disposal in conformance with provisions of Public Law 80-537. Having established that these lands and associated waters were of national significance, this Bureau requested that they be made available for refuge purposes. GSA refused on the grounds that the lands were best suited for agriculture. As the result of efforts of this Bureau assisted by the State of Arkansas and many local interests, the refuge was established. Today, there exists in this vicinity a concentration of waterfowl in excess of 60,000 birds and a public fishing lake of 500 acres.

Other projects involving land acquisition which deserve special mention are Cheatham Lock and Dam project, Tennessee; Barkley Lake and Dam Project, Kentucky and Tennessee; Jackson Lock and Dam, Alabama Sulphur River project, Texas and Arkansas; Central and Southern Florida Flood Control project, Florida; and Mississippi River and Tributaries project, Lower Mississippi Alluvial Valley.

Had the State and this Bureau not been aggressive in the case of the Cheatham project, certain lands below the operating pool level, now under management by the Tennessee Game and Fish Commission, would have been acquired by easement instead of in fee title. On Barkley, we have not only defended our request for the acquisition of lands to replace those to be inundated within Kentucky Woodlands National Wildlife Refuge, we have substantiated our recommendation that title to about 12,000 acres of lake bottom be purchased in the upper reaches.

Failing to obtain consent of the Corps of Engineers to acquire floodway lands below Texarkana Dam by fee title rather than by easement, we assisted the State of Arkansas in obtaining options on about 12,000 acres. A part of the cost of this land will be defrayed upon receipt of payment for flowage easement by the Corps as was agreed following the series of conferences.

Lands made available to this Bureau and to the Florida Game and Fresh Water Commission within Conservation Areas 1, 2, and 3 were little less than a miracle. The total acreage involved is almost 300,000. For this we can thank the Jacksonville District Engineer, as well as the Flood Control District, since they urged that this Bureau and the State take prompt action. Had the work been delayed as little as two or three years following the project authorization, the flood control district would never have been able to have purchased these lands since real estate prices have skyrocketed throughout the State.

Coming up for consideration are recommendations that approximately 300,000 acres be acquired for fish and wildlife and flood control purposes within the Mississippi River and Tributaries project area. In substantiation of our request we have pointed out how in many instances the primary function of existing floodways has been jeopardized because easements have not prevented agricultural, residential or even industrial encroachment.

While the road may be long, and hard, the Jackson Lock and Dam project affords encouragement. Efforts to have approximately 5,000 acres of project lands acquired in fee title has involved the preparation of special reports, frequent meetings with the Corps of Engineers, conferences at Washington level, two public hearings, and finally the introduction of a special bill to Congress. If passed, this bill will authorize the Corps to acquire the lands described in fee title rather than by easement. It is nationally recognized as the first case of this kind of cooperation between the Corps of Engineers and the U. S. Fish and Wildlife Service, under the Fish and Wildlife Coordination Act, as amended by P.L. 85-624.

Coastal Marshes and Estuaries. The first study involving coastal problems undertaken by River Basin Studies was in 1947 to determine the effects of diversion of the Santee River on fish and wildlife resources of the Santee Delta marshes. Changes in the ecology of this area resulting from salt-water intrusion were documented and the Corps' plan for restoration was endorsed in our report.

The project has never been constructed, but the information gained has proven to be of great value in the development of plans which have been put into effect for other coastal areas. In the Mermentau River Basin, for example, recommendations were made with respect to the installation and operation of locks to prevent excessive salt-water intrusion. Special reports with respect to ecological changes in the marshes of Sabine and Calcasieu Parishes, Louisiana, 1951, led to improved relationships with the Department of Agriculture.

Subsequently we reported upon the fishery benefits which would accrue from increased salinities in Indian River with the opening of Sebastian Inlet, Florida.

This project, which has been constructed, affords some of the best salt-water fishing on the Atlantic Coast.

Another project involving control of salinity, food availability, and related factors is our recommended reintroduction of fresh water from the Mississippi River into the subdelta marshes below New Orleans. The Corps of Engineers has approved the general design of this project, although further coordination will be required before agreement can be reached as to mans of implementation.

Our preliminary examination report on the efforts of hydraulic dredging and filling in Boca Ciega Bay, Florida, in 1955, initiated a chain reaction culminating in widespread public interest in estuarine problems. Estuarine research by Federal and State agencies also was stimulated.

Due in part to our efforts in cooperation with other interests, plans for the diversion of flood waters from the St. Johns River into Indian River, Florida, were deferred. Fish and wildlife habitat afforded by Back Bay and Currituck Sound, were also protected against excessive drainage as would have resulted from the Princess Anne County Watershed project, Virginia. Assistance was also rendered the State of North Carolina in reporting upon the deleterious effects of shell dredging in Currituck Sound. To protect shellfish resources in the James River estuary, Virginia, and on water bottoms along the route of the Intracoastal Waterway, and the Gulf Outlet project, Louisiana, the Corps has taken special precautions in planning canal alignment and deposition of spoil.

The desirability of aligning the proposed Freshwater Bayou navigation canal to avoid dissection of valuable fish and wildlife habitat was reported upon by River Basin Studies at a coordination meeting held with local landowners. Subsequently, a survey of the Freshwater Bayou project was also undertaken by the Vermilion Bay Corporation and a report submitted to the Board of Engineers for Rivers and Harbors in opposition, August, 1959. Thus, industry joined hands with conservation forces in an effort to save valuable fish and wildlife habitat from this type destruction.

About the Future. In this review we have portrayed a part of the story of River Basin Studies, but it is more than that. It is the story of conservation forces everywhere who have worked toward a more balanced program of water-resource development.

Of the progress made, we believe that the demonstration of success obtainable through united effort is our greatest single accomplishment. Fish and wildlife conservation is now generally recognized as a purpose of water resource development programs.

We, therefore, look forward to a sustained River Basin Studies program future of fish and wildlife conservation will largely depend on how well we phasis on coordinated research, planning, education, and development. The by the States as well as the Fish and Wildlife Service with still more emperform individually and as a team.

AN EVALUATION OF RIVER BASIN STUDIES IN THE SOUTHEAST

By Dr. Wendell L. Johnson
Chief, Fishery Section, Branch of River Basin Studies
Bureau of Sport Fisheries and Wildlife

The River Basin Studies Program in the Southeast is 14 years, 2 months and 12 days old as of this day, October 27, 1959.

It began as did the programs in other regions because there was a need for the conservation of fish and wildlife affected by water development projects constructed by the Federal Government or under Federal permit or license. The program has grown because it has contributed much toward meeting that need; and it will probably endure as long as the Federal Government is engaged in water-resource development.