

FILE

Report of Fisheries Investigations
Inventory of Species Present in Red Bluff Reservoir near Angeles, Texas

by

Lawrence Campbell
Project Leader

Dingell-Johnson Project Leader F-5-R-6, Job B-17
April 16, 1957 - April 16, 1958

H. D. Dodgen - Executive Secretary

Texas Game and Fish Commission
Austin, Texas

Marion Toole
Coordinator

Kenneth C. Jurgens & William H. Brown
Assistant Coordinators

Job Completion Report

State of TEXAS

Project No. F-5-R-6

Name: Fisheries Investigations and Surveys
of the Waters of Region 3-B.

Job No. B-17

Title: Inventory of Species Present in Red
Bluff Reservoir near Angeles, Texas

Period Covered:

April 16, 1957 - April 16, 1958

Abstract:

Extreme fluctuations in the lake level at critical periods, high salinity, and other physical phenomena limit the potential productivity of Red Bluff Reservoir. The existing fish populations are dominated by gizzard shad and white bass and renovation methods are required before other game species may be expected to be contributive to the fishery yield. It is recommended that resurvey work include negotiations with the New Mexico authorities to determine if a cooperative management venture can be arranged.

Objectives:

To determine species present and their relative abundance as well as to determine the ecological factors influencing their distribution.

Procedure:

Fifty-eight (58) gill net sets were made at nine locations in the reservoir. Experimental nylon gill nets, measuring 125 feet long by eight feet deep and made up in five, 25-foot sections, were used. Mesh sizes for these nets increased progressively in each following section, at half-inch intervals, beginning with a one-inch square mesh section and terminating with a three-inch square mesh sections.

Twenty-seven (27) seining collections were made at five seining stations in the reservoir. In nearly all collections, both 26 foot, $\frac{1}{4}$ inch mesh bag seines and 15 foot, $\frac{1}{4}$ inch mesh, common sense seines were used. To estimate relative abundance of the species seined, a count was made of all individuals taken in two hauls with a 26 foot, $\frac{1}{4}$ inch mesh bag seine. In addition to this work, collections with a 4 foot, $\frac{1}{16}$ inch mesh, common sense, fry seine was taken.

Water analyses to determine dissolved oxygen content and the quantity of dissolved carbon dioxide were made periodically. Surface temperature, pH and weather conditions were recorded for each netting and seining collection. Turbidity was measured on two occasions.

In netting collections, samples from each collection and for each species were weighed, measured and sexed. This work was done in the field. Stomachs containing food

were preserved for laboratory examination. Similar work for seining collections included identification, weighing and measuring. Individual specimens not readily identifiable in the field were preserved in 10 percent solution of formalin. These were later identified in the laboratory.

Findings:

Red Bluff Reservoir is the fifth in a series of major reservoirs located on the Pecos River. It is impounded by a 9,200 foot compacted earth-fill dam, located three miles upstream from Screwbean Draw, and 4.5 miles north of the town of Orla, Texas, and is designed to have a total storage capacity of 307,000 acre feet of water. The contributing watershed of 20,720 square miles is in the lower Staked Plains. The reservoir is primarily for the impoundment and control of irrigation waters and is owned by Red Bluff Power Control District, whose offices are in Pecos. About 15,000 acres in Reeves, Ward, and Pecos Counties may be irrigated when water supplies permit. As shown in the accompanying hydrology data (Tables 5 & 6), the reservoir is subject to extreme fluctuation because of its use. It is the most saline inland reservoir in the state and possibly in the south; and is generally unstable in nature. The area, particularly in the upper portions of the reservoir which is subject to inundation, is covered with dense concentrations of salt cedar. Access to much of the reservoir area is difficult. Although bulrushes, Scirpus sp., are present in sparse and very limited concentrations, the reservoir has no vegetation problem. Turbidity was not recordable; pH was from 7.8 to 8.0; dissolved oxygen was from 7 to 10 ppm; and dissolved carbon dioxide was from 0 to 14 ppm. Subsurface infiltration, or seepage of water into the river bed above the reservoir, transported and deposited an estimated 279 tons of salt each 24 hours and a "saline" stratification was considered as possible.

