

AD-A034 136

SPORT FISHING INST WASHINGTON D C
EVALUATION OF PLANNING FOR FISH AND WILDLIFE AT CORPS OF ENGINE--ETC(U)
JUN 76

F/G 13/2

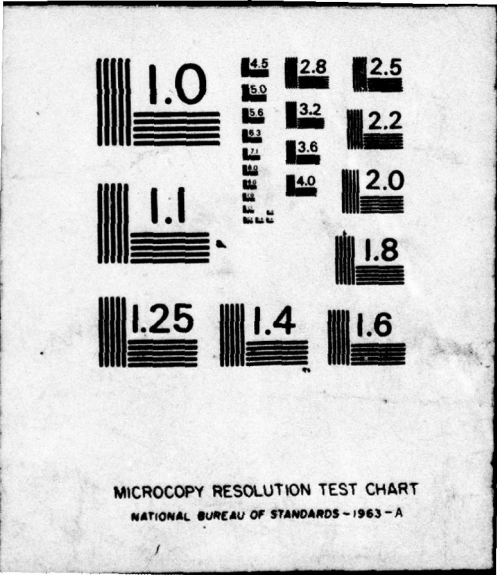
DACW73-74-C-0040

NL

UNCLASSIFIED

1 OF 1
AD 34136
DATE
FILMED





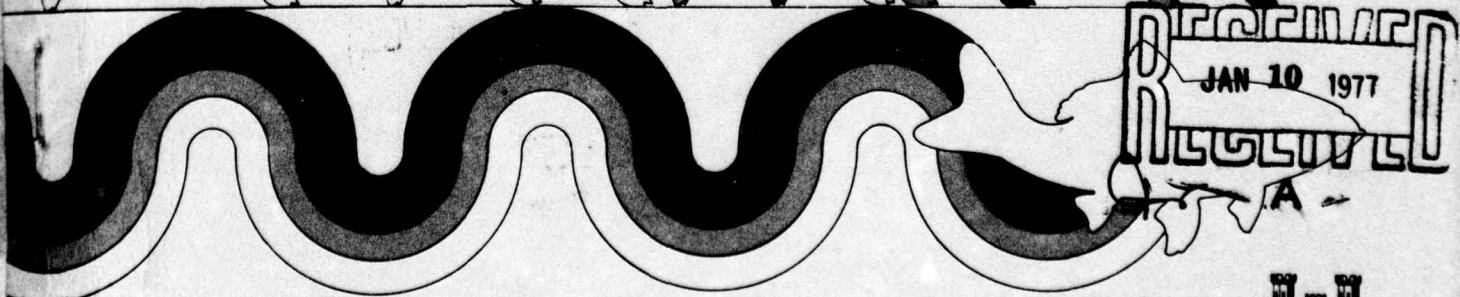
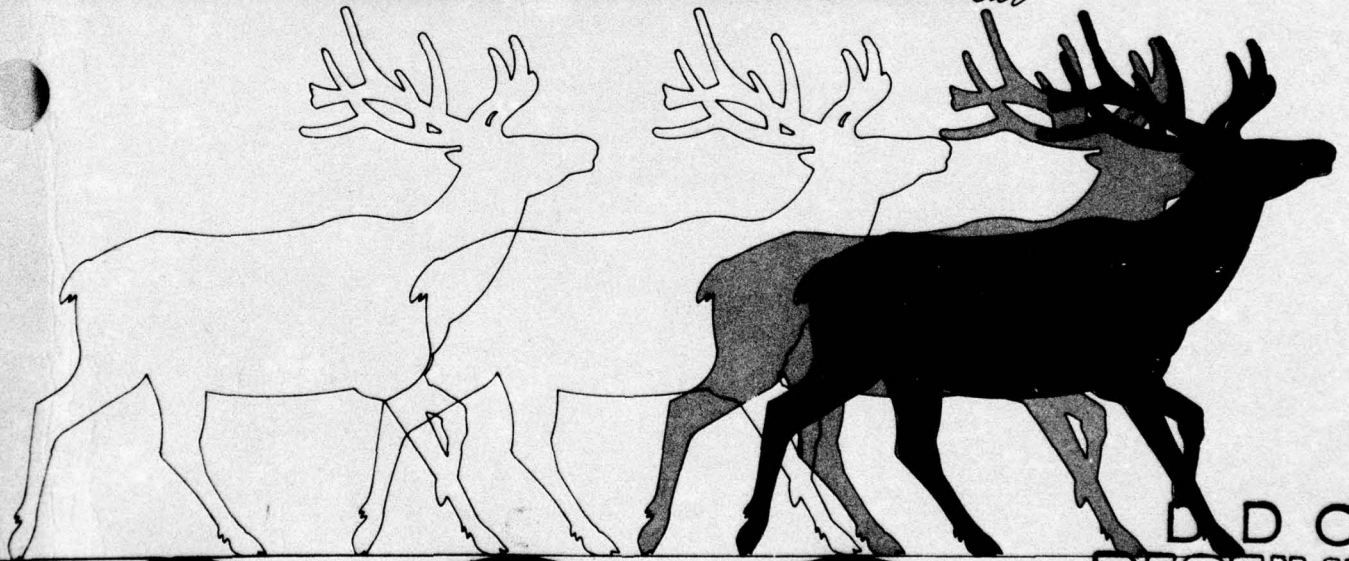
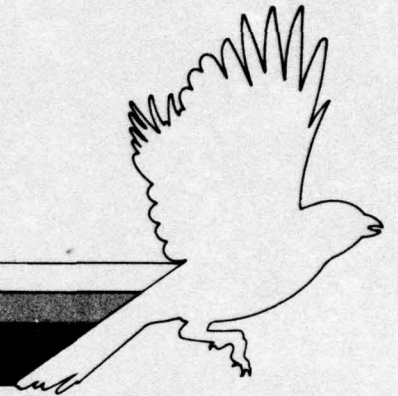
ADA 034136

5

Evaluation of Planning for Fish & Wildlife

John Redmond
Reservoir Project

June 1976



D D C

RECEIVED
JAN 10 1977
REGISTRY

Approved for
Public Release.
Distribution Unlimited

New
409992



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

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ⑥ Evaluation of Planning for Fish and Wildlife at Corps of Engineers Reservoirs - John Redmond Reservoir,		5. TYPE OF REPORT & PERIOD COVERED ⑨ Interim rept.
7. AUTHOR(s)		6. PERFORMING ORG. REPORT NUMBER
✓ 15		8. CONTRACT OR GRANT NUMBER(s) DACW73-74-C-0040 <i>new</i>
9. PERFORMING ORGANIZATION NAME AND ADDRESS Sport Fishing Institute <i>set up</i> 608 13th Street, N.W. Washington, D.C. 20005		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS ⑬ 48 p.
11. CONTROLLING OFFICE NAME AND ADDRESS Office, Chief of Engineers Washington, D.C. 20314		12. REPORT DATE ⑪ Jun 76 ✓
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES 41
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		
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, VA 22151		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Fish resources Wildlife refuge Planning recommendations Wildlife resources John Redmond Reservoir Preimpoundment predictions Planning evaluation Postimpoundment occurrences		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Kansas John Redmond Reservoir is a 3,804 ha impoundment completed by the CE in 1964 to provide flood control, water conservation, recreation, and water supply benefits. The total project of 12,829 ha includes 7,487 ha under cooperative agreement with the FWS for management as the Flint Hills National Wildlife Refuge. An additional 596 ha of project lands are licensed for game management to the KFFGC. (cont on p 1473B) ←		

Block 20 - Abstract (Continued, P 1473A)

Post-impoundment surveys indicate that the project (including refuge) annually supports an average of 10,132 man-days of hunting activity, including 2,263 man-days of upland game hunting and 7,869 man-days of waterfowl hunting. The waterfowl hunting prediction was three times greater, and predicted upland game hunting activity was four times greater than actual occurrences. Use of the project by migratory waterfowl was as expected for ducks (approximately 3,000,000 days, annually) but has averaged only 20 percent of the predicted level for geese, (477,655 days annually).

The qualitative fisheries predictions were generally accurate. Assuming that the term "reservoir" as used in the predictive report included consideration of both lake and tailwater, the predicted volume of angling, (84,000 man-days) was about 38 percent higher than the actual angler pressure of 1974. (61,000 man-days). The post-impoundment angling use in the Grand (Neosho) River below the John Redmond Reservoir was four times the value predicted in the pre-impoundment report.

The general project evaluation prepared by the FWS in 1961 was perfunctory, at best. Later reports prepared by the FWS in 1963 to justify authorization of the national wildlife refuge, were more comprehensive.

ACQUISITION OR	
NTIS	<input checked="" type="checkbox"/>
DDC	<input type="checkbox"/>
UNANALYZED	<input type="checkbox"/>
JUSTIFICATION	
BY	
DISTRIBUTION/AVAILABILITY	
Dist.	
A	

UNCLASSIFIED

CONTENTS

	<u>Page</u>
PROJECT PERSONNEL	11
LIST OF TABLES	iii
LIST OF FIGURES	iv
INTRODUCTION	1
Location	1
Authorization	1
Physical Features	1
Area Description	2
Descriptive Reports	2
WILDLIFE RESULTS AND DISCUSSION	6
Wildlife Resources -- Pre-impoundment Predictions	6
Wildlife Resources -- Post-impoundment Occurrences	12
Wildlife Resources -- Evaluation of Planning Input	20
(1) Waterfowl	21
(2) Upland Game	24
FISHERY RESULTS AND DISCUSSION	26
Fishery Resources -- Pre-impoundment Predictions	26
Fishery Resources -- Post-impoundment Occurrences	28
Fishery Resources -- Evaluation of Planning Input	30
(1) Qualitative Assessment of the Reservoir Community	30
(2) Quantitative Projection of Angling Use	33
(3) Qualitative Evaluation of the Sport Fishery	35
SUMMARY	37
BIBLIOGRAPHY OF SOURCE REFERENCE MATERIAL	40

PROJECT PERSONNEL

Robert Martin (Project Leader)

Norville Prosser (Assistant Project Leader)

Marcia Cavanaugh (Project Secretary)

Richard Stroud (Contractor's Representative)

CONSULTANT'S REVIEW

The interpretations of terrestrial wildlife aspects by project personnel were submitted in draft report form to consultative review and evaluation by specialists on the staff of the Wildlife Management Institute. Their evaluation was accomplished solely on the basis of facts presented in the manuscript without benefit of supplemental field reconnaissance. All suggestions of substance offered by the consultant are reflected in this report.

