UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

ECOLOGICAL SERVICES

FORT WORTH, TEXAS

A REPORT ON THE AQUATIC RESOURCES OF THE CYPRESS BAYOU BASIN, TEXAS

JULY 1984

PLANNING AID REPORT

on the

AQUATIC RESOURCES

of the

CYPRESS BAYOU BASIN, TEXAS

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U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
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INTRODUCTION

The following aquatic resources information is provided as planning assistance on the Cypress Bayou Basin study. It has been prepared in accordance with Section 2(a) of the Fish and Wildlife Coordination Act (48 Stat.401, as amended; 16 U.S.C. 661 et seq.) and the fiscal year 1984 Transfer Funding Agreement, Appendix A Scope of Work.

A planning aid report, dated January 22, 1981, was previously provided to the Corps of Engineers describing the effect various flow regimes in Big Cypress Bayou below Lake O'the Pines would have or stream fisheries habitat. Preliminary aquatic resources data on Cypress Bayou Basin was also provided in a second planning aid letter of March 16, 1982. The latter report presented a brief description of the basin's aquatic resources and a discussion of problems, needs, and opportunities for these resources.

The purpose of this current report is to provide detailed aquatic resources data for use by the Fort Worth District during the project Plan Formulation Conference scheduled for September 1984. Specific objectives include the presentation of aquatic baseline information, characterization of aquatic habitats within the project area, and development of preliminary instream flow and fishery-related recreation recommendations.

Should the District identify a viable water resources project in the Cypress Bayou Basin, fish and wildlife studies will be refined during subsequent planning activities, and recommendations to protect, mitigate, or enhance these resources will be provided in a final Fish and Wildlife Coordination Act report.

DESCRIPTION OF THE STUDY AREA

The Cypress Bayou Basin study area is located primarily in northeast Texas, upstream from and including Caddo Lake. It is bounded on the north by the Sulphur River Basin, on the west and south by the Sabine River Basin, and on the east by Twelvemile Bayou Basin. The watershed lies within Franklin, Wood, Titus, Camp, Morris, Cass, Upshur, Gregg, Marion, and Harrison Counties in Texas and Caddo Parrish, Louisiana (Plate 1).

Major streams of the Cypress Bayou Basin study area include Big Cypress, Little Cypress, and Black Cypress Bayous. Above its confluence with Little Cypress and Black Cypress Bayous, Big Cypress drains 950 square miles. Little Cypress and Black Cypress have drainages of 730 and 390 square miles, respectively. The entire basin, including Caddo Lake, has a length of approximately 88 miles, maximum width of 48 miles, and drains 2,780 square miles. The Cypress Bayou watershed represents about 1.1 percent of the total area of Texas.

Climate of the Cypress Bayou Basin is generally considered subtropical with hot, humid summers and relatively mild winters. Precipitation is evenly distributed throughout the year and averages 45 inches.

More detailed information on the climatology, topography, geology, and description of the study area watershed can be found in reports by the Texas Water Development Board (1966), Smith et al (1966), U.S. Army Corps of Engineers (1968, 1981) and Kindle, Stone & Associates, Inc. (1982).

AQUATIC RESOURCES

Three major types of aquatic ecosystems occur within the Cypress Bayou Basin. These include natural streams, stock ponds and small conservation lakes, and large manmade reservoirs. For the purposes of this report, discussions will be limited to streams and reservoirs greater than 250 surface acres, since these ecosystems are the most likely to be impacted or created by water resources development projects.

Ponds and other small water areas provide important aquatic habitats and a significant recreational fishery. However, the extent of these waters in the basin planning area has not been accurately or recently inventoried. In 1967, the U.S. Soil Conservation Service (1970) estimated a total of 6,547 surface acres of small water areas between 2-40 acres in size occur within the five major counties of the Little and Black Cypress Bayou watersheds. This was an increase over the 5,600 surface acres inventoried in 1958 by SCS. Biological or recreational data are generally not available for these small water areas, because they are privately owned and have no public access facilities or management.

Stream Habitats

Lotic habitats within the Cypress Bayou Basin are diverse, ranging from intermittent headwaters to perennial, sluggish meandering streams. Within the Texas portion of the Cypress Basin, there are approximately 380 miles of free-flowing streams. Numerous oxbows, sloughs, and backwaters occur throughout the basin, especially in its lower reaches near Caddo Lake. Plates 2 and 3 display major stream habitat features observed during surveys of the basin. These features primarily include riffles, heavily timbered runs, open water pools, and backwaters or sloughs.

Substrates of the streams are relatively homogeneous and are composed primarily of sand, silt, clay, or organic detritus. The nature of the substrate depends upon the geology and runoff characteristics (i.e., soils, topography, stream gradient, current velocity, etc.) of the specific stream.

Aquatic vegetation in Cypress Basin streams is dictated by these same physical features as well as the fluctuating nature of the streams and their water quality. The most common aquatic plants noted during field surveys included smartweeds (Polygonum spp.) pondweeds (Potamogeton spp.), duckweed (Lemna sp.), water primrose (Ludwigia peploides), and a variety of sedges and rushes. Major woody species occurring on the stream banks or overhanging the stream include baldcypress (Taxodium distichum), water elm (Planera aquatica), black willow (Salix nigra), and buttonbush (Cephalanthus occidentalis). These latter species provide important canopy and instream

cover for aquatic life, especially where their rootwads or limbs interface with the stream's surface (Plate 4).

Water quality of the basin is rated as good to excellent with most parameters exceeding the State water quality standards (Freese and Nichols 1977, WAPORA 1981, Kindle, Stone & Associates 1982). Localized water quality problems have occurred in the basin, however, as a result of low dissolved oxygen levels and elevated concentrations of chlorides, total dissolved solids, coliforms, and nutrients.

Low dissolved oxygen levels (<5.0 mg/l) typically occur during the summer months and result from a combination of high water temperatures, low stream flows, and oxidation of naturally occurring organic materials deposited in the stream from forestland runoff. The lowest concentrations of dissolved oxygen in the basin (yearly averages between 5.5 and 5.9 mg/l) occur in Black Cypress Bayou, Segment 406, and Jim's Bayou, Segment 407. Higher chlorides, total dissolved solids, coliforms, and nutrient concentrations are generally attributed to industrial, municipal, and residential discharges to the basin's waters. Oil field brines have also contributed to the deterioration of water quality.

