An additional charge of $0.30 was made to hoop nets for average annual depreciation. In summary, variable costs per lift were $1.80 for gill nets and $2.20 for hoop nets.

Average landings per unit of effort were 55.5 pounds for gill nets valued at $4.20 and 84.8 pounds valued at $3.80 for hoop nets. The residual of catch value less variable costs amounted to $2.40 for gill nets and $1.60 for hoop nets. According to the average value per pound received for the catch of each gear, the fishermen required on the average 23 pounds per gill net lift and 48 pounds per hoop net lift to cover variable costs. Over the full season it would be necessary for the fishermen to cover all costs. At any one time, however, it would have paid the fishermen to set their gear when landings per unit of effort were expected to exceed the above rates.

THE CORPS OF ENGINEERS AND THE FISHERIES EFFORT

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It is seldom that a Corps of Engineers representative has the opportunity to address a group of conservationists except either in a defensive capacity or in the role of arbiter in a project dispute, neither of which is enjoyable. The opportunity for the Corps of Engineers to express itself as an agency that is interested in, and working for, the conservation effort is welcome indeed. Having been active at the state level in marine fisheries and wildlife for many years, I am only too well aware of the general feeling in the past that many Federal agencies seem to be invading the prerogatives of the state conservation efforts. I can assure you at this time that the Corps of Engineers does not want to, nor does it intend to, venture into the fields of fisheries and wildlife management. It has always been the policy of the Corps to turn the management of these resources in our project areas over to the states involved, and attempt to coordinate project activities so that the minimum of damage will be done to these resources and their lot will be to improve wherever and whenever possible.

We have all heard of the detrimental aspects of some Corps of Engineers projects with respect to the wildlife resources. In the past I am sure that many of us have heard Corps personnel at one time or another say that the Corps is not in the business of raising fish or quail. To a certain degree this has been true, but not entirely so. It is true, however, that the request by a Congressional leader in Washington for an impoundment in his state does not indicate that the proposed multimillion dollar structure is for the raising of trout or bass. Such requests are based on one or more primary considerations, hydro-electric power, navigation, flood control, water quality, recreation, or water supply are considered as factors in the calculations for determination of the cost-benefit ratio. The approval, by necessity, has been based on justification in the above mentioned fields. Because of this, primary consideration in project operations is given to these fields.

We all like to talk of the "good old days," when those days might not have been as good as we would like to believe. The vagaries of recollection tend to emphasize only what we want to believe. This is true of the fisheries efforts and stream conditions of the past.

A few of us here can still remember when many of our streams were not materially affected by the impoundments that now appear to be everywhere. There is some question, however, of the value of the fisheries statistics from those halcyon days of yore. Most of them were based on stories told in the barber shop or the hardware store.

The real effect of an impoundment or any other development can only be determined through an undertanding of the before and after

picture. This is difficult to obtain when the "before" data is as fuzzy as it is in many cases. To be considered a good fishing area, and one which aids in the attainment of nationwide satisfactory effort, any potential fishing site must qualify in three respects: it must have a high fish population; its population must have the proper game and forage-fish relationship; and it must be utilized by the fisherman.

I have been to a lake known as Bat Lake. It lies around 115°N longitude and 55°48′ W. latitude. It is full of fish that can be easily caught. It also happens to be 240 miles north of Calgary, Alberta, Canada, and serves about as much use to the national fisheries effort as does the Mojave Desert. It occupies this position because of its lack of utilization.

A little known fact is that the Corps of Engineers' impoundments receive more man-days of recreational use than do any other single Federal recreational system, including the National Park Service, the Fish and Wildlife Service, the National Forest Service, or the Bureau of Land Reclamation. As of August 1, 1967, Lake Sidney Lanier in Georgia had already exceeded 7½ million visitor-days of recreational use during the year. Some 20 percent of these persons engaged in fishing, which results in about 1½ million visitor-days as of August first. I would venture to state that fishing at this lake over the last 3 years was greater than all the fishing on the Chattahoochee River between the time that Columbus arrived and the time of the construction of the dam and the resulting lake. Reports indicate that the fishing is still good.

