Suggestions for Conducting Pre-impoundment Fishery Surveys[1]

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In Oklahoma, long periods of drought and recurrent conditions of excessive runoff have created the need for conservation of water and control of floods. Several agencies of federal and state governments have been authorized to study and present plans for possible solution of problems related to flood control and water conservation. The resulting plans often included building of reservoirs and the creation of bodies of water which may have many uses. Municipal, industrial and agricultural interests may also impound water, and in many cases no consideration is given to the aspect of fishery resources.

Many conditions affecting the biota immediately arise when water is impounded, and the organisms if they are to survive must fit and adjust themselves to the changeable conditions which exist in a mulitpurpose reservoir.

Fish comprise a numerous and highly important component of the biota of these artificial lakes, and in recent years have taken on a position of prime economic import to many communities.

Of the approximately 450,000 acres of artificially-impounded water in Oklahoma only about 10 percent was studied by fishery biologists prior to impoundment. In order that the fishery resources may be more completely understood and wisely utilized an appraisal must be made of the various biotic and physical factors characteristic of the proposed reservoir area.

A suggested method is presented for obtaining existing information which is essential to fishery biologists, lake managers, resident engineers, construction agencies and others interested in conducting fishery investigations, or fish management programs.

There are certain phenomena common to all reservoir areas, which, when considered in their minutia, become basic to planning for the fishery. There are numerous works in the various related fields which present standard operating procedures for conducting surveys. There are few, however which give a resume of the related data regarding the potential fishery of a proposed reservoir. The fishery biologist is, therefore, dependent upon basic data regarding the proposed reservoir area which must come from fact-finding organizations and the sponsoring or construction agency. It is to those data, from many varied sources, that this paper proposes to give weight and consideration as being indispensable in planning for the fishery program of a proposed lake.

The builders of reservoirs generally have three basic sets of data which are available to the biologist; large scale topographic maps, hydrologic data and the hypothetical operation information.

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Use of Topographic Maps

Topographic maps furnish the biologist with the best morphometric data available. These maps provide the gradients of streams in the reservoir area from the maximum design water surface to the damsite, as well as the area of the lake at various elevations.

Use of Hypothetical Operation Curve

The hypothetical operation curve obtained from the sponsoring or constructing organization is used by them to predict the time and duration of the proposed lake levels. These data furnish the biologist with one of the most important tools for studying the proposed lake and assist him in formulating recommendations for a number of phases of fish management. The average annual minimum and maximum pool elevations, the time of year at which draw-downs may occur, when terrestrial vegetation may be inundated or aquatic vegetation exposed, and an index as to the nature and direction of the hydrosere can be predicted from these data. Areas having certain morphometric features which will furnish spawning sites for certain species at various lake levels can also be determined.

The areas suitable for the operation of commercial fishing gear can be located. In order to accommodate this fish management practice some flush clearing may be required and such recommendations can be made from these data. Proposals for locating fish shelters, fishing piers, floating docks, launching ramps and other aids to the angler, areas where thermoclines may develop can also be established.

Use of Geological Surveys

Geological surveys have been conducted in considerable detail at both state and county levels, and these data are available in the form of bulletins and reports provided by both federal and state organizations. By overlaying the reservoir map with these geologic data, the different outcroppings which are destined to be flooded by the lake at various levels of its operation will be apparent. These data are valuable because shoreline fluctuations can be determined ahead of time and some insight into the influence of these exposures on the adjacent water is thereby provided.

Use of Soil Survey Data

The maps and bulletins of the Bureau of Chemistry and Soil, and the Soil Conservation Service are highly valuable. These data may also be overlaid on the reservoir map to provide a method whereby calculations of shoreline distances at different elevations can be made. The soil types destined for inundation are also apparent. Knowledge of the soil types should indicate to the biologist what the sorting action of the water and the rearrangement of the soil materials will do to produce sand bars, gravel bars, mud flats and other deposits as well as the development of different shoreline vegetation.

Use of Climatological Data

Climatologic data which are available in varying degrees of detail must be utilized in the apprasial of the future body of water. The nature, duration and intensity of the wind can have a profound effect on the turbidities, sedimentation, density currents and the persistence of a thermocline.

The length of the growing season and its effect on the hydrosere must also be taken into account.

The climate's control of the hydrology in the form of flows into the lake is significant since local or generally turbid conditions and density currents are thereby created.

Currents must be taken into account in the placement of brush piles and other types of fish attractors, and in the operation of fish management practices.