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Use Predictions for Waterfowl Hunting and Upland Game Hunting of the John Redmond Project Associated with Various Development Plans	11
2	Estimated Numbers of Waterfowl Hunter-days at the John Redmond Reservoir Project, 1970 through 1974	16
3	Estimated Numbers of Annual Hunter-days for Species Other than Waterfowl (Primarily Upland Game) Associated with the John Redmond Reservoir Project, 1970 through 1974	17
4	Annual Duck-day Use and Goose-day Use Estimated for the Flint Hills National Wildlife Refuge, 1967 through 1974	19
5	Pre-impoundment Predictions Related to Waterfowl and Actual Post-impoundment Occurrences Recorded at the John Redmond Reservoir	22
6	Sport Fish Harvest and Angling Effort at John Redmond Reservoir in 1974	31
7	Species Composition of the 1974 John Redmond Reservoir Sport Fish Harvest	32
8	Sport Fishery Creel Statistics for 10 Kansas Federal Reservoirs (Impounded Surface) 10 Years or Greater in Age (All Data was Gathered During the 1974 Angling Season)	36

LIST OF FIGURES

Figure

1

John Redmond Reservoir and Associated Game Management Areas and Other Prominent Physical Features.

Page

3

INDIVIDUAL RESERVOIR PROJECT EVALUATION REPORTS

THE JOHN REDMOND RESERVOIR PROJECT

INTRODUCTION

Location

The John Redmond Reservoir project is located in Lyon and Coffey Counties, about 60 miles south of Topeka, Kansas. The local economy is predominantly one of agriculture, and population density is low. The largest town in Lyon and Coffey Counties is Emporia, which had a 1970 population of 23,327. John Redmond Dam is on the Grand (Neosho) River at river mile 343.7 approximately 2 miles northwest of Burlington, Kansas. Interstate Route 35 (from the Kansas City metropolitan area) passes approximately 10 miles north of the project, and the lake is almost directly accessible from U. S. Route 75. Administratively, the John Redmond project is located in the Tulsa District of the Southwestern Division, U. S. Army Corps of Engineers (CE).

Authorization

The project was originally authorized as the Strawn Dam and Reservoir by the Flood Control Act of May 1950 (Public Law 516, 81st Congress, Chapter 188, 2nd session) for flood control, water conservation, recreation, and water supply. The project was redesignated the John Redmond Reservoir and Dam by Act of Congress (Public Law 85-327, 85th Congress, 2nd session) dated February 15, 1958. The Flood Control Act of 1965 contained authorization for the acquisition of additional acreage for purposes of enlarging and enhancing the proposed national wildlife refuge.

Physical Features

Construction of John Redmond Reservoir began in July 1959 and was completed in August 1964. At conservation pool elevation 316.7 m (1,039 ft.) mean sea level (msl),

3,804 ha (9,400 ac) are impounded. At flood control elevation 325.5 m msl (1,068 ft.), there are $8.0 \times 10^8 \text{ m}^3$ (644,600 ac-ft.) of flood water storage and a surface area of 12,829 ha (31,700 ac). The watershed is comprised of 7,809 km^2 (3,015 mi^2) of the upper Neosho River Valley. Total project land area (including flowage easements) is 12,828 ha (31,701 ac) (1). The flood storage basin is extremely shallow and subject to frequent inundation. The entire flood control storage can be expected to be utilized once every 13 years (2). Most of the water supply storage, authorized as a primary project benefit, will be used as cooling water for a proposed nuclear generating plant (after diversion to separate storage basin).

Approximately 7,487 ha (18,500 ac) of project lands are under cooperative agreement with the Branch of Wildlife Refuges, U.S. Fish and Wildlife Service (FWS) and are administered as the Flint Hills National Wildlife Refuge. The Kansas Forestry, Fish and Game Commission (KFFGC) has 596 ha (1,472 ac) of project land and water under license for wildlife management. This area is known as the Otter Creek Game Management Area. The reservoir and management areas are shown in Figure 1.

Area Description

The reservoir is located in a broad, shallow valley wherein the more upland portions of terrain are characterized by low, rounded hills. Cottonwood, elm, ash, and various species of oak and hickory typify the area's perennial vegetation. Much of the higher elevation areas are characterized by native grasses that are dominated by big and little bluestems. The principal agricultural crops in the area are wheat, corn, alfalfa, and grain sorghum.

Descriptive Reports

John Redmond Reservoir project files were examined at both federal and state agency offices. Specific sources of pertinent data visited during the John Redmond Reservoir study included: (1) National Archives in Washington, D.C., Kansas Forestry,

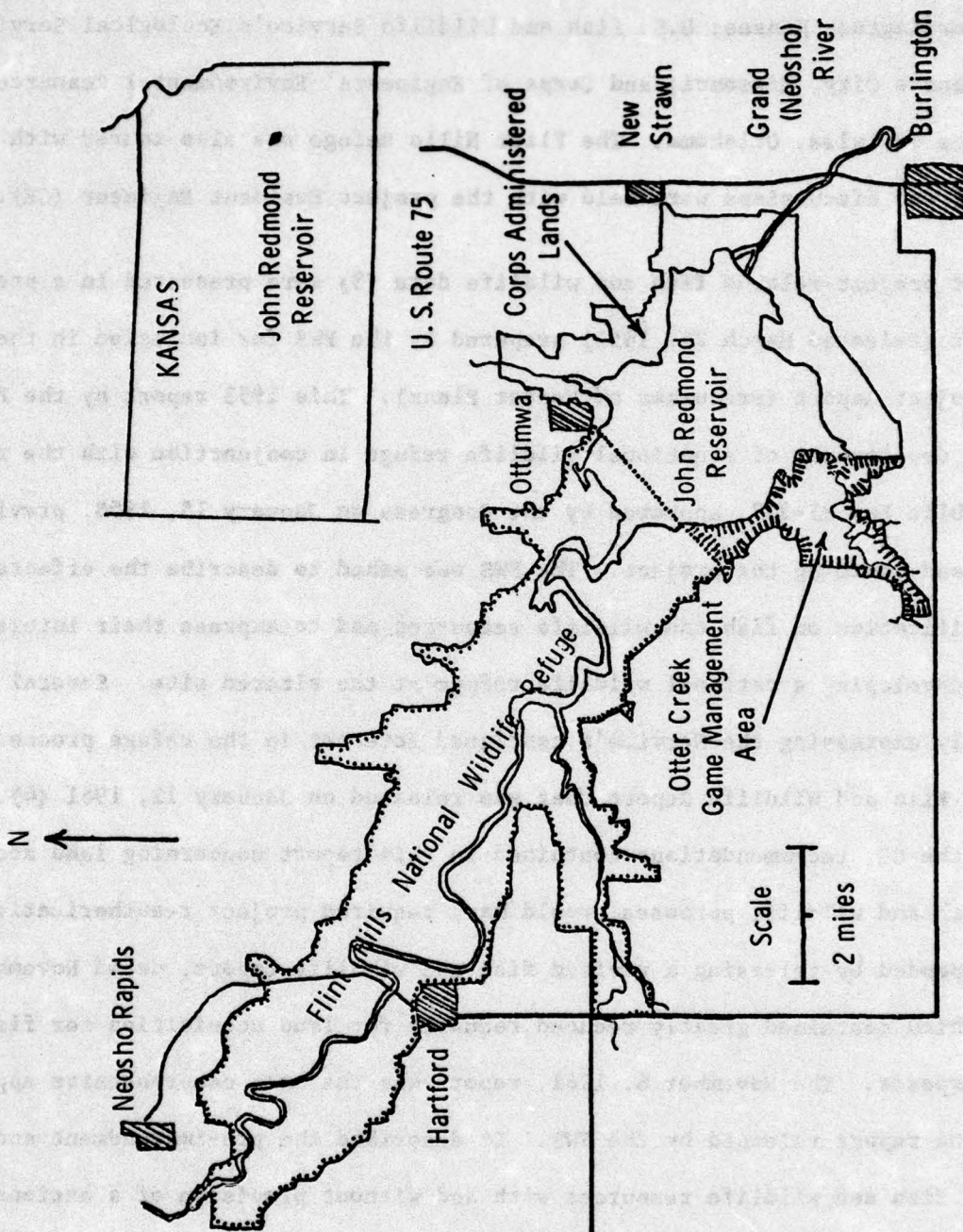


Figure 1 -- John Redmond Reservoir and associated game management areas and other prominent physical features.

Fish and Game Commission in Pratt, Kansas; Flint Hills National Wildlife Refuge Office in Burlington, Kansas; U.S. Fish and Wildlife Service's Ecological Services Office in Kansas City, Missouri; and Corps of Engineers' Environmental Resources Branch Office in Tulsa, Oklahoma. The Flint Hills Refuge was also toured with refuge staff and discussions were held with the project Resident Engineer (CE).