Stream flows in Little Cypress and Black Cypress Bayous are relatively uninfluenced by man's activities. No major impoundments or diversions have been constructed on either the main stem or tributaries of these streams. In contrast, extensive water resources development has occurred on Big Cypress Bayou.

According to U.S. Geological Survey records for water years 1947-1983, annual stream flows as measured at the Little Cypress Bayou gage 6.8 miles upstream of its confluence with Big Cypress Bayou (U.S.G.S. 07346070) averaged 527 cubic feet per second (cfs). Average median flow was 285 cfs. Discharges at Black Cypress gage (U.S.G.S. 07346045) located 5.2 miles upstream from its mouth had annual mean and median values of 333 and 184 cfs, respectively.

Stream Fishery

Little baseline data is available on the stream fishery of Cypress Bayou Basin. Texas Parks and Wildlife Department conducted a basic survey and inventory of fish species present in the Marion County portions of Little, Black, and Big Cypress Bayous in the early 1950's (Kemp 1954a, 1954b). In 1956, a similar study was conducted by the State for upstream counties of the basin (Bonn 1956). In 1980, Central and Southwest Services, Inc. sampled aquatic habitats on Big Cypress, Little Cypress, and four nearby creeks in conjunction with baseline studies for a potential lignite surface mine near Karnack, Texas (Central and Southwest Services 1980). A composite checklist of the fish species observed during these studies is included as Appendix A to this report.

A total of 71 fish species were observed during the surveys, with a similar number of species found in Little Cypress, Black Cypress, and Big Cypress

Bayous. Three species, the bowfin, creek chubsucker and striped shiner, were observed only in the smaller tributary streams and may be indicative of the specialized habitat preferences of these fish. Major stream sport fishes include the largemouth and spotted bass, channel catfish, white bass, white and black crappie, and the sunfishes. Primary forage species include gizzard and threadfin shad, forage size sunfishes, and various shiners, minnows and suckers.

The variety of species collected throughout the Cypress Basin is indicative of the high diversity and quality of the lotic habitats. These habitats have high value for aquatic species and are becoming scarce on a national and ecoregion basis due to man's activities such as water resources, agricultural, and forestry development. The Fish and Wildlife Service classifies Cypress Bayou Basin stream habitats as Resource Category 2 and prescribes a mitigation goal of "no net loss of in-kind habitat value" (U.S. FWS 1981).

Reservoir Habitats

Extensive water resources development has occurred on Big Cypress Bayou. Eight reservoirs ranging in size from 650 to 26,800 surface acres at normal pool elevation have been constructed for municipal and industrial water supply, recreation, and flood control (Table 1).

Table 1. Pertinent data for existing reservoirs, Cypress Bayou Basin, Texas.

Reservoir	Conservation Pool Capacity (Acre-ft.)	Conservation Pool Surface Area (Acres)
Lake Cypress Springs	100,400	3,400
Monticello	40,100	2,000
Bob Sandlin Lake	213,350	9,460
Ellison Creek	24,700	1,516
Johnson Creek	10,100	650
Welsh	23,587	1,365
Caddo Lake	128,810	26,800
Lake O'the Pines	254,900	18,700

These reservoirs provide excellent lentic habitats for a variety of warm water fish species. In general, most of the reservoir watersheds contain large amounts of upland and bottomland timber, much of which was left uncleared and inundated during impoundment. The relatively flat topography of the watersheds and numerous small tributary streams also provides abundant shorelines with large littoral areas. The combination of large amounts of timber, brush, littoral zones, and nutrients provides for a highly productive fishery.

Lush growths of aquatic vegetation provide ample cover and a food source for forage and sport fishes within the basin's impoundments. Management surveys indicate American lotus (Nelumbo lutea) and water hyacinth (Eichornia crassipes) are the two most common floating aquatics. Other major floating and submerged species include pondweeds, water milfoil (Myriophyllum spicatum), muskgrass (Chara sp.), coontail (Ceratophyllum demeraum), elodea (Elodea densa), parrotfeather (Myriophyllum brasiliense), water primrose, and duckweed (Toole 1981, 1983a, 1983b). A checklist of aquatic plants noted during State management surveys of basin reservoirs is attached as Appendix B.

Aquatic vegetation is normally abundant in shallow-water shoreline areas by mid-summer and is often considered noxious due to its impact on reservoir recreation activities. However, control measures are normally required only in high-use recreation areas.

Physiochemical characteristics of the reservoirs are typical of other impoundments located in the east Texas pineywoods ecoregion. pH levels are slightly acidic and total alkalinity, specific conductance, turbidity, and total hardness are relatively low. The reservoirs thermally stratify during the hot summer months. Low dissolved oxygen concentrations are also common due to decomposition of organic materials and a lack of water mixing from reduced inflows and wind action. However, no major water quality problems harmful to the fish populations have been observed during the State's fisheries management surveys.

Reservoir Fishery

Numerous surveys have been conducted on basin reservoirs by the Texas Parks and Wildlife Department during the course of their fisheries management activities. The State's surveys indicate the reservoirs provide an excellent fishery. Major species sought by fishermen include the largemouth bass, white bass, channel and flathead catfish, and white and black crappie. Other important sport fishes are the bluegill, redear sunfish, spotted bass, chain pickerel, and introduced hybrid striped bass. Primary forage species are the gizzard and threadfin shad, forage size sunfishes, shiners, and minnows (Toole 1981, 1983a, 1983b). Appendix C provides a composite checklist of 66 fish species collected in major reservoirs of the Cypress Basin.

Standing crop estimates for Caddo Lake, Lake O'the Pines, and Bob Sandlin Lake, based on cove rotenone sampling, illustrate the productivity of these waters. In 1980, Caddo Lake yielded a total of 1,062 pounds of fish per acre of cove sampled (Toole 1981). Approximately 9 percent (%) of this total was sport fish, while 87% of the total represented one forage species - gizzard shad. Most of the shad were greater in length than 8 inches and were not considered forageable size. Sampling bias is thought to have contributed to this unbalanced situation, since samples sites were selected in relatively deep coves and large schools of shad moved into the area prior to treatment. Discounting the gizzard shad collection, largemouth bass

composed about 8.5 pounds per acre or 6.4% of the standing crop. According to Toole, however, the representation of catchable size largemouth bass in the 1980 Caddo Lake data does not accurately represent the standing crop of this important sport fish, since sampling could not be conducted in the numerous bayous and secondary channels of the lake which concentrate fish during the summer months.