One of the advantages accruing from the construction of this reservoir is the development of a trout fishery in the lake. Prior to this, the fishing for trout was scarce at best this far downstream, but at this time, the trout fishing pressure is very high in addition to the efforts to catch other native species.

In the event that some statistical individual considers the size of Lake Sidney Lanier and produces a trump card of effort-per acre, we can go to the other extreme. The West Fork of Mill Creek Reservoir in Ohio had a total annual attendance of 1,397,600, with a peak day of 37,200 persons in 1966. This reservoir has a normal recreational pool of 200 acres, or a statistical average of 93 persons per acre if 50 percent of these people went fishing. To go further, this amounts to about one person fishing every 400 square feet.

The Corps of Engineers will readily agree that some reservoir practices do not coincide with what is considered as the best fisheries management at the moment. Wherever and whenever possible there is a definite effort on the part of the Corps to incorporate resources management into their operations. The Corps at the present time in the Southeast is attempting to correlate reservoir fluctuation and levels with the spawning activities of the game fish in order that a successful spawn may be accomplished. On the other hand, they have undertaken programs of fast fluctuation to attempt to control the spawning of the rough fish. All such operations are performed under the supervision of fisheries technicians of the states involved.

On reservoirs where navigational structures are involved, the locks have been temporarily adjusted to allow surface waters with a high content of dissolved oxygen to flush through and mix with the waters of the tailraces having a low dissolved oxygen content. In a number of cases fisheries technicians of the state organizations have observed the first instances of fish distress and in coordination with the Corps have been able to hold off what could have been a severe fish kill due to the lack of available oxygen.

Great effort is being made by the Corps to design its future structures so that the problem of low dissolved oxygen content in the turbine discharges can be eliminated. The practical application of multi-level intakes, weirs and aeration are being considered by the Corps of Engineers at the present time. At one of our projects in Georgia, Carters Reservoir, we are planning for a pumped-storage system that will be

advantageous to the fishery. At this time we feel that this will make the impoundment and its tailwaters free from the problem of low dissolved oxygen.

To those of us who are familiar with estuarine problems, it has long been obvious that management in this field consists primarily of environmental manipulations. The Corps of Engineers is one of the agencies that has done a part of estuarine alteration in dredging for navigation. Some of these developments have not been conducive to the welfare of the commercial and sports fisheries populations, and the Corps views these programs with justifiable concern. When a commercial community desires estuarine channels, and a project is investigated and authorized by Congress and funds are made available to the Corps for the purpose, the Corps of Engineers must do the work. In the preliminary investigations and discussions concerning these projects, the asistance of state conservation agencies is needed to balance the tide of consideration as to the feasibility of the projects. The effect of such projects on the marine resources involved is becoming more and more important to the feasibility considerations, as less and less of the estuarine environment is becoming available to the estuarine biota.

In a recent statement, Lt. General William F. Cassidy, Chief of Army Engineers, emphasized the increased importance of this resource consideration in the over-all study and construction of projects. The upgrading of these considerations has been one of the most progressive movements within the Corps in this field for many years. While the Fish and Wildlife Coordination Act impressed and emphasized the importance of such considerations, the increased concern and interest within the Corps itself has accomplished more than anything else to alleviate some of the problems that have developed in the past.

While all the above conditions might superficially sound as if the end of our problem is in sight, unfortunately this is not the case. A typical Corps problem, and one which is found on a greater or smaller scale throughout the coastal area, is presented by the Mobile Bay Deep Draft Ship Channel. Continued maintenance of this channel has created a series of spoil islands that have accomplished the following results:

1. It has altered the natural current pattern in the Bay which in turn has:
   (a) Adversely affected the natural reproduction of the oyster resources; and
   (b) Extended the outward limits of siltation settling.