The earliest project-related fish and wildlife data (3) were presented in a preliminary report (released March 26, 1953) prepared by the FWS for inclusion in the CE Definite Project Report (precursor of Master Plans). This 1953 report by the FWS recommended development of a national wildlife refuge in conjunction with the reservoir. Public Law 85-327, approved by the Congress on January 15, 1958, provided for relocating and renaming the project. The FWS was asked to describe the effects of project modification on fish and wildlife resources and to express their interest, if any, in developing a national wildlife refuge at the altered site. Several letters affirmatively expressing the Service's continued interest in the refuge preceded the updated Fish and Wildlife Report that was released on January 12, 1961 (4). According to the CE, recommendations contained in this report concerning land acquisition for fish and wildlife purposes, would have required project reauthorization. The Service responded by releasing a revised fish and wildlife report, dated November 6, 1961 (5), which contained greatly reduced requests for land acquisition for fish and wildlife purposes. The November 6, 1961, report was the most comprehensive applicable planning report released by the FWS. It described the pre-impoundment and post-impoundment fish and wildlife resources with and without provision of a national wildlife refuge at the John Redmond project. The document was prepared for inclusion in the CE General Design Memorandum No. 4 (6). An amendatory report, more comprehensively addressing the refuge-related land acquisition proposal, was released by the FWS on January 15, 1963 (7). In response to a request from the CE, the FWS submitted a special report relating to the refuge development proposal. This report,

dated August 20, 1963 (8), along with a supplementary letter, dated November 19, 1963 (9), was appended to the CE Survey Report (10), when it was submitted to the Congress.

All of the FWS planning materials (reports and letters) were released through the Service's Regional Office in Albuquerque, New Mexico. Although a major effort was made to locate them, the informal "basic data" support files, describing the techniques and considerations employed by the FWS to generate the use predictions, could not be found. Sources contacted for this information included FWS offices in Albuquerque, Denver, Tulsa, and Kansas City. The individual who actually authored the major planning report of November 1961 was also contacted at his present station in Princeton, Indiana, in an attempt to ascertain the specific methods employed to develop the fish and wildlife-related predictions.

Examination of available pre-construction documents failed to provide any indication of a specific time-frame for either fish and wildlife use or angler and hunter utilization projections. Therefore, this evaluation was based upon the available post-impoundment empirical data which reflect conditions existing at the project approximately 10 years after impoundment.

Post-impoundment data were available from various state and federal agencies for portions of the total area affected by the project. The KFFGC provided both sport fishery statistics and estimates for man-days of hunting on the Otter Creek Game Management Area, under license to the State. The principle source of information about both wildlife and hunting pressure was the staff of the Flint Hills National Wildlife Refuge (FWS). The CE use estimates for the project were also consulted.

WILDLIFE RESULTS AND DISCUSSION

Wildlife Resources -- Pre-impoundment Predictions

The general predictive evaluation by the FWS concerning the John Redmond Reservoir project, released in November 1961 (5), summarized the pre-impoundment wildlife resources of the project area as follows:

"Upland game in the project area consists mainly of cottontails, raccoons, opossums, fox squirrels, and mourning doves, but significant numbers of bobwhites and greater prairie chickens are also present. Waterfowl use of the area is limited to the Neosho River, the few permanent oxbow sloughs, and periodically inundated, poorly drained areas. Snow and blue geese use the bottom lands when they are flooded in the spring, and migratory ducks use these areas when heavy precipitation occurs in the spring and fall. Without the project, the upland-game resources would be expected to provide hunting with associated hunter's expenditures of \$9,950 annually. Expenditures associated with waterfowl hunting would be about \$1,500 annually.

"Although there are raccoons, opossums, skunks, minks, and foxes in the project area, significant numbers are not trapped because of low prices now paid for pelts."

Data available in an interoffice communication prepared by the FWS Albuquerque Regional Office (11) permitted the translation into equivalent man-days of use of the monetary values presented in the 1961 planning report. The \$9,950 annual value for upland game was the product of 3,110 man-days of estimated annual hunting and an assigned value of \$3.20 per day. The \$1,500 annual value for waterfowl was derived by multiplying 225 man-days of estimated annual hunting pressure by an assigned daily value of \$6.70. The total estimated hunter use of the John Redmond Reservoir project area prior to construction of the reservoir (pre-impoundment use) was approximately 3,335 man-days.

Post-construction predictions concerning the status of the wildlife populations on the project and the extent of man's use of these resources were contained in several reports and letters submitted by the FWS to the construction agency. The let-

ter report of November 6, 1961, contained the earliest wildlife resource projections related to reservoir construction, viz:

"The project will permanently inundate 9,400 acres of upland-game habitat and impair the value for wildlife on about 15,000 additional acres in the reservoir area. Reduced flooding on bottom land below the dam will permit improved drainage and more intensive agricultural use thereby eliminating critical winter cover for upland game. As a result, many opportunities for hunting upland game will be lost. Increased waterfowl habitat created by establishment of the reservoir can be expected to provide much waterfowl hunting with associated hunters' expenditures of about \$39,000 annually."

* * *
"The reservoir will create a body of water that will be attractive to waterfowl. It is anticipated that with proper management, a refuge would attract large concentrations of geese and ducks, especially divers, during the fall, winter, and spring months."

* * *
"A national wildlife refuge in connection with John Redmond Reservoir would provide migrating and wintering habitat, distribute the waterfowl resource in the flyway, provide additional hunting, and would be an important unit in the national migratory bird management program."

* * *
"It is considered that the benefits from the refuge will be at least equal to the cost of purchasing and developing the land and will fully justify such cost. In addition to these benefits, it is reasonable to expect the refuge to make possible an increase in local waterfowl and upland-game hunting which would result in sportsmen's expenditures of about \$30,000 annually."

The August 8, 1962, FWS interoffice communication (11) converted the \$39,000 of predicted post-impoundment waterfowl value to an equivalent of 5,860 man-days of hunting use (valued at \$6.70 per day). It is noteworthy that no prediction was made by the FWS in their 1961 letter report concerning the value of upland game under post-impoundment conditions. This circumstance may have reflected an inadvertent omission, since their subsequent communication of August 8, 1962, assumed 1,500 man-days of upland game hunting valued at \$3.20 per day. The estimated \$30,000 of annual value attributed to the wildlife refuge, if established, was associated in the latter communication with an estimated 5,000 additional man-days of hunting having

an average value of \$6.00 per day.

The 1961 report contained these three specific recommendations designed to mitigate for project-related loss of wildlife resources:

- (1) A minimum instantaneous release of 75 second-feet be provided the Neosho River downstream from John Redmond Dam, a portion of said waters to be available to the extent of 5,000 acre-feet annually for downstream diversion to the Neosho County State Waterfowl Refuge.
- (2) That the project be constructed to include a national wildlife refuge with the reservoir conservation pool level established at the highest practical elevation.
- (3) That approximately 5,000 acres of lands above those for primary project purposes be acquired in fee in lieu of easement as an integral part of the project at an estimated cost of \$500,000, and that this land together with other project lands and water areas be available to the Bureau of Sport Fisheries and Wildlife under a General Plan in accordance with the provisions of Section 3 of the Fish and Wildlife Coordination Act.

As interagency planning progressed in relation to providing certain additional lands for the development of a national wildlife refuge at the John Redmond project, in combination with primary project lands, the FWS prepared a special report concerning waterfowl development potential. The Service's special report on waterfowl development was released on August 20, 1963 (8). Specific waterfowl development projections contained in the report were as follows:

"Lands within the John Redmond Reservoir maximum flood pool will provide an ideal situation for creating a national wildlife refuge which would be of significance in the national migratory bird management program.

"In addition to the national importance, a refuge would benefit the local area. Private lands adjacent to the refuge as well as those in the general vicinity of the reservoir would have high potential as private waterfowl hunting developments. The refuge would also be of major importance through reduction of waterfowl crop depredations which can be expected to occur especially during spring months. Food supplies grown for waterfowl on the refuge would assist materially in holding birds,

largely snow and blue geese, on the managed portion of the reservoir.

"Through analysis of waterfowl trends, it is estimated that waterfowl use of the refuge would amount to 3,000,000 duck-days and 2,250,000 goose-days annually."

* * *
"Waterfowl and upland game hunting directly associated with the refuge, but not necessarily on refuge lands, would provide an additional 8,000 man-days of hunting over that which would otherwise occur without a refuge. Value of this hunting is estimated to be \$30,000 annually. When conditions in the flyway permit, the Secretary of the Interior, under existing statutes, may open up parts of the refuge to public hunting. Even greater hunting benefits would accrue to the refuge when this occurs."

* * *
"The annual monetary benefits stemming from the establishment and development of the national wildlife refuge at John Redmond Reservoir would be two-fold: (1) those resulting from the basic valid assumption that benefits to the national waterfowl management program would be at least equal to the costs, and (2) those resulting from increased local hunting of waterfowl and upland game."

Two specific recommendations were contained in the special waterfowl development report. These recommendations represented a reiteration, with slight modification, of the third recommendation presented in the 1961 general report, viz:

- (1) That the Corps of Engineers acquire in fee title in lieu of easement about 3,400 acres of land within the acquisition guide contour, elevation 1,073, and acquire in fee title about 320 acres of land outside the acquisition guide contour at an estimated cost to the project of \$500,000.
- (2) That contingent upon consumation of Recommendation No. 1, the Corps of Engineers make available to the Bureau of Sport Fisheries and Wildlife about 24,000 acres of project land and water area for fish and wildlife management purposes in accordance with the terms of a General Plan formulated pursuant to Section 3 of the Fish and Wildlife Coordination Act.

The CE was unsatisfied with the support data provided by the FWS in their special report of August 20, 1963. The CE therefore solicited additional information relating to the benefits which could be expected as a result of refuge development.

A statement of supplementary refuge-associated wildlife benefits was provided in

response by the FWS on November 19, 1963 (9), although that statement was not included in the report that was eventually submitted by the CE to the Congress. These additional projections, which related to the conditional opening of the refuge to public hunting, were as follows:

"While it is not possible to state definitely at this time that the refuge will be open to hunting, there is a reasonable probability that it will be so opened. And if this should happen, we estimate that about 17,500 man-days of waterfowl hunting and 6,200 man-days of upland-game hunting annually could result. Applying \$4.50 a man-day for waterfowl hunting and \$2.00 a man-day for upland-game hunting, the additional benefits (over and above the \$30,000 given in the report) would amount to approximately \$91,100 annually. The difficulty in using such additional benefits of course stems from the uncertainty related to opening up the refuge to hunting, particularly for waterfowl which necessarily would depend on conditions in the Central Flyway. Frankly, it is very difficult to advise your office on the use of such additional benefits at this time other than to note that they may take place."

Hunting use predictions supplied to the construction agency by the FWS during various stages of project planning are summarized in Table 1.

In 1962, the CE advised the FWS that specific approval would have to be received from the Congress in order to acquire the additional acreage requested for creation of a national wildlife refuge at the John Redmond Reservoir project. As the first step toward obtaining the required Congressional approval, the proposal for acquisition of additional land was subjected to the established "5-step procedure," routinely employed by the CE, which progressed according to the following sequence:

- (1) The FWS formulated and updated plans for wildlife management (including assessing benefits expected) and submitted these plans to the construction agency as required.
- (2) The wildlife management plans were presented and discussed with interested Senators and Congressmen on August 23, 1962.
- (3) The views of the Governor of Kansas regarding the refuge proposal were obtained on January 2, 1963.
- (4) A public hearing to discuss the planned refuge was held in Emporia, Kansas, on December 4, 1962.

Table 1.--Use predictions for waterfowl hunting and upland game hunting on the John Redmond Reservoir project associated with various development plans

Proposed development and management options	Date prediction released	Annual hunter-use (man-days)		
		Waterfowl	Upland game	Total
Reservoir without ¹ wildlife refuge	Nov. 6, 1961	5,860	1,500	7,360
With refuge (refuge ² hunting prohibited)	Aug. 20, 1963	11,460	3,900	15,360
With refuge (refuge ³ open to hunting)	Nov. 19, 1963	28,960	10,100	39,060

¹ Monetary values of report converted to man-day values as provided in interoffice FWS correspondence dated August 8, 1962.

² Report contained estimate of 8,000 additional man-days of waterfowl and upland game hunting valued at \$30,000 under these conditions. Assuming daily values of \$4.50 and \$2.00 for waterfowl and upland game hunting, respectively, the relative distribution was assumed to be 70 percent waterfowl hunting and 30 percent upland game hunting.

³ Report contained estimate of 17,500 additional days of waterfowl hunting and 6,200 additional man-days of upland game hunting under these conditions.

- (5) The CE submitted a favorable report to Congress, recommending modification of the project so as to provide for acquisition of the requested additional acreage, on May 26, 1965.

Following completion of this process, the Congress authorized (Flood Control Act of 1965) the Secretary of the Army to acquire an additional 3,720-acre tract, at an estimated cost of \$730,000, for the establishment of a national wildlife refuge in conjunction with the John Redmond Reservoir project. In other refuge-related administrative actions, 18,500 acres of project lands (lands acquired for other project purposes, not including the additional acres specifically authorized in 1965 by the Congress for the refuge) were made available to the FWS under Cooperative Agreement dated September 1, 1966 (12).

About four years later, on October 15, 1970, the FWS reassessed the matter and requested the CE to desist from acquisition of the additional acreage which they had previously requested and had been authorized by the Congress in 1965 (13). In explanation, the FWS indicated that a review of four years of experience with their management of the 18,500-acre Flint Hills National Wildlife Refuge at the project suggested that the existing acreage would be adequate to support the desired waterfowl resource.

Wildlife Resources -- Post-impoundment Occurrences

There are three distinct and administratively separate wildlife management areas contiguous with the perimeter of the John Redmond Reservoir. The staff having management responsibilities for each area provided post-impoundment wildlife information for their particular area. The largest such area is the Flint Hills National Wildlife Refuge, administered by the FWS. Administration of the remaining wildlife lands adjacent to the reservoir is about equally divided between the KFFGC (Otter Creek Game Management Area) and the CE (Figure 1).

When first established in 1966, under Cooperative Agreement, the Flint Hills National Wildlife Refuge was essentially an agricultural area having approximately 66 percent of its total area in some type of crop production. The refuge-development objective was to create a multi-habitat complex characterized by maximum interspersion of habitat types. To date, cooperative farming agreements involving approximately 8,000 acres of the refuge have been consummated with 40 individuals. The refuge has been only partially developed for public hunting purposes. Eleven waterfowl marshes comprising 624 surface acres were developed in 1972. Approximately 250 acres were seeded to grass and 34,000 multiflora rose bushes were planted to improve upland game habitat. Complete refuge development for hunting, as envisioned by the refuge staff in 1972, would require construction of 12 additional water units totaling 1,016 surface acres of waterfowl marsh habitat and approximately six additional miles of roads to provide access for waterfowl hunters. Development plans to accommodate upland game management needs included the conversion of 1,500 additional acres of farmland to grassland, the planting of multiflora rose seedlings to provide strip cover along fields and roads, and the planting of 100,000 seedling trees and shrubs to provide additional food and cover (14).

The Flint Hills National Wildlife Refuge is managed primarily for migratory waterfowl. Management emphasis is directed toward enhancement of duck hunting; goose hunting is considered to represent incidental use. General refuge hunting regulations correspond to regulations established by the KFFGC. From January 1 through September 30, refuge regulations permit hunting of mourning doves, rails, gallinules, snipes, rabbits, squirrels, raccoons, and general predators. Hunting is permitted throughout the refuge during this period. From October 1 through December 31, hunting is permitted only on the designated hunting units comprising the refuge's south side. Species that may be harvested legally during this restricted season include greater prairie chicken, pheasant, quail, mourning dove, gallinule, snipe, woodcock, rabbit, squirrel, raccoon, coyote and other predators, and waterfowl (coot, mergan-

ser, geese, and ducks). During this same period, a special archery deer season is in effect over the entire refuge area.

Refuge personnel estimate hunting utilization of the refuge by means of a network of vehicle traffic counters (15). An average of 10 such counters are located at the major points of access to the refuge. Estimates of refuge use by means of car counters are subject to considerable potential error. The counters are occasionally subject to flood-water damage because of the broad, shallow configuration of the reservoir basin. Frequent malfunctioning of the counters, usually caused by vandalism and vehicular damage, requires much repair work to maintain them in working order. The car counts obtained are routinely multiplied by various expansion factors, including number of hunters per vehicle, and are corrected for nonhunter vehicular traffic (approximately 10 percent) in order to estimate the number of hunters using the refuge. The resulting statistics are expanded and elaborated further by applying various modifying ratios. These reflect target species hunted, length of trip, and harvest success rates, assessed through hunter interviews conducted by refuge staff at infrequent intervals. Estimates of hunter-use are summarized in the Refuge System's annual Public Use Reports (16).

The 1,472-acre Otter Creek Wildlife Management Area was licensed to the KFFGC in 1968, for the conservation and management of resident game as well as other wildlife species. To date, according to a KFFGC official (17), the area has not been developed to the extent planned. No farming is yet being conducted on the property and no area game manager has been employed to administer the tract. Hunting pressure estimates for the Otter Creek Wildlife Management Area were developed during routine area visitations by KFFGC staff. Although no specific data are available, relating to hunting effort and/or harvest by major game groups, KFFGC personnel estimate that hunting pressure is divided about equally between waterfowl and upland game.

A 5,467-acre tract of project lands located near the dam is administered by the CE.

Although little development of wildlife habitat has occurred thus far, a wildlife management plan for the area has been prepared and is now being implemented (18). A network of car-counters is maintained on project roads by the CE to enable estimation of visitations on project lands. Vehicular counts secured at individual access points are routinely expanded by a load factor of 4 to yield estimates of the number of people visiting the project. These estimates are then multiplied by varying percentages to estimate the number of individuals participating in nine separate recreational pursuits.

Discussions with the Resident Engineer (CE) revealed that the figures that had been reported on the CE Reservoir Project Monthly Visitation Data forms (19) were erroneous. He then provided revised percentages for the number of hunting visitations by type of hunting, for each of the access points. In consequence, the numbers of visitor-days reported on the monthly project visitation forms were correspondingly corrected by means of 33 percent reduction. The data adjustment was considered necessary because the CE load factor of 4 people per car was evidently excessive for hunters. A figure of 2.7 hunters per car, as developed by the FWS refuge staff, was substituted in the computation.

The estimated number of man-days expended on the CE administered project lands, as well as on the Otter Creek State Management Area and the Flint Hills National Wildlife Refuge are presented for waterfowl hunting in Table 2, and for upland game hunting in Table 3. Waterfowl hunting pressure on the total project averaged 7,869 hunter-days per year for the period 1970 to 1974. Upland game hunting totaled 2,263 hunter-days per year for the same period of years.

In addition to the waterfowl hunting estimated on the federal and state project lands, an unknown number of man-days of waterfowl hunting occurred on and near the periphery of

Table 2.--Estimated number of waterfowl hunter-days at the John Redmond Reservoir project, 1970 through 1974

Project component	Estimated hunter-use (man-days)					Average
	1970	1971	1972	1973	1974	
Flint Hills National Wildlife Refuge	3,425	5,115	2,859	2,400	3,677	3,495
Otter Creek State Management Area	1,000	(942)*	(942)*	750	1,075	942
CE administered hunting areas	3,614	4,002	3,314	3,255	2,973	3,432
Total	8,039	10,059	7,115	6,405	7,825	7,869

*No actual data available, average of other years used in place of missing information.

Table 3.--Estimated number of annual hunter-days for upland game associated with the John Redmond Reservoir project, 1970 through 1974

Project component	Estimated number of hunter-days (man-days)					Average
	1970	1971	1972	1973	1974	
Flint Hills National Wildlife Refuge	703	800	1,046	828	306	737
Otter Creek State Management Area	1,000	(942)*	(942)*	750	1,075	942
Corps administered hunting area	479	759	594	330	759	584
Total	2,182	2,501	2,582	1,908	2,140	2,263

*No actual data available, average of other years used in place of missing information.

the project. The magnitude of this hunting pressure was judged to have been of sufficient intensity to have resulted in the harvest of approximately 1,200 geese during the 1975 waterfowl season (15).

Use of the refuge by migratory waterfowl is routinely estimated and reported on an annual basis by the refuge staff. The reported annual estimates of waterfowl-use of the Flint Hills National Wildlife Refuge is summarized in Table 4 as reported in National Wildlife Refuge System Documents (20).

No additional migratory waterfowl use is desired by the FWS, according to refuge staff (15). Production of resident waterfowl on the refuge is estimated to be approximately 50 mallards and 300 wood ducks annually (21). Because of the frequency of refuge flooding, the refuge staff does not encourage use of the refuge by nesting waterfowl (15).

The 1961 FWS recommendation for 5,000 acre-feet of storage at John Redmond Reservoir for diversion to the Neosho County State Waterfowl Refuge was not adopted by the construction agency. The CE provided the following reasons for refusing to accept the recommendation (18):

(1) The planned water releases to meet water supply and pollution abatement needs would provide greater flows than recorded periods of low flow.

(2) The planned storage, without the requested additional storage, placed the flood control pool at the practical upper economic limit since relocation costs and urban protection would increase rapidly above that elevation.

(3) The diversion of water for the requested purpose would require that water rights be obtained, and granting of water rights, for the proposed purpose would pose a difficult problem.

The KFFGC did obtain legal water right to 75 cfs from the Grand (Neosho) River for the

Table 4. Annual duck-day use and goose-day use estimated for the Flint Hills National Wildlife Refuge, 1967 through 1974

Year	Estimated annual waterfowl visitations	
	Duck-day use	Goose-day use
1967	1,888,498	264,913
1968	2,206,770	224,575
1969	3,522,201	517,293
1970	4,229,159	502,869
1971	3,742,046	562,422
1972	2,457,463	631,971
1973	3,314,100	480,000
1974	1,513,890	637,200
Average	2,859,266	477,655

Neosho County State Waterfowl Refuge. This requirement can be met independent of the amount of water released from John Redmond Reservoir, however.

A flow of 500 to 600 cfs is necessary in the Grand (Neosho) River before the pumps which flood the Neosho County State Waterfowl Refuge will operate. The 1975 fall flow was not adequate to permit operation of the pumps and the KFFGC was unable to flood the refuge even though they had a right to 75 cfs at the refuge (17).

Wildlife Resources -- Evaluation of Planning Input

During the various stages of fish and wildlife plan formulation, the monetary values assigned to a day of hunting for waterfowl and upland game were changed. In the November 6, 1961 report, a day of waterfowl hunting was valued at \$6.70 and a day of upland game hunting was assigned a value of \$3.20. In that report, the proposed refuge was assigned an annual value of \$30,000 based upon an expected 5,000 man-days of hunting.

In the next report addressing the wildlife refuge (dated August 20, 1963), the proposed refuge was still valued at \$30,000 in annual benefits. However, the per day monetary values were reduced to \$4.50 per day for waterfowl hunting and \$2.00 per day for upland game hunting. To maintain the \$30,000 in annual benefits the FWS increased the hunting pressure prediction to 8,000 man-days. Within a two-year period the FWS increased the predicted use of the refuge by 3,000 man-days, a 60 percent increase.

The several FWS predictive reports contain generally inadequate background information to substantiate wildlife-related projections. Inclusion in the reports of

brief discussions of the factors considered during formulation of the predictions concerning wildlife visitations and hunting activity would have improved the utility of the planning reports. The relationship between the predictions and influencing factors, such as regional population trends, dimension of assumed area of project impact, and diversity and magnitude of the wildlife resources expected to use the project area, should have been incorporated into the reports to establish a foundation for the various predictions. The absence of such information within the formal documentation was particularly critical in as much as the informal "basic data" files have been lost or destroyed (if originally compiled). It was impossible, therefore, to associate the various wildlife predictions with any particular planning consideration or procedure.

(1) Waterfowl

Examination of specific wildlife-related projections revealed that their accuracy varied considerably. A comparison of waterfowl-related predictions provided by the FWS to the construction agency, at several stages of project planning and construction, and the actual post-impoundment use of and by waterfowl (as reflected by information collected to date) is summarized in Table 5.

It can be readily seen that use of the project by waterfowl hunters has been substantially less than the level projected by the FWS during the planning stages of the project. Several factors may have affected use of the refuge by waterfowl hunters. Although the additional acreage originally considered necessary by the FWS to permit proper refuge development was not obtained (at FWS request), the anticipated duck-use of the refuge was reached. Therefore, it seems unlikely that the decision not to enlarge the refuge (thereby remaining approximately 25% smaller than originally conceived) accounts for the gross overestimate of waterfowl hunter use. On the other hand, the lack of development of the refuge to stipulated post-project

Table 5.--Pre-impoundment predictions related to waterfowl and actual post-impoundment occurrences recorded at the John Redmond Reservoir project

Statistical parameter	Pre-impoundment predictions						Post-impoundment occurrences No.
	Without refuge		With refuge		Open to hunting No.	% deviation	
	No.	% deviation	Closed to hunting No.	% deviation			
No. hunter-days	5,860	-34.3	11,460	+ 45.6	28,960	+268.0	7,869
No. duck-days	-	-	3,000,000 ¹	+ 4.9	3,000,000 ¹	+ 4.9	2,859,266
No. goose-days	-	-	2,250,000	+371.1	2,250,000 ¹	+371.1	477,655
Total no. waterfowl days	-	-	5,250,000	+ 57.3	5,250,000 ¹	+ 57.3	3,336,921

¹ No prediction was contained in the report of waterfowl-days if refuge was open to hunting. The assumption was that limited hunting pressure would exert a negligible effect on waterfowl use.

levels conceivable could have been a factor contributing to the lower-than-predicted useage of the project by waterfowl hunters. By 1972, only 50 percent of the waterfowl marshes (38% by acreage) that had been conceived as constituting complete development had been constructed. Although completion of the planned refuge development may generate additional waterfowl hunter use of the project, the present levels of development and hunter use would indicate that the projected hunting use (estimated at 28,960 hunter-days by the FWS) was far too high. In fact, the waterfowl hunter use predicted by the FWS to occur with the refuge in place but closed to hunting (11,460 hunter-days) was significantly greater (+46%) than the observed post-construction useage with the refuge open to hunting (7,869 hunter-days).

As noted previously, the FWS prediction of the number of duck-days of anticipated use of the refuge by ducks was very close to actual use by those waterfowl. On the other hand, the FWS prediction of goose-days use of the refuge was nearly five times higher than actual post-impoundment use of the refuge by geese. One possible reason why the estimated and actual goose-use figures are so dissimilar may be associated with the failure to obtain the proposed 3,720 acres of additional lands. However, on October 15, 1970, the FWS requested the CE not to acquire the additional lands, stating "... we have found that the project lands covered by the 1966 Cooperative Agreement are sufficient to produce the required yields of waterfowl food." Apparently, therefore, the less than expected use of the refuge by geese can not be related to a limited waterfowl food supply. A more probable explanation for the large error in the goose-use estimate is that the estimate of goose-days reported by the FWS was inadvertently increased during the computational stage. Examination of informal support data (marginal notations appearing on project correspondence) suggests the possibility that the predicted value used in the report was accidentally inflated tenfold. If so, the adjusted estimate of 225,000 goose-days per year would have resulted in an underestimate (by some 50 percent) of the observed post-construction use of the refuge by geese. However, it must be

recognized that the 2,250,000 figure was used in all predictive reports supplied by the FWS to the CE. Therefore, the hard fact is, whatever the explanation, that the refuge's value as a goose resting and feeding area was severely over-estimated by the FWS.

(2) Upland Game

The FWS reported annual pre-construction hunting pressure for upland game amounting to 3,110 man-days on the affected project lands. The planning report expressed concern that construction of the reservoir would impair upland game habitat on 15,000 acres of project lands within the flood pool in addition to the 9,400 acres that were to be permanently inundated. No quantitative post-impoundment estimates were provided in the report, although subsequent interoffice communications indicated that the FWS expected that the extent of hunting for upland game (man-days of use) would be reduced substantially (to some 1,500 man-days) after project construction.

It has already been noted that the FWS subsequently proposed the development of a national wildlife refuge in conjunction with the project. In this connection, the FWS predicted an increase of 2,400 man-days (total 3,900 man-days) in hunting for upland game if the refuge were acquired. Moreover, they predicted an increase of 6,200 man-days (total of 10,100 man-days) of such use if approximately 40 percent of the wildlife refuge was open to hunting.

Although the completed project included provision for the recommended wildlife refuge, which subsequently was opened to hunting, the predicted increase in upland game hunting failed to materialize. The fact is, post-impoundment upland game hunting on project lands (2,263 man-days/year) has been less than one-fourth the 9,700 man-days/year that were predicted in the FWS letter reports. The 2,263 man-days/year recorded for post-project construction upland game hunting, represents a loss of some 847 man-days/year (-27%)

from the pre-construction estimate of 3,110 man-days/year. The total project includes 12,828 ha, of which 3,804 ha, or 30 percent, is permanently flooded. Therefore, if the upland game hunting pressure estimates are accurate, it must be assumed that upland game hunters are making no greater use of the 9,024 ha, occasionally inundated John Redmond Reservoir flood pool than prior to project construction. It should be emphasized, however, that the post-impoundment use estimates are probably more precise than the pre-impoundment estimate which could have been too high.

FISHERY RESULTS AND DISCUSSION

Fishery Resources -- Pre-impoundment Predictions

The only FWS report which described the fisheries aspects of the proposed John Redmond Reservoir project was the revised report dated November 6, 1961 (5).

Following is the entire section of this report which addressed the sport fisheries of the project area under pre-impoundment conditions:

"Fishing in the project area is limited to the Neosho River and a few small natural sloughs and ponds. The stream is an important resource for sport fishermen not only within the reservoir site but downstream to Lake O' The Cherokees (Grand Lake), Oklahoma. Principal fish species are largemouth bass, channel catfish, flathead catfish, bullhead, carp, drum, and buffalo fishes. Without the project, the stream is expected to have extensive annual use with associated fishermen's expenditures of \$132,000."

No estimate of fishing use (man-days), equivalent to the monetary estimate, was provided in the latter report; however, such an estimate was contained in an earlier rough draft of the report, dated March 8, 1960 (22). According to the earlier rough draft report, streams within the reservoir site supported 3,520 man-days of annual fishing use, valued at \$11,000. Streams below the reservoir site supported 38,250 man-days of fishing use annually, valued at \$120,600. Thus, the estimated value of the pre-impoundment fishery was \$131,600 (rounded to \$132,000 in the official report dated November 6, 1961).

The projected impact on local fisheries resources of the John Redmond Reservoir construction was described in the November 1961 report as follows:

"John Redmond Reservoir can be expected to provide excellent reservoir fishing, but construction and operation of the project will have a significant influence on the Neosho River below the dam. At conservation pool elevation, the reservoir will have a surface area of 9,400 acres and will inundate about 18 miles of the Neosho River. Although pollution will be reduced in the river below the dam, modified flows will reduce stream fishing on the long stretch downstream to Lake O' The Cherokees (Grand Lake) in Oklahoma. With the project, it is estimated that the reservoir and the Neosho River will have a value of \$342,500

annually in associated fishermen's expenditures."

As in the case of the pre-impoundment estimate, no corollary post-impoundment estimate of fishing use (man-days) was provided; only the monetary value was estimated. The March 8, 1960 rough draft report is the only source of estimates of fishing use, both before and after project construction.

Examination of the latter document revealed that the streams below the reservoir site were expected to support 24,630 man-days of angler-use annually, valued at 77,100, and that the reservoir was expected to generate 84,800 man-days of angler use annually, valued at \$265,400. Total sport fishing use of affected waters under post-impoundment conditions was projected at 109,430 man-days, taking into account the predicted loss of 13,890 man-days from use of the stream fishery below the reservoir.

The 1961 report commented as follows regarding the potential reduction in stream fishing:

"The project will cause the loss of valuable stream fishing habitat, and fishing in the project area will be greatly reduced. It is estimated that a minimum flow of 75 second-feet maintained in the Neosho River below the dam would compensate for most of this loss."

Two other fisheries-related matters were discussed in the 1961 report, namely, undesirable fish populations, and standing timber within the reservoir basin.

Regarding undesirable fishes, the FWS said:

"John Redmond Reservoir can be expected to develop undesirable fish populations and special control methods or management measures, including use of certain areas within the conservation pool for seining, may be necessary."

Concerning timber left standing in the reservoir basin, the FWS said:

"Since much of the reservoir area is devoid of vegetation, the retention of as much timber and brush as possible in the reservoir would be desirable. It is estimated that about 200 acres

of timber and brush could be left standing without endangering project works or operation."

The FWS made two recommendations related specifically to the reservoir fishery,

viz:

- (1) That seining areas be designated by the Corps of Engineers in cooperation with the Kansas Forestry, Fish and Game Commission and the Bureau of Sport Fisheries and Wildlife.
- (2) That timber and brush be left standing in the reservoir in locations where it does not conflict with public health laws or interfere with project works or operation, including the proposed national wildlife refuge.

The FWS made two additional recommendations related to both the fish and the wild-life resources, viz:

- (1) That a minimum instantaneous release of 75 second-feet be provided into the Neosho River downstream from John Redmond Dam.
- (2) That at least eight public access areas be developed and adequate access roads be maintained.

Fishery Resources -- Post-impoundment Occurrences

Immediately after John Redmond Reservoir was impounded in 1963, the KFFGC initiated a fish stocking program. Game fish species planted in the lake included crappie and channel catfish in 1963; largemouth bass, walleye, and bluegill in 1964; and striped bass in 1966 (23). Early in this period (exact date unknown), white bass were also planted. Test netting to sample the fish population was conducted in May 1965; August 1966; and July 1967 (24). In the 1965 sample, 15 species of fish were captured, including three species of game fish -- largemouth bass, walleye, and channel catfish. Sixty percent of the sample, by number was made up by six species of non-game fishes. The 1966 sampling revealed an expanding crappie population, in as much as crappie comprised 45 percent of the total number of fish caught. Three additional species of game fishes -- spotted bass, white bass, and flathead catfish -- appeared in the 1966 collections, but no largemouth bass were taken. One

additional species of non-game fish -- gizzard shad -- was also captured, and non-game fishes collectively comprised 35 percent of the total catch by number. Little further change in the fish population was revealed by the 1967 fish sampling activity. Game fishes comprised 3.8 percent of the test-netting sample, and included white bass, channel catfish, and flathead catfish. For the second successive year, no largemouth bass were captured during the test-netting procedure. The panfish species group was dominated by white crappie, and the non-game fish species group (seven species) constituted 63 percent of the sampling catch by number (61% by weight). Gizzard shad, carp, and river carpsucker were the most frequently captured non-game species of fish.

In the late winter and early spring of 1967, severe fish kills occurred over approximately 25 percent of the area of the reservoir's upper basin. Walleye, white bass, and catfishes were among the species affected. Effluents from livestock feedlots located along the Grand (Neosho) River above the reservoir were identified as the cause of these mortalities. Subsequent state legislation provided for more effective control of such wastes, and the problem has not recurred (25).

In 1974, the KFFGC conducted a creel study on John Redmond Reservoir, as part of their statewide lake and reservoir survey program, and recorded its findings in a Job Progress Report for its Dingell-Johnson Project F-15-R-10 (26). The latter report was selected to serve as the principal data base for subsequent analysis of both qualitative and quantitative aspects of the fishery. It was considered that the data secured by means of the carefully-designed creel survey conducted by the KFFGC would be more precise than the estimates of angler-use, based exclusively on data provided from car counters, available from CE Monthly Project Visitation Data reports.

For purposes of the KFFGC creel survey, the reservoir area was divided into three sampling units. Unit A represented the reservoir south of the Flint Hills National Wildlife Refuge boundary and included the Grand (Neosho) River (excluding the stilling basin) to Burlington City Dam. Unit B included the reservoir, Grand (Neosho) River, and streams lying within the refuge extending upstream to Neosho Rapids. The third sampling unit of the survey was the stilling basin. A diagram of the reservoir and project lands is provided in Figure 1. Table 6 summarizes catch and effort in the sport fishery at the John Redmond Reservoir during the period March through October, 1974.

Table 7 summarizes the species composition data for the 1974 sport fish harvest at John Redmond Reservoir. Examination of these data shows that white bass was the most frequently captured species, heavily dominating the sport fishery of both the stilling basin and the more riverine upper reservoir (Unit B). Approximately equal numbers of channel catfish and white crappie combined to account for 41 percent of the harvest. Of the game species originally stocked by the KFFGC, crappie, and white bass contributed significantly to the sport fishery. Largemouth bass and striped bass failed to contribute to the harvest, and negligible numbers of walleye and bluegill were caught.

Fishery Resources -- Evaluation of Planning Input

It was possible to evaluate the accuracy of the planning input relating to three specific areas of post-impoundment fishery resource development for the John Redmond Reservoir project. These areas are: (1) qualitative assessment of the reservoir fish community, (2) quantitative projection of angling use, and (3) qualitative evaluation of the actual John Redmond Reservoir sport fishery.

(1) Qualitative Assessment of the Reservoir Fish Community

Non-game species of the free-flowing Grand (Neosho) River fish community underwent rapid expansion following impoundment of John Redmond Reservoir, as projected by the

Table 6.--Sport fish harvest and angling effort at the John Redmond Reservoir in 1974. Data summarized from KFFGC Dingell-Johnson report (25)

Statistical parameter	Sampling unit				Total project area
	Unit A	Unit B	Unit A&B	Stilling basin	
Number of anglers interviewed	580	321	901	280	1,181
Estimated no. fishermen trips	18,559	7,782	26,341	34,822	61,163
Estimated no. fishermen hours	88,318	39,146	127,464	126,126	253,590
Mean trip length	4.68	5.03	4.84	3.62	4.15
Estimated no. fish harvested	18,911	15,016	33,927	66,886	100,813
Fish harvested/trip	1.02	1.93	1.29	1.92	1.65
Fish harvested/hour	0.2	0.4	0.3	0.5	0.4
Total weight of fish harvested					
Kilograms	12,348	11,972	24,320	40,920	65,240
Pounds	27,200	26,369	53,569	90,131	143,700
Weight of fish caught/trip					
Kilograms	0.67	1.54	0.92	1.18	1.07
Pounds	1.47	3.39	2.03	2.59	2.35
Weight of fish caught/hour					
Kilograms	0.14	0.31	0.19	0.32	0.26
Pounds	0.31	0.67	0.42	0.72	0.57

Table 7.--Species composition of sport fish harvest in 1974 at the John Redmond Reservoir. Harvest data presented for each sampling unit and for the total reservoir complex

Sampling Unit	Channel catfish		Bluegill		White crappie		Green sunfish		Smallmouth buffalo		Carp		Freshwater drum		Flathead catfish		White bass		Walleye		Blue sucker		Total No.
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Unit A	122	22.6	0	0	139	25.7	0	0	55	10.2	63	11.6	71	13.1	9	1.7	81	15.0	1	0.1	0	0	541
Unit B	179	30.6	1	0.2	82	14.0	2	0.3	7	1.2	33	5.7	20	3.4	14	2.4	247	42.2	0	0	0	0	585
Stilling Basin	51	10.1	0	0	90	17.9	0	0	12	2.4	51	10.2	58	11.5	2	0.4	238	47.3	0	0	1	0.2	503
Total	352	21.6	1	tr	311	19.1	2	0.1	74	4.6	147	9.0	149	9.2	25	1.6	566	34.8	1	tr	1	tr	1,629

FWS in their predictive report. Fish collections obtained by the KFFGC two years following impoundment were dominated by non-game species, although desirable sport fish species (both indigenous and introduced) -- crappie, channel catfish, white bass, and walleye -- were also collected. Sampling catches in subsequent years reflected increased diversification of the fish community, including the non-game species. Seining areas were provided by the construction agency as had been recommended by the FWS to facilitate non-game fish control. No effort has been made, however, to control the abundance of non-game fish in the reservoir, either by state personnel or through contracts with private enterprise. Commercial fishing is not presently permitted in Kansas. The KFFGC conducted a study in the summer of 1975 to evaluate the commercial fishing potential at John Redmond Reservoir, but results of the study are not available for evaluation.

(2) Quantitative Projection of Angling Use

Interpretation of the precise extent of the discrepancy between predicted and observed values of angling at John Redmond Reservoir was somewhat obscured by the lack of a clear definition of the term "reservoir" as used in the FWS predictive report of 1961. The predictive documents contained no information to indicate whether the term "reservoir" included the tailwaters and other waters associate with the project. On the assumption that the term "reservoir" included both the reservoir proper plus the tailwater, the predicted angler-use (84,000 man-days) was nearly 38 percent higher than the 61,000 man-days reported by the KFFGC in their comprehensive creel survey of 1974. The KFFGC survey covered the stilling basin and approximately 15 miles of the Grand (Neosho) River (partly above and below the reservoir), as well as the reservoir proper. If the term "reservoir" (as used in the FWS predictive report of 1961) was meant to include only the area within the actual impoundment, the angler-use prediction by the FWS in 1961 was approximately 3.2

times higher than actual use reported by the KFFGC as a finding of the creel survey in 1974. About 57 percent (34,822 man-days) of the total angling activity estimated from the 1974 creel survey took place in the stilling basin, while the remaining 43 percent (26,341 man-days) occurred on the reservoir, itself.

On the other hand, angler-use predictions for the downstream fishery appear to have been grossly underestimated. In its predictive 1961 report, the FWS estimated that only 24,630 man-days of fishing would occur in the downstream fishery, extending from the John Redmond Dam to Grand Reservoir, Oklahoma (some 187 miles), unless their recommendation to provide 75 cfs of minimum flow from the project was implemented. With implementation of their recommendation for a minimum flow of 75 cfs, the FWS predicted that the downstream fishery would support about 38,520 man-days of angling. The FWS recommendation for minimum flow was never implemented; however, supplemental releases from the project to ensure a minimum flow of 30 cfs at Chanute, Kansas were made later at the request of the U.S. Environmental Protection Agency.

A recent (May 21, 1975) FWS report to the District Engineer, Tulsa, concerning a bank stabilization project proposed by the CE, estimated that approximately 155,000 man-days of angling occur annually on 177 miles of the Grand (Neosho) River stretching from the John Redmond Dam to the Kansas-Oklahoma line (27). Biologists with the KFFGC assisted in developing this latest estimate and, recently (personal communication), have indicated that it is an accurate reflection of current angler use of the river (25). Such level of use represents approximately 42.5 angler-trips/acre, based on a computed surface area of 3,647 acres for the section of river involved.

Assuming the 1975 estimate of 155,000 man-days/year is valid, current fishing pressure in the downstream fishery is over 6 times greater than the annual angling activity (24,630 md/yr) predicted by the FWS in the absence of 75 cfs minimum flow

caveat and more than 4 times greater than their prediction (38,520 man-days/year) given implementation of their minimum flow recommendation. Thus, it would appear that the lack of the recommended minimum flow of 75 cfs had little, if any, impact on the downstream fishery. The water released from the project to meet the 30 cfs water quality requirement at Chanute, Kansas may have constituted critical flow for the downstream fishery.

(2) Qualitative Evaluation of the Sport Fishery

A comparison of various angling parameters collected from John Redmond Reservoir and nine other federal reservoirs of similar age (10 years or older) in Kansas supported the pre-construction prediction by the FWS that "excellent fishing" would prevail at the John Redmond Reservoir (Table 8). The average weight of fish caught per trip at John Redmond Reservoir was exceeded at only one other Kansas reservoir (Kanopolis). Although less intensively fished (6.92 angler-trips/ha) than most other Kansas reservoirs (9.71 trips/ha), the total harvest at John Redmond Reservoir (63.9 kg/ha) was close to the mean for the other reservoirs (7.02 kg/ha).

Table 8.--Sport fishery creel statistics for 10 Kansas federal reservoirs (reservoir proper) 10 years or greater in age. All data were gathered during the 1974 angling season

Statistical Parameter	Name of reservoir										Mean	
	John Redmond	Pemona	Tuttle Creek	Council Grove	Kanopolis	Lovevell	Fall River	Toronto	Cedar Bluff	Kirvin		
Surface area												
Hectares	3,804	1,619	6,406	1,157	1,544	1,208	1,052	1,133	2,115	1,441	2,148	
Acres	9,400	4,000	15,830	2,860	3,815	2,986	2,600	2,800	5,227	3,561	5,308	
Angler use												
Angler hours	127,464	57,426	164,401	45,651	58,273	26,675	143,498	66,764	125,657	97,804	91,361	
Angler trips	26,341	15,131	37,787	12,622	17,245	7,553	29,512	16,137	24,025	22,094	20,845	
Hours per hectare	33.50	35.48	25.67	39.44	37.73	22.09	136.37	58.91	59.40	67.88	42.50	
Hours per acre	13.56	14.36	10.39	15.96	15.27	8.94	55.19	23.84	24.04	27.47	17.21	
Trips per hectare	6.92	9.34	5.91	10.90	11.17	6.25	28.05	14.23	11.49	15.32	9.71	
Trips per acre	2.80	3.78	2.39	4.41	4.52	2.53	11.35	5.76	4.65	6.20	3.93	
Angler harvest												
No. fish caught	33,927	13,351	67,396	18,118	41,824	13,156	46,533	19,530	24,326	21,416	29,958	
No. fish per hour	0.27	0.23	0.41	0.41	0.65	0.49	0.32	0.21	0.14	0.18	0.33	
No. fish per trip	1.29	0.88	1.78	1.42	2.01	1.74	1.58	1.21	1.01	0.88	1.43	
No. fish per hectare	8.92	8.25	10.53	15.64	27.08	10.90	44.23	17.25	11.49	14.85	13.94	
No. fish per acre	3.61	3.34	4.26	6.33	10.96	4.41	17.90	6.98	4.65	6.01	5.64	
Wt. fish caught												
Kilograms	24,298	4,356	32,025	5,877	21,765	5,952	23,148	9,242	10,082	14,087	15,083	
Pounds	53,569	9,603	70,602	12,957	47,982	13,121	51,032	20,375	22,226	31,055	33,252	
Wt. fish per hour												
Kilograms	0.19	0.05	0.20	0.13	0.37	0.22	0.16	0.14	0.08	0.15	0.16	
Pounds	0.42	0.12	0.43	0.28	0.82	0.49	0.36	0.31	0.18	0.32	0.36	
Wt. fish per trip												
Kilograms	0.92	0.18	0.86	0.47	1.26	0.79	0.78	0.57	0.42	0.64	0.73	
Pounds	2.03	0.40	1.89	1.03	2.78	1.74	1.73	1.26	0.93	1.41	1.60	
Kg. fish per hectare	6.39	2.69	5.00	5.08	14.10	4.92	22.01	8.16	4.76	9.78	7.02	
Lb. fish per acre	5.70	2.40	4.46	4.53	12.58	4.39	19.63	7.28	4.25	8.72	6.26	
Wt. per fish caught												
Kilograms	0.72	0.33	0.48	0.33	0.52	0.45	0.50	0.47	0.42	0.66	0.50	
Pounds	1.58	0.72	1.05	0.72	1.14	1.00	1.10	1.04	0.92	1.45	1.11	

SUMMARY

John Redmond Reservoir is located in eastern Kansas in a predominantly rural area having an essentially agricultural economy. The project was authorized in 1950 to provide flood control, water conservation, recreation, and water supply benefits. Construction began in 1959 and the reservoir, which has a conservation pool of 3,804 ha (9,400 ac) and a flood pool of 12,829 ha (31,700 ac) was completed in 1964. Project lands at conservation-pool elevation total 12,829 ha (31,700 ac), of which 7,487 ha (18,500 ac) are under cooperative agreement with the FWS for management as the Flint Hills National Wildlife Refuge. The cooperative agreement establishing the refuge was concluded in 1966. In addition to the refuge, 596 ha (1,472 ac) of project lands are licensed for game management purposes to the KFFGC.

Planning projections related to wildlife were provided by the FWS for the project in general in 1961. In its general planning report of 1961 the FWS estimated that post-impoundment waterfowl hunting would be worth \$39,000 annually and, if a national wildlife refuge was provided, would accrue \$30,000 of additional annual benefits. No quantitative estimates of hunter-use (man-days of hunting) were provided by the FWS in their 1961 report to the CE. However, it was determined from interoffice communications and preliminary draft reports in FWS files that 5,860 man-days of waterfowl hunting and 1,500 man-days of upland game hunting were anticipated. An expectation of 5,000 additional hunter-days (including both waterfowl and upland game hunting) was indicated by these same documents if a refuge was developed. Actual predictions relating to the effect of refuge development was submitted in official correspondence to the CE by the FWS in 1963. The letter-reports of 1963 amended from 5,000 to 8,000 man-days the estimates of increased hunter-use previously associated with provision of a refuge. Furthermore, if approximately 40 percent of the refuge were opened for hunting, the FWS estimated that the project could provide 23,700

additional man-days of hunting valued at \$91,100 annually. Waterfowl visitations predicted as a result of refuge development amounted to 3,000,000 duck-days and 2,250,000 goose-days annually.

Post-impoundment surveys of hunter-use were conducted by one state agency (KFFGC) and two federal agencies (CE and FWS) having wildlife administrative responsibilities over separate portions of the John Redmond project lands. The collective estimates resulting from these surveys indicate that the total project (including the refuge) annually supports an average of 10,132 man-days of hunting activity, including 2,263 man-days of upland game hunting and 7,869 man-days of waterfowl hunting.

The considerable increase in hunting predicted by the FWS to result from refuge development (40 percent open to hunting) has not occurred. Predicted waterfowl hunting activity was 3 times greater and predicted upland game hunting activity was 4 times greater than post-impoundment occurrences. Utilization of the refuge by migratory waterfowl has reached the level projected during pre-impoundment planning for ducks but not for geese. In the former case, recent use averaged 2,859,266 duck-days annually, about as predicted. Use of the facility by geese, however, has been much less than was expected, averaging 477,655 goose-days annually, which is only about 20 percent of the projected level of such use.

Pre-impoundment predictions concerning qualitative aspects of the post-impoundment fishery resource correctly anticipated expansion of the non-game fraction of the fish population and development of a comparatively high quality sport fishery for game fish within the reservoir itself.

On the other hand quantitative predictions were less accurate concerning utilization of the fishery under post-impoundment conditions. The predictive report failed to adequately define and delineate the "reservoir" and "downstream" fisheries. Only

"reservoir" and "streams below reservoir" categories were discussed. No mention was made of the tailwater fishery (34,822 man-days) which developed in the stilling basin and represented 57 percent of the total fishing activity at the project.

On the assumption that the term "reservoir" included both the impounded water area plus the tailwater, the predicted volume of angling (84,000 man-days) was about 38 percent higher than the actual amount of angling (61,000 man-days) estimated from the comprehensive creel survey of 1974, which included the stilling basin and approximately 15 miles of the Grand (Neosho) River (partly above and below the reservoir), as well as the impoundment itself. If the term "reservoir," (as used by the FWS in their predictive report of 1961) meant only the area within the reservoir proper, the 1961 prediction by the FWS of post-impoundment angling activity was about 3.2 times greater than indicated from the creel survey conducted by the KFFGC in 1974.

Predicted annual fishing activity on the Grand (Neosho) River below John Redmond Reservoir was substantially less than the level recently estimated by the fisheries staff of the KFFGC. Estimated post-impoundment use by anglers (155,000 man-days/year) of downstream waters was about 4 times greater than the level of use (38,520 man-days/year) predicted by the FWS in their 1961 report, even though a contingent FWS recommendation to provide 75 cfs of minimum flow was not implemented.

As evidenced by the brevity of their formal report, the general project evaluation by the FWS (completed when project construction was well under way) was perfunctory, at best. Later planning reports, prepared by the FWS to justify authorization of a national wildlife refuge at the project, were more comprehensive. In both circumstances, the formal documents lacked any indication as to how the various fish and wildlife-associated predictions were generated. Such lack was particularly critical because the informal "basic-data" support file, normally compiled to substantiate and guide the various subjective predictions and recommendations, no longer exists.

REFERENCES

1. Recreation-Resource Management System (RRMS). 1973. 1973 Annual Report for John Redmond Reservoir. Office, Chief of Engineers, Washington, D.C.
2. Tulsa District. 1975. Draft Environmental Statement of the Operation and Maintenance Program for John Redmond Dam and Reservoir, Grand Neosho River, Kansas, Marion Lake, Cottonwood River, Kansas, and Council Grove Lake, Grand Neosho River, Kansas. Tulsa, Oklahoma. May 1, 1975.
3. Department of the Interior, Fish and Wildlife Service. 1953. A preliminary report on fish and wildlife resources in relation to the plan for the Strawn Reservoir, Grand (Neosho) River, Kansas. March 26, 1953.
4. Department of the Interior, Fish and Wildlife Service. 1961. Letter report on the John Redmond Dam and Reservoir Project, Coffey and Lyon Counties, Kansas. January 12, 1961.
5. Department of the Interior, Fish and Wildlife Service. 1961. Revised report on the John Redmond Dam and Reservoir Project, Coffey and Lyon Counties, Kansas. November 6, 1961.
6. Tulsa District. 1962. John Redmond Dam and Reservoir, Grand (Neosho) River, Kansas; general design memorandum. Design memorandum no. 4. Tulsa, Oklahoma. February 19, 1962.
7. Gatlin, John C., 1963. Regional Director, Albuquerque Regional Office, U.S. Fish and Wildlife Service, letter of January 15, 1963.
8. Department of the Interior, Fish and Wildlife Service. 1963. Special report on waterfowl development potential associated with the John Redmond Dam and Reservoir Project, Coffey and Lyon Counties. August 20, 1963.
9. Gatlin, John C., 1963. Regional Director, Albuquerque Regional Office, U.S. Fish and Wildlife Service, letter of November 19, 1963.
10. John Redmond Dam and Reservoir, Grand (Neosho) River. 1965. Senate Document No. 27, 89th Congress, 1st Session. U.S. Government Printing Office, Washington, D.C.
11. Bennett, Carey H., 1962. Acting Regional Director, Albuquerque Regional Office, U.S. Fish and Wildlife Service, telegraphic message of August 8, 1962.
12. Cooperative Agreement Between the Department of the Army and the Department of the Interior, Bureau of Sport Fisheries and Wildlife. Unpublished. September 1, 1966.
13. Stephens, Robert F., 1970. Acting Regional Director, Albuquerque Regional Office, U.S. Fish and Wildlife Service, letter of October 15, 1970.
14. Stemmerman, Lyle A., 1972. Revised hunting, fishing and trapping plan for the Flint Hills Refuge. Unpublished. April 25, 1972.
15. Long, Michael J., 1975. Refuge Manager, Flint Hills National Wildlife Refuge, U.S. Fish and Wildlife Service. 1975 personal communication.

16. National Wildlife Refuge System. Public use reports for Flint Hills National Wildlife Refuge. 1970-1974. Washington, D.C.
17. Dick, Donald J., 1975. Supervisor of Development and Management, Kansas Forestry, Fish and Game Commission. 1975 personal communication.
18. Risher, Thomas P., 1976. Resident Engineer, John Redmond Reservoir Project. U.S. Army Corps of Engineers. 1975 personal communication.
19. Tulsa District, U.S. Army Corps of Engineers. Unpublished. Monthly project visitation data for John Redmond. Multilith Data Sheets, (January 1970-December 1974). Office Resident Engineer, Burlington, Kansas.
20. National Wildlife Refuge System, U.S. Fish and Wildlife Service. Unpublished. Average monthly waterfowl populations at Flint Hills National Wildlife Refuge. Multilith Data Sheets. (January 1967-December 1974). Office Refuge Manager, Burlington, Kansas.
21. Long, Michael J., 1973. Narrative report for Flint Hills National Wildlife Refuge for period January 1973 to July 1973.
22. Annon. 1960. Draft supplementary report on the John Redmond Dam and Reservoir Project. Accompanied cover letter from Forrest S. Romero to Regional Director, Albuquerque, New Mexico. March 8, 1960.
23. Hartmann, Robert F., 1966. Job Progress Report for Dingell-Johnson Project F-15-R-2, Kansas Forestry, Fish & Game Commission.
24. Hartmann, Robert F., 1967. Job Progress Report for Dingell-Johnson Project F-15-R-3, Kansas Forestry, Fish & Game Commission.
25. Hartmann, Robert F., 1975. Assistant Chief of Fisheries, Kansas Forestry, Fish & Game Commission. 1975 personal communication.
26. Ray, Johnny and Tom Gengerke. 1975. Job Progress Report for Dingell-Johnson Project F-15-R-10, Kansas Forestry, Fish & Game Commission.
27. Department of the Interior, Fish and Wildlife Service. 1975. Reconnaissance report on fish and wildlife resources in relation to the proposed bank stabilization project on the Grand (Neosho) River in Kansas below John Redmond Dam. May 21, 1975.