Fish Populations:

a. Relative Abundance - Because of the previously described concentrations of salt cedar and other obstructions seining could be done as described only near the dam. For that reason gill netting collections are probably more reliable in indicating this aspect of the population study. The species taken are listed in an annotated checklist.

b. Species Distribution - Information pertaining to species distribution in Red Bluff Reservoir is included partly in the annotated checklist and partly in the section of the report dealing with trends and influences of the principal fish populations.

Annotated Checklist of Species of Fish Taken in Red Bluff Reservoir

Lepisosteidae (gars)

Lepisosteus osseus (longnose gar) - common and especially abundant near the mouth of the river.

Clupeidae (shad and herrings)

Dorosoma cepedianum (gizzard shad) - the most numerous and widely distributed species in the reservoir. Abundant and relatively large in size.

Characidae (tetras)

Astyanax fasciatus (Mexican jumper) - probably released by persons handling bait. Found near the dam.

Catostomidae (suckers)

Carpionodes carpio (river carpsucker) - common and abundant, taken in all reservoir areas, high average coefficient of condition, however, apparently there was no significant increase during the second year of work.

Moxostoma congestum (gray redhorse sucker) - common but usually restricted to the mouth of the river.

Ictiobus bubalus (smallmouth buffalo) - common and occurring throughout the reservoir. Not listed or included under undesirable species since they are sought by sportsmen of the area and have commercial value.

Cyprinidae (minnows)

Cyprinus carpio (carp) - common and fairly abundant, taken at all netting stations, possibly controlled or partially controlled by salinity.

Notropis lutrensis (redhorse shiner) - common, probably the dominant minnow for the lake.

Pimephales vigilax (parrot minnow) - common but less numerous than redhorse shiners or killifishes.

Ameiuridae (catfishes)

Ictalurus natalis (yellow bullhead) - not actually taken but known to be present immediately below release structures and above reservoir in river. Significance undetermined.

Ictalurus punctatus (channel catfish) - common but not numerous, evenly distributed but less concentrated in the upper reservoir.

Pylodictus olivaris (flathead catfish) - rare and apparently not present in the saline upper reservoir near the river mouth.

Cyprinodontidae (killifishes and topminnows)

Fundulus kansae (plains killifish) - common and abundant, probably next to shad as the most numerous species for the reservoir.

Gambusia affinis (mosquitofish) - abundant in all areas where protection was afforded.

Serranidae (basses)

Roccus chrysops (white or striped bass) - abundant, the most numerous game species, concentrated near the Pecos mouth, high average coefficient of condition, apparently particularly well suited to this type habitat.

Centrarchidae (black basses and sunfish)

Micropterus salmoides (largemouth bass) - rare, and confined in distribution to the areas low in salinity near the dam. Unimportant as a resource, no juvenile fish taken in seining, condition poor and indicative of unsuccessful reproduction.

Chaenobryttus gulosus (warmouth bass) - rare, taken in seining only.

Lepomis cyanellus (green sunfish) - common and fairly abundant near the dam.

Lepomis macrochirus (bluegill) - of about equal importance with green sunfish, more widely distributed, but not important as a game species.

Lepomis microlophus (redeer sunfish) - rare, taken in one collection only.

Lepomis megalotis (longear sunfish) - rare, but more numerous than redear.

Pomoxis annularis (white crappie) - possibly the most numerous contrarchid, but apparently stunted and not present in the extremely saline areas of the river mouth.

Percidae (perches and darters)

Percina caprodes (logperch) - not actually taken in reservoir, but present in the stream immediately below.

Sciaenidae (drum)

Aplodinotus grunniens (freshwater drum) - not actually taken in year's netting, but observed in fishermen catches and taken in the previous year of inventory. Believed to be much more common than netting would indicate, more widely distributed, and of some importance as a game fish.

Table 1. Results of Gill Netting Collections taken from Red Bluff Reservoir from May 1, 1955 through April 16, 1958

Species	No.	% by No.	Total Wt. Oz.	Avg. Wt. Oz.	% by Wt.	Avg. K
Gizzard shad	700	46.69	2,821	4.0	15.18	1.67
River carpsuckers	135	9.00	3,105	23	16.71	2.31
Redhorse suckers	8	0.54	144	18	0.77	2.18
Carp	36	2.41	720	20	3.87	2.55
Smallmouth buffalo	45	3.00	2,160	48	11.62	2.92
Freshwater drum	12	0.80	72	6	0.38	2.34
Longnose gar	25	1.67	1,075	43	5.78	0.51
Channel catfish	124	8.27	2,232	18	12.01	2.10
Flathead catfish	2	0.13	76	38	0.40	2.08
Largemouth bass	6	0.40	114	19	0.61	2.34
White crappie	32	2.31	240	7.5	1.28	3.90
Sunfishes	13	0.87	38	2.9	0.20	4.13
White bass	361	24.09	5,776	16	31.19	2.38
Total	1,499	100.18	18,573		100.00	

Table 2. Results of Gill Netting Collections taken from Red Bluff Reservoir from April 16, 1958 through April 16, 1959

Species	No.	% by No.	Total Wt. Oz.	Avg. Wt. Oz.	% by Wt.	Avg. K
Longnose gar	100	12.98	5,600	56	33.69	.77
Gizzard shad	286	37.15	858	3	5.18	1.29
Smallmouth buffalo	80	10.38	5,120	64	30.81	2.54
River carpsuckers	216	28.06	3,456	16	20.79	1.97
Carp	8	1.04	192	24	1.15	1.37
Channel catfish	8	1.04	384	48	2.31	2.04
White bass	68	8.83	952	14	5.73	1.89
Sunfishes	4	0.52	56	14	0.34	4.28
Totals	770	100.00	16,618		100.00	

Table 3. Specific Population Data for Comparative and Analytical Purposes for Red Bluff Reservoir

Species	No.	Percent	Avg. Wt. (Oz.)	% by Wt.
Excessive Populations for Undesired Species				
Gizzard shad	986	71.39	3.92	34.10
River carpsuckers	351	25.42	19	57.85
Carp	44	3.19	20	8.05
Total	1,381	100.00		100.00
Desirable Species and Game Fish				
Largemouth bass	6	1.00	19	1.18
White bass	429	71.62	15.6	69.51
White crappie	32	5.34	7.5	2.47
Channel catfish	132	22.04	19	26.84
Total	599	100.00		100.00
Excessive or Undesirable Species				
Game Fish	1,381	69.75	11,152	56.04
	599	30.25	8,746	43.96
Total	1,980	100.00	19,898	100.00

Table 4. Water Quality for Red Bluff at Orla, Texas

		1947	1951	1952	1953	1954	1955	1956	7 Year Average PPM
Cl PPM	Max.	2400	2380	2960	6990	6790	5020	2840	2090
	Min.	880	430	1050	2840	1620	900	1000	
	Avg.	1706	1260	2310	3870	2650	1150	1690	
Na & K PPM	Max.	1460	1500	1840	4440	4290	3220	1790	1307
	Min.	528	270	637	1790	1380	656	650	
	Avg.	1008	813	1460	2340	1700	743	1090	
SO ₄ PPM	Max.	2080	2120	2290	2990	2980	1790	2130	1785
	Min.	1090	635	1430	2070	1100	826	1350	
	Avg.	1768	1750	2120	2480	1720	978	1680	
Solids PPM	Max.	6500	6880	7980	15600	15200	10800	7340	5949
	Min.	3010	1660	3810	7570	4280	2730	3620	
	Avg.	5194	4580	6780	9760	6790	3350	5190	
Ca & CO ₃ Carbonates	Max.	2450	2370	2600	3400	3430	2010	2320	2043
	Min.	1290	742	1690	2380	1260	952	1510	
	Avg.	2063	1930	2370	3010	1930	1140	1860	
O ₂	Max.					11	9	7.5	8.08
	Min.					6	8	7	
	Avg.	No Records Available				8.5	8.5	7.25	
CO ₂	Max.					13		14	7.25
	Min.					0		2	
	Avg.					6.5		8	

Table 5. Hydrology and Fluctuation Data for Red Bluff Reservoir
(1953 - 1958)

	Date	El.	Acre Ft.
1953	January	2795.2	28,780
	February	2796.5	31,100
	March	2796.8	31,900
	April	2796.2	30,700
	May	2796.1	30,500
	June	2795.2	28,780
	July	2794.2	26,980
	August	2792.8	24,580
	September	2792.0	23,300
	October	2788.8	18,840
	November	2791.1	21,950
	December	2793.5	25,750
1954	January	2799.1	36,840
	February	2799.2	37,080
	March	2792.9	24,740
	April	2799.2	27,080
	May	2798.9	36,380
	June	2796.7	31,700
	July	2790.2	20,680
	August	2794.9	28,220
	September	2788.9	18,970
	October	2797.5	33,350
	November	2797.7	33,770
	December	2798.1	34,620
1955	January	2826.7	164,200
	February	2826.4	162,000
	March	2823.4	141,600
	April	2810.1	115,600
	May	2816.7	102,500
	June	2812.2	80,900
	July	2805.0	53,000
	August	2793.3	25,410
	September	2796.7	31,700
	October	2826.6	163,500
	November	2826.5	162,800
	December	2826.4	162,000
1956	January	2816.7	102,500
	February	2816.8	103,000
	March	2816.0	99,000
	April	2812.3	81,350
	May	2810.8	74,700
	June	2807.0	60,000
	July	2800.7	40,750
	August	2794.2	26,960

Table 5. Hydrology and Fluctuation Data for Red Bluff Reservoir
(Continued)

Date		El.			Acre Ft.	
1956	September			2791.9		23,150
	October			2815.1		94,500
	November			2815.5		96,500
	December			2816.2		100,000
Date	Max. El.	Min. El.	Avg.	Fluc.	Avg. Ac. Ft.	
1955	October	115.1	96.7	105.0	18.4	55,900
	November	115.5	115.1	115.3	0.4	95,500
	December	116.2	115.5	115.85	0.7	97,900
1956	January	116.7	116.3	116.5	0.4	101,500
	February	116.9	116.8	116.85	0.1	103,200
	March	116.8	116.3	116.55	0.5	101,700
	April	115.9	112.7	114.3	3.2	91,700
	May	112.3	111.0	111.65	1.3	78,400
	June	110.7	107.0	108.8	3.7	66,700
	July	107.0	100.7	103.8	6.3	48,500
	August	100.5	95.1	97.8	5.4	33,980
	September	94.0	92.2	93.1	1.8	24,900
	October	92.5	91.9	92.2	0.6	23,620
	November	93.4	92.9	93.1	0.5	25,070
	December	95.0	93.5	94.2	1.5	26,960
1957	January	96.0	95.0	95.5	1.0	29,430
	February	95.0	83.5	89.3	11.5	19,490
	March	86.2	83.5	84.8	2.7	14,000
	April	86.8	86.2	86.6	0.6	16,010
	May	87.1	85.4	86.3	1.7	15,660
	June	89.6	88.9	89.3	0.7	19,490
	July	88.9	88.0	88.5	0.9	18,450
	August	96.8	88.6	92.7	8.2	24,400
	September	94.2	87.9	90.0	6.3	22,300
	October	91.0	87.2	88.1	3.8	19,280
	November	93.2	91.2	92.2	1.0	23,670
	December	94.9	93.3	93.6	1.6	26,815

Table 5. Hydrology and Fluctuation Data for Red Bluff Reservoir
(Continued)

Date	Max. El.	Min. El.	Avg.	Fluc.	Avg. Ac. Ft.
1958 January	96.5	94.9	95.7	1.6	30,360
February	97.8	96.6	97.2	1.2	32,700
March	98.7	97.8	98.2	0.9	34,960
April	98.7	94.3	96.5	4.4	31,540
May	104.3	94.3	99.3	10.0	39,020
June	104.6	102.7	103.6	1.9	48,950
July	103.3	100.0	101.6	3.3	43,450
August	105.6	97.0	101.3	8.6	43,700
September	110.2	104.6	107.4	5.6	62,050
1959 January	18.05	17.45	17.75	0.60	108,500
February	18.82	18.30	18.56	0.52	112,650
March	18.80	17.75	18.27	1.05	111,000
April	17.60	15.52	16.56	2.08	96,000

Table 6.

The following data are intended primarily to illustrate the extremes of fluctuation as they occurred during the various months and are for specific instances rather than to provide general perspective. Volume and verticle variations are not necessarily from the same year and should not be considered as average figures. It was necessary to present this evidence in this manner since the topography of the reservoir basin is such that surface increase (and a corresponding significant increase or decrease in volume) may occur with relatively little increase or decrease in lake level. The verticle fluctuation increases per unit volume as the lake is recessed into the more extreme natural depression that is the reservoir basin. The maximum volume and minimum volume are from the same month in the same year.

Fluctuation Data for Six Recent Years (1953 thru 1959)

Month	Maximum Vol. Ac/ft.	Minimum Vol. Ac/ft.	Vert. Fluc. Max.	Avg. Ac/ft.	Avg. Vert. Fluc. in Ft.
January	108,500	112,650	- 1.6	77,000	+ 2
February	162,000	141,600	- 2.92	80,000	+ 1
March	141,600	115,600	- 6.3	69,000	- 5
April	115,600	102,500	- 4.6	53,000	- 3
May	102,500	53,000	- 10.0	46,000	- 3
June	80,900	53,000	- 7.2	42,000	- 2
July	53,000	25,410	- 12.3	41,000	- 0
August	29,240	18,840	- 8.6	34,000	- 6
September	163,500	31,700	+ 29.3	46,000	+ 8
October	23,670	19,280	+ 3.8	46,500	+ 4
November	25,750	21,950	+ 2.1	68,500	+ 5
December	36,840	34,620	+ 1.6	74,000	+ 3

Other Aspects of Hydrological Findings

In Table 6 the average volume in acre feet and the average figure for verticle fluctuations were arrived at by taking an average volume for thirty days for each month for each year and obtaining an average volume for the six year period. The fluctuations within any specific month are not taken into account or thus illustrated although for several months and in particular for May and June the fluctuations within the month were much more extreme than indicated by an average fluctuation figure. June is probably more illustrative than other months. Although the average fluctuation is a minus two feet; in four of six instances the figure was nearer the maximum figure of a minus 4.6 feet. Average annual vertical fluctuation was about 21.2 feet and the average annual variation in volume was 20,500 acre feet. However, extreme fluctuation in the first eight months of the year may be best illustrated from the 1955 and 1956 records. In 1955 the reservoir was reduced from a storage of 164,200 acre feet in January to 25,410 acre feet in August, or to 15.48 percent of its January volume. During the same period the reservoir was reduced 33.4 feet vertically. In 1956 the reservoir contained 102,000 acre feet and was reduced to 23,150 acre feet by the following September, or about 22.69 percent of its January volume. During this period the lake receded 24.7 feet vertically. The fluctuation trend may be generalized by stating that almost without a monthly exception rapid reduction occurs during the spring and summer because of withdrawals for irrigation, and a build up in storage takes place during the fall and winter when the water is not required for agricultural purposes.

The effect of this hydrological procedure on fish life will be discussed under fish population trends and influences.

Trends and Influences of the Fishery Populations

Hydrological Influence

Examination of the hydrology charts and those on the results of gill netting collections will focus attention on the effect of water utilization practices and their obvious effect on the game fish populations. The absence or insignificance of large-mouth bass, white crappie and other late spring spawners is obviously due or, at least, greatly influenced by the annual drop in the lake level of about eight or ten feet during April, May and June. The net result of these practices is that at best a minimum spawning requirement is provided and growing room for the progeny is continually reduced at the period when it is most urgently needed for a fishery yield of those species. This phenomena plus the more or less stabilization of the lake's waters when the white bass spawn resulted in their complete dominance of the game species in the reservoir. Gizzard shad, also apparently benefiting from early spawning, have dominated the forage species. Extreme fluctuations in the lake level in June and July virtually prohibit the successful spawning of catfishes, and it is considered probable that fish of this kind occurring in netting collections were spawned in the contributive streamways or were released from hatcheries.

Salinity and Other Water Quality Properties

Salinity in Red Bluff Reservoir varies between a maximum of about 4,000 ppm to a minimum of less than 1,500 ppm. There is direct relationship between quantity of storage and salinity. At times when flow into the upper reservoir is at a minimum, and especially when evaporation is high, an extreme salinity results in fish kills. Drum, river

carpsuckers, carp, smallmouth buffalo and white crappie have been apparently killed by this occurrence, and it is also concluded that spawns for these species are occasionally, or often, destroyed. There is apparently, at least temporarily, and under specific conditions, a kind of saline stratification. It is common practice of the persons responsible for water released to "flush out" this highly saline layer by releasing a suitable volume before water, to be used down stream for irrigation, is released.

Interpopulation Influences

Only one interdependence of significance appeared to exist. For practical purposes the relationship between white bass and gizzard shad may be said to produce the only fishery asset available and utilized by sportsmen. The extent of dominance of these species is best illustrated in Table 3. Of all fish taken that were not specifically regarded as game species, gizzard shad made up 71.39 percent numerically. White bass dominated all game species by making up 71.62 percent of that group. Of all fish taken in gill nets the combined totals for white bass and gizzard shad made up 71.75 percent of the catch. River carpsuckers were increasing rapidly during the later survey period, and for the last twelve months made up 28.06 percent of the catch by number. Carp actually decreased, but the difference in occurrence is so slight that it is not considered significant. If smallmouth buffalo are included with the undesirable species as shown in Table 3, the dominance of undesirable species over desirable species is 72.05 percent numerically as compared to 27.95 percent for game species.

Other Aspects of the Fish Populations

Fifty-eight (58) gill net sets and twenty-seven (27) seining collections resulted in obtaining fish of twenty-four (24) species and eleven (11) families. There was no lack of forage species indicated by either seining or netting. Co-efficients of condition, however, were less than is usually expected for the region. This phenomena or condition may result entirely from the described hydrological conditions and water utilization practices but this is not as yet proven. The salinity that apparently destroys production of some species does not apparently effect others, primarily catfishes. However, fishing results for other species are generally unproductive.

Significance of Distribution of Principal Species

The concentration of game species as they occurred in gill net collections was rather pronounced and is shown on the accompanying map. Whether this congregation by species is a result primarily of currents within the reservoir or salinity is not as yet determined. The reservoir, however, was productive from a fishing standpoint only in these areas and for the species shown.

Summary:

1. Fifty-eight (58) gill net sets and twenty-seven (27) seining collections resulted in the capture of twenty-four (24) species of fish from eleven (11) families.
2. Fluctuations for Red Bluff Reservoir are prohibitive to the successful spawning of largemouth bass, channel catfish, white crappie and possibly several other game species.
3. Hydrological conditions and water utilization practices are beneficial to white bass and gizzard shad. These two species make up over 71 percent of all individuals captured in gill net collections.

4. Rough fish or undesirable species make up 72 percent of the fish taken in gill net collections. River carpsuckers increased significantly during the last twelve (12) months of inventory.

5. Salinity may be a significant control on some species of fish, and there appears to be a kind of saline stratification in the reservoir.

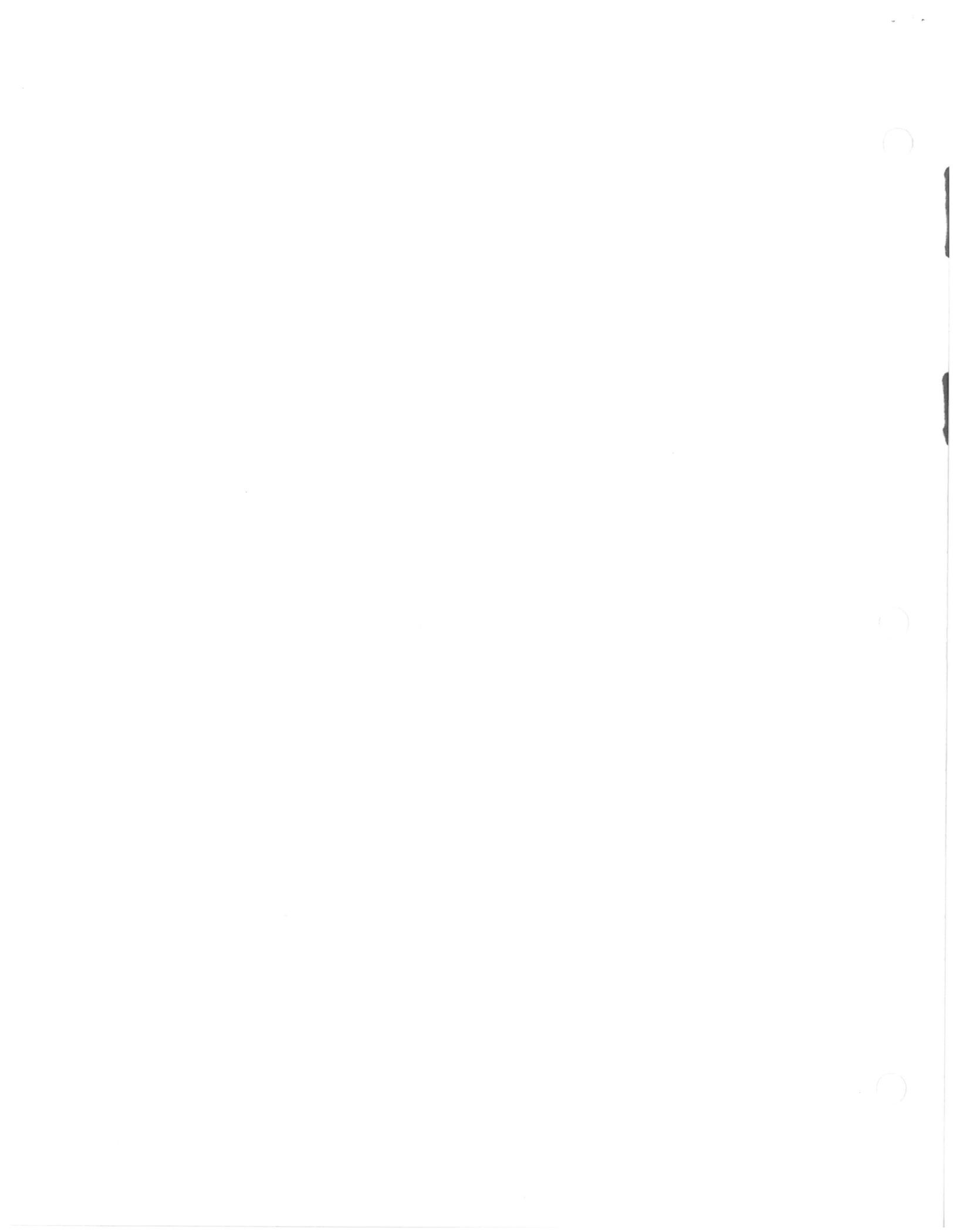
Recommendations:

An appraisal of the evidence obtained during this survey results in the obvious conclusion that management effort is required before fishing can be improved. However, no population control effort is practical at this time because critical areas of the water impounded reaches into New Mexico and into the stream above the state line. This portion of the area to be managed cannot be treated without the consent and co-operation of that state. For that reason it is recommended that this reservoir be included in the resurvey work for the region, and that negotiations be undertaken with the New Mexico authorities to determine if a cooperative venture in the management of these resources can be arranged.

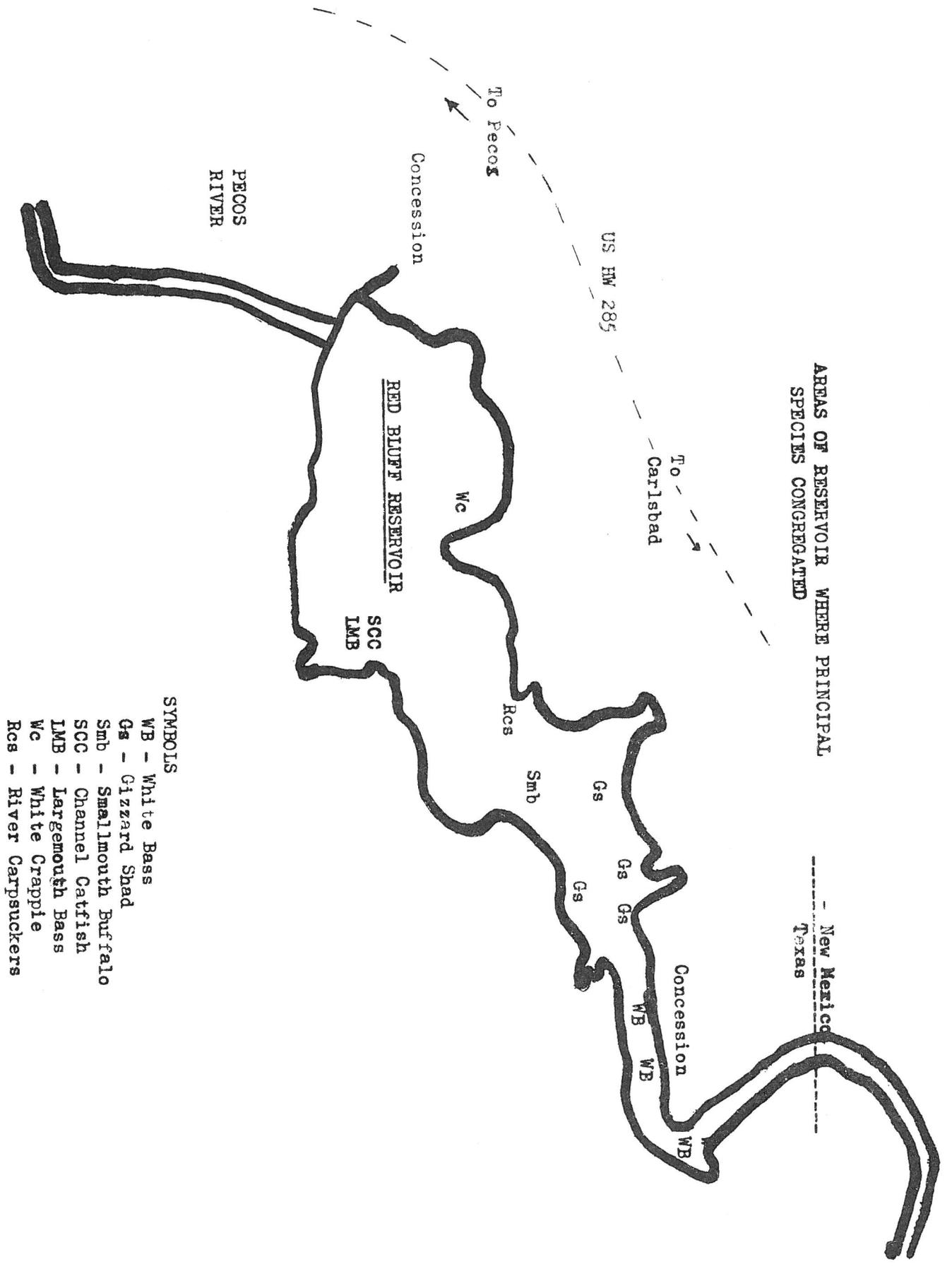
Prepared by Lawrence Campbell
Project Leader

Approved by Marion Toole
Director Inland Fisheries Division

Date December 1, 1959



AREAS OF RESERVOIR WHERE PRINCIPAL SPECIES CONGREGATED



SYMBOLS

- WB - White Bass
- Gs - Gizzard Shad
- Smb - Smallmouth Buffalo
- SCC - Channel Catfish
- LMB - Largemouth Bass
- Wc - White Crappie
- Rcs - River Carpsuckers