By superimposing the windrose on the proposed lake surface the points of shoreline at which waves will break normally or otherwise can be determined.

Use of Sedimentology

Sedimentation is a nearly universal phenomenon, and is a continuous process in most lakes. It exists in varying degrees in all bodies of water and is of particular importance to the fishery biologist of this region. It often occurs at an accelerated rate and quickly alters the general aspect of the reservoir. Studies are generally made by the constructing or sponsoring interests so that the life of the reservoir may be calculated. Aside from the damaging effects of loss of water-storage capacity, siltation is of grave concern to the fishery biologist.

Siltation and sedimentation generally occurs in the form of deltaic deposits in estuaries and mouths of streams and creeks. Fertile soils may be covered by much less fertile outwash and, less frequently, fertile materials are deposited on sterile bottom conditions.

The general clarity of the lakes and its ultimate fishery productivity is dependent to a considerable extent on the nature of the deposits and on the extent of their redistribution by waves, currents and turnover.

The fluctuations which occur during use or operation of a reservoir expose deltas and often cause other deposits to be moved. Movement of these materials into the lower levels of the lake generally occurs while the lake level is being reduced, and happens rather slowly. Conversely, rises which are rapid add sediments at upper levels of the impoundment. Such rapid rises could prevent materials from being brought from the depths.

Waves which break normal to a shoreline of unconsolidated deposits or soil may be expected to produce locally high turbidities and in time will move these finer sortings to greater depths in the lake.

Waves which do not break normal to a shoreline of friable or erosible material will sort and move them to other points along the shore. This causes the development of bars and spits which may obliterate or markedly change adjacent outcrops and gravelly shorelines, or cover areas with finer materials.

Shorelines consisting of ledges or expsoures of indurated or consolidated materials or gravel deposits which are clean need not be considered as contributors to turbidity or damaging sediments. The hydrosere is inspearably bound to the conditions of sedimentation which is initiated, in fluctuating lakes, at the creation of the lake and plays an important role in the development of its general aspect.

Use of Data From Neighboring Lakes and Ponds

Data available from the examinations of neighboring lakes is highly recommended and the following information should result from such studies: species composition of the fish population, the hydrosere as influenced by sedimentation, the occurrence of turn over, ice formation, development of thermoclines and human use.

Summary of Method

A coordinated examination of data pertaining to as many as possible of the physical characteristics of the reservoir area must be made. Interpretations of the influence of the interaction of these phenemona on the body of water are possible and prognostications can be made regarding the fishery of proposed lakes.

The following sequential method is suggested. By superimposing on the reservoir topographic map data obtained from the hypothetical operation curve, the area, elevation and morphometry of the lake during operation is determinable. Soil and geologic data plotted on the lake area will show what soils will be inundated and subjected to wave action at various lake levels. To superimpose the windrose on the lake area, will indicate where the action of waves will sort friable and erosible materials and where these materials will be deposited. Other phenemona which can be determined are the development and distribution of thermoclines, sedimentation, local turbidities, areas suitable for the spawning of certain species, areas suitable for the use of commercial fishing gear, areas for establishing angler aids such as fishing piers, floating docks, fish attractors and boat launching ramps. The areas where vegetation, submergent and emergent, will develop under the plan of reservoir operation can also be predicted.

Summary of Materials

The following items are considered as being essential to the examination of an area proposed for impoundment.

(1) Large scale topographic maps prepared by the constructing or sponsoring agency (2) large scale aerial photographs from the S.C.S. or Corps of Engineers or Bureau of Reclamation (3) United States Geological Survey Topographic Sheets (4) maps prepared by state agencies such as the Oklahoma Highway Department County Maps (5) Hydrologic data prepared by the constructing or sponsoring agency (6) water supply papers of the United States Geological Survey (7) the publications or compilations of the Water Resources Agency of the State (8) water quality papers which included water chemistry by the same agencies (9) Climatological data prepared by the United States Weather Bureau. These data are often available directly from the stations making these observations. (10) Geologic maps and bulletins giving surface features and sub-surface phenomena are available for most areas in the form of state and federal publications. (11) Soil maps of the Bureau of Chemistry and Soils and the accompanying bulletins (12) the detailed surveys of the Soil Conservation Service (13) State and local soil analysis services as Oklahoma State University Soil Analysis Service and private laboratories (14) those data showing the hypothetical operation of the reservoir generally spoken of by the construction or sponsoring agency as the Hypothetical Operation Curve (15) Siltation studies by the United States Geological Survey, Soil Conservation Service, Corps of Engineers, State Geological Survey and private agencies.