Cove rotenone data for Lake O'the Pines and Bob Sandlin Lake may be more indicative of the sport fishery. Average standing crops, based on two years of data for each reservoir, yielded approximately 299 and 177 pounds of fish per acre, respectively. Sport fish comprised 63% of this total at Lake O'the Pines and 42% at Bob Sandlin. These numbers are high, since most of the sunfishes are included as sport fish, and the standing crops have not been adjusted to reflect that portion of the sunfish population of forage size. Black bass populations averaged 37.5 pounds per acre or 12.4% of the population at Lake O'the Pines and 22.2 pounds per acre or 11.3% of the population at Bob Sandlin.

Several of the basin's reservoirs, particularly Monticello and Welsh, have become well known for their trophy largemouth bass fishing and are drawing widespread interest from the press, outdoor publications, and bass clubs. As of Spring 1984, six of the top 10 largemouth bass in Texas came from these two reservoirs. The second largest, a 15-pound, 3-3/4 ounce fish, was taken from Lake Welsh and is the largest bass ever taken from public waters in Texas. The introduction of Florida-strain largemouths in the early 1970s is generally credited with the success of the largemouth bass fishery on these reservoirs.

AQUATIC EVALUATION METHODOLOGY

Pursuant to the FY 1984 Scope of Work and coordination with members of the Corps of Engineers planning team, this report provides preliminary recommendations concerning instream flows for Little Cypress and Black Cypress Bayous. Instream flow studies are being conducted on these streams to correspond with water development alternatives (i.e., Marshall and Black Cypress Lakes) being evaluated by the Fort Worth District. Preliminary human use and economic data, in the form of estimated recreation resource requirements, is also provided for economic analyses.

Instream Flow Methodology

Streamflows were evaluated using the Fish and Wildlife Service Instream Flow Incremental Methodology (IFIM). This method quantifies available aquatic habitat for target evaluation species and their individual life history stages (i.e., adult, spawning, fry, and juvenile) at different flow regimes. Such information can be utilized to identify streamflow levels or other management features necessary to meet fishery management objectives for the stream (Bovee 1982).

The IFIM consists of two subroutines: (1) a hydraulic simulation model and (2) a habitat model. The hydraulic model simulates velocity, depth, and

substrate distributions within a channel as flow is varied and expresses these measurements as surface area. The model is calibrated with field measurements of a known flow. Several hydraulic simulation techniques are available, however, for the purposes of this initial planning aid report the one-flow, Water Surface Profile (WSP) model was used. This model requires only one set of cross-section and water surface elevation measurements to calibrate, and is useful for developing "ball park" estimates of habitat conditions. More detailed hydraulic simulation models (i.e., the three-flow, IFG-4 program) will be used to refine the streamflow recommendations as additional data is collected and planning progresses on the Cypress Basin project.

The habitat program or Physical Habitat Simulation System (PHABSIM), uses probability-of-use or habitat preference curves of target evaluation species to compute a species' preference for a combination of velocity, depth, and substrate conditions. This preference factor is multiplied by the surface area of the stream having that specific velocity, depth, and substrate combination to obtain the species' weighted usable area (WUA). WUA's, which are analagous to habitat units of the Habitat Evaluation Procedures, can be calculated for a range of flows thus providing an estimate of the impact of streamflow changes on aquatic habitats.

The calibration flows measured on Little Cypress and Black Cypress Bayous permitted an extrapolation range of 25-150 cfs for evaluation in this report. All field hydraulic measurements and PHABSIM analyses referenced above were conducted in accordance with published IFIM guidance manuals (Bovee and Milhous 1978, Milhous et al. 1981, Bovee 1982). Field techniques used in the collection of hydrologic stream data are illustrated in Plate 5.

Study sites for the streamflow investigations were selected on Little Cypress and Black Cypress Bayous in the vicinity of the alternative damsites under consideration. Two reaches were evaluated on Little Cypress--one immediately downstream from the Highway 154 crossing and one upstream of the Highway 3001 crossing. The Highway 154 site is located in the proposed Marshall Reservoir basin, while the Highway 3001 site is approximately 3 1/2 miles downstream of the damsite. The study reach on Black Cypress Bayou is located north of Berea, about 3/4 mile above the proposed damsite. Study sites were selected on the basis of their representativeness of the streams and their ability to provide access for boats and other field equipment. Photographs of the selected study reaches are provided in Plates 6, 7, and 8.

Instream flow recommendations for the Cypress Basin are based on the habitat needs of the channel catfish, spotted bass, white bass, longear sunfish, and river darter. These species were selected for evaluation because of their preference for stream habitats during all or part of their life cycle, their significance as sport fish, their varied reproductive and feeding requirements, and the availability of habitat preference curves. Due to project time constraints, existing species preference curves, developed by the Cooperative Instream Flow Group of the U.S. Fish and Wildlife

Service, were used to compute WUA's in the IFIM analyses. These curves, constructed from criteria and guidance provided by Bovee and Cochnauer (1977), are attached as Appendix D.

The preference curves utilized are drafts developed during efforts to collate published data related to the preferences of fish for such hydraulic parameters as velocity, depth, and substrate. The Fort Worth Ecological Services field office is currently cooperating with the Corps District and Waterways Experiment Station in a cooperative fishery study of the Cypress Bayou Basin. The objective of this study is to gather fisheries data specific to the Cypress Basin and to develop species preference curves for application of IFIM and Habitat Evaluation Procedures during project impact analyses. Techniques utilized for the collection of this fisheries data are illustrated in Plates 9 and 10. Additional biological and hydrological sampling will allow refinement of the instream flow recommendations as planning proceeds.

Recreation Supply-Demand Analysis

This report provides estimates of the recreation resource requirements in mandays needed to maintain the quality of sportfishing within the Cypress Bayou Basin study area. For the purposes of this recreation analysis, the five major counties drained by Little Cypress and Black Cypress Bayous were considered. These counties are Cass, Gregg, Harrison, Marion, and Upshur (Plate 1).

Fishing recreation supply data for streams and reservoirs was developed from inventories of aquatic habitat and estimated fisheries production and harvest statistics (Wood 1961; Toole 1975, 1976). For these evaluations, it was assumed that the total resource capability or mandays supply would remain constant through the period of analysis, 1980-2000. However, under actual conditions supply would be expected to vary as a result of unquantifiable factors such as losses or gains of habitat, population dynamics, and fisheries management activities.

Fishing recreation demand data was supplied by the Comprehensive Planning Branch of the Texas Parks and Wildlife Department. This data, abstracted from the 1968 Household Demand Survey and Texas Outdoor Recreation Plan, represents the total resident and non-resident fishing pressure exerted upon the study area (TPWD 1981).

Fishing recreation resource requirements, or needs for fishing in mandays, are the difference between supply and demand available for the county within the study area. Preliminary data are also provided on the estimated sportfishing gains or losses which could potentially occur from development of alternative damsites in the basin, based upon the maximum resource capability of the reservoir and streams.

RESULTS AND DISCUSSION

Instream Flow Methodology

The range of streamflows evaluated during the Water Surface Profile (WSP) hydraulic simulation (i.e., 25-150 cfs) permitted the identification of maintenance flows for Little Cypress Bayou and Black Cypress Bayou. Maintenance flow is basically defined as the instantaneous discharge required to maintain the fishery at a biologically acceptable level of productivity, or the flows necessary to maintain the status quo of the stream fishery. These maintenance flows are the baseline by which the health of the ecological system should be judged, and from which incremental impacts or enhancement values can be evaluated.

The current WSP hydraulic simulation can not be used to identify minimum (survival) or optimum flows for these streams, since the one calibration flow does not allow extrapolation to lower or higher flows than 25 and 150 cfs, respectively. Project investigations will be conducted the remainder of this fiscal year to gather additional hydraulic and biological data for refinement of the IFIM and for input into the Cooperative Fishery Study.

Weighted usable areas (WUA's) computed from the WSP hydraulic simulation for the five evaluation species are summarized in Tables 2, 3, and 4 for the three study sites. Only the adult life stage of the longear sunfish and river darter was evaluated due to the lack of preference curves on other life history stages. These WUA's were plotted versus the discharges simulated in order to determine the inflection point (i.e., where each incremental decrease in flow sharply reduces WUA and each incremental increase in flow yields a marginal increase in WUA). This inflection point was assumed to represent the maintenance flow required for the species' life history stage.

WUA's for spawning, fry, juvenile, and adult life history stages of the evaluation species as determined for the Little Cypress Bayou, Highway 154, site are displayed in Figures 1-4. At this site, stream flows ranging from 50-100 cfs appear to represent the level at which evaluation species can maintain an adequate spawn (Figure 1). Figure 2 indicates that fry appear to require a flow of 50-75 cfs. Juveniles and adults appear to require maintenance flows of approximately 50 and 100 cfs, respectively. The higher flow levels required for adults and spawning is generally indicative of the affinity of the evaluation species for medium to larger rivers and the greater space requirements of the species to carry out their biological functions (Orth and Maughan 1981, Bovee 1982).

Figures 5-8 and Table 3 display the WUA's determined by the IFIM for Little Cypress Bayou just upstream of Highway 3001. Spawning requirements for the channel catfish, spotted bass, and white bass are approximately 100 cfs, although WUA's increase throughout the range of flows simulated (Figure 5).

Table 2. Weighted usable area in ft^2/1,000 ft. of stream for Little Cypress Bayou at Highway 154, January 31, 1984.

Life Stage Evaluation Species	Discharge (cfs)					
	25	50	75	100	125	150
Spawning						
Channel catfish	11,256	27,527	36,847	40,395	40,841	40,531
Spotted bass	36,853	43,153	38,193	33,352	26,989	24,674
White bass	17,736	22,376	24,463	27,913	29,274	30,028
Fry						
Channel catfish	2,477	3,635	4,507	4,901	5,175	5,356
Spotted bass	20,748	35,712	41,835	44,519	46,657	49,964
White bass	37,132	40,487	38,322	37,123	34,098	33,366
Juveniles						
Channel catfish	1,925	2,872	2,992	2,651	2,341	2,203
Spotted bass	21,482	33,675	36,574	37,366	38,352	39,680
White bass	26,191	38,945	43,517	47,775	50,947	53,408
Adults						
Channel catfish	3,455	12,500	21,297	26,650	30,281	33,293
Spotted bass	8,766	26,182	37,858	42,237	43,879	45,606
White bass	5,614	19,416	31,370	38,396	41,805	44,473
Longear sunfish	34,828	38,952	34,224	29,281	32,755	34,485
River darter	25,746	34,545	38,558	41,681	47,727	52,680

Table 3. Weighted usable areas in $ft.^2$/1,000 ft. of stream for Little Cypress Bayou at Highway 3001, February 1, 1984.

Life Stage & Evaluation Species	Discharge (cfs)					
	25	50	75	100	125	150
Spawning						
Channel catfish	2,335	7,116	11,084	13,931	15,473	16,699
Spotted bass	19,424	27,536	33,498	37,828	40,031	41,635
White bass	10,639	16,497	20,739	24,906	28,276	31,482
Fry						
Channel catfish	3,119	5,069	6,673	8,134	9,518	10,853
Spotted bass	6,694	12,353	15,214	15,710	16,596	16,632
White bass	17,984	24,985	27,979	29,483	30,679	31,875
Juveniles						
Channel catfish	859	1,614	2,298	2,793	3,114	3,350
Spotted bass	5,918	9,874	11,757	12,893	13,875	14,321
White bass	10,861	18,927	25,224	29,744	34,125	37,627
Adults						
Channel catfish	1,683	6,084	12,052	17,029	19,942	22,860
Spotted bass	1,028	5,736	9,847	12,422	13,457	14,773
White bass	764	4,457	9,330	13,441	17,508	20,961
Longear sunfish	16,283	17,812	16,145	16,812	18,584	20,414
River darter	16,324	25,192	30,497	36,018	40,845	45,239

Table 4. Weighted usable areas in ft.^{2}/1,000 ft. of stream for Black Cypress Bayou Near Berea, February 2, 1984.

Life Stage & Evaluation Species	Discharge (cfs)					
	25	50	75	100	125	150
Spawning						
Channel catfish	4,682	13,031	18,588	22,380	23,544	24,000
Spotted bass	26,895	32,755	36,431	37,079	36,377	34,897
White bass	14,196	18,417	21,980	24,911	27,456	29,724
Fry						
Channel catfish	2,907	4,512	5,818	6,978	7,966	8,723
Spotted bass	11,353	20,611	26,265	26,657	26,019	24,717
White bass	27,192	30,946	31,657	31,462	30,534	29,928
Juveniles						
Channel catfish	1,229	2,056	2,535	2,795	2,874	2,828
Spotted bass	11,340	16,697	18,795	18,617	18,496	18,261
White bass	16,257	25,653	31,271	34,818	37,665	40,324
Adults						
Channel catfish	1,975	8,931	16,497	24,175	28,200	30,369
Spotted bass	2,783	11,458	18,091	22,580	23,153	23,044
White bass	1,908	7,491	14,549	20,445	24,994	28,766
Longear sunfish	23,556	20,535	17,729	16,913	15,760	15,166
River darter	19,817	27,791	32,768	36,586	39,983	42,830

FIGURE 1

LITTLE CYPRESS BAYOU AT HIGHWAY 154

LIFE STAGE AND EVALUATION SPECIES

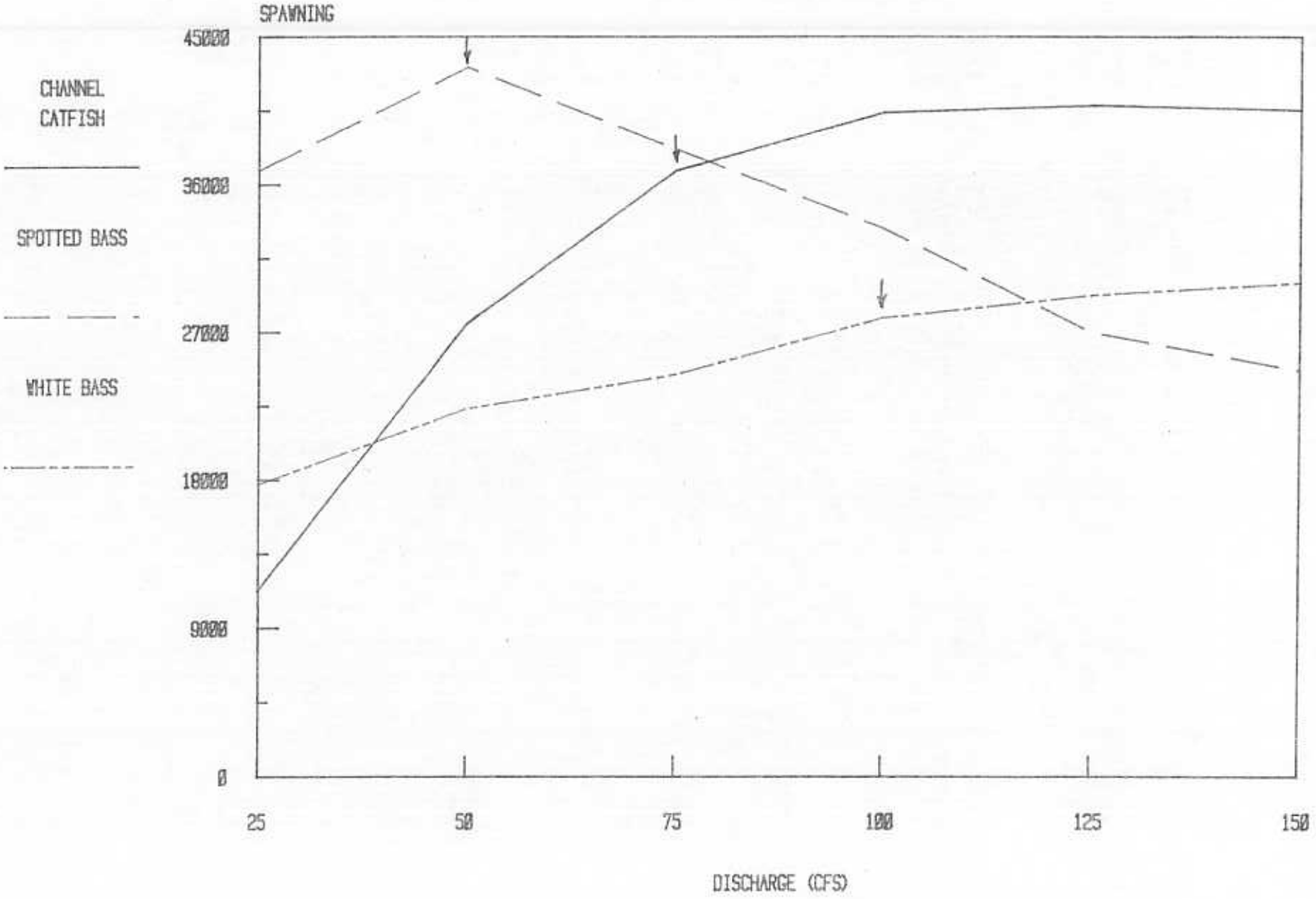


FIGURE 2

LITTLE CYPRESS BAYOU AT HIGHWAY 154

LIFE STAGE AND EVALUATION SPECIES

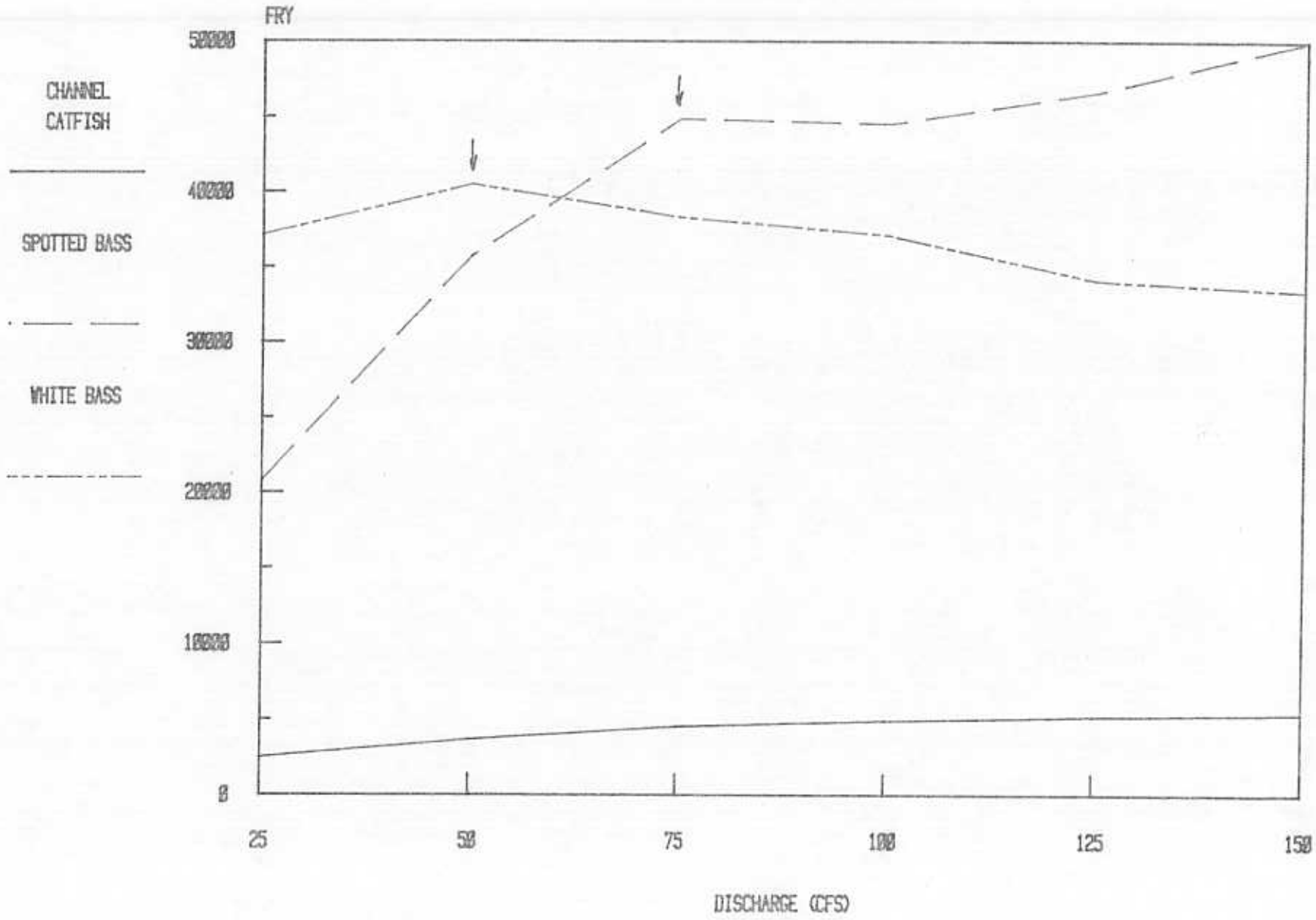


FIGURE 3

LITTLE CYPRESS BAYOU AT HIGHWAY 154

LIFE STAGE AND EVALUATION SPECIES

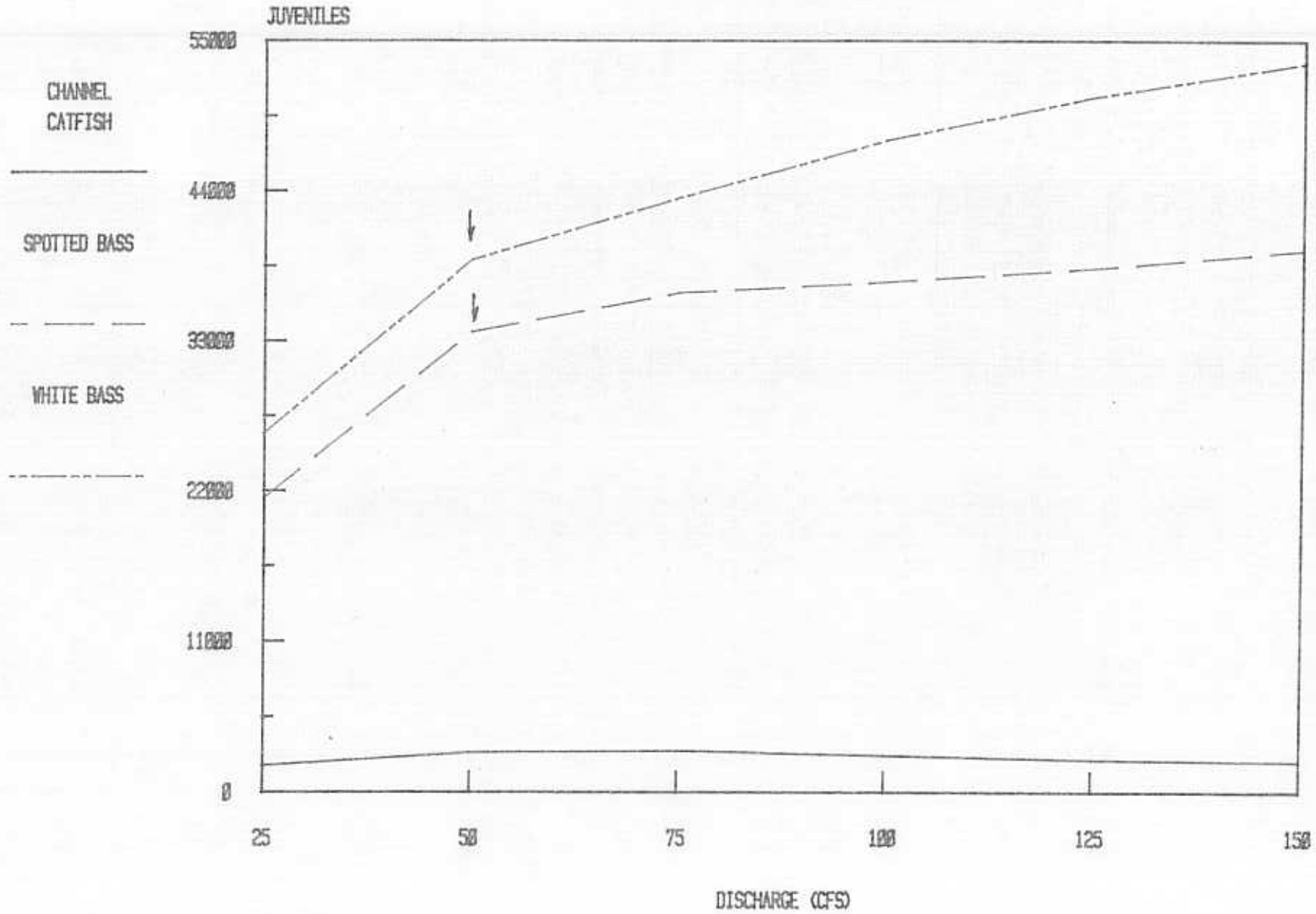


FIGURE 4

LITTLE CYPRESS BAYOU AT HIGHWAY 154

LIFE STAGE AND EVALUATION SPECIES

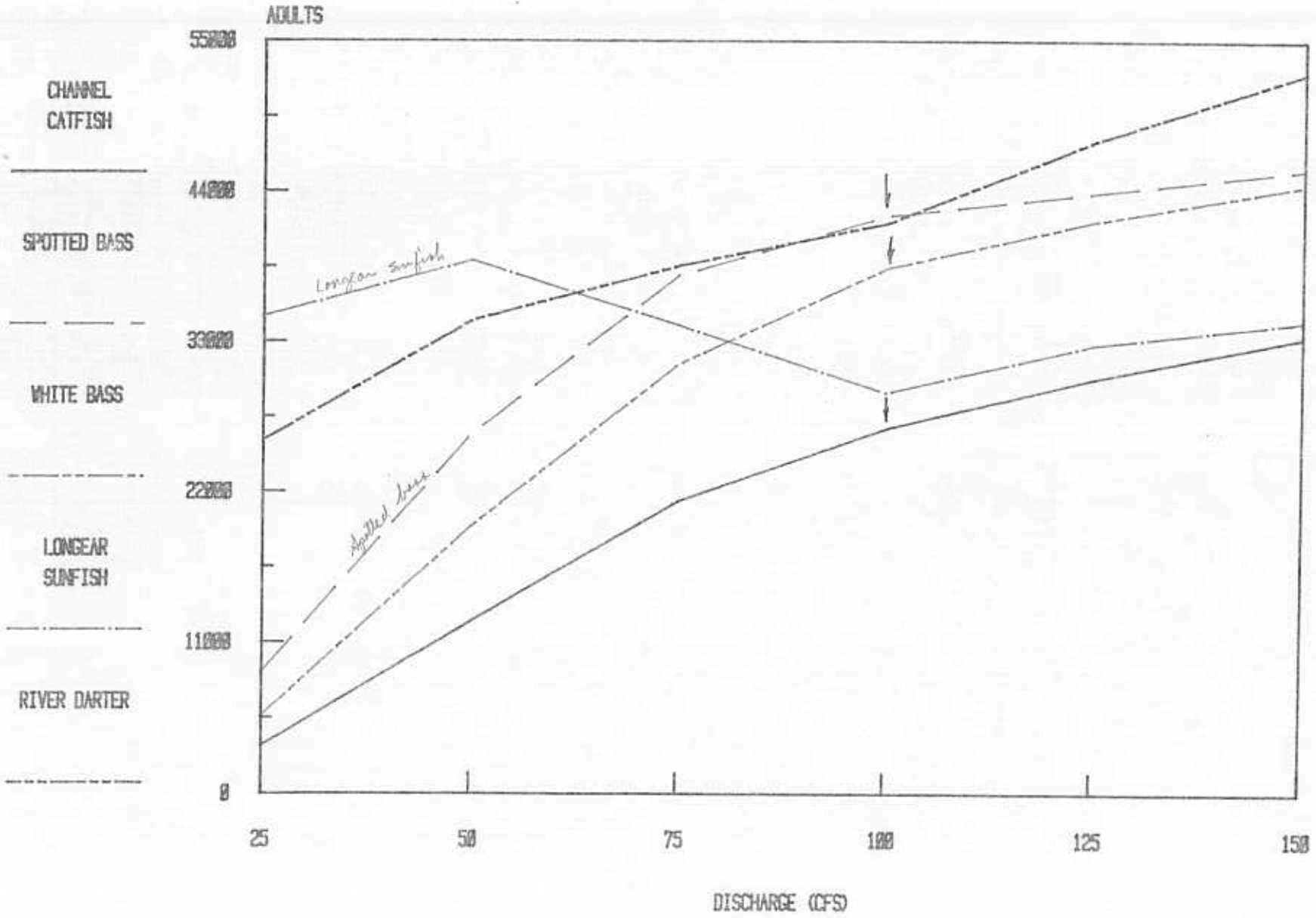


FIGURE 5

LITTLE CYPRESS BAYOU AT HIGHWAY 3001

LIFE STAGE AND EVALUATION SPECIES

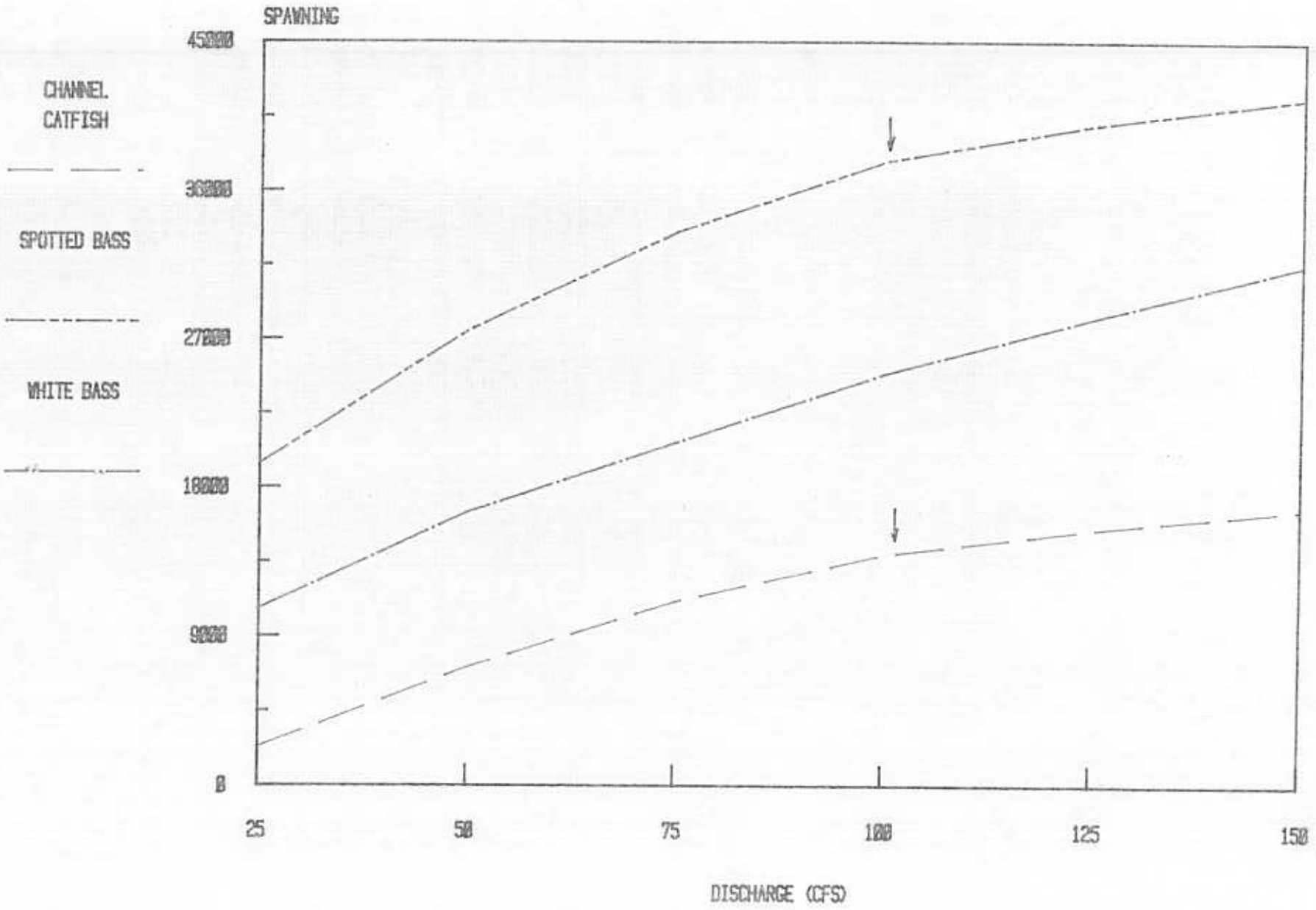


FIGURE 6

LITTLE CYPRESS BAYOU AT HIGHWAY 3001

LIFE STAGE AND EVALUATION SPECIES

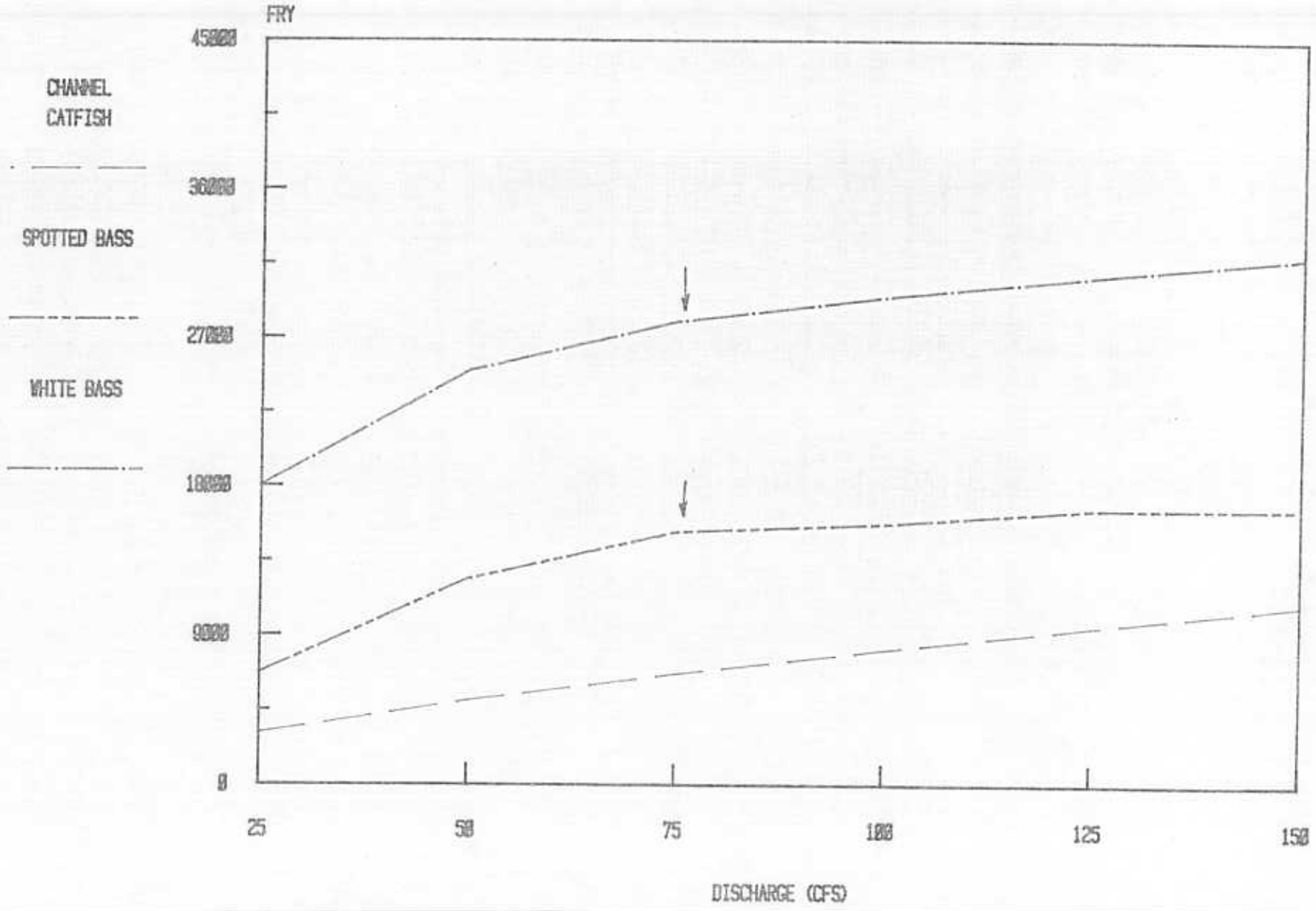


FