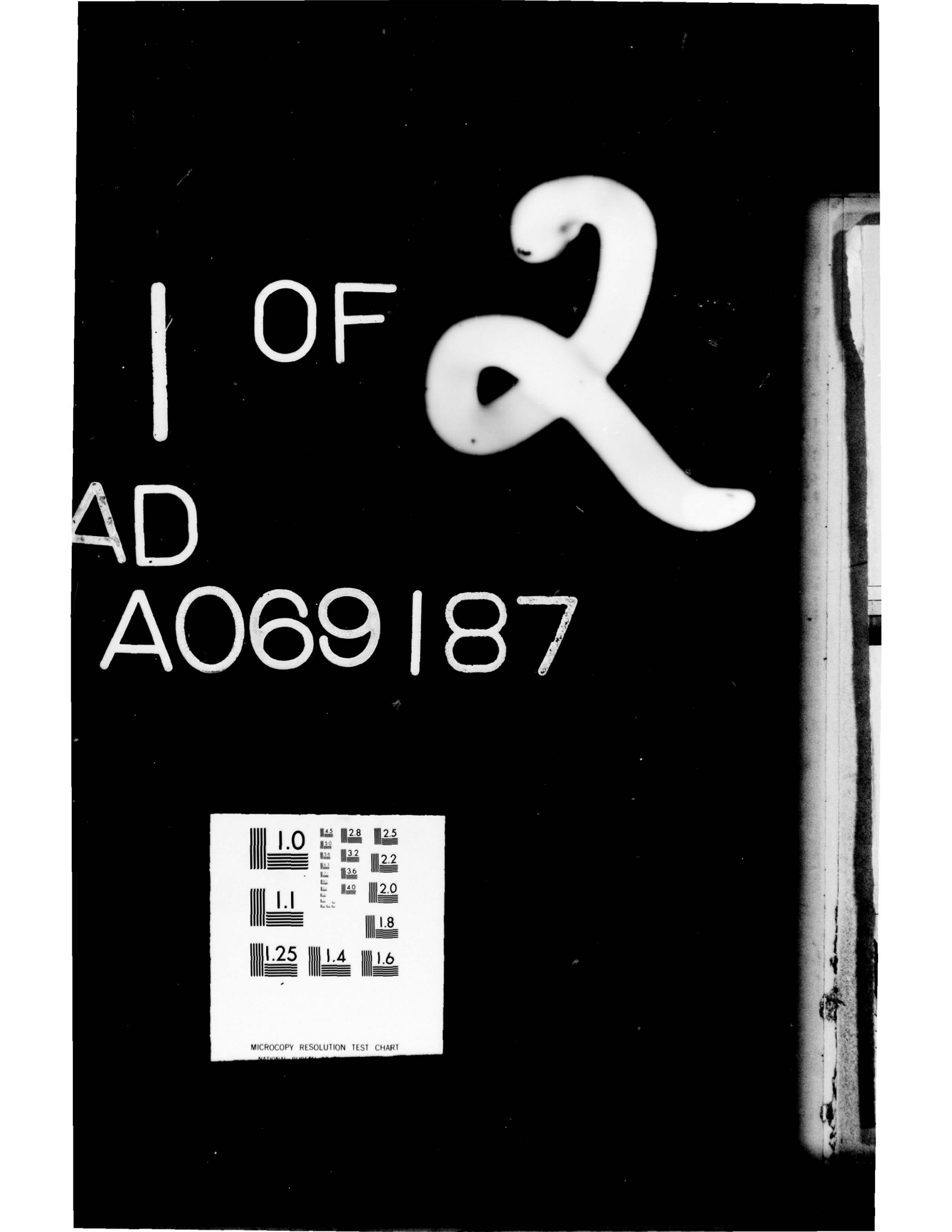
AD-A069 187 SPORT FISHING INST WASHINGTON D C F/G 6/3
EVALUATION OF PLANNING FOR FISH AND WILDLIFE AT CORPS OF ENGINE--ETC(U)
FEB 79 DACW73-74-C-0040
UNCLASSIFIED NL

1 OF 2
AD A069187




1 OF 2
AD
A069187
1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8
MICROCOPY RESOLUTION TEST CHART

AD A069187

DDC FILE COPY

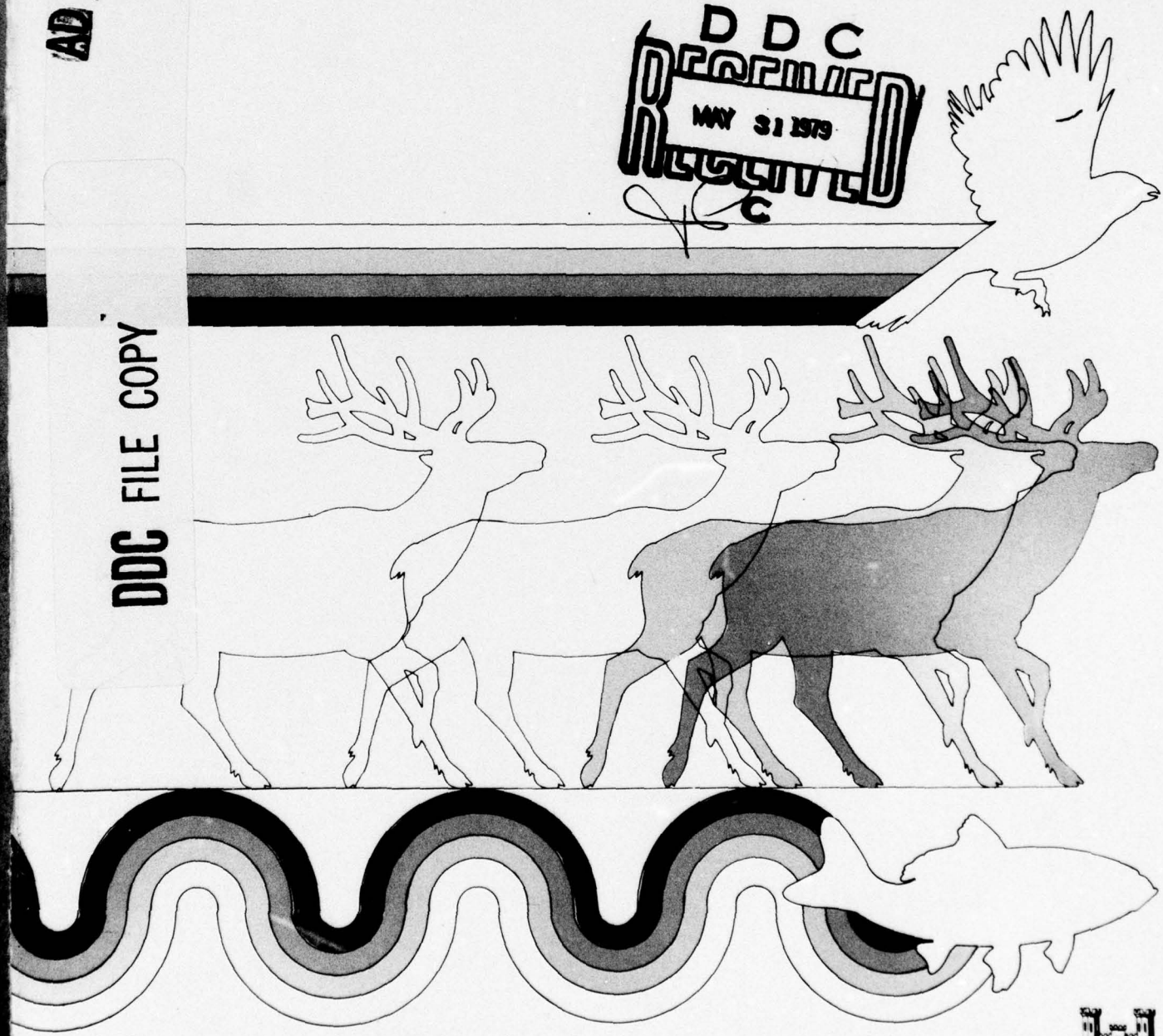
5

LEVEL II

Evaluation of Planning for Fish & Wildlife

East Lynn Reservoir Project
February 1979

DDC
RECEIVED
MAY 31 1979
C



Approved for
Public Release.
Distribution Unlimited

79 05 24 021

Department of the Army
Office of the Chief of Engineers
Washington, D.C. 20314

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER (6)	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER (9)	
4. TITLE (and Subtitle) Evaluation of Planning for Fish and Wildlife at Corps of Engineers Reservoirs-East Lynn Reservoir Project, West Virginia	5. TYPE OF REPORT & PERIOD COVERED Interim rept.
6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s) (15)	8. CONTRACT OR GRANT NUMBER(s) DACW 73-74-C-0040
9. PERFORMING ORGANIZATION NAME AND ADDRESS Sport Fishing Institute 608 13th Street, NW Washington, D. C. 20314	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Office, Chief of Engineers Washington, D. C. 20314 (11)	12. REPORT DATE Feb[illegible] 1979
	13. NUMBER OF PAGES 103
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) (12) 105p.	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151, and DDC.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Fishery resources	Wildlife resources
Planning recommendation	Pre-impoundment predictions
East Lynn	Post-impoundment occurrences
Planning evaluation	West Virginia

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Authorized by the Flood Control Act of June 28, 1938, Public Law No. 761 (Seventy-fifth Congress, third session), the East Lynn Reservoir Project provides for flood control, recreation, and fish and wildlife conservation. The project is located on East Fork of Twelvepole Creek in Wayne County, West Virginia, approximately six air miles southeast of Wayne, West Virginia. Reservoir impoundment was initiated in the spring of 1972.

(Continued next page)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

409992 LB

At seasonal recreation pool elevation of 202 m (662 ft) mean sea level, the project consists of a 407 ha (1,005 ac) lake completely surrounded by approximately 9,521 ha (23,527 ac) of contiguous highlands, comprising an overall project acquisition of 9,928 ha (24,532 ac) in fee.

The U. S. Fish and Wildlife Service (FWS) submitted three separate reports (August 15, 1961; July 2, 1964; and October 9, 1964) describing pre-project conditions and predicting post-impoundment impacts on fish and wildlife resources. These reports responded to corresponding U.S. Army Corps of Engineers (CE) project development proposals displaying widely divergent parameters of impoundment size and scope of project land acquisition that evolved over the years. The fact that the FWS was unaward of the profound changes in project boundaries and impoundment size which transpired between submission of their August 15, 1961, report and their subsequent July 2, 1964, draft report (almost three years later) indicated a deplorable lack of sustained coordination between the CE and FWS.

Fishery considerations were treated in greater depth than wildlife aspects in all three FWS reports. Well conceived fishery-oriented recommendations in the FWS report provided for maximum enhancement of project fishery resources. These recommendations were subsequently approved by the CE and eventually implemented. Only one recommendation submitted by the FWS was applicable to project wildlife resources. This recommendation prescribed that the West Virginia Department of Natural Resources (WVDNR) should manage fish and wildlife resources on all project lands and waters except those reserved for reasons of safety, recreation, was never implemented because of the inability of the WVDNR to secure adequate funding.

The FWS reports correctly predicted that adverse impacts on fish and wildlife utilization attributable to the project could be successfully mitigated. Fish and wildlife have benefitted substantially from the project as a result of the newly developed reservoir fishery and the large area of peripheral land purchased in conjunction with the project which is protected from incompatible uses. Average annual post-impoundment reservoir and tailwater angler use was estimated to be 44.8 times higher than corresponding pre-impoundment stream use. Annual post-impoundment hunter use was estimated to have exceeded without-project use estimations (assuming the absence of WVDNR management of project lands) by approximately 81 percent.

It should be emphasized, however, that these man-day use values, particularly for hunting man-day use, represent "best estimates" and/or opinions rendered by professionals closely associated with the project rather than empirical data collected according to a statistically designed study.

ACCESSION for
NTIS White Section
DDC Buff Section
UNANNOUNCED
JUSTIFICATION
BY
DISTRIBUTION/AVAILABILITY CODES
Dist. SPECIAL
A

STUDY TO EVALUATE THE ADEQUACY AND PREDICTIVE VALUE OF FISH AND WILDLIFE PLANNING RECOMMENDATIONS AT CORPS OF ENGINEERS RESERVOIR PROJECTS

PHASE II
INDIVIDUAL RESERVOIR PROJECT EVALUATION REPORTS

THE EAST LYNN RESERVOIR PROJECT

Conducted for Office, Chief of Engineers, U.S. Army

By Sport Fishing Institute, Washington, D.C.

Under Contract No. DACW73-74-C-0040

PREFACE

This document was prepared by staff of the Sport Fishing Institute for the U.S. Army Corps of Engineers (CE) under contract number DACW73-74-C-0040. The contract requires the compilation and comparison of pre- and post-construction data treating fish, wildlife, or both fish and wildlife (depending upon data availability) for twenty separate CE water development projects. This report presents the findings for one of the twenty individual project evaluations.

Upon completion of the full series of twenty separate studies, a final report will be prepared which will contain an analysis of the validity of the predictive procedures used in fish and wildlife planning, and will contain recommendations for improving the planning process.

This evaluation of the adequacy and accuracy of fish and wildlife planning at the East Lynn Lake project in West Virginia was made possible only through the participation and active cooperation of many individuals. U.S. Army Corps of Engineers personnel Ed Goodno, Pat Kantley and Mike White, all in the Huntington District Office, and Ellis Smith, East Lynn Lake Project Manager, provided much helpful information. James McKevitt, U.S. Fish and Wildlife Service, Annapolis, Maryland, supplied copies of the pre-construction fish and wildlife-related planning reports. Several members of the West Virginia Department of Natural Resources supplied available descriptive information regarding current conditions for fish and wildlife communities and dependent recreational use at the East Lynn project. Among these individuals were Bert Pierce, Steve Muth, Grady Coda, Ray Knotts and

James Rawson. Chester McConnell, Southeast Field Representative, Wildlife Management Institute, participated in the field investigation and reviewed the manuscript.

CONTENTS

	PAGE
PREFACE	i
CONTENTS	iii
LIST OF TABLES	iv
LIST OF FIGURES	vii
PROJECT PERSONNEL	viii
INTRODUCTION	1
Location	1
Authorization	1
Physical Features	1
Area Description	5
Acquisition of Descriptive Data	7
WILDLIFE RESULTS AND DISCUSSION	8
Wildlife Resources -- Pre-impoundment Predictions	8
Wildlife Resources (Without Project)	10
Wildlife Resources (With Project)	11
Wildlife Resources -- Post-impoundment Occurrences	18
Wildlife Resources -- Evaluation of Planning Input	28
FISHERY RESULTS AND DISCUSSION	34
Fishery Resources -- Pre-impoundment Predictions	34
Fishery Resources (Without Project)	34
Fishery Resources (With Project)	35
Fishery Resources -- Post-impoundment Occurrences	47
Stocking	49
Fish Population Sampling	51
Creel Surveys	63
Fishery Resources -- Evaluation of Planning Input	76
SUMMARY	87
BIBLIOGRAPHY OF SOURCE REFERENCE MATERIAL	91

LIST OF TABLES

Table		Page
1	Summary of physical characteristics of East Lynn Reservoir	4
2	East Lynn Reservoir -- pertinent land acquisition - lake area relationships [total land acquisition of 9,928 ha (24,532 ac)]	6
3	Elevation (msl) and surface area of reservoirs prosed for development in the Twelvepole Creek Basin Flood Control project (extracted from the August 15, 1961, FWS report)	9
4	Estimates of average annual hunting pressure (man-days) predicted for East Lynn Reservoir project lands (with and without implementation of FWS recommendation for management by the WVDNR) as presented in the August 15, 1961, July 2, 1964, and October 9, 1964 FWS reports	17
5	Number of acres and percentage composition (by forest type and age of stand) of timbered areas present on East Lynn Reservoir project lands, 1972 (adopted from Appendix B, The Forest Management Plan for East Lynn Lake)	19
6	Subjective analysis of aspects of major game species abundance and utilization on East Lynn Reservoir project lands as developed by professional biologists, foresters and CE project personnel in 1972	21
7	Comparison of pre-impoundment (1971) and post-impoundment (1972-1977) CE estimates of hunter-use (hunting man-days) on East Lynn Reservoir project lands [9,921 ha (23,527 ac)]	23
8	Estimated number of post-impoundment hunting man-days expended at the East Lynn Reservoir project for squirrel, deer, rabbit and "other" game species (1975-76)	25
9	Comparison of project size, number of hunter man-days and number of hunter man-days/ac predicted by the October 9, 1964, FWS Final Report with post-impoundment occurrence estimates	32

LIST OF TABLES (CONTINUED)

Table		Page
10	Average annual fishing pressure (man-days) and monetary sport fishery values ($) predicted in the August 15, 1961 FWS report (with and without implementation of recommended reservoir fishery management regime) and the 1964 FWS reports (with and without implementation of recommended access provisions) at East Lynn Reservoir	48
11	Stocking records for East Lynn Reservoir, 1971-1974. Stocking density in brackets [no/ha (no/ac)], based on summer pool area of 406.7 ha (1,005 ac)	50
12	Total fish biomass and percentage composition comprised by "game fish," "panfish," and "other" categories collected by annual (1972-1977) cove rotenone sampling conducted at East Lynn Reservoir in late July or early August at Brushy Creek and Lakeside embayments	52
13	Biomass of fish collected by cove rotenone sampling at East Lynn Reservoir, 1972, 1975-1977. (Composite of 2, one acre, samples collected annually in late July or early August at Brushy Creek and Lakeside embayments, respectively)	54
14	East Lynn Reservoir number and percentage composition of black bass recovered per acre by cove rotenone sampling, 1972, 1975-1977	59
15	Composite length frequency distribution of bass collected by shoreline electrofishing at three selected areas from May through November, 1975-77. (Approximately 10.8 miles of shoreline sampled per year in 1975, 1976 and 10.2 miles in 1977)	61
16	Average number of young-of-year and older black bass sampled per mile of shoreline electrofishing at East Lynn Reservoir, 1975-1977	62
17	Number and percentage size class distribution of black bass collected per mile of shoreline by electrofishing at East Lynn Reservoir, 1975-1977	64

LIST OF TABLES (CONTINUED)

Table		Page
18	Summary of selected creel survey statistics collected by annual WVDNR creel surveys (April through October), 1973-1977. (Values expressed on a per acre basis in parentheses)	65
19	Comparison of CE and WVDNR estimates of angler usage at East Lynn Reservoir, 1973-1977	67
20	Calculated East Lynn Reservoir and tailwater man-day angler usage, 1973-1977	70
21	Number of fish caught/ha and percentage composition, by species, recorded in WVDNR creel surveys at East Lynn Reservoir, 1973-1977	72
22	Comparison of the relationship between black bass angling catch rates and standing crop estimates of harvestable size bass derived from electrofishing and cove rotenone samples obtained at East Lynn Reservoir, 1975-1977	74
23	Comparison of the predicted angler usage (man-days) at East Lynn Reservoir as contained in the August 15, 1961, FWS report (with and without implementation of recommended reservoir fishery management regimes) and the 1964 FWS reports (with and without implementation of recommended access provisions) with average post-impoundment occurrences from 1973-1977	79
24	Comparison of pre- and post-impoundment fish biomass and percentage game fish composition derived from electrofishing samples collected in East Fork of Twelvepole Creek. (Post-impoundment data from East Lynn Reservoir tailwater)	83
25	Comparison of average annual post-impoundment man-day use estimates for East Lynn Reservoir and tailwater (1973-1977) with average annual pre-impoundment man-day use estimated for comparable stream sections in the 1964 FWS report	86

LIST OF FIGURES

Figure		Page
1	Map of East Lynn Reservoir	2

SPORT FISHING INSTITUTE

PROJECT PERSONNEL

Robert Martin
(Project Leader)

Norville Prosser
(Assistant Project Leader)

Richard Stroud
(Contractor's Representative)

Mary Burroughs
(Project Secretary)

CONSULTANT'S REVIEW

Professional terrestrial wildlife consultative services were provided by the staff of the Wildlife Management Institute (WMI). Project personnel were accompanied by a WMI staff specialist during field reconnaissance and on on-site discussions. The terrestrial wildlife portion of the prepared evaluative manuscript was reviewed and evaluated by WMI. All pertinent suggestions offered by the consultant are reflected in this report.