2. From a navigational point of view, it has divided the bay into two distinct bodies of water by limiting east-west traffic to access channels between spoil banks.

3. By channeling the discharge of the Mobile River along the western side of Mobile Bay, it has directed the pollution from the Mobile area into and across prime oyster areas.

As opposed to this series of misfortunes to shellfishes, we must realize that the ship channel is the life blood of the City of Mobile and its surrounding trade area. Not counting the value of the tow-boat traffic, the channel is the source of 280 million dollars per year of import-export trade into the City of Mobile. This income is dependent on the channel being maintained. In this operation there is one basic fact that must be considered, and that is that digging holes results in dirt to dispose of.

The present volume of spoil removed from this channel by maintenance dredging is 12½ million cubic yards per operation. Present contract cost using the existing method of spoil disposal is about 10 cents per cubic yard, or a total project cost of around $1,250,000.00. The use of hopper-dredging on this project would bring the cost up to 50 cents per yard or a project cost of $6,250,000.00 and it would take over 1,000 24-hour days to go over the job once. The second alternative is the building of contained spoil areas along the channel into which the spoil would be deposited. These would be piling structures extending about

nine feet above the water. At a rate of 12¼ million cubic yards every three years, we would soon have a causeway system from one end of the bay to the other. This would bring about a complete destruction of the upper bay in a short period of time, and would soon make it possible to hop down the bay from one spoil island to the next.

Now the Corps of Engineers is staffed by persons such as you and me. We all enjoy the availability of water for recreational purposes of one sort or another. While you may like to fish or water ski, I like to spend the weekend on the Bay sailing with my two sons. I have been Chief of the Seafoods Division for the State of Alabama and therefore appreciate the commercial fisheries problem only too well. Because of the above considerations, I have a personal as well as a professional interest in the welfare of Mobile Bay. If someone could develop a system of spoil disposal on this project that would not cause serious alterations to the Bay, the Corps of Engineers would appreciate it if you would bring it to our attention.

While deposition of spoils often creates a problem, the location of public nevigation channels through the estuaries remains one of serious consideration. In Louisiana, with its many marine industries, this is of particular importance. The only way in which such problems can be avoided is by close coordination of activities by the States and the Corps of Engineers. The payment of damage claims to the oyster farmer or the destruction of oyster beds cannot be considered as prudent operations, but neither can the deliberate planting of shells and oysters on the side slopes of channel or spoil banks which must be maintained.

In Alabama, there has been instigated a cooperative plan between the State and the Corps whereby the highly nutritive spoil banks are used for the growing of seed oysters along the Mobile Ship Channel. The Corps of Engineers notifies the State when maintenance activities are about to get under way and the State then removes the small oysters and plants them on their productive beds.

In other fields of conservation-recreation endeavors, the Corps has provided acreage for wildlife and waterfowl management areas. It has developed lands and acquired properties for use for fish hatcheries, campgrounds, and boat ramps. Such properties, and at various times expensive control facilities have been involved, are turned over to the states for their administration upon their request.

Some of these projects end up in a sort of a vacuum, however. In one state the Corps of Engineers, upon the request of the state conservation agency, built a system of dikes and water control structures for the purpose of developing a waterfowl management area. This was done at a cost of around $50,000. When it came time for the state to take over the project upon the completion of the developments, the state found that the private landowners involved would not go along with the program, so the project is still where it was some years ago.

Perhaps the best indication of the Corps' attitude concerning the natural resources affected by their projects is the intensified development and expansion of their internal organization. In every District and Division Office, there is in operation at this time, or is being organized, a section or branch known as the Water Quality Section, the Environmental Resources Branch, or the Wildlife and Fisheries Resource Section. Regardless of its name, its function is the same—increased coordination with state and Federal agencies in an attempt to decrease or eliminate resource damage and where possible to enhance the resource to the best of their combined abilities.