INDIVIDUAL RESERVOIR PROJECT EVALUATION REPORTS

EAST LYNN RESERVOIR PROJECT

INTRODUCTION

Location

The project is located in Wayne County, West Virginia, approximately six air miles south-southeast of Wayne, West Virginia. It lies about 10 miles above the mouth of the East Fork of Twelvepole Creek and 42 miles above the mouth of Twelvepole Creek where it enters the Ohio River near Ceredo, West Virginia. The population of Wayne County is 37,581. Huntington, West Virginia (population 74,315) and Ashland, Kentucky (population 29,245) are the largest cities within a 25 mile radius of the project. Dewey Lake and Bluestone Reservoir, two CE impoundments, lie 70 miles to the southwest and 90 miles to the southeast, respectively.

Authorization

The East Lynn Reservoir project was authorized by the Flood Control Act of June 28, 1938, HR 10618, Public Law No. 761 (Seventy-fifth Congress, third session). The project provides for flood control, recreation, and fish and wildlife conservation.

Physical Features

At seasonal recreation pool elevation of 202 m (662 ft) mean sea level (msl), the project consists of a 408 ha (1,005 ac) lake buffered by some 9,521 ha (23,527 ac) of contiguous highlands, comprising an overall project acquisition of 9,928 ha (24,532 ac) in fee (Figure 1). In addition to the present fee acquisition, easements to 39 ha (96 ac) have been obtained; fee acquis-

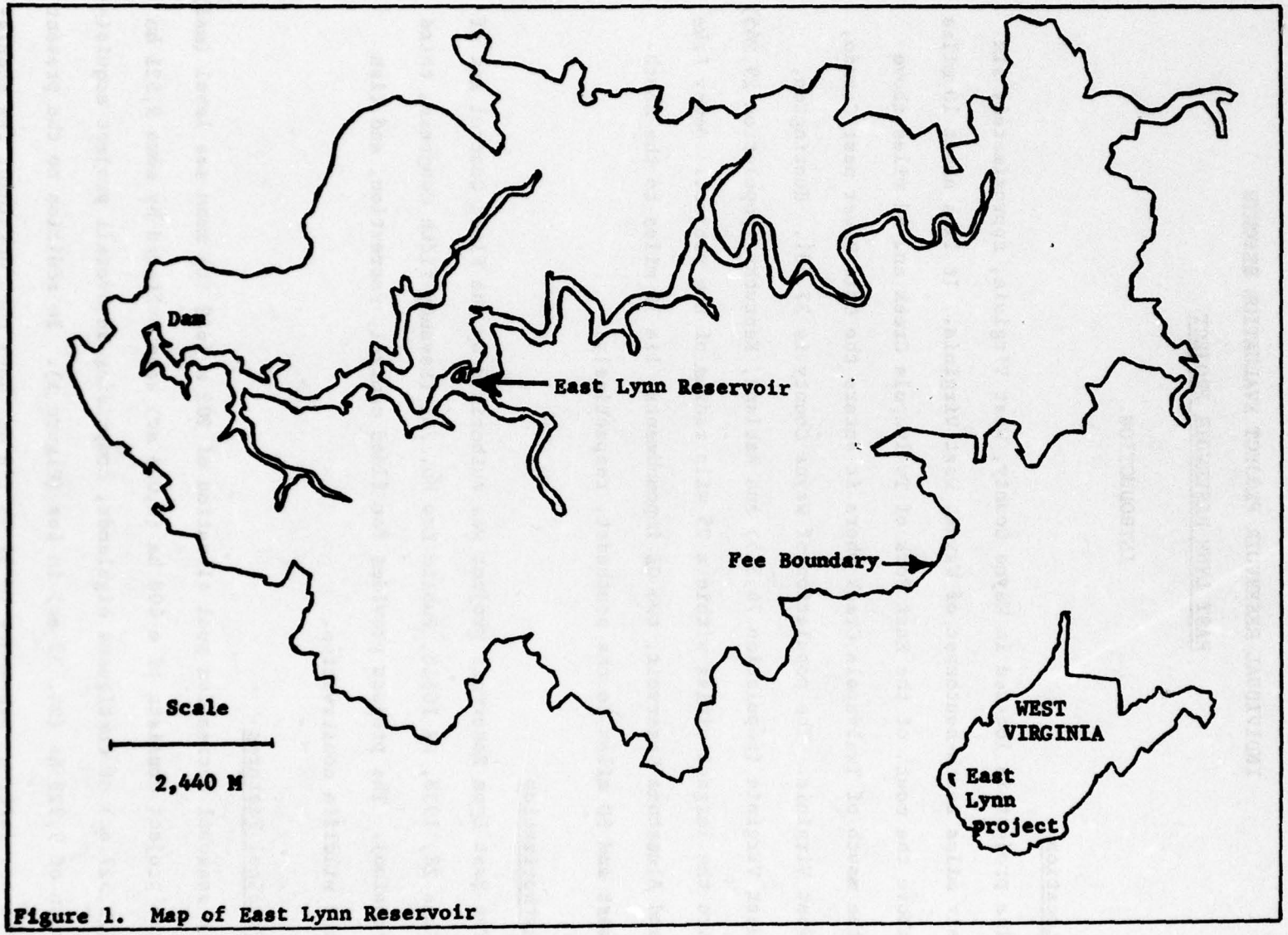


Figure 1. Map of East Lynn Reservoir

ition of an additional 122 ha (301 ac) is planned for later.

Steep-sided and sinuous in configuration, the lake has a shoreline length of about 74 km (48.5 mi). Maximum depth is 14.6 m (48 ft) at the seasonal recreation pool level, which is maintained from mid-April to mid or late November. Storage capacity at recreation pool elevation amounts to 2.12 x $10^7 m^3$ (17,190 ac ft) with a mean depth of 5.2 m (17 ft). Lake level fluctuation during the recreational season is minor, depending on needs for storage of flood waters and/or for drawdown to maintain the authorized downstream minimum release of 10 cfs.

The lake is drawn down about 1.8 m (6 ft) to winter pool elevation 220 m (656 ft) msl by mid or late November to provide essential flood storage capacity during the winter and early spring. At the top of the flood pool, 124 m (701 ft) msl, the lake has a maximum storage capacity of 10.16 x 10^7 m^3 (82,500 ac ft). Other pertinent physical lake features are presented in Table 1. The intake structure, located in the right-side abutment, is a concrete lined, circular tunnel 4 m (13 ft) in diameter by 190.5 m (625 ft) in length. Flow is regulated by three 173 x 350 cm (68-120 in) hydraulically operated slide gates. The low flow system consists of two 1.2 x 0.9 m (4 x 3 ft) inlets, one each at invert elevations 200 m (658 ft) located 1.2 m (4 ft) and 4 m (13 ft), respectively, below the surface at the seasonal pool level. Discharge is controlled by an hydraulically operated 76 cm (30 in) gate valve. Capacity of each low flow inlet, at the seasonal pool level, is 132 to 154 cfs. The stilling basin is concrete lined, of jump type design, 1.2 m (4 ft) deep, 15.5 m (51 ft) long, and 9.8 m (32 ft) wide.

Table 1. -- Summary of physical characteristics of East Lynn Reservoir

	Winter pool	Seasonal pool	Flood pool
Elevation (msl)			
m	200	202	214
ft	656	662	701
Area			
ha	333	407	951
ac	823	1,005	2,351
Storage vol.			
m^3	$1.44 \times 10^7 m^3$	$2.12 \times 10^7 m^3$	$10.16 \times 10^7 m^3$
ac. ft.	11,705	17,190	82,500
Max. depth			
m	12.8	14.6	25.5
ft	42	48	87
Mean depth			
m		5.2	
ft		17	
Shoreline length			
km		73.7	
mi		45.8	
Drainage area			
km^2		334	
mi^2		133	
Min. flow release			
m^3/sec		.28	
cfs		10	

The CE operates and maintains 387 ha (956 ac) for public recreation, 8,670 ha (21,424 ac) for fish and wildlife conservation (with the advice and assistance of the West Virginia Department of Natural Resources), and the remaining 871 ha (2,152 ac) for project operation purposes. Pertinent land acquisition-lake area relationships are depicted in Table 2.

Area Description

The 334 km^2 (133 mi^2) sparsely populated watershed lies within the Appalachean Plateau's physiographic province, Kanawha section, and varies in elevation from 244-550 m (800-1,800 ft) msl. The valley slopes are steep and vegetated by secondary growth deciduous forest (primarily oak-hickory). Gas production within the project area is a major component of the local economy. Farming is confined to the narrow bottoms along streams. Although commercial coal mining has not been conducted within the lake drainage area, numerous openings have been made to obtain coal for local home use.

Annual precipitation averages 110 cm (43.5 in). Basin runoff is highest during the winter months. Historic stream flow measurements obtained prior to impoundment indicated a normal annual average flow of 152 cfs and an annual minimum average flow of 59.4 cfs. The maximum monthly average stream flow was 677 cfs and the minimum monthly average flow recorded was 0.286 cfs (1).

As indicated in the Fish and Wildlife Service reports of 1961 and 1964, the water quality of the East Fork of Twelvepole Creek appeared adequate to support typical coolwater stream communities of fish and associated aquatic or-

Table 2. -- East Lynn Reservoir -- pertinent land acquisition - lake area relationships [total land acquisition of 9,928 ha (24,532 ac)]

Pool	Impoundment Area		Land remaining Area		%
	Ha	Ac	Ha	Ac	
Winter	333	823	9,595	23,709	96.7
Seasonal	407	1,005	9,521	23,527	95.9
5 yr. flood	599	1,480	9,329	23,052	94.0
Max. flood	951	2,351	9,015	22,181	90.4

ganisms. However, high concentrations of iron and manganese were noted during subsequent pre-impoundment stream sampling investigations conducted between 1965 and 1972 (2). Other water quality parameters fell within normal ranges. Values for Ph averaged in the neighborhood of 7.0; total alkalinity, 23 mg/l; and specific conductance, 68 micromhos/cm. Oxygen values approximated saturation levels during all sampling periods.

Acquisition of Descriptive Data

The pre-construction planning reports that were prepared by the U.S. Fish and Wildlife Service (FWS) were located in the files of the Ecological Service's Area Office in Annapolis, Maryland. Substantiating support data relating to the FWS reports were sought at both the Washington, D.C., offices of the FWS and at the National Archives, also in Washington, D.C. Unfortunately, these informal basic data could not be located. U.S. Army Corps of Engineers (CE) files on the East Lynn Lake project were reviewed at the CE District Office in Huntington, West Virginia. Project personnel also met with fisheries and wildlife personnel of the West Virginia Department of Natural Resources, both in Huntington and during a tour of the project. The Corps' East Lynn project personnel also participated in the familiarization tour of the East Lynn project.

WILDLIFE RESULTS AND DISCUSSION

Wildlife Resources -- Pre-impoundment Predictions

The first discovered substantive reference to wildlife aspects of the East Lynn project was a letter report dated August 15, 1961, prepared and sent by the FWS to the CE Huntington District Engineer (3). This report addressed the collective wildlife resources of the entire Twelvepole Creek Basin which were expected to be affected by the proposed comprehensive flood control project, including Beech Fork and Cabwaylingo reservoirs as well as the East Lynn project. Pertinent physical parameters of the three reservoirs, supplied by the CE, were contained in the August 15, 1961, report of the FWS (Table 3).

The fact that the data contained in the report were presented as a composite of all three proposed reservoir sites made it impossible to segregate specific attributes applicable solely to the East Lynn project. As a case in point, project land acquisition plans were described in the FWS report as follows:

> It is expected that all lands required for construction purposes and all lands within the approximate 5-year frequency flood pool will be acquired in fee simple title and that flowage easements will be obtained for lands lying between the 5-year flood frequency elevation and the top of the maximum flood control pool. Severance lands above the 5-year-frequency pool will be acquired in fee simple title in instances where hardship to affected landowners might otherwise result. Approximately 9,500 acres of land will be acquired in fee simple title in the three reservoir sites.

Unfortunately, it was not possible to determine the proportion of the total 3,845 ha (9,500 ac) project area proposed for purchase that should be allocated to the East Lynn project alone. As a consequence, it was not pos-

Table 3 . -- Elevation (msl) and surface area of reservoirs proposed for development in the Twelvepole Creek Basin Flood Control project (extracted from the August 15, 1961, FWS report)

	Conservation pool*				Maximum flood pool			
	Elevation		Area		Elevation		Area	
	m	ft	ha	ac	m	ft	ha	ac
East Lynn	202	663	567	1,400	210	690	1,052	2,600
Beech Fork	177	581	210	520	187	613	700	1,730
Cabwaylingo	229	752	65	160	243	789	267	660
Total	--	--	842	2,080	--	--	2,019	4,990

* Data for East Lynn Reservoir refer to "summer" pool level. Beech Fork and Cabwaylingo Reservoirs refer to "winter" pool levels

sible to clearly establish wildlife resource values specifically for the East Lynn project. However, it may be assumed with reasonable confidence that the general parameters outlined in the report applied equally to all three reservoirs. Composite pre-impoundment (without-project) wildlife resources values for the three reservoirs were described in the 1961 FWS report as follows:

Wildlife Resources (Without Project)

The Twelvepole Creek watershed is largely hilly and forested. With the exception of the timbered bottom lands, a significantly high percentage of the lands in the Beech Fork and East Lynn project areas may be broadly classified as agricultural lands. The small flat areas bordering the streams are cultivated for corn and garden crops, while the open grasslands along the hillsides are used as pasture. The Cabwaylingo site, located partially in Cabwaylingo State Forest, is predominantly wooded.

Resident game species of importance in the Twelvepole watershed are gray squirrels, cottontails, ruffed grouse, bobwhites, and white-tailed deer. Fur-animal species include muskrat, mink, red fox, gray fox, skunk, opossum, and raccoon. Very little trapping activity occurs in the vicinity of the reservoir sites.

Gray squirrels are the most numerous and are heavily hunted in the project area. The average annual utilization of the squirrel resource amounts to about 1 hunter day per 8 acres, or 1200 hunter-days. Appraised at $1.50 per hunter-day, the recreational value of this sport amounts to $1800 per year. Cottontails, ruffed grouse, and bobwhites are hunted to a lesser degree, but the combined hunting pressure upon these three species is comparable to that sustained by the gray squirrel or 1200 hunter days. The same recreational value is assigned to this activity. The total value of upland game hunting sport, therefore, amounts to $3600 per annum.

Whitetailed deer are occasionally seen on or near the reservoir sites, but no deer hunting is permitted in the counties in which the reservoirs would be located. Whitetails are trapped in other sections of the State where populations are high and are released in the Wayne County area. The Department of Natural Resources has been concentrating some effort in the Wayne area so as to establish a deer herd in that section. During the Spring of 1960, the State introduced wild turkeys in the vicinity of the West Fork Reservoir site to provide a resident breeding stock. Recent observations made by the State personnel indicated that

the introduction of this game species has been reasonably successful.

Under present conditions, squirrel, cottontail, grouse, and bobwhite hunting opportunities may be expected to remain the same or slightly increase in coming years. With passage of time, it is expected that deer and turkeys will become established and, in turn, will provide additional hunting opportunities to satisfy the needs of a segment of the local hunter population.

Analysis of the data provided in the foregoing indicates an expected overall pre-impoundment upland game hunting pressure on project lands of approximately 0.25 hunter-days per acre (2,400 hunter-days ÷ 9,500 ac).

As with the description of pre-impoundment wildlife resources, the post-impoundment predictions contained in the FWS report of 1961 were general in nature and described the composite impact on all three proposed reservoirs. Post-impoundment (with-project) wildlife impacts were described, in part, af follows:

Wildlife Resources (With Project)

The construction and operation of three reservoirs in the Twelvepole Creek Basin project will result in losses of bottom-land wildlife habitat amounting to approximately 2,080 acres. Although the lands that would be flooded are not considered high quality habitat, they provide sufficient cover to sustain the native upland game species.

Possible benefits to wildlife may occur through the creation of resting and limited feeding and nesting environment for waterfowl. At the present time migrant waterfowl which normally fly within the vicinity of two of the project areas now rest at the Dickson Dam Reservoir, approximately one mile west of the Beech Fork Reservoir site. Whether the reservoirs will attract significantly more resident and migrating waterfowl is questionable. Since the purchase of those project and severance lands above conservation pool level would result in no major change in land-use practices, the hunter utilization would be essentially unchanged on that portion of the Reservoir. It is estimated that the wildlife habitats that will be inundated by the permanent pools will account for a loss of 260 hunter-days annually.

Apparently the authors of the report did not consider the bottomland that was to be permanently flooded to be as valuable for wildlife as the contiguous highlands scheduled for acquisition. The data reflecting bottomland loss suggest that the permanently flooded bottomlands would support only 0.125 hunter-days per acre (260 hunter-days ÷ 2,080 ac), as contrasted with 0.25 hunter-days per acre programmed for the entire area.

On the assumption that recommended management measures would be implemented, the report also presented optimistic predictions of increased wildlife production and related hunting use following reservoir construction, viz:

> As a result of the construction of the three reservoirs, the reduction in numbers of resident humans in the project area will favor wildlife productivity. Increased hunter utilization should result.
>
> The lands planned for acquisition which border on the reservoir will mitigate wildlife losses on lands to be inundated. However, before significant wildlife benefits can be realized it will be necessary to make available to the West Virginia Dept. of Natural Resources for wildlife management purposes all Federally-owned project lands under the provision of a General Plan. Under conditions of good game management, it is expected that the hunter-day use of these project areas would approximately double. Based on this assumption, annual utilization of squirrels, cottontails, ruffed grouse, and bobwhites would increase to about one-hunter day of use per four acres per year, producing an annual recreational value of approximately $5,600. If wild turkeys and deer are stocked and become established on suitable portions of the large blocks of severance lands, it is anticipated that additional hunting opportunities would be provided. It can be expected that deer-hunter use would amount to about one hunter-day per 25 acres per year, while the hunting effort for wild turkey would be comparable to that sustained by the squirrel, cottontail, grouse, and bobwhite.
>
> Appraised at $3.00 per hunter-day for deer hunting and $15.0 per hunter-day for turkey hunting the combined recreational value of these two activities amounts to $3,700 per year. The total value of upland game and big game sport, therefore, would amount to $9,300 annum under proper management.

The only formal recommendation concerning wildlife resources contained in the 1961 FWS report was as follows:

> That all project lands which are acquired in fee simple title, together with included water areas, be made available to the West Virginia Department of Natural Resources, in accordance with a General Plan for Fish and Wildlife management for each reservoir site, as provided in Section 3 of the Fish and Wildlife Coordination Act, 48 Stat. 401 as amended, 16 U.S.C. 661 et seq., except for such portions as may be reserved by the construction agency for reasons of safety, efficient operation, or protection of public property.

In summary, the authors of the FWS report of August 15, 1961, predicted, subject to the provision that all project lands be made available to the West Virginia Department of Wildlife Resources for purposes of intensive management, that the lands planned for acquisition which bordered the reservoir would effectively mitigate wildlife losses expected to be caused by inundation of bottomlands. In fact, they predicted that hunting use (hunter-days) would double for upland game species on the remaining peripheral reservoir lands. The possible need for additional lands to mitigate or enhance wildlife losses was not addressed in any of the three FWS reports.

Land acquisition policies of the CE during subsequent project planning stages were governed by the "Joint Policies of the Departments of the Interior and the Army Relative to Reservoir Project Lands" as published in the Federal Register, dated 22 February 1962, Volume 27, page 1734.

Pertinent extracts from this document follow (4):

> Fee title will be acquired for the following:
>
> (a) Lands necessary for the dam and all permanent structures.

(b) Lands below the maximum flood storage pool plus a strip of land of a minimum width of 300 feet horizontally from this pool line.

(c) Lands necessary to provide for public access to the reservoir, including such lands as are needed to meet present and future requirements for fish and wildlife as determined necessary pursuant to the Fish and Wildlife Coordination Act, and such lands as are necessary to meet present and future requirements for outdoor recreation, as may be authorized by Congress.

While the above policy contemplates that the United States own in fee, land around the reservoir in insure ready access to the shore, easements in lieu of fee title may be acquired under certain special conditions and circumstances, in lands located in remote reaches of the reservoir....

In accordance with the intent of the law, actual, practical, and realistic negotiations will be conducted with each landowner to the same extent practiced normally between willing buyers and willing sellers in an effort to arrive at a satisfactory settlement....

(i) Isolated Properties. Properties isolated due to loss of access will be purchased in lieu of replacing access when such acquisition is in the best interests of the Government.

On July 2, 1964, almost three years after release of their initial report of August 15, 1961, the FWS submitted a draft letter report to the CE which dealt exclusively with the East Lynn Reservoir project (5). At this juncture, the FWS report was expressed in the context that 2,347 ha (5,800 ac) in fee simple title would be acquired for the project.

Wildlife resources were described briefly as follows:

> Without the project big game (deer) is valued at 200 hunter days while the total value for small game (ruffed grouse, gray squirrel, cottontail rabbit, bobwhite quail, raccoon) has been estimated at 7,000 hunter days.

As had been stipulated in the initial FWS report (1961), the FWS draft letter report dated July 2, 1964, reiterated that wildlife resource losses due

to impoundment could be adequately mitigated if all remaining lands scheduled for purchase in fee simple title were made available to the WVDNR for wildlife management purposes, viz:

> With the project the East Lynn Reservoir will inundate about 1,480 acres of small game habitat that provided an estimated 3,000 hunter days annually. Inundation of this habitat will result in an initial loss of 3,000 hunter days unless lands above the flood pool are turned over to the West Virginia Department of Natural Resources for management purposes. By turning these lands over to the West Virginia Department of Natural Resources, this loss could be recaptured and a slight benefit provided in the small game category. This benefit, added to the fact that more waterfowl would now use the area, would result in a total incidental wildlife benefit of approximately 2,000 hunter days as a result of the project.
>
> To mitigate the loss of 3,000 man days of hunting opportunities resulting from inundation of the prime game habitat of the bottom lands, all lands acquired in fee simple title, over and above that needed for project operations, should be made available to the West Virginia Department of Natural Resources for fish and wildlife management purposes in accordance with a General Plan for Fish and Wildlife Management, as provided in the Fish and Wildlife Coordination Act, except for sections reserved for safety, intensive recreation, efficient operation, or protection of public property.

The cover letter conveying the FWS draft letter report of July 2, 1964, requested CE comments prior to July 10, 1964. The CE response, dated July 9, 1964, indicated general approval of the FWS recommendations contained in the draft report. At the same time, the CE provided the FWS a copy of the revised plans for development which detailed an expanded land acquisition program for the East Lynn reservoir project (6).

Subsequently, on October 9, 1964, the FWS submitted to the CE a revised final letter report concerning the East Lynn Reservoir project (7). This letter report was included in Appendix I to CE Design Memorandum No. 44, Preliminary Master Plan for East Lynn Reservoir, Twelvepole Creek, West Vir-

ginia, dated May 11, 1965 (8). Reflecting the expanded land acquisition program as previously indicated by the CE, the final FWS letter report of October 9, 1964, noted that the East Lynn Reservoir project would involve the fee purchase of approximately 11,332 ha (28,000 ac) of land occupying the stream bed to the ridge lines. Such acquisition represented a dramatic increase over the 2,347 ha (5,800 ac) purchase boundary estimated in the previous draft report.

Without-project wildlife resources were described in the October 9, 1964, FWS letter report as follows:

> Wildlife resources within the area of project influence consists of white-tailed deer and small game species such as ruffed grouse, gray squirrel, cottontail rabbit, bobwhite quail, and raccoon. Hunting pressure is moderate. It is estimated that wildlife population of the area will provide average annual hunter use of 1,500 man days for deer and 13,500 man days for small game throughout the period of analysis.

FWS predictions of the project's impact on wildlife resources and recommendations for mitigation were similar to those expressed in both their 1961 and 1964 draft reports, viz:

> With the project the East Lynn Reservoir will inundate about 1,005 acres of small game habitat. An additional 475 acres within the five year flood frequency pool will be reduced in value. This will result in an initial loss of 2,400 hunter days. However, since project plans provide for management of project lands above the flood pool by the West Virginia Department of Natural Resources, this loss will be compensated and a slight benefit provided in the small game category. This benefit, added to anticipated gains in waterfowl use of the reservoir, will result in total incidental wildlife benefits estimated at 5,000 hunter days resulting from the project.

Pre- and post-construction estimates and predictions of hunting use, as described in the three FWS reports, are summarized in Table 4.

Table 4 . -- Estimates of average annual hunting pressure (man-days) predicted for East Lynn Reservoir project lands (with and without implementation of FWS recommendation for management by the WVDNR) as presented in the August 15, 1961, July 2, 1964 and October 9, 1964 FWS reports

	August 15, 1961 report* No.	July 2, 1964 draft report No.	October 9, 1964 final report No.
Without-the-project			
Project area			
Ha	3,845	2,347	11,322
Ac	9,500	5,800	28,000
No. hunter-days	2,400	7,200	15,000
No. hunter-days/ac	0.25	1.24	0.54
With-the-project			
Project area (land)			
Ha	3,003	1,748	10,925
Ac	7,420	4,320	26,995
No. hunter-days			
w/o mgt. by WVDNR	1,855	4,200	12,600
w/ mgt. by WVDNR	3,710	9,200	20,000
No. hunter-days/ac			
w/o mgt. by WVDNR	0.25	1.0	0.47
w/ mgt. by WVDNR	0.50	2.1	0.74
Net, with proj. develop.			
Project area**			
Ha	- 842	- 599	- 407
Ac	- 2,080	- 1,480	- 1,005
No. hunter-days			
w/o mgt. by WVDNR	- 545	- 3,000	- 2,400
w/ mgt. by WVDNR	+ 1,310	+ 2,000	+ 5,000

* The August 15, 1961 report data reflects the total Twelvepole Creek flood control project (includes development of two other reservoir sites in addition to the East Lynn project)

**Equivalent to area projected for impoundment at summer pool elevation

Wildlife Resources -- Post-impoundment Occurrences

As finally evolved, the terrestrial wildlife resource base for the East Lynn project amounted to some 9,921 ha (23,527 ac) of land completely surrounding (from ridge top to ridge top) a 407 ha (1,005 ac) reservoir at summer pool elevation 202 m (662 ft) msl.

Approximately 8,853 ha (21,876 ac) above flood pool elevation 214 m (701 ft) msl are primarily forested with numerous small clearings along stream banks and ridge tops. The remaining 668 ha (1,651 ac) below flood pool elevation are open and represent abandoned pasture and crop land (9). The open lands invariably supported woody plant invasion species, such as sumac, hawthorn, sourwood, blackgum, and pine, as well as blackberry, green briar, and many seed-producing grasses and weeds that are intensively utilized by wildlife.

Oak-hickory forests (red oak 28 percent, white oak 24 percent) make up 52 percent of the total forest ecosystem. Mixed mesophytic or "cove hardwoods" associations (yellow popular, scarlet oak, basswood, maple, black walnut, etc.) comprise the remaining 48 percent (Table 5).

The forested areas represent several successional stages reflecting a previous history of heavy timber exploitation and overgrazing. Many miles of service roads are maintained by utilities to provide access to operating gas wells.

Stands of young trees [in which individual trees have a diameter less than 153 mm (6 in) measured 1.4 m (4.5 ft) above ground level comprise more than 50 percent of the area] constituted 41 percent of total forested area, in-

Table 5 . -- Number of acres and percentage composition (by forest type and age of stand) of timbered areas present on East Lynn Reservoir project lands, 1972 (adopted from Appendix B, The Forest Management Plan for East Lynn Lake)

Forest classification* Forest type	Size class*							
	Young		Intermediate		Old growth		Total	
	Ac	%	Ac	%	Ac	%	Ac	%
Oak Hickory (Red oak)	97	1	5,942	55	97	5	6,136	28
Oak Hickory (White oak)	4,414	48	171	1	635	32	5,220	34
Subtotal	4,511	49	6,113	56	732	37	11,356	52
Mesic (Cove hardwoods)	4,504	50	4,750	44	1,266	63	10,520	48
Total	9,015	100	10,863	100	1,998	100	21,876	100
Percent by size classification	41		50		9		100	

* The oak-hickory-white oak group consists of stands in which species of oaks and hickories predominate, and in which oaks of the white oak group are most prevalent. The oak-hickory-red oak group consists of stands in which species of oaks and hickories predominate, and in which oaks of the red oak group are most prevalent. The mesic hardwoods consist of stands in which mixed mesophytic or "cove hardwood" species predominate. Young growth hardwoods are stands in which hardwood vegetation 6" DBH or less (diameter at 4½ feet above the ground) comprise more than 50% of the main stand. Intermediate growth hardwoods are stands in which hardwood vegetation 6" to 12" DBH comprise more than 50% of the main stand. Old growth hardwoods are stands in which hardwoods greater than 12" DBH comprise more than 50% of the main canopy

termediate size trees [153 to 304 mm diameter (6 to 12 in)] 50 percent, and old growth stands [greater than 304 mm (12 in) diameter] the remaining 9 percent (10).

The multiple successional habitat stages represented on the property support diverse populations of game, furbearer, and non-game species of wildlife. A total of 149 species of birds, 36 species of mammals, 27 species of amphibians, and 25 species of reptiles have been identified within project boundaries. Although no empirical quantitative wildlife population data have been collected, subjective evaluations were made by professional biologists in 1972 (first year of impoundment). Their concensus judgement was that the population levels of most major game species, excepting a "high" population level designation for groundhog and fox, ranged from "low" to "moderate" (Table 6). Mourning dove and waterfowl populations were considered "low"; ruffed grouse, bobwhite quail, and raccoon populations were judged "low-moderate"; and eastern cottontail, gray squirrel, and whitetail deer populations were judged "moderate." An average of 15 to 20 broods of wood ducks are produced annually on the project.

Potential levels of population abundance were described as "moderate" for the eastern cottontail and waterfowl; "moderate-high" for mourning dove and raccoon; "high-moderate" for ruffed grouse; and "high" for all other species.

Levels of hunting use in 1972 were described as "low-moderate" for waterfowl; "moderate" for mourning dove, bobwhite quail, and groundhog; "moderate-high" for raccoon; "medium-low" for ruffed grouse; and "high" for all

Table 6 . -- Subjective analysis of aspects of major game species abundance and utilization on East Lynn Reservoir project lands as developed by professional biologists, foresters and CE project personnel in 1972

Species	Present population	Potential population	Present use	Potential use
Ruffed grouse	Low-moderate	High-moderate	Medium-low	High
Eastern cottontail	Moderate	Moderate	High	High
Mourning dove	Low	Moderate-high	Moderate	High
Eastern gray squirrel	Moderate	High-moderate	High	High
Raccoon	Low-moderate	Moderate-high	Moderate-high	High
White-tailed deer	Moderate	High	High	High
Groundhog	High	High	Moderate	High
Waterfowl	Low	Moderate	Low-moderate	High
Fox	High	High	High	High
Bobwhite quail	Low-moderate	High	Moderate	High

other species. The potential use of all game and furbearers was described as "high."

Hunting use (man-days) estimates on project lands have been collected annually by the CE since 1971. These estimates were derived by extrapolation from visitor-use interviews and vehicle traffic counter data collected from lands located on the east side of the project. Hunter estimates were calculated by multiplying the number of vehicles on project lands times 2.7 (hunters per vehicle). Additional subjective estimates were derived from frequent visual counts of hunters made by CE personnel during routine inspection trips to the 4,452 ha (11,000 ac) tract on the west side of the reservoir which was not serviced by road counters. Approximately 70 percent of the total hunting effort occurred on the west side tract. A summary of the annual estimates of hunting effort computed by the CE is presented in Table 7.

Pre-impoundment hunting use in 1971 (immediately prior to impoundment in the spring of 1972) was estimated at 3,250 man-days (0.14 man-days/acre). Hunting-use estimates more than doubled the following year (7,250 man-days). By 1977, estimated hunting use on the project area had increased by about 820 percent above 1971 levels, and amounted to an estimated 29,900 man-days (1.3 man-days/ac). Overall, the post-impoundment (1972-1977) hunting use estimates averaged 20,523 man-days (0.87 man-days/ac), which amounted to an increase of some 531 percent over the 1971 pre-impoundment estimate.

These annual CE estimates of hunting use did not provide a breakdown of hunting effort by individual game species. However, based on the opinions of local CE field personnel, the bulk of the hunting effort was

Table 7 . -- Comparison of pre-impoundment (1971) and post-impoundment (1972-1977) CE estimates of hunter-use (hunting man-days) on East Lynn Reservoir project lands [9,921 ha (23,527 ac)]

Year	Man-days		Percent increase	
	Total no.	No/ac	Annual	Cumulative
Pre-impoundment*				
1971	3,250	0.14	--	--
Post-impoundment**				
1972	7,250	0.31	123	--
1973	13,400	0.57	85	312
1974	21,100	0.90	57	549
1975	22,800	0.97	8	602
1976	28,700	1.2	26	783
1977	29,900	1.3	4	820
Avg. 1972-77***	20,523	0.87	--	--

* Pre-impoundment (the reservoir was not impounded until the spring of 1972)

** It should be emphasized that these man-day use estimates represent "best estimates" and/or opinions rendered by professionals closely associated with the project rather than empirical data collected according to a statistically designed study

*** Post-impoundment years

assigned to squirrel hunting, 70 percent. Deer hunting accounted for 15 percent, and rabbit hunting 5 percent. The remaining 10 percent of the total annual hunting effort was divided between upland game species (bobwhite quail, ruffed grouse, mourning dove) and furbearers (raccoon and fox). Waterfowl hunting effort was described as negligible, with no more than an average of 25 ducks and two or three Canada geese bagged annually.

The WVDNR conducted a statewide hunter survey in 1975-76 which provided estimates of hunting effort (man-days) expended for individual game species in Wayne County where the East Lynn Reservoir project is located. Estimates of hunting effort (for squirrels, deer, and rabbits) derived from the WVDNR survey were considered to be reasonably valid. However, estimates for other species were not included because of prohibitively wide confidence intervals attributed to small sample size.

In addition to the county hunting-effort survey data, local WVDNR conservation officers supplied estimates of the percentage of the total countywide hunting effort that occurred within East Lynn project boundaries. By applying the percentages estimated by the conservation officers to the countywide estimates of hunting effort derived from the WVDNR survey, it was possible to arrive at an estimate of the number of man-days spent hunting on East Lynn Reservoir project lands (Table 8).

These data provide an estimate of total hunting effort amounting to 19,689 man-days on project lands. Included are 11,757 man-days of hunting for squirrels, 3,475 man-days for deer, 2,488 man-days for rabbits, and 1,968 man-days for other endemic game species. The close agreement of this in-

Table 8. -- Estimated number of post-impoundment hunting man-days expended at the East Lynn Reservoir project for squirrel, deer, rabbit and "other" game species (1975-76)*

Species	WVDNR survey estimates for Wayne County	CE project contribution to Wayne County totals	
	Number man-days	Percent	Calculated no. man-days
Squirrel	42,753	27.5	11,757
Deer	13,901	25.0	3,475
Rabbit	16,587	15.0	2,488
Other species	**	--	1,968***
Calculated total			19,689

* Data extrapolated from results of a hunter use survey of Wayne County conducted in 1975-76 by the WVDNR and estimates of percentage composition of the total county hunting effort (by species) on project lands as supplied by the CE and WVDNR personnel familiar with the project area

** Estimates for other species not included because of prohibitively wide confidence intervals attributed to small sample size (other species included bobwhite quail, dove, ruffed grouse, waterfowl, raccoon, vox, groundhog and woodcock)

*** CE personnel estimate that hunting effort for species other than squirrel, deer and rabbit constituted 10 percent of total hunting effort on project

dependently derived estimate of total annual hunting effort (19,689 man-days) with the CE estimate of 20,523 man-days (post-impoundment average) is noteworthy.

All three FWS reports (August 15, 1961; July 2, 1964; October 9, 1964) strongly recommended that all project lands, over and above those needed for project operation, be made available to the WVDNR for fish and wildlife management. The CE fully accepted these recommendations.

In a letter dated July 9, 1964, addressed to the Regional Director of the FWS, the Chief of the Ohio River Division, CE, indicated full acceptance of the recommendation to assign to the WVDNR the responsibility for fish and wildlife management (6), viz:

> All project lands, except for such areas reserved for general recreation, for reasons of safetyand for operation purposes, will be made available to the West Virginia Department of Natural Resources in accordance with a General Plan for Fish and Wildlife Management.

This recommendation was incorporated in all subsequent project documents dealing with the East Lynn Reservoir project.

The WVDNR expressed an early interest in assuming responsibility for managing both the fish and wildlife resources on the East Lynn Reservoir project, subject to the availability of adequate fiscal resources. The Governor of the state of West Virginia, in replying to an inquiry from the CE, indicated that the WVDNR would cooperate fully (11), viz:

> Participation by the State of West Virginia will be necessarily limited by the amount of funds made available for this purpose by the Legislature. However, within these limits you can be assured that the State Department of Natural Resources is fully prepared to render all possible aid in implementing these plans.

> Barring additional appropriations, such assistance will most probably consist of law enforcement, and fisheries and game management.

Apparently, the WVDNR was unable to marshall the necessary funds for assumption of full responsibility for game management, although fisheries management and law enforcement functions were carried out. Interviews with WVDNR personnel and a review of correspondence between the WVDNR and the CE in subsequent years indicated a mutual interest in negotiating a license agreement which would provide for wildlife management on project lands by the WVDNR (12,13). However, by 1975 (some four years following impoundment), the WVDNR was still unable to assume game management responsibilities. This circumstance was clearly stated in a letter dated July 9, 1975, from the director of the WVDNR to the CE district engineer (14), viz:

> It has been brought to my attention that the Huntington District is interested in this Department's plans in regard to a possible License Agreement covering fish and wildlife management on East Lynn and Beech Fork Lakes. At the time these lakes were proposed, an interest was shown in fish and wildlife management based upon available funds.
>
> After discussing this with the division of wildlife, I find that current inflation and other new state management areas have resulted in insufficient funds to assume land management responsibilities on these two areas. The fisheries resources will be managed and applicable state laws will be enforced. Perhaps at some later date, if additional funds become availabe, further consideration will be given to a fish and wildlife license on these areas.

The CE is making a minor effort for the management of project wildlife resources, absent a capability by the WVDNR to do so substantially as yet. The WVDNR contribution has been restricted to providing consultative advice for scientific wildlife management planning and for providing wildlife law enforcement on project lands.

Due primarily to fiscal constraints, the CE wildlife management program has been minimal to date. The excellent potential for wildlife management on project lands is not being realized. On-site improvements include the planting of approximately 100 acres of wildlife food plots in widely scattered areas and appropriate thinning of timber stands to promote increased wildlife food production. Several of the many abandoned apple orchards which remain have been pruned and otherwide managed to improve their productivity. The CE, in consultation with the WVDNR, has also developed extensive wildlife management plans for possible future implementation by the WVDNR. Meanwhile, the numerous small fields scattered over project lands are reverting to forest. This natural succession of vegetation is eliminating much of the diversity of the habitat and will be detrimental to open land wildlife species. As time progresses, these fields will become more expensive to reclaim and manage.

Wildlife Resources -- Evaluation of Planning Input

The FWS prepared separate reports pertinent to the East Lynn Reservoir project describing pre-project conditions and predictions of post-impoundment impacts on wildlife resources. These reports responded to three respective CE proposals involving widely divergent parameters of impoundment size and land acquisition planning.

For example, a total of only 3,845 ha (9,500 ac) was originally proposed for fee acquisition at all of the three reservoir projects included in the preliminary FWS report dated August 15, 1961. Three years later, in its draft letter report of July 2, 1964, the FWS indicated that 2,347 ha (5,800 ac) were scheduled for purchase at the East Lynn Reservoir project, alone.

Only three months later, apparently in response to information supplied by the CE in their comments of July 9, 1964, addressing the FWS draft report, the FWS letter report dated October 9, 1964, fixed the proposed East Lynn Reservoir project fee purchase at 11,332 ha (28,000 ac) -- almost five times larger than previously described.

In addition, the size of the proposed impoundment cited in the final FWS report (1964), 407 ha (1,005 ac), was considerably smaller than the 599 ha (1,480 ac) impoundment considered in the earlier draft report.

The fact that the FWS apparently was unaware of such profound changes in the proposed project boundaries and impoundment size indicated a deplorable lack of sustained coordination between the CE and FWS.

Also, the three FWS reports reflected an ambivalent assessment of extant wildlife resource values supported by project bottomlands. The FWS report of 1961 stated that the bottomlands to be flooded were "not considered high quality habitat," while their draft report of 1964 characterized the project bottomlands as "prime game habitat." The 1961 report (involving 3 lake sites) estimated that bottomlands to be flooded, 842 ha (2,080 ac), would account for the loss of only 260 man-days of hunting annually (some 0.125 man-days/ac). The 1964 draft report, on the other hand, projected a loss of 3,000 man-days of hunting effort in the 599 ha (1,480 ac) area proposed for impoundment (2.1 man-days/ac), or more than 16 times the loss per acre predicted in the 1961 report. Loss of hunting opportunity in the 407 ha (1,005 ac) impounded area projected in the final report of the FWS (October 9, 1964) was also substantially higher than the predictions in

the 1961 report. In its final report the FWS predicted a project loss of 2,400 man-days of hunting, including a total loss within the impoundment and a partial loss within the 192 ha (475 ac) five-year flood frequency pool areas.

Each of the three FWS reports predicted that all adverse impacts on wildlife resources and hunting opportunity caused by the project could be successfully mitigated, and additional project benefits generated, if the WVDNR were allowed to manage the remaining project lands proposed for acquisition by the CE. This unanimous conclusion was predicated on an assumption that WVDNR management of the remaining lands would result in an approximate doubling of the number of man-days of hunter use that otherwise would have been supported.

There was close agreement among the conclusions in the three FWS reports with respect to the successful resolution of project mitigation requirements even though there were great disparities displayed in the respective FWS reports between proposed project acquisition boundaries and FWS assessments of habitat values. The fact that the eventually authorized project boundaries included approximately 9,521 ha (23,527 ac) of land completely surrounding a 407 ha (1,005 ac) lake (23.4 ratio of land to water) undoubtedly contributed to the reliability of the FWS prediction that the project would mitigate all wildlife losses and provide for additional wildlife benefits.

The WVDNR has never been able to assume responsibility for wildlife management on post-construction project lands because of fiscal limitations.

WVDNR wildlife management activities have been restricted to enforcement of applicable state game laws and regulations. Wildlife management by the CE has been minimal, to date, consisting of the establishment of a few food plots and limited application of timber and orchard husbandry practices, which have provided marginal wildlife benefits.

Nonetheless, as noted in Table 9, the estimated post-construction hunting use of the area (0.85 man-days/ac) has substantially exceeded (by 81 percent) the FWS predictions of hunter use (0.47 man-days/ac) in the absence of management by the WVDNR. Estimated post-construction hunting use has also been about 15 percent higher than the FWS predicted it would be in the circumstance where wildlife management would be undertaken by the WVDNR. It should be emphasized, however, that these man-day use estimates represent "best estimate" and/or opinions rendered by professionals closely associated with the project rather than empirical data collected according to a statistically designed study.

It was unfortunate, indeed, that the WVDNR was unable to take advantage of the opportunity for managing wildlife resources on the project.

Overall, the planning input pertinent to wildlife resources contained in the three FWS reports was considered minimal. Only perfunctory attention was paid to describing existing pre-project wildlife resources. None of the reports exhibited in-depth treatment of the many wildlife resource-base and hunter-use parameters necessary to develop adequate post-impoundment predictions. The reports contained only one recommendation which applied to project wildlife resources -- that the WVDNR be authorized to

Table 9. -- Comparison of project size, number of hunter man-days and number of hunter man-days/ac predicted by the October 9, 1964, FWS Final Report with post-impoundment occurrence estimates

	FWS report predictions	Post-impoundment estimates*	Net change Amount	%
Project land area				
No. acres	26,995	23,527	-3,468	-13
No. hunter man-days				
w/o mgt. by WVDNR	12,600	20,000**	+7,400	+59
w/ mgt. by WVDNR	20,000	N.A.	N.A.	N.A.
No. man-days/ac.				
w/o WVDNR mgt.	0.47	0.85	+0.38	+81
w/ WVDNR mgt.	0.74	N.A.	N.A.	N.A.

* It should be emphasized that these man-day use estimates represent "best estimates" and/or opinions rendered by professionals closely associated with the project rather than empirical data collected according to a statistically designed study

** Approximate -- based on results of annual CE hunter use estimates (20,523 post-impoundment man-day average) and an independent assessment of 19,689 man-days developed from WVDNR county-wide hunter use surveys

manage all contiguous project lands after construction. While this recommendation was certainly well founded, the reports would have benefitted by additional recommendations pertaining to the implementation of appropriate land use and wildlife management regimes.

FISHERY RESULTS AND DISCUSSION

Fishery Resources -- Pre-impoundment Predictions

The fishery resources of the East Lynn Reservoir project were accorded more detailed analysis than were the wildlife resources in each of the three FWS project reports. The first FWS report, dated August 15, 1961, collectively addressed the fish and wildlife resources endemic to the Twelvepole Creek Basin, West Virginia that would be affected by the comprehensive flood control project proposed by the CE. This basinwide project included proposals for the construction of three reservoirs, East Lynn Reservoir, Beech Fork Reservoir, and Cabwaylingo Reservoir.

At the early planning stage, the proposed East Lynn Reservoir was expected to encompass approximately 566 ha (1,400 ac) at summer pool elevation 202 m (663 ft) msl, 322 ha (820 ac) at winter pool elevation 198 m (650 ft) msl, and 1,052 ha (2,600 ac) at the maximum flood control elevation 210 m (690 ft) msl. It was estimated that 20.1 km (12.5 mi) of the reservoir's major tributary, East Fork of Twelvepole Creek, would be affected by the proposed East Lynn Reservoir project.

Pre-project stream fishery resources were described as follows:

> Fishery Resources (Without Project)
>
> The Twelvepole Creek system, including the East Fork, West Fork, and Beech Fork, supports a moderately productive warm-water stream fishery. Irregular stream flows, scouring of the channels, and an unbalanced population of fish species limit the fishery.
>
> The more important game fishes in the three project areas include smallmouth bass, catfish, rock bass, sunfish and hatchery-reared rainbow trout. Carp and suckers are also present. The best catfish and bass fishing are found on the East Fork Branch.

West Fork provides substantial fishing opportunities to trout fishermen.

Stream fishing activity is generally heaviest during the week ends. Available data indicate that the warm-water fisheries in the three project areas average about the same degree of use, or about 30 man-days per mile of stream per year during an average 150-day season.

Rainbow trout were restricted to the West Fork of Twelvepole Creek. The report appraised the pre-impoundment value of the warmwater fishery of East Fork at $375. This sum assumed an annual fishing pressure of 375 man-days of fishing (30 man-days per mile x 12.5 miles of stream) valued at $1.00 per man-day of warmwater fishing, as adopted by the Interagency Committee on Water Resources (15).

Fishery resources with the project, even without intensive post-impoundment fishery management, were predicted to be substantially greater, viz:

Fishery Resources (With Project)

Construction of three reservoirs will result in significant changes in the fishery resources of the Twelvepole Basin. The project will eliminate 24 miles of stream fishery habitat, including 0.5 mile of the heavily fished 4-mile segment of trout waters on West Fork. The reservoir facilities will increase the opportunity for fishing in the Twelvepole Basin. A lake-type fishery is expected to develop in these reservoirs, provided they are not polluted by old coal mines which may be flooded by the project. The city of Huntington, with a population of about 84,000 and only 10 to 45 miles from the reservoir area, will produce an intensive fishery utilization of these reservoirs.

Approximately 56,000 licensed fishermen reside within the six counties[1/] which will be directly influenced by development of Twelvepole Creek project. According to national statistics the numbers of fishermen are increasing at a rate faster than the population. Based on current trends it is estimated that about 134,000 fishermen will reside in the vicinity of the project area by

---

1/ Boone, Cabell, Lincoln, Logan, Mingo & Wayne Counties.

the end of the next 50 year period[2/]. The number of fishermen living in this area during the 50 year economic life of the project is expected to average about 95,000.

Assuming that the quality of impounded waters will be satisfactory for fish production, and assuming construction of adequate public-use facilities, it is estimated that the three reservoirs combined will support 20,000 man-days of fishing annually-Beech Fork Reservoir will receive 12 man-days of use per acre per year; East Lynn Reservoir, 8 man-days per acre; and Cabwaylingo Reservoir, 15 man-days per acre. The incidental fishery accruing to the project will increase fishing opportunities over the without-the-project condition by 17,400 man-days per year. The recreational value will be increased $17,400.

East Lynn Reservoir, absent intensive fishery management, was expected to provide a minimum of 11,200 man-days of fishing per year (1,400 ac x 8 man-day/acre) having a value of $11,200 at $1.00 per man-day. Subtracting the pre-project stream fishery value ($375.00), assumed to be lost after impoundment, the net annual fishery "benefit" attributable to the East Lynn Reservoir project was computed at $10,825.

However, the authors of the August 15, 1961, letter report presumed that the proposed reservoirs, if managed properly, afforded excellent potential for enhanced fishery benefits, viz:

The southern portion of West Virginia (of which the Twelvepole Creek is a part) contains a sizeable portion of the population and industrialization of the State. The recreation needs of this population are great and are constantly increasing. Although there is a shortage of publicly-owned areas for general recreational activities, the fish and wildlife recreational situation is even more inadequate. Future population increases in this region will make additional demands on these facilities. Installation of the proposed reservoirs in this watershed, with subsequent development of the fish and wildlife resources will, to some extent, alleviate this situation.

2/ Estimates are based on a report issued by the Senate Select Committee on National Water Resources, Print No. 18, 86th Congress, 2nd Session, April 1960.

As indicated earlier in this report the installation of project facilities will provide lake-type fisheries in an area where only stream fisheries now exist. In order to realize adequate utilization of the new reservoir fisheries, public access should be provided. It will be necessary to construct boat launching ramps and ample parking areas at each fisherman access point. It is important that planning for these facilities be a cooperative venture of the Corps of Engineers and the West Virginia Department of Natural Resources.

To produce and maintain maximum benefits from the three reservoirs it would be necessary to include certain fishery management techniques in the project plans. Chemical treatment of all streams tributary to the reservoirs to remove rough fish species would be desirable. Treatment should begin in August or September immediately after gate closure. Restocking of the reservoir with preferred game species such as largemouth bass, channel catfish, flathead catfish, and crappies would be necessary to assure desired species balance. Provisions for trapping, seining, and other measures to control rough fish species should be planned into each reservoirs.

It is widely recognized that conflicts often develop between fishermen and water skiers, as well as other forms of boating. In order to insure that portions of the project reservoirs will be available for fishing, hunting and other wildlife uses without undue interference from the above-named activities, it will be necessary to include zoning regulations in management plans. The selection of zoned areas should be coordinated between the planning agency and the West Virginia Department of Natural Resources.

A potential exists for development of excellent tailwater fisheries downstream from the respective reservoirs. Evaluation of these fisheries is not included at this time; however, the magnitude of these potential fisheries, if developed, could equal or exceed production within the reservoirs, depending upon the degree of development permitted in relation to other project functions. Potential for warm-water fisheries and/or trout fisheries development is indicated. In either instance, multiple level outlet works installed in each dam would be an important feature prerequisite to development of the fisheries. Further studies involving water temperatures, reservoir storage and release regimen, and other project operational features will be required prior to determination of possibilities for development of the downstream fisheries.

During field investigations of the project areas it was noted that there were a number of abandoned coal mine adits located along the lower slopes of the East Fork stream valley. Although these mines probably have no effect on the stream at the present

time, there is a possibility that future inundation of this area may result in a mine acid pollution problem. Additional studies will be required to determine what possible effects these mines might have on development of reservoir and downstream fisheries.

Implementation of a sound fishery management program would increase fisherman use on the Beech Fork Reservoir to approximately 9,360 man-days (18 man-days per acre) per year; the East Lynn Reservoir to approximately 16,800 man-days (12 man-days per acre) per year; and the Cabwaylingo to about 3,520 man-days (22 man-days per acre) per year. Because a higher quality fishery is expected with good management and because fishermen will travel greater distances, the value of a fisherman day is estimated at $1.50. Accordingly, the annual recreational value, attributed to the fishery, is expected to increase to an estimated $14,040, $25,200 and $5,280 in the Beech Fork, East Lynn and Cabwaylingo Reservoirs, respectively.

As noted in the foregoing, the adoption of an active fishery management program was expected to enhance fishery values substantially at East Lynn Reservoir. Use was expected to increase by 50% (from 11,200 to 16,800 man-days). At the same time, by providing a higher quality fishery, the value of the fishing was expected to increase by 50% (from $1.00 to $1.50 per man-day), which would more than double (125% increase) the overall reservoir fishery value.

The specific management recommendations advanced by the authors of the August 15, 1961, FWS report were as follows:

(1) That the entire drainage upstream from each reservoir be chemically treated to remove all fish life just prior to or at time of closing the gates.

(2) That at least two access sites be constructed to Beech Fork Reservoir, three at East Lynn Reservoir, and one at Cabwaylingo Reservoir. Each site should be provided with a parking lot and boat launching facilities.

(3) That seining and trapping areas for rough fish control be provided during land clearing operations in the reservoir area, where such areas are determined necessary by the West

Virginia Department of Natural Resources.

(4) That a reservoir zoning plan be formulated in connection with over-all planning for the three reservoirs to insure that specified areas will be available for fishing, hunting, and other wildlife purposes and with a minimum of conflict with other recreational uses. It is further recommended that the reservoir zoning plan be developed cooperatively by the Corps of Engineers, the West Virginia Department of Natural Resources, and this Bureau.

(5) That all project lands which are acquired in fee simple title, together with included water areas, be made available to the West Virginia Department of Natural Resources, in accordance with a General Plan for Fish and Wildlife management for each reservoir site, as provided in Section 3 of the Fish and Wildlife Coordination Act, 48 Stat. 401 as amended, 16 U.S.C. 661 et seq., except for such portions as may be reserved by the construction agency for reasons of safety, efficient operation, or protection of public proerty.

(6) That the Corps of Engineers, as a part of its investigations, participate in appraising the effects of acid pollution on the reservoir values and in determining the means and measures which should be undertaken, if necessary, prior to or concurrent with reservoir construction, to prevent adverse effects from upstream conditions.

(7) That additional studies be conducted by this Bureau in cooperation with the West Virginia Department of Natural Resources prior to project construction, at an estimated additional cost to the project of $4,000 to: (a) determine type of tailwater fishery development most suitable downstream from each dam; (b) determine minimum stream flow and optimum water-temperature for downstream areas; (c) determine extent and cost of necessary programs for control of undesirable fish; (d) cooperatively determine exact locations for access sites, and (e) locate areas and further describe plans for seining and trapping rough fish -- these studies to form the basis for such reasonable modifications of project facilities and operations as may be desirable in order to obtain maximum fish and wildlife benefits consistent with over-all project purposes.

Nearly three years later, the FWS submitted a draft report (July 2, 1964) to the CE which dealt exclusively with the East Lynn Reservoir project. Shortly thereafter, the FWS issued their final letter report (October 9,

1964). Although the draft report of July 2, 1964, was considerably more detailed that the final version of October 9, 1964, the essential project parameters outlined and the major conclusions set forth were identical regarding project impacts on fishery resources.

Apparently reflecting updated engineering planning specifications provided by the CE, both the July 2, 1964, draft and the October 9, 1964, final report incorporated several adjustments in the physical parameters of the project that had been made since 1961. The two major changes affecting the fishery resource included a reduction in the area of the summer pool from 567 ha (1,400 ac) to 407 ha (1,005 ac) and the new provision for a minimum flow release from the dam of 10 cfs.

The brief description of pre-project fishery resources in the 1964 FWS reports was similar to that provided in 1961, viz:

> The fisheries in the East Fork of Twelvepole Creek are of low value. This is attributed to low fertility, an unbalanced fish population, and erratic water flows which cause much stream scouring. A small population of warm-water fish is found in the stream. Catfish and smallmouth bass dominate the sportfish catch. Fishing pressure is low. About 30 fisherman days per mile are exerted on the stream. This is equivalent to an average of 550 man days of fishing annually for the area influenced by the project.

Each of three FWS reports estimated that the East Fork of Twelvepole Creek supported 30 man-days of warmwater fishing per mile prior to the construction of East Lynn Reservoir. However, the 1964 reports estimated the total pre-project stream fishery resource at 550 man-days annually, contrasting with only 375 man-days estimated in the 1961 report. The greater total stream fishing pressure estimated in the 1964 reports can be attributed to the assumption of a greater stream length occurring within the area of pro-

ject influence. Additionally, the 1964 FWS reports took into account a 5.3 km (3.3 mi) tailwater section which was ignored in the 1961 report.

The draft report of July 2, 1964, predicted that post-impoundment tailwater fishing pressure would increase substantially over pre-project levels, viz:

> Fisherman use of that portion of East Fork immediately downstream from the dam will increase considerably with the construction of the East Lynn Dam. Fisheries values of a tailwater area usually surpass those of the original stream due to the increase in productivity of the water and fish attraction produced by the turbulence. In the case of the East Lynn project, the stabilization of flows should further increase the value of fish habitat.
>
> Average annual fisherman use of the section of the creek between the dam site and the town of East Lynn, without the project, is approximately 100 fisherman days. This figure will increase to 500 fisherman days following project construction.
>
> Additional benefits will be obtained if parking and access facilities are provided. A 25-car parking area should be constructed downstream from the dam. This parking area would double the average annual fisherman use of the downstream fishery, giving a benefit of 500 fisherman days. This parking area should be made available to the West Virginia Department of Natural Resources which agency would be responsible for its administration and maintenance.

The CE apparently concurred with the recommendation in the FWS draft report to provide suitable angler access to the tailwaters. This circumstance seems to have been evidenced by the fact that the FWS's final report of October 9, 1964, predicted that the following changes would occur in tailwater angling pressure:

> Average annual fisherman use of the stream section between the dam site and the town of East Lynn, without the project, is approximately 100 fisherman days. This figure will increase to 1,000 fisherman days following project construction due to more stable stream flows and improved access. Approximately 500 man days are attributed to the planned access area downstream from the dam.

Estimates of reservoir angling pressure contained in the 1964 FWS reports were substantially higher than the 16,800 man-days per year predicted in the 1961 report. The FWS draft report of July 2, 1964, described reservoir angling potential as follows:

> The southwestern portion of West Virginia is virtually devoid of sport fishing opportunities. There are no lakes or reservoirs of any consequence in the area, and stream fishing has been reduced in value by pollution. The construction of the East Lynn Reservoir will provide a resource heretofore unavailable which should be developed for maximum utilization.
>
> The construction of the reservoir will replace 450 man days of stream fishing with 34,200 fisherman days of lake-type fishing annually. Construction of the project will result in a loss of 50 fisherman days of stream fishing and a benefit of 34,200 fisherman days of lake-type fishing. This is a total benefit of 34,150 fisherman days having a net recreational value of $51,150.

However, the report stipulated that adoption of recommendations for access implementation could be expected to increase reservoir angling opportunity even further, viz:

> If adequate fisherman access is provided, the East Lynn Reservoir should support an additional 6,050 man days, or 40,250 man days in all. To provide this utilization, three boat-launching sites in the reservoir area proper with parking facilities at each would be needed. Each parking lot should be considered in addition to any others which might be constructed for other recreational purposes. The initial cost of each of these areas, including land acquisition and development, is estimated at $4,000. These areas should be made available to the West Virginia Department of Natural Resources. That agency would assume responsibility for their administration and maintenance.
>
> Special consideration has been given to the selection of the sites to establish them as far as possible from general recreational areas. This has been done to eliminate the conflict between the two types of recreation. To further assist in separating the fisherman from speed-boating and water-skiing activities, fisherman access area development should consist of no more than a suitable parking area and boat-launching facilities. Picnic tables and other such additions serve to attract recreationists other than fishermen, with the resulting conflicts that normally ensue.

In addition to these recommendations for provision of adequate access, the July 2, 1964, draft report also addressed the following topics pertinent to the management of the East Lynn Reservoir fishery:

> Angler catches of predatory game fish such as smallmouth and largemouth bass are predicted on annual successful reproduction and survival rates. Water level fluctuations during the spawning season can often wipe out an entire year's crop of young bass. Reservoir operations should be planned to prevent, insofar as possible, any undue water level changes during the spring months. Operation schedules should be planned and coordinated with the West Virginia Department of Natural Resources.
>
> To provide fish attraction areas within the reservoir, timber should be allowed to remain standing in selected coves which are to be inundated. These areas should be chosed in cooperation with the West Virginia Department of Natural Resources.
>
> All fisheries values in this report are based on the maintenance of suitable water quality for fish production. Reduction in values will occur if mine drainage enters the reservoir. As indicated in our 1961 report on Twelvepole Creek Basin, future inundation of a number of coal mine adits located along the lower slopes of the East Fork stream valley may result in a mine acid pollution problem. The Corps of Engineers, as a part of its investigation, participates in appraising the effects of acid pollution on the reservoir values and determines means and measures which should be taken to prevent adverse effects on upstream conditions.

The specific fishery management recommendations made in the same draft report are as follows:

> In order to obtain maximum production and utilization of the fish and wildlife resources in the area of project influence, it is recommended --
>
> 1. That three access sites at a cost of $4,000 apiece be provided within the reservoir area; each site to accommodate 25 cars and boat trailers with adequate boat launching facilities.
>
> 2. That an access and parking lot (25 cars) be constructed downstream from the dam.
>
> 3. That an access area with parking for 25 cars and trailers and a boat ramp located at the confluence of Kiah Creek and East

Fork, Twelvepole Creek be reserved for future development.

4. That the above parking and access areas be made available to the West Virginia Department of Natural Resources which will be responsible for their administration and maintenance.

5. That insofar as possible, operation of the dam should include plans for maintenance of a static water level during the smallmouth and largemouth bass spawning periods.

6. That timber be allowed to remain standing in selected cove areas which are to be inundated to provide for fish attraction.

7. That all existing roads terminating at the reservoir be left intact to permit access and boat launching for fishermen.

8. That a complete study be made by your agency as soon as practicable to determine whether the presence of coal mine adits in the project area will cause any lowering of water quality in the reservoir and, if so, determine what procedures can be undertaken to prevent this damage.

9. That all project lands which are acquired in fee simple title, together with included water areas, be made available to the West Virginia Department of Natural Resources in accordance with a General Plan for Fish and Wildlife Management as provided in the Fish and Wildlife Coordination Act, except for such portions as may be reserved by the construction agency for reasons of safety, efficient operation, or protection of public property.

The CE, in a letter dated July 9, 1964 (6), generally approved the recommendations contained in the FWS draft report of July 2, 1964, viz:

> The review draft of your report on fish and wildlife resources at the East Lynn Reservoir on Twelvepole Creek, West Virginia, has been reviewed and our comments on your recommendations are given in the following paragraphs. One copy of the report on which some statistical corrections have been made is returned herewith. Also inclosed is a copy of the preliminary plan of development showing the proposed access sites and government taking.
>
> Recommendation 1. Three lakeside access sites which include boat launching facilities are proposed, two of which are at sites proposed in your report. It is believed that these sites

will adequately serve both general recreation and fishery purposes.

Recommendation 2. A fisherman access is proposed downstream from the dam.

Recommendation 3. An access area with boat launching and parking facilities at the mouth of Kiah Creek is proposed for future development.

Recommendation 4. The parking and access areas along with other developments will be made available to the West Virginia Department of Natural Resources for administration and maintenance.

Recommendation 5. Insofar as possible, this recommendation will be compiled with.

Recommendation 6. It is proposed to leave some timber standing in selected areas for fishery purposes.

Recommendation 7. All existing roads into the pool area will be left open for access.

Recommendation 8. An investigation will be made to determine the presence of coal mine adits and the effect on water quality in the reservoir.

Recommendation 9. All project lands, except for such areas reserved for general recreation, for reasons of safety and for operation purposes will be made available to the West Virginia Department of Natural Resources in accordance with a General Plan for Fish and Wildlife Management.

The opportunity to review the draft of your report before final release is appreciated.

Subsequent negotiations between the FWS and CE, regarding various reservoir access stipulations contained in the draft FWS report of July 2, 1964, satisfactorily resolved outstanding problems. This fact is attested by the following extracts from the final report of the FWS, dated October 9, 1964:

This letter constitutes our conservation and development report on the East Lynn Reservoir project, Wayne County, West

Virginia. The project was authorized by the Flood Control Act of 1938. This report is prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401 as amended; 16 U.S.C. 661-666 inc.) in cooperation with the West Virginia Department of Natural Resources. That agency concurs in the report as indicated in its letter dated September 23, 1964.

A previous draft report on this project was submitted to you for review and comment on July 2, 1964.

Mr. Barnes' letter of comments on that draft dated July 9, 1964 indicates that most of our recommendations for fish and wildlife developments will be included in project plans. In addition, agreements between members of our respective staffs, confirmed in Mr. Taylor's letter of August 4, 1964, have resulted in adoption of your preliminary plan of development for reservoir access and use. Accordingly, we are pleased to note that those measures necessary for optimum development and use of project related fish and wildlife resources, are now incorporated into the overall project plan upon which evaluations in this revised report are based....

It is also our understanding that plans for this project include provisions for development of three access sites to the reservoir with boat launching ramps, and one site for fisherman access to the stream below the dam. Two of these sites (sites 1 and 2, plate 1) will be developed primarily for fisherman use. Horsepower restrictions will be imposed in these arms of the reservoir to prevent water skiing and boating activities from conflicting with fishing. In addition, the other tributary arms plus the reservoir upstream from Cove Creek, as shown on plate 1, will have horsepower limitations as designated by strategic location of buoys. Site 3 (plate 1) will be developed principally for water skiers and pleasure boaters, but the launching ramp will also be available for fishermen. Another access site to include parking and boat launching facilities at the confluence of Kiah Creek is proposed for future development.

Other items in the project plan of development include the following: (1) timber will be left standing in selected areas for fishery purposes; (2) existing roads to the pool area will be left open for access; (3) an investigation will be made to determine the presence of coal mine adits and the effect on water quality in the reservoir; (4) insofar as possible, operation of the dam will include plans for maintenance of a stable water level during the smallmouth and largemouth bass spawning periods; (5) all project lands and included water areas, except for such areas reserved for general recreation, for reasons of safety, and for operation purposes, will be made available to the West

> Virginia Department of Natural Resources in accordance with a General Plan for Fish and Wildlife Management; and (6) establishment of horsepower regulations and selection of areas for non-removal of timber will be accomplished cooperatively between the West Virginia Department of Natural Resources, the Corps of Engineers, and the Bureau of Sport Fisheries and Wildlife.

The October 9, 1964, final report of the FWS echoed the general findings of the earlier draft report. Predictions of the net effect of project construction on tailwater and reservoir fisheries were as follows:

> Construction of the reservoir will replace 450 man days of stream fishing within the reservoir site with 40,250 fisherman days of lake-type fishing annually. The project will result in an overall gain of 450 fisherman days of stream fishing and 40,250 fisherman days of lake-type fishing. This is a total benefit of 40,700 fisherman days, having a net recreational value of $61,000. Approximately 6,050 man days of the total benefits are attributed to the provision of the three access sites planned for the reservoir.

A summary of use predictions and monetary values assessed in the 1961 and 1964 FWS reports is provided in Table 10.

Fishery Resources -- Post-impoundment Occurrences

The WVDNR fish division played a key role throughout the pre-impoundment project planning phases. It has also conducted extensive post-impoundment fishery evaluation studies, beginning with the first year of impoundment (March 15, 1972) through the present.

Implementing previous project report recommendations, approximately 56 km (35 m) of streams (including the entire watershed within project boundaries) were reclaimed with rotenone on June 26 and 27, 1971 (2). Restocking of the watershed with appropriate sport and prey fish species was undertaken shortly thereafter.

Table 10. -- Average annual fishing pressure (man-days) and monetary sport fishery values ($) predicted in the August 15, 1961 FWS report (with and without implementation of recommended reservoir fishery management regimes) and the 1964 FWS reports (with and without implementation of recommended access provisions) at East Lynn Reservoir

Report designation	Stream Fishery									Reservoir Fishery				Total Fishery	
	Above dam site				Tailwater				Total						
	Stream length		No. man-days	Man-days/ mi.	Stream length		No. man-days	Man-days/ mi.	Man-days	Area		No. man-days	Man-days/ acre	No. man-days	($) Value*
	km	mi			km	mi				ha	ac				
Aug. 15, 1961 Report															
Without fish mgt.															
Without proj.	20.1	12.5	375	30	--	--	--	--	375	--	--	--	--	375	375
With proj.		0	0	0	--	--	--	--	0	566.5	1,400	11,200	8	11,200	11,200
Net	20.1	-12.5	-375	-30	--	--	--	--	-375	566.5	+1,400	+11,200	8	10,825	10,825
With fish mgt.															
Without proj.	20.1	12.5	375	30	--	--	--	--	375	--	--	--	--	375	375
With proj.		0	0	0	--	--	--	--	0	566.5	1,400	16,800	12	16,800	25,200
Net	20.1	-12.5	-375	-30	--	--	--	--	-375	566.5	+1,400	+16,800	12	16,425	24,825
1964 Reports															
No special access provision															
Without proj.	24.1	15.0	450	30	5.3	3.3	100	30	550	--	--	--	--	550	825
With proj.		0	0	0	5.3	3.3	500	150	500	406.7	1,005	34,200	34	34,700	55,520
Net	24.1	-15.0	-450	-30	5.3	3.3	+400	+120	- 50	406.7	+1,005	+34,200	34	+34,200	54,700
Special access provision															
Without proj.	24.1	15.0	450	30	5.3	3.3	100	30	550	--	--	--	--	550	825
With proj.		0	0	0	5.3	3.3	1,000	300	1,000	406.7	1,005	40,250	40	41,250	61,875
Net	24.1	-15.0	-450	-30	5.3	3.3	+900	+270	+450	406.7	+1,005	+40,250	40	40,700	61,000 (rounded)

* The Aug. 15, 1961 report assessed a value of $1.00/man-day for both the unmanaged stream and reservoir fisheries and a value of $1.50/man-day for managed reservoir fishery. The 1964 report assessed a $1.50 man-day value for all fishing man-days.

Survival of the newly stocked fish was enhanced by construction of a 40.5 ha (100 ac) holding pool at a site immediately upstream from the East Lynn Dam. This pool was created by a temporary dam constructed by the CE specifically to facilitate initial pre-impoundment fish stocking efforts.

Stocking

The initial pre-impoundment stocking (1971) consisted primarily of sport fish species. These included fingerling smallmouth bass, largemouth bass, walleyes, channel catfish, black crappies, and redbreast sunfish (Table 11). Adult brook silversides, a small prey species endemic to lower elevation Ohio River drainage streams, were also stocked to provide a supplemental food supply. Muskellunge fingerlings were stocked in 1972, along with additional largemouth bass fingerlings and walleye fry. Planting of muskellunge fingerlings and walleye fry was continued in 1973 and 1974. Threadfin shad, a plankton feeding pelagic prey species, were stocked in 1972 and again in 1973.

The initial stocking effort (1971) was highly successful. Fish population studies revealed excellent reproduction of largemouth bass, black crappies, brook silversides, and redbreast sunfish. Threadfin shad, stocked as adults in the spring of 1972, spawned successfully during the summer of 1972. Large numbers of this temperature-sensitive species were observed dying during the following winter (December, 1972, to January, 1973). Although absent from samples collected during fish population studies, a considerable number of smallmouth bass (stocked

Table 11 -- Stocking records for East Lynn Reservoir, 1971-1974. Stocking density in brackets [no/ha (no/ac)], based on summer pool area of 406.7 ha (1,005 ac)

Species	Year stocked												Total no. stocked
	1971			1972			1973			1974			
	Size		No.	Size		No.	Size		No.	Size		No.	
	Cm.	In.		Cm.	In.		Cm.	In.		Cm.	In.		
Smallmouth bass	5-8	(2-3)	21,773 [54 (22)]										21,773
Largemouth bass	8-15	(3-6)	20,000 [49 (20)]	5-8	(2-3)	45,000 [111 (45)]							65,000
Muskellunge				13-18	(5-7)	4,226 [10 (4)]	13-20	(5-8)	9,980 [25 (10)]	8-28	(3-11)	11,808 [29 (12)]	
Walleye	25	(10)	137 [.34 (.14)]		Fry	1,500,000 [3,688 (1,492)]		Fry	1,500,000 [3,688 (1,492)]		Fry	1,500,000 [3,688 (1,492)]	4,500,137
Channel catfish	5-10	(2-4)	54,595 [134 (54)]										54,595
Black crappie	4-6	(1.5-2.5)	10,500 [26 (10)]										10,500
Redbreast sunfish	5-6	(2-2.5)	11,000 [27 (11)]										11,000
Threadfin shad				5-10	(2-4)	4,000 [10 (4)]	5-10	(2-4)	10,000 [25 (10)]				14,000
Brook silversides	5-8	(2-3)	156 [.38 (.16)]										156

as fingerlings in 1971) were caught by anglers in 1972.

Fish polulation sampling

Typical of newly established reservoirs, growth rates of all fish species were excellent during the first year of impoundment. Walleye fry introduced in the spring of 1972 exhibited excellent survival and growth, averaging 160 mm (6.3 inches) by early August. Other stocked species also exhibited rapid growth. Largemouth bass, smallmouth bass, black crappies, and redbreast sunfish, which were stocked as fingerlings in 1971, averaged 254 mm (10 inches); 216 mm (8.5 inches); 118 mm (7 inches), and 132 mm (5.2 inches), respectively, by August, 1972.

Excellent reproduction and growth also was noted among other unstocked fish species that were indigenous to the Twelvepole Creek watershed. Young-of-the-year spotted bass, bluegills, black bullheads, yellow bullheads, and white suckers were collected during routine cove rotenone sampling in August, 1972. The rotenone samples, taken annually by the WVDNR to provide an assessment of fish standing crops, were obtained from each of two 0.4047 ha (1 ac) coves (16).

The total fish biomass obtained in the cove rotenone samples averaged 67 kg/ha (60 lbs/ac) over the six-year sampling period (1972-1977), ranging from a low of 37 kg/ha (33 lbs/ac) in the second year of impoundment to 105 kg/ha (94 lbs/ac) in 1975 (Table 12.).

"Panfish" species (primarily bluegills and black bullheads) dominated the reservoir fish community, averaging about 48 percent of the total

Table 12. -- Total fish biomass and percentage composition comprised by "game fish," "panfish" and "other" categories* collected by annual (1972-1977) cove rotenone sampling conducted at East Lynn Reservoir in late July or early August at Brushy Creek and Lakeside embayments

Year	Total biomass		"Game fish"			"Panfish"			"Other"		
	kg/ha	lbs/ac	kg/ha	lbs/ac	%	kg/ha	lbs/ac	%	kg/ha	lbs/ac	%
1972	77.3	68.9	14.9	13.3	19.4	57.2	51.0	74.0	5.2	4.6	6.7
1973	37.1	33.1	8.0	7.1	21.5	20.4	8.2	55.1	8.7	7.8	23.4
1974	62.2	55.5	10.5	9.4	16.9	14.4	12.9	23.2	37.3	33.2	59.9
1975	105.2	93.9	9.9	8.8	9.4	41.3	36.9	39.3	54.0	48.2	51.3
1976	50.7	45.2	7.7	6.8	15.1	20.3	18.1	40.0	22.7	20.3	44.9
1977	72.1	64.2	12.1	10.8	16.8	39.4	35.1	54.7	20.6	18.3	28.5
Avg.	67.4	60.1	11.1	9.9	16.5	32.2	28.7	47.7	24.1	21.5	35.8

* "Game fish" include piscivorous species (largemouth, spotted and smallmouth bass, black crappie, muskellunge, walleye, channel catfish); "panfish" include bluegill and other sunfishes, and black and yellow bullheads; and "other" include prey species (threadfin shad, brook silversides, minnows, darters, madtoms), and spotted sucker, white sucker, hog sucker and silver redhorse

standing crop of fish over the six-year period of record. The highest proportion of panfishes in the standing crop of fish was noted during the first year of impoundment (74 percent), and the lowest was recorded during the third year of impoundment (16-21).

Bullheads (primarily young-of-the-year black bullheads) comprised over 63 percent of the total fish biomass in 1972 (the first year of impoundment). They declined dramatically to 5.7 percent by 1975, 2.4 percent in 1976, and made up only 1.3 percent of the fish biomass by 1977 (Table 13).

The void in the fish community left by the substantial decline of the bullhead biomass after the first year was filled by sunfishes (primarily bluegills) and suckers (primarily spotted suckers). Bluegills and other sunfishes increased from an average of 10.5 percent of the fish biomass in 1972 to 33.4 percent by 1975, 37 percent in 1976, and 53.4 percent by 1977. Suckers increased dramatically from less than 2 percent of the total fish biomass collected in 1972 to almost 48 percent by 1975. They then declined to approximately 17 percent in both 1976 and 1977.

The biomass of piscivorous "game fish" species, particularly the black basses (largemouth bass, smallmouth bass, and spotted bass) and black crappies, exhibited greater stability over the six-year sampling period than did either the "panfishes" (sunfishes and bullheads) or the "other" fishes (primarily suckers). Black bass biomass declined from a high of slightly over 12 percent during the first year of impoundment (1972) to a low of 5 percent in 1975. It then increased to 8.4 percent of the total reservoir fish biomass recovered in the 1976 and 1977 cove rotenone

Table 13. -- Biomass of fish collected by cove rotenone sampling at East Lynn Reservoir, 1972, 1975-1977. (Composite of 2, one acre, samples collected annually in late July or early August at Brushy Creek and Lakeside embayments, respectively)

Species	Fingerlings								
	Size range (mm)	kg/ha				Size range (inches)	lbs/ac			
		1972	1975	1976	1977		1972	1975	1976	1977
Largemouth bass	0-102	.8	tr	.2	.2	0-4	.7	tr	.2	.2
Smallmouth bass	0-102	.0	tr	tr	--	0-4	.0	tr	tr	--
Spotted bass	0-102	.2	.3	.6	.6	0-4	.2	.3	.5	.5
Total black bass	0-102	1.0	.3	.8	.8	0-4	.9	.3	.7	.7
Walleye	0-203	1.2	--	--	--	0-8	1.1	--	--	--
Muskellunge	0-305	tr	--	--	--	0-12	tr	--	--	--
Crappie (black)	0-102	3.7	tr	.1	.2	0-4	3.3	tr	.1	.2
Sunfish*	0-76	4.3	2.7	6.1	3.1	0-3	3.8	2.4	5.4	2.8
Channel catfish	0-102	--	--	--	tr	0-4	--	--	--	tr
Bullhead*	0-102	37.9	tr	tr	tr	0-4	33.8	tr	tr	tr
Sucker*	0-102	.1	--	--	--	0-4	.1	--	--	--
Brook silversides	0-102	1.1	.1	.3	tr	0-4	1.0	.1	.3	tr
Threadfin shad	0-102	.3	--	.1	--	0-4	.3	--	.1	--
Others*	0-102	1.1	1.8	1.9	.5	0-4	1.0	1.6	1.7	.4
Total		50.7	4.9	9.3	4.6		45.3	4.4	8.3	4.1

Table 13. -- (Continued)

Species	Intermediate								
	Size range (mm)	kg/ha				Size range (inches)	lbs/ac			
		1972	1975	1976	1977		1972	1975	1976	1977
Largemouth bass	104-203	2.2	.6	.1	.9	4.1-8	2.0	.5	.1	.8
Smallmouth bass	104-203	.1	--	--	--	4.1-8	.1	--	--	--
Spotted bass	104-203	3.6	2.9	1.1	1.3	4.1-8	3.2	2.6	1.0	1.2
Total black bass	104-203	5.9	3.5	1.2	2.2	4.1-8	5.3	3.1	1.1	2.0
Walleye	203-305	--	--	--	--	8.1-12	--	--	--	--
Muskellunge	--	--	--	--	--	--	--	--	--	--
Crappie (black)	104-178	.2	2.5	1.2	5.0	4.1-7.0	.2	2.2	1.1	4.5
Sunfish*	79-140	2.1	28.6	10.2	27.2	3.1-5.5	1.9	25.5	9.1	24.3
Channel catfish	104-254	.2	.7	1.5	.8	4.1-10.0	.2	.6	1.3	.7
Bullheads*	104-203	9.2	5.5	.9	.7	4.1-8.0	8.2	4.9	.8	.6
Sucker*	104-254	--	.2	--	.4	4.1-10	--	.2	--	.4
Brook silversides	104+	--	--	--	--	4.1+	--	--	--	--
Threadfin shad	104+	--	--	--	--	4.6+	--	--	--	--
Others*	104+	1.8	--	1.5	.6	4.1+	1.6	--	1.3	.5
Total		19.4	41.0	16.5	37.0		17.4	36.5	14.7	33.0

Table 13. -- (Continued)

Species	Harvestable								
	Min. size (mm)	kg/ha				Min. size (inches)	lbs/ac			
		1972	1975	1976	1977		1972	1975	1976	1977
Largemouth bass	206	2.1	.3	.8	1.3	8.1	1.9	.3	.7	1.2
Smallmouth bass	206	.5	--	1.0	--	8.1	.4	--	.9	--
Spotted bass	206	--	1.0	.4	1.7	8.1	--	.9	.4	1.5
Total black bass	206	2.6	1.3	2.2	3.0	8.1	2.3	1.2	2.0	2.7
Walleye	307	--	.8	--	--	12.1	--	.7	--	--
Muskellunge	--	--	--	--	--	--	--	--	--	--
Crappie (black)	180	.1	1.0	--	--	7.1	.1	.9	--	--
Sunfish*	142	1.7	4.0	2.6	8.1	5.6	1.5	3.6	2.3	7.2
Channel catfish	257	--	--	.7	--	10.1	--	--	.6	--
Bullheads*	206	2.3	.6	.3	.2	8.1	2.1	.5	.3	.2
Sucker*	257	1.1	52.1	19.2	19.0	10.1	1.0	46.5	17.1	17.0
Brook silversides	--	--	--	--	--	--	--	--	--	--
Threadfin shad	--	--	--	--	--	--	--	--	--	--
Others*	--	--	--	--	--	--	--	--	--	--
Total		7.8	59.8	25.0	30.3		7.0	53.4	22.3	27.1

Table 13. -- (Continued)

Species	Grand total, all size classifications											
	Kg/ha				Lbs/ac and % composition							
	1972	1975	1976	1977	1972		1975		1976		1977	
					Wt	%	Wt	%	Wt	%	Wt	%
Largemouth bass	5.2	.9	1.1	2.5	4.6	6.7	.8	.9	1.0	2.2	2.2	3.4
Smallmouth bass	.6	tr	1.0	--	.5	.7	tr	--	.9	2.0	--	--
Spotted bass	3.8	4.3	2.1	3.6	3.4	4.9	3.8	4.0	1.9	4.2	3.2	5.0
Total black bass	9.6	5.2	4.2	6.1	8.5	12.3	4.6	4.9	3.8	8.4	5.4	8.4
Walleye	1.2	.8	--	--	1.1	1.1	.7	.7	--	--	--	--
Muskellunge	tr	--	--	--	tr	--	--	--	--	--	--	--
Crappie (black)	4.0	3.5	1.3	5.3	3.6	5.2	3.1	3.3	1.2	2.7	4.7	7.3
Sunfish*	8.1	35.3	18.8	38.4	7.2	10.3	31.5	33.4	16.8	37.0	34.3	53.4
Channel catfish	.2	.7	2.1	.8	.2	.3	.6	.6	1.9	4.2	.7	1.1
Bullheads*	49.4	6.0	1.2	.9	43.7	63.1	5.4	5.7	1.1	2.4	.8	1.3
Sucker*	1.2	52.3	19.2	19.5	1.1	1.6	46.7	49.5	17.1	37.7	17.4	27.1
Brook silversides	1.1	.1	.3	tr	1.0	1.4	.1	.1	.3	.7	tr	--
Threadfin shad	.3	--	.1	--	.3	.4	--	--	.1	.2	--	--
Others*	2.9	1.8	3.4	1.0	2.6	3.7	1.6	1.7	3.0	6.7	.9	1.4
Total	78.0	105.7	50.6	72.0	69.0	--	94.0	--	45.0	--	64.0	--

* Sunfish include bluegill, redbreast sunfish and rock bass; bullheads include black and yellow bullheads; suckers include white sucker, hog sucker, spotted sucker and silver redhorse; others include minnows, darters and madtoms

samples. Largemouth bass, successful survivors from among the fish planted in 1971 and 1972, comprised the greatest segment of the total black bass biomass recovered in the 1972 cove rotenone samples. Numerically, fingerling and harvestable-size largemouth bass were also more abundant than the other two black bass species; largemouths comprised 82 percent of the fingerling black bass and 75 percent of the harvestable size bass collected in 1972 (Table 14). By 1975, however, spotted bass had become more abundant than largemouth bass. Spotted bass continued to dominate the cove rotenone samples (both numerically and by weight) obtained in subsequent years. Smallmouth bass remained a minor constituent of the black bass assemblage recovered in cove rotenone studies throughout the investigation.

Black crappie biomass peaked in 1977 (7.3 percent of the total reservoir biomass), compared with 2.7 percent in 1976, 3.3 percent in 1975, and 5.2 percent in 1972. Only a few walleyes and/or muskellunge were taken during the first few years of impoundment. These two species were completely absent from cove rotenone collections obtained in 1976 and 1977.

As noted above, annual cove rotenone sampling was carried out throughout the investigation. Additionally, the WVDNR Fish Division in 1975 initiated an intensive sampling program by means of electro-fishing, which was continued through 1977.

Three shoreline sections of approximately 0.7 mile each were electrofished at approximate one-month intervals, from May through November in 1975, 1976, and 1977. Approximately 10.8 miles of shoreline were sampled in

Table 14. -- East Lynn Reservoir number and percentage composition of black bass recovered per acre by cove rotenone sampling, 1972, 1975-1977

Size class*	Largemouth bass No./ac.	%	Spotted bass No./ac.	%	Smallmouth bass No./ac.	%	Total all bass No./ac.
Fingerling							
1972	36	82	8	28	--	--	44
1975	3	7	40	92	0.5	1	43.5
1976	26.5	21	100.5	79	0.5	tr	127.5
1977	21.5	23	72	77	--	--	93.5
Intermediate							
1972	35.5	40	53	60	--	--	89
1975	4	14	24	86	--	--	28
1976	1.5	13	10	87	--	--	11.5
1977	5	28	13	72	--	--	18
Harvestable							
1972	3.0	75	--	--	1	25	4
1975	0.5	20	2	80	--	--	2.5
1976	2.0	57	1	29	0.5	14	3.5
1977	3.0	50	3	50	--	--	6.0
Total							
1972	74.5	54	61	45	1.5	1	137
1975	7.5	10	66	89	0.5	1	74.0
1976	30.0	21	111.5	78	1.0	1	142.5
1977	29.5	25	88	75	--	--	117.5

* Fingerling size, 0-11.2 cm (0-4.4 inches); Intermediate, 11.3-18.8 cm (4.5-7.4 inches); Harvestable, $\geq$18.9 cm (7.5 inches)

both 1975 and 1976, and 10.2 miles in 1977. Unfortunately, adverse weather conditions in 1977 prevented sampling at one station during October of that year. The sampling stations surveyed included representative areas on the upper East Fork, the Lick Creek area, and on the reservoir main stem opposite the boat docks and marina. Each of the three sections surveyed were electrofished at night, with a 230 volt A.C., boat-mounted generator. Black bass were collected by two men employing dip nets at the front of the electrofishing boat. After electrofishing along each shoreline section, the black bass taken were measured, weighed, scale-sampled and released. Electrofishing was then resumed, returning along the same shoreline.

A composite length frequency of the black bass collected during the annual electrofishing surveys is presented in Table 15. Collectively, an average of 45.7 black bass (all three species combined) were collected per mile of shoreline in 1975, 47.5 bass per mile in 1976, and 36.2 bass per mile in 1977. Young-of-the-year bass appeared less frequently in the electrofishing sample than older age groups (Table 16). Total young-of-the-year bass abundance was highest in 1976 (14.4/shoreline mile) as compared to 7/shoreline mile in 1975 and 6.5/shoreline mile in 1977. Spotted bass comprised the majority of the young-of-the-year bass collected each year (3.6/shoreline mile in 1975, 12/shoreline mile in 1976 and 5.2/shoreline mile in 1977). Largemouth bass young-of-year averaged 3/shoreline mile in 1975, 2.2 in 1976 and 1.2 in 1977. Young-of-year smallmouth bass were collected only in 1975 (0.5/shoreline mile).

Table 15. -- Composite length frequency distribution of bass collected by shoreline electrofishing at three selected areas from May through November, 1975-77. (Approximately 10.8 miles of shoreline sampled per year in 1975, 1976 and 10.2 miles in 1977)

Size range		Largemouth bass			Spotted bass			Smallmouth bass			Total		
Cm	(Inches)	1975	1976	1977	1975	1976	1977	1975	1976	1977	1975	1976	1977
0-8.6	(0-3.4)	5	18	10	9	106	34	1			15	124	44
8.7-11.2	(3.5-4.4)	14	6	3	16	39	51	4			34	45	54
11.3-13.7	(4.5-5.4)	19	6	11	46	37	36	3			68	43	47
13.8-16.2	(5.5-6.4)	17	4	22	64	50	34	2	2		83	56	56
16.3-18.8	(6.5-7.4)	18	10	20	73	50	28	1	1		92	61	48
18.9-21.3	(7.5-8.4)	28	19	23	37	42	15		2		65	63	38
21.4-23.9	(8.5-9.4)	35	17	19	19	27	17		0	1	54	44	37
24.0-26.4	(9.5-10.4)	23	14	11	12	12	5		1		35	27	16
26.5-29.0	(10.5-11.4)	14	12	7	9	6	4				23	18	11
29.1-31.5	(11.5-12.4)	5	9	2	3	3	5				8	12	7
31.6-34.0	(12.5-13.4)	4	6	2	2	2	1			1	6	8	4
34.1-36.6	(13.5-14.4)	2	3	0	3		0				5	3	0
36.7-39.1	(14.5-15.4)	1	2	3	1		1				2	2	4
39.2-41.7	(15.5-16.4)	2	0	1							2	0	1
41.8-44.2	(16.5-17.4)		2	0							0	2	0
44.3-46.7	(17.5-18.4)	1	2	1					1		1	3	1
46.8-49.3	(18.5-19.4)		1	1					1			2	1
Total		188	131	136	294	374	231	11	8	2	493	513	369
No. bass/mi.		17.4	12.1	13.3	27.2	34.6	22.6	1	.74	.2	45.7	47.5	36.2

Table 16. -- Average number of young-of-year and older black bass sampled per mile of shoreline electrofishing at East Lynn Reservoir, 1975-1977

	1975		1976		1977	
	Y.O.Y.	Older	Y.O.Y.	Older	Y.O.Y.	Older
Largemouth bass						
May	0	5	0	0	0	24
June	0	16	0	0	1	13
July	6	19	9	7	4	2
August	8	20	1	10	2	9
September	3	12	3	13	1	12
October	2	13	1	8	0	16
Average	3	14.2	2.2	9.6	1.2	12.5
%	17	83	19	81	9	91
Spotted bass						
May	0	7	0	29	0	29
June	1	14	0	31	3	24
July	2	47	23	26	7	15
August	7	34	12	19	4	6
September	8	26	34	21	13	22
October	5	17	8	12	3	4
Average	3.6	24.4	12	23.0	5.2	17.5
%	13	87	36	64	23	77
Smallmouth bass						
May	0	0	0	1	0	0
June	0	0	0	2	0	0
July	2	0	0	0	0	1
August	1	1	0	2	0	0
September	2	1	0	0	0	0
October	0	0	0	0	0	0
Average	0.5	0.3	0	0.7	0	.2
%	63	37	0	100	0	100
Total						
May	0	12	0	39	0	53
June	1	30	0	42	4	37
July	8	66	33	33	11	18
August	15	55	12	31	6	7
September	13	39	27	34	14	34
October	6	31	14	21	3	20
Average	7	39	14.4	33	6.5	30
%	15	85	30	70	18	78

Spotted bass clearly dominated the fingerling and intermediate-size classes of black bass collected over the three-year period of electrofishing inventory. Largemouth bass, however, dominated the larger size classes (Table 17). Largemouth bass 29 cm (11.5 inches) and larger comprised 63 percent of the total number of black bass collected in 1975, about 78 percent in 1976, and 56 percent in 1977. Spotted bass made up 38, 16, and 39 percent in 1975, 1976, and 1977, respectively, of these larger black bass sampled. No smallmouth bass in this size class were collected in 1975. They comprised only 6 and 5 percent of the total number of black bass 29 cm (11.5 in) and larger collected in 1976 and 1977, respectively.

Harvestable-size bass [defined for purposes of analysis as bass 19.8 cm (7.5 in) or larger] amounted to 18.6 bass per shoreline mile in 1975, 17 bass per shoreline mile in 1976, and 11.8 bass per mile in 1977.

Creel Surveys

Creel surveys at East Lynn Reservoir were initiated by the WVDNR in 1973 (second year of impoundment) and continued through 1977, only on the reservoir per se. The surveys were conducted biweekly, at random times and dates during daylight hours, annually from April 1 through October (Table 18). Comparable creel surveys of the tailwater fishery were not made by the WVDNR.

From 1975 through 1977, the creel clerk recorded the number of fish caught and released by each angler interviewed as well as the number of fish retained. Creel data reported for 1973 and 1974 included only the number

Table 17. -- Number and percentage size class distribution of black bass collected per mile of shoreline by electofishing at East Lynn Reservoir, 1975-1977

Size class		Total number (all species)			Largemouth bass			Spotted bass			Smallmouth bass		
Cm	In	1975	1976	1977	1975	1976	1977	1975	1976	1977	1975	1976	1977
0-11.2	0-4.4												
Number		4.54	15.65	9.61	1.8	2.2	1.3	1.4	13.4	8.3	0.5	0	0
%					48.7	14.2	13.3	38.5	85.8	86.7	12.8	0	0
11.3-18.8	4.5-7.4												
Number		22.50	14.81	14.80	5.0	1.9	5.2	16.9	12.7	9.6	0.6	0.3	0
%					22.2	12.5	35.1	75.3	85.6	64.9	3.8	1.9	0
≥18.9	7.5												
Number		18.61	17.04	11.76	10.6	8.1	6.8	8.0	8.5	4.7	0	0.5	0.2
%					57.2	47.3	58.3	42.8	50.0	40.0	0	2.7	1.7
≥29.1	11.5												
Number		2.22	2.96	1.76	1.4	2.3	1.0	0.8	0.5	0.7	0	0.2	0.1
%					62.5	78.1	55.6	37.5	15.6	38.9	0	6.3	5.5

Table 18. -- Summary of selected creel survey statistics collected by annual WVDNR creel surveys (April through October), 1973-1977. (Values expressed on a per acre basis in parentheses)

	1973	1974	1975	1976	1977
Total no. angling trips	20,917	22,885	19,179	13,058	15,451
No. angling trips/ha	51 (20.8)	56 (22.8)	47 (19.1)	32 (13.0)	38 (15.4)
Total no. hours fished	126,256	123,014	107,728	68,726	83,746
Avg. no. hrs. fished/trip	6.0	5.4	5.6	5.3	5.4
No. hrs. fished/ha	309 (126)	302 (122)	264 (107)	168 (68)	205 (83)
Total no. fish caught/ha*	--	--	345 (140)	117 (47)	100 (41)
No. fish harvested/ha	77 (31)	71 (29)	112 (45)	33 (13)	25 (10)
No. fish caught/hr.*	--	--	1.3	0.7	0.5
No. fish harvested/hr.	0.25	0.23	0.42	0.20	0.12
No. black bass caught/ha*	--	--	45 (18)	17 (7)	23 (9)
No. black bass harvested/ha	32 (13)	16 (6)	13 (5)	3 (1)	5 (2)
No. black bass caught/hr.*	--	--	0.169	0.102	0.111
No. black bass harvested/hr.	0.105	.053	.048	.019	.024

* Includes fish caught and released as well as fish harvested. No record was kept of the number of fish caught and released in 1973 or 1974

of fish actually harvested. A 304 mm (12 in) minimum size limit for black bass was first applied in 1976, continued through 1977.

Monthly estimates of the number of angler visitations also were made annually by the CE during these same years. These CE estimates included night visitations and provided coverage of winter and early spring months (November through March) which were not accounted for by the WVDNR creel surveys. Separate estimates for angling visitations to the reservoir tailwater were also made by the CE. It must be noted that the CE estimates of angler use visitations were derived from data collected by vehicle traffic counters, expanded from limited (6 days per year) visitor interviews. The latter were conducted during the spring, summer, and fall. Separate estimates of winter season angler useage were made by reservoir personnel based on visual counts.

A comparison of the number of reservoir angling trips estimated by the WVDNR on-site creel surveys and the CE traffic counts is presented in Table 19. The CE angler use estimates average approximately 7.6 times greater than estimates developed in the WVDNR creel survey over the same period (April 1 through October 31).

Although inflated, the CE angler visitation data appear, however, to have reasonably reflected annual trends in angling participation rates over the five-year census period. It is noteworthy that both WVDNR and CE angler use estimates for the April-October period followed a similar chronological pattern. Both estimates for the April through October period indicated a modest increase in angling pressure in 1974 over 1973,

Table 19. -- Comparison of CE and WVDNR estimates of angler usage at East Lynn Reservoir, 1973-1977

	CE estimates			WVDNR estimates		Ratio of CE/ WVDNR estimates**
	Total (12 months)	April-October		April-October	Adjusted total*	
	No. trips	No. trips	% of total	No. trips	No. trips (12 mos.)	
1973	185,719	159,164	85.7	20,917	24,407	7.6
1974	211,417	167,863	79.4	22,885	28,822	7.3
1975	178,560	159,835	89.5	19,179	21,429	8.3
1976	114,576	91,835	80.2	13,085	16,315	7.0
1977	139,757	122,054	87.3	15,451	17,699	7.9
Avg.	166,006	140,150	84.4	18,303	21,734	7.6

* Computed by dividing the April-October WVDNR estimates by the percentage of the annual total CE estimates which occurred during the April-October time period

** Computed by dividing CE trip estimates by WVDNR trip estimates

followed by a modest decline in 1975. Both indices reflect a precipitous drop in angling participation in 1976, the first year of a minimum 304 mm (12 in) size limit for retention of black bass. Each agency's estimates indicated a subsequent modest increase in the number of angling trips in 1977.

On the average, over the same five-year time frame (1973-1977), about 84.4 percent (ranging from a low of 79.4 percent in 1974 to a high of 87.3 percent in 1977) of the total number of angling visitations accounted for in the annual 12-month CE surveys occurred during the April-October census period covered by the WVDNR creel survey. The remaining angling trips registered in the CE survey (15.6 percent of the total) occurred in the months of November, December, January, February, and March. Those months were not covered by the WVDNR creel survey.

Increasing the WVDNR annual creel survey angling trip estimates by an average of 15.6 percent, to account for the five-month period of each year not censused, provides a more realistic estimate of the annual angling pressure applied at East Lynn Reservoir. With this adjustment, the number of estimated annual reservoir angling trips amounts to 24,407 in 1973, 28,822 in 1974, 21,429 in 1975, 16,315 in 1976 and 17,669 in 1977.

These adjusted annual estimates of the number of reservoir angling trips should be considered as minimal because they do not take night fishing into account. Local WVDNR conservation officers estimate that night fishing may account for up to 20 percent of the total angling effort (Grady Coda, pers. comm., 1978).

CE estimates of angler visitations at the East Lynn Reservoir project also included separate estimates of angling trips made in the reservoir tailwater. The WVDNR did not conduct creel surveys of the tailwater fishery.

It was assumed that the reported CE estimates of the number of tailwater angling trips would be subject to the same inflationary biases as described previously for CE estimates of reservoir angler use. Adjustment of the CE estimates of angler man-day usage in the tailwater were made with the assumption that the tailwater estimates were biased in the same direction and magnitude as indicated for the CE reservoir angler man-day estimates (Table 20).

Adjusted angler usage of the East Lynn Reservoir tailwater averaged an estimates 2,918 trips (man-days) per year over the five-year survey period. The estimated number of tailwater angling trips increased from 2,774 in 1973 to a high of 3,843 in 1974, and declined steadily to 3,106 in 1975, 2,813 in 1976 and 2,058 in 1977.

No angler interviews were conducted at any time either at night or during the additional five winter and early spring months reflected in the adjusted fishing pressure values. As a result, it was not possible to estimate accurately the total fish harvest from the reservoir. Nevertheless, it was possible to arrive at minimal harvest values and to determine annual trends by relying solely on the annual (April through October) creel surveys conducted by the WVDNR.

Table 20. -- Calculated East Lynn Reservoir and tailwater man-day angler usage, 1973-1977

	CE man-day use estimates			Adjusted man-day use estimates		
	Tailwater	Reservoir	Ratio	Reservoir*	Tailwater**	Total project
1973	21,082	185,719	8.8	24,407	2,774	27,181
1974	28,205	211,417	7.5	28,822	3,843	32,665
1975	25,760	178,560	6.9	21,429	3,106	24,535
1976	19,833	114,576	5.8	16,315	2,813	19,128
1977	16,213	139,757	8.6	17,699	2,058	19,757
Avg.	22,239	166,006	7.5	21,734	2,918	24,652

* As previously computed in Table 19

** Computed by dividing the calculated WVDNR reservoir man-day usage by estimated CE reservoir/tailwater man-day use ratios

Total fish harvest and catch rate were highest during the early years of impoundment, peaking during the third year (1975) with a harvest of 112 fish/ha (45/ac) and a catch rate of 0.42 fish/hr. Both the total fish harvest and catch rate declined abruptly in 1976 to 33 fish/ha (13/ac) with a catch rate of 0.20 fish/hr. The decline continued in 1977 to 25 fish/ha (13/ac) with a catch rate of 0.12 fish/hr.

Black crappies, averaging 38 percent of the total number of fish harvested, and bluegills (28 percent) dominated the harvest over the five-year survey period (Table 21). The harvests of these two centrarchid species, 44 crappie/ha (18/ac) and 43 bluegill/ha (18/ac), were both highest in 1975 (third year of impoundment).

Bullheads averaged around 12 percent of the total number of fish harvested over the five-year census period, and channel catfish 1 percent. Bullheads, 11.2 fish/ha (4.5/ac), were most abundant in 1975. Channel catfish, an average 1 fish/ha (0.4/ac), were most abundant in 1977, which reflected successful stocking efforts in previous years.

Muskellunge, reflecting progressively increased fingerling stocking in 1972, 1973, and 1974, were harvested in greatest numbers in 1976 and 1977. An average of 0.3 fish/ha (0.1/ac) and 0.4 fish/ha (0.2/ac) were harvested in 1976 and 1977, respectively.

Walleyes comprised only a minor constituent (less than 0.5 percent) of the fish harvested in any census year, although stocked extensively as fry in 1972, 1973, and 1974. The greatest walleye harvests were recorded in

Table 21. -- Number of fish caught/ha and percentage composition, by species, recorded in WVDNR creel surveys at East Lynn Reservoir, 1973-1977

	Number fish harvested/ha					Number fish caught/ha*		
	1973	1974	1975	1976	1977	1975	1976	1977
Largemouth bass	24.7	11.9	9.8	2.5	2.8	39.4	14.7	17.6
Spotted bass	5.9	3.3	2.3	0.60	1.9	3.4	1.0	2.8
Smallmouth bass	1.8	0.70	0.70	0.20	0.30	1.8	1.5	2.3
Total black bass	32.4	15.9	12.8	3.3	5.0	44.6	17.2	22.7
Walleye	0.25	0.13	tr	0	0	tr	tr	tr
Muskellunge	0.21	tr	0.22	0.30	0.40	0.24	0.25	0.70
Black crappie	26.5	15.1	44.4	19.1	7.8	78.6	30.8	16.7
Bluegill**	11.5	29.7	42.8	7.2	5.5	164.6	54.4	47.6
Channel catfish	0.18	0.10	0.10	0.30	1.0	0.77	0.30	1.6
Bullhead	5.7	9.4	11.2	2.8	4.9	56.2	13.5	11.0
Total	77	70	112	33	25	345	117	100

	Percentage composition of harvest						Percentage composition of fish caught*			
	1973	1974	1975	1976	1977	Avg.	1975	1976	1977	Avg.
Largemouth bass	32	17	9	8	8	15	11	13	18	14
Spotted bass	8	5	2	2	11	5	1	1	3	2
Smallmouth bass	2	1	0.60	0.30	1	1	0.60	0.90	2	1
Total black bass	42	23	11	10	20	21	13	15	23	17
Walleye	0.30	0.20	tr	0	0	0.10	tr	tr	tr	tr
Muskellunge	0.30	tr	0.20	0.80	2	0.60	0.10	0.20	0.70	0.30
Black crappie	35	21	40	58	32	38	23	26	17	22
Bluegill**	15	42	38	22	22	28	48	47	47	47
Channel catfish	0.20	0.10	tr	0.90	4	1.0	0.20	0.30	2	0.80
Bullhead	7	13	10	8	20	11	16	12	11	13

* Includes fish caught and released in addition to fish harvested in 1975, 1976 and 1977
** Includes redbreast sunfish
tr -- Trace (less than 0.1)

1973, 0.25 fish/ha (0.1/ac), and 1974, 0.13 per ha (0.05/ac). No walleyes were harvested in subsequent years, indicating poor survival of the fish stocked within the reservoir. A considerable number of walleyes were reported caught in the tailwater during 1972 and 1973.

Typical of newly impounded waters, the black bass harvest was highest in the initial years of impoundment. A total of 32 bass/ha (13/ac) were harvested in 1973, the second year of impoundment, which declined by 50 percent in 1974 to 16/ha (6/ac). The decline continued in 1975, to 12.8/ha (5/ac). In 1976, the first year of the 304 mm (12 in) black bass minimum size limit, the bass harvest declined precipitously to 3.3 bass/ha (1.3/ac). This substantial harvest decline (74 percent) accompanied a drop in fishing pressure of 64 percent. The black bass harvest increased by 52 percent, to 5/ha (2/ac) in 1977, accompanying a lesser increase (22 percent) in fishing pressure.

An effort was made to determine whether these black bass creel statistics could be correlated with standing crop estimates resulting either from cove rotenone or electrofishing sampling. It was assumed that black bass catch rates would be positively correlated with bass standing crops and inversely correlated with angling pressure. It was also assumed that the creel survey statistics were reasonably accurate.

Table 22 presents the relationships between black bass standing crop values of catchable size fish obtained by cove rotenone and electrofishing sampling pressure in 1975, 1976 and 1977. Catchable size bass were defined as bass 18.9 cm (7.5 in) and larger and were expressed as the number

Table 22. -- Comparison of the relationship between black bass angling catch rates and standing crop estimates of harvestable size bass derived from electrofishing and cove rotenone samples obtained at East Lynn Reservoir, 1975-1977

	1975	1976	1977
Angling pressure			
Total hrs. fished	107,728	68,726	83,746
Hrs./shoreline mi. (45.8 miles of shoreline)	2,352	1,501	1,829
Hrs./acre (1,005 acres)	107.2	68.4	83.3
Total no. bass creeled	18,193	7,033	9,259
Calculated rate of catch			
Number of bass creeled ÷ the number of hours fished per shoreline mile	7.7	4.7	5.1
Number of bass creeled ÷ the number of hours fished per acre	170	103	111
Standing crop estimates [≥18.9 cm (7.5 in)]			
No./shoreline mi. (electrofishing samples)	18.6	17.0	11.8
No./acre (cove rotenone samples)	2.5	3.5	6.0
Ratio of rate of catch to standing crop estimates (availability ratio)*			
Electrofishing samples	2.4	3.6	2.3
Cove rotenone samples (x100)**	1.5	3.4	5.4

* Availability ratio represents the standing crop estimates (no.) divided by the calculated rate of catch

** The calculated availability ratios based on cove rotenone samples were multiplied by 100 to convert to whole numbers for comparison with data based on electrofishing samples

of bass collected per acre for cove rotenone samples and/or as the number of bass collected per shoreline mile for electrofishing samples. To expedite appropriate comparison, angling pressure was expressed as the number of hours fished/ac (for comparison with cove rotenone samples) or as the number of hours fished per mile of shoreline (for comparison with electrofishing samples).

An annual availability index was computed by dividing standard numbers of catchable bass collected (number per unit of cove area sampled with rotenone and/or unit of shoreline distance sampled by electrofishing) by the pressure-adjusted catch rates for bass angling. The latter values were calculated by dividing the total number of bass creeled by the appropriate number of hours fished per unit of area or shoreline distance.

The black bass standing crop estimates based on electrofishing data appeared to be far more reliable than corresponding estimates based on cove rotenone samples. Attesting to that conclusion, annual availability indices based on standing crop estimates derived from electrofishing (2.4 in 1975, 3.6 in 1976, and 2.3 in 1977) were far more consistent with trends in angling harvest than comparable indices derived from cove rotenone sampling data (1.5 in 1975, 3.4 in 1976, and 5.4 in 1977).

Similarly, electrofishing proved superior to cove rotenone sampling for estimating bass population size in a recent study conducted by the WVDNR at Sherwood Lake, a 67 ha (166 ac) impoundment located in southeastern West Virginia (22).

Fishery Resources -- Evaluation of Planning Input

A review of the three pertinent FWS reports dealing with the fishery resource of the East Lynn project (draft reports dated August 15, 1961, and July 2, 1964; and final report dated October 9, 1964) and related correspondence with the WVDNR and the CE, indicates that considerable effective interagency cooperation occurred throughout critical stages of project planning.

The FWS report of August 15, 1961, which responded to the initial CE project proposal for construction of three reservoirs on the Twelvepole Creek watershed, was particularly thorough. Fishery-oriented recommendations contained in this preliminary report appeared to be well advised. They served as the foundation for the more refined recommendations that were issued by the FWS in their subsequent (1964) report specifically to address the East Lynn Reservoir project as finally constructed.

Examples of the forward-looking planning recommendations formulated in the preliminary (1961) FES report included recommendations for funding studies (as an additional cost to the project) to determine,(a) the type of fishery most suitable to tailwater areas, (b) the appropriate minimum stream flow and optimum water temperatures for downstream areas, (c) the extent and cost of necessary programs for control of undesired fish, (d) the exact locations for access sites, and (e) suitable areas and plans for seining and trapping rough fish. These early recommendations were later accommodated, as suggested by the FWS, through cooperative efforts of the WVDNR, FWS, and CE. It was particularly noteworthy that the CE

approved funding for the additional studies proposed by the FWS (23). Also, the WVDNR accomplished a partial reclamation of the reservoir watershed, in 1972, prior to the stocking of desired sport fish species.

Subsequent FWS reports, in 1964, recommended immediate development of three specific boat access sites on the reservoir (two primarily for anglers with suitable zoning provisions to prevent conflict with water skiing and general boating activities) and future development at a fourth site.

Other fishery recommendations made by the FWS in its 1964 report included the following: (1) timber to be left standing in selected areas for fishery purposes; (2) existing roads to the pool area to be left open for access; (3) an investigation to be made to determine the presence of coal mine adits and their effect if any on water quality in the reservoir; (4) insofar as possible, operation of the dam to include plans for maintenance of a stable water level during the smallmouth and largemouth bass spawning periods; (5) all project lands and included water areas, except for such areas reserved for general recreation, for reasons of safety, and for operation purposes, to be made available to the West Virginia Department of Natural Resources in accordance with a General Plan for Fish and Wildlife Management; and (6) establishment of horsepower regulations and selection of areas for non-removal of timber to be accomplished cooperatively among the West Virginia Department of Natural Resources, the Corps of Engineers, and the Bureau of Sport Fisheries and Wildlife.

The location of fisherman access sites received considerable attention from all concerned agencies. In a letter dated 9 July, 1964, addressed to the USFWS, the Chief, Engineering Division of the Ohio River Division, CE, reported concurrence with proposed access recommendations, viz (6):

> Recommendation 1. Three lakeside access sites which include boat launching facilities are proposed, two of which are at sites proposed in your report. It is believed that these sites will adequately serve both general recreation and fishery purposes.
>
> Recommendation 2. A fisherman access is proposed downstream from the dam.
>
> Recommendation 3. An access area with boat launching and parking facilities at the mouth of Kiah Creek is proposed for future development.
>
> Recommendation 4. The parking and access areas along with other developments will be made available to the West Virginia Department of Natural Resources for administration and maintenance.

The preceding recommendations for access, as well as all other major fishery-related recommendations contained in the FWS reports, were eventually undertaken by the CE.

Predictions of angler usage included in the 1961 and 1964 FWS reports are compared in Table 23 with estimated post-impoundment occurrences, derived from creel surveys conducted by the WVDNR. The 1961 report of the FWS provided separate predictions calculated for "managed" (16,800 man-days) and "unmanaged" (11,200 man-days) reservoir fisheries. The same report failed to consider the tailwater fishery. Both predictions concerning the reservoir fishery proved to be substantially lower than the estimated post-impoundment (1973-1977) angler usage, averaging 21,723 man-days annually. The prediction for a "managed" reservoir fishery which

Table 23. -- Comparison of the predicted angler usage (man-days) at East Lynn Reservoir as contained in the August 15, 1961, FWS report (with and without implementation of recommended reservoir fishery management regimes) and the 1964 FWS reports (with and without implementation of recommended access provisions) with average post-impoundment occurrences from 1973-1977.

	Reservoir		Tailwater		Total	
	No.	% change	No.	% change	No.	% change
A. Post-impoundment occurrences						
Man-days	21,734		2,918		24,652	
B. Pre-impoundment predictions						
1961 FWS report						
(Without fish management)						
Man-days	11,200		*		11,200	
Net	-10,534	-48			-13,452	-55
(With fish management)						
Man-days	16,800				16,800	
Net	-4,934	-23			-7,852	-32
1964 FWS report						
Without spec. access prov.						
Man-days	34,200		500		34,700	
Net	+12,466	+57	-2,418	-83	+10,048	+41
With spec. access prov.						
Man-days	40,250		1,000		41,250	
Net	+18,516	+85	-1,918	-66	+16,598	+67

* No estimate made for tailwater fishery in 1961 FWS report

was presented in the 1961 FWS report was an estimated 23 percent less than actual occurrence. The preliminary prediction by the FWS for use of the "unmanaged" reservoir fishery fell below post-impoundment experience by an estimated 48 percent.

The 1964 predictions by the FWS of post-impoundment angler use included separate estimates with respect to both reservoir and tailwater fisheries. The 1964 FWS report indicated, further, that provision of "special angler access" facilities could be expected to generate substantial added use.

The predicted 40,250 man-days of reservoir use, predicated on development of special angler access areas, was projected to be significantly higher (by 17 percent) than the 34,200 man-days of angler-use the FWS predicted in the absence of such facilities. However, both estimates proved to be substantially higher than observed post-impoundment occurrences with recommended access facilities in place. The prediction of reservoir use which assumed no construction of special angler access facilities was 57 percent higher than observed post-impoundment use (with fully developed access). The prediction predicated on the provision of special angler access facilities was 85 percent higher than observed post-impoundment occurrences aided by developed access sites.

Conversely, predictions of annual angler use of the tailwater (500 man-days without provision for special angler access facilities; 1,000 man-days assuming development of special access facilities) were considerably underestimated in the 1964 report of the FWS. These predicted levels of

use were 83 percent and 66 percent less, respectively, than the 2,918 man-days of estimated average annual post-impoundment use by anglers.

The striking disparity between reservoir use predictions contained in the FWS report of 1961 [29.6 man-days/ha (12/ac) for a "managed" fishery] and their 1964 report [98.8 man-days/ha (40/ac), assuming development of adequate angler access facilities] could not be explained on the basis of information contained in the project documents available for examination. Although an exhaustive search was made of relevant data storage facilities, it was not possible to locate any supporting basic data describing the rationale and/or techniques employed in developing projections for the number of man-days of post-impoundment angler usage which appear in the FWS report of 1964.

The failure of the FWS authors of the 1964 report to include adequate exposition of the strategy employed in deriving their predictions for man-days of post-impoundment angler use constitutes a major procedural flaw in the planning process. Unfortunately, this same circumstance has plagued the majority of other FWS planning documents examined to date.

Predictions of angler usage incorporated within the 1961 FWS report, on the other hand, were documented by extrapolation both from projections estimating the average number of anglers expected to reside within the vicinity of the reservoir over a 50-year period and from the anticipated availability of similar types of angling waters. Other pertinent factors duly considered by the authors of the preliminary (1961) FWS report included the potential influence of intensive reservoir fisheries manage-

ment, sport fish species composition, water quality, and development of angler access.

Treatment of pre- and post-impoundment water quality parameters in the FWS reports was variable. On the positive side, the 1961 and 1964 FWS reports consistently recommended a minimum low flow release of 10 cfs. This proposal, which was accepted and later implemented by the CE, proved to be adequate. Minimum flows less than the prescribed 10 cfs were rarely released, primarily in the early years of impoundment. Failures to release the prescribed minimum low flow were attributed to an unforseen shift of the rating curve in the low range of flow.

FWS predictions that tailwater fish populations would be improved as a result of more stable stream flow were borne out by subsequent post-impoundment investigations. As noted in Table 24, the total biomass of tailwater fish, based on electrofishing sampling in 1974 and 1975, averaged 78.3 kg/ha (96.9 lbs/ac). By comparison, total fish biomass in the same general area in the pre-impoundment years of 1966 and 1971 averaged 46.4 kg/ha (41.4 lbs/ac). Game fish biomass increased from an average of 14.9 kg/ha (13.3 lbs/ac) in pre-impoundment sampling to 37.1 kg/ha (33.1 lbs/ac) in post-impoundment samples. The percentage of the total fish biomass comprised by game fish species increased from an average of 32 percent in pre-impoundment samples to 47 percent of the post-impoundment tailwater samples.

It appeared that the increased proportion of game fish in the total tailwater fish biomass following impoundment could be partially attributed

Table 24. -- Comparison of pre- and post-impoundment fish biomass and percentage game fish composition derived from electrofishing samples collected in East Fork of Twelvepole Creek. (Post-impoundment data from East Lynn Reservoir tailwater)

	Pre-impoundment			Post-impoundment		
	1966[1]	1971[2]	Average	1974[3]	1975[4]	Average
Total biomass						
kg/ha	49.6	43.2	46.4	97.4	59.2	78.3
lbs/acre	44.3	38.5	41.4	86.9	52.8	69.9
% Gamefish	34.7	29.2	32.0	50.1	42.8	47.4
Game fish biomass						
kg/ha	17.2	12.6	14.9	48.8	25.3	37.1
lbs/acre	15.3	11.2	13.3	43.5	22.6	33.1

1. After Miles, 1966 (24)
2. After Tarter, 1972 (25)
3. After Goodno, 1975 (2)
4. After Muth, et. al, 1974 (19)

to downstream movement of fish from the reservoir. Clearly, the post-impoundment tailwater fish population was more representative of the reservoir than of the East Fork of Twelvepole Creek prior to impoundment. Walleyes, muskellunge, black crappies, and channel catfish, all of which had been stocked in the reservoir, were abundant in the post-impoundment tailwater electrofishing samples. In fact, walleyes were more abundant in tailwater collections than in comparable reservoir collection, suggesting substantial downstream movement through the reservoir discharge facilities.

However, the 1961 and the 1964 FWS reports failed to identify high concentrations of iron and manganese in the East Fork of Twelvepole Creek which were noted during subsequent pre-impoundment water quality investigations conducted between 1965 and 1972 (26).

Post-impoundment water quality studies conducted by WVDNR illustrated the unexpected impact of reservoir stratification on certain water quality parameters in both reservoir and tailwater, particularly oxygen, iron and manganese levels. Typically, reservoir stratification developed in mid-spring and became increasingly severe during the summer and early fall. Nearly isothermal conditions existed from late November through February. The upper level of the thermocline usually ranged between 3 to 4.6 m (10 to 15 ft) by late July or early August. Although epilimnial water quality was excellent, oxygen depletion was usually severe in the hypolimnion, and iron and manganese levels became elevated at lower reservoir depths during the late summer and fall. These adverse water quality

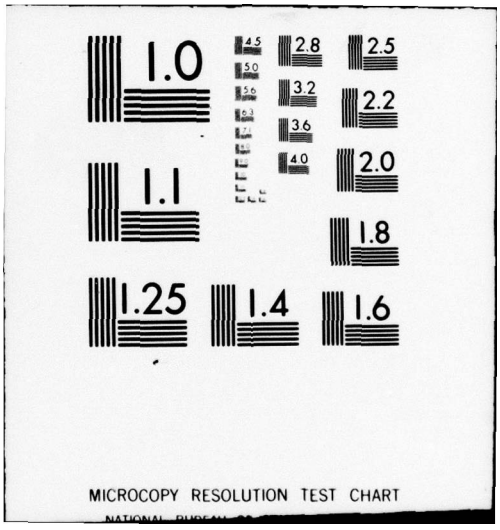
AD-A069 187 SPORT FISHING INST WASHINGTON D C F/G 6/3
EVALUATION OF PLANNING FOR FISH AND WILDLIFE AT CORPS OF ENGINE--ETC(U)
FEB 79 DACW73-74-C-0040

UNCLASSIFIED NL

2 OF 2
AD
A069187



END
DATE
FILMED
7-79
DDC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1
8.0
9.0
MICROCOPY RESOLUTION TEST CHART

impacts caused by project construction were not anticipated in either of the 1961 or 1964 FWS reports.

Except for periods of hypolimnial discharge from the reservoir, water quality of the tailwater was generally adequate to support a diverse fish community. However, elevated levels of iron (particularly) sulfides, and manganese occurred in the tailwater during periods of hypolimnial release from the reservoir. The abundance of benthic organisms in the tailwater was severely reduced during a period of hypolimnial discharge in 1973 (2). Also, extremely high levels of iron were found in the tailwater in 1974 during an extended period of hypolimnial discharge which was requested by the WVDNR to provide the cold water discharge necessary to facilitate an experimental year-round trout fishery in the tailwater. This experimental WVDNR program was subsequently abandoned, following which an epilimnial reservoir discharge regime was implemented thereby substantially eliminating further water quality problems in the tailwater.

The overall impact on sport fishery resources of construction of the East Lynn Reservoir project appeared to be highly favorable. Estimates of pre-impoundment angler use on comparable sections of the Twelvepole Creek Watershed affected by subsequent reservoir construction amounted to a total of 550 man-days per year [450 man-days/yr in the 5.3 km (3.3 mi) tailwater section]. Estimated average annual post-impoundment (1973-1977) angler use, a total of 24,652 man-days, was nearly 45 times estimated pre-project use (Table 25).

Table 25. -- Comparison of average annual post-impoundment man-day use estimates for East Lynn Reservoir and tailwater (1973-1977) with average annual pre-impoundment man-day use estimated for comparable stream sections in the 1964 FWS report

Location	Pre-impoundment stream fishery No. man-days	Post-impoundment fishery No. man-days	Ratio
Above dam site	450	21,734	48.3
Below dam site	100	2,918	29.2
Total project	550	24,652	44.8

SUMMARY

The East Lynn Reservoir project is located on East Fork of Twelvepole Creek in Wayne County, West Virginia, approximately six air miles south-southeast of Wayne, West Virginia. Huntington, West Virginia; and Ashland, Kentucky, are within a 25-mile radius of the project.

As completed, the project consists of a total fee purchase area of approximately 9,928 ha (24,532 ac). Included is a 407 ha (1,005 ac) impoundment, at seasonal recreational pool level, completely surrounded by 9,521 ha (23,527 ac) of contiguous highlands. The CE operates and maintains 387 ha (956 ac) for public recreation, 8,670 ha (21,424 ac) for fish and wildlife conservation (with the advice and assistance of the West Virginia Department of Natural Resources), and the remaining 871 ha (2,152 ac) for project operation purposes (23).

The FWS submitted three separate reports (dated August 15, 1961; July 2, 1964; and October 9, 1964) describing pre-project conditions and predicting post-impoundment impacts on fish and wildlife resources. These reports responded to corresponding CE project development proposals displaying widely divergent parameters of impoundment size and scope of project land acquisitions that evolved over the years.

The FWS report of August 15, 1961, which responded to the initial CE proposal for construction of three reservoirs on the Twelvepole Creek watershed, was more substantive than the subsequent FWS reports. Both their July 2, 1964, draft report and their October 9, 1964 final report failed

to include adequate basic data describing the rationale and/or techniques employed in developing projections of post-impoundment hunting and angling use. However, fishery considerations were treated in greater depth than wildlife aspects in all three FWS reports. Only perfunctory effort was made to describe the pre-project wildlife resources. Well conceived fishery-oriented recommendations provided for maximum enhancement of the project's fishery resource base and subsequent utilization by anglers.

No specific recommendations pertaining to wildlife resources were advanced in any of the reports other than the general stipulation that "all project lands and included water areas, except for such areas reserved for general recreation, for reasons of safety, and for operation purposes, will be made available to the West Virginia Department of Natural Resources in accordance with a General Plan for Fish and Wildlife Management." Unfortunately, this recommendation was never implemented because of the inability of the WVDNR to secure adequate funding. As a result, WVDNR wildlife management activities have been restricted to enforcement of applicable state game laws and regulations. Conversely, all of the fishery-related recommendations of the FWS were subsequently accepted and approved by the CE and eventually implemented.

The several FWS reports reflected a greater intensity and continuity of coordination between the CE, FWS and WVDNR for fishery-oriented affairs than was evident for wildlife. In response to recommendations made in the initial (1961) FWS report, the Corps funded interim studies to inves-

tigate the type of fishery most suitable for the reservoir tailwater and to determine appropriate minimum stream flow and water temperatures. The CE constructed a temporary 40.5 ha (100 ac) holding pool immediately upstream from the East Lynn dam in 1971 (prior to impoundment in the spring of 1972) in order to facilitate the fish stocking efforts by the WVDNR.

FWS predictions of post-impoundment hunter and angler use were both somewhat wide of the mark. The final FWS predictions, in their October 9, 1964 report, overestimated angler use by approximately 67 percent and underestimated hunter use by some 81 percent. However, the FWS reports correctly predicted that adverse impacts on fish and wildlife utilization caused by the project could be successfully mitigated. The final FWS report predicted that the project would provide substantial fishery benefits and slight hunting benefits.

The reservoir has supported an average of some 21,734 angler man-days per year (1973 to 1977) of warmwater sport fishing. Post-impoundment angler use of the project area, therefore, has averaged 48.3 times the estimated annual pre-impounded stream usage of 450 angler man-days. Annual post-impoundment tailwater usage has averaged 2,918 angler-days or about 29.2 times the 100 angler-days of estimated pre-impoundment use.

Estimated annual post-impoundment hunter use of project lands (1972-1977) has averaged some 0.85 trips/acre (approximately 20,000 man-days), or 81 percent higher than the FWS prediction of 0.54 trips/acre without the project. It should be emphasized, however, that these man-day use values, particularly for hunting man-day use, represent "best estimates" and/or

opinions rendered by professionals closely associated with the project rather than empirical data collected according to a statistically designed study.

It seems evident that the enhanced opportunity for public hunting that accrued through the purchase of extensive formerly private land holdings, 9,521 ha (23,527 ac), contributed substantially to the greater than anticipated hunting pressure which subsequently occurred on project lands.

REFERENCES

1. Huntington District. 1974. Final Environmental Impact Statement, East Lynn Lake, Twelvepole Creek, West Virginia. U.S. Army Engineers, Huntington, West Virginia. August 23, 1974.

2. Goodno, E. J. 1974. Post-impoundment Limnology of the East Lynn Lake Tailwater, East Fork of Twelvepole Creek, Wayne County, West Virginia. M.S. Thesis, Marshall University, Department of Biological Sciences.

3. Gottschalk, J. S. 1961. Twelvepole Creek Basin, West Virginia. A Detailed Report on Fish and Wildlife Resources. U.S. Fish and Wildlife Service. August 15, 1961.

4. Huntington District. 1963. Memorandum concerning land acquisition policies. U.S. Army Engineers, Huntington, West Virginia. October, 1963.

5. Jacobson, F. L. 1964. Draft letter report on fish and wildlife resources of the East Lynn Reservoir project, Wayne County, West Virginia. U.S. Fish and Wildlife Service. July 2, 1964.

6. Barnes, J. N. 1964. Huntington District, U.S. Army Corps of Engineers. Letter of July 9, 1964.

7. Jacobson, F. L. 1964. Letter report on fish and wildlife resources of the East Lynn Reservoir project, Wayne County, West Virginia. U.S. Fish and Wildlife Service. October 9, 1964.

8. Abbot, E. E. 1965. East Lynn Reservoir - Design Memorandum No. 4A, Preliminary Master Plan. Ohio River Division, U.S. Army Corps of Engineers. May 11, 1965.

9. Huntington District. 1977. East Lynn Lake Fish and Wildlife Management, Appendix D to Master Plan. Huntington District, U.S. Army Corps of Engineers. April, 1977.

10. Huntington District. 1973. Appendix B, Forest Management Plan, East Lynn Lake Master Use Plan. U.S. Army Corps of Engineers, Huntington, West Virginia. March 7, 1973.

11. Hulett, C. S. 1968. Governor of State of West Virginia. Letter of August 23, 1968.

12. Brackenrich, J. D. 1973. West Virginia Department of Natural Resources, letter of June 1, 1973.

13. Latimer, I. S. 1975. West Virginia Department of Natural Resources. Letter of June 1, 1973.

14. Latimer, I. S. 1975. West Virginia Department of Natural Resources. Letter of July 9, 1975.

15. Weicking, E. H. 1960. Report on the panel on recreational values of the Subcommittee on Evaluation Standards (Inter-Agency Committee on Water Resources). May 24, 1960.

16. Miles, R. E. 1973. Reservoir Investigations, East Lynn Reservoir Study, Dingell-Johnson Proj., F-11-R-11, West Virginia Department of Natural Resources, 10 p. (Mimeo).

17. Muth, S. E. 1974. Reservoir Investigations, East Lynn Reservoir Study, F-11-R-12, West Virginia Department of Natural Resources, 3 p. (Mimeo).

18. Muth, S. E. 1975. Reservoir Investigations, East Lynn Reservoir Study, F-11-R-13, West Virginia Department of Natural Resources, 4 p. (Mimeo).

19. Muth, S. E. and B. E. Pierce. 1976. Reservoir Investigations, East Lynn Reservoir Study, F-11-R-14, West Virginia Department of Natural Resources, 22 p. (Mimeo).

20. Muth, S. E. and B. E. Pierce. 1977. Reservoir Investigations, East Lynn Reservoir Study, F-11-R-15, West Virginia Department of Natural Resources, 19 p. (Mimeo).

21. Muth, S. E. and B. E. Pierce. 1978. Reservoir Investigations, East Lynn Reservoir Study, F-11-R-16, West Virginia Department of Natural Resources, 15 p. (Mimeo).

22. Woodrum, J. E. 1979. Comparison of rotenone and electrofishing population estimates to lake draining. Proc. 32nd Annu. Conf. S. E. Assoc. Game and Fish Comm. (In press).

23. Beemer, H. W. 1977. Supplement No. 3 to Design Memorandum No. 4B, Master Plan, East Lynn Lake, West Virginia. Ohio River Division, U.S. Army Corps of Engineers. August 3, 1977.

24. Miles, R. W. 1966. Pre-impoundment survey East Fork of Twelvepole Creek, West Virginia Department of Natural Resources. 8 p.

25. Tarter, D. C. 1972. A pre-impoundment investigation of the limnology of East Fork of Twelvepole Creek, Lincoln, Mingo, and Wayne Counties, West Virginia. W. Va. Acad. Sci. 44 No. 1:94-103.

26. Huntington District. 1974. Final Environmental Statement, East Lynn Lake, Twelvepole Creek, West Virginia. Huntington District, U.S. Army Corps of Engineers, August 23, 1974.

☆U.S. GOVERNMENT PRINTING OFFICE: 1979 O—625-894/1418 REGION 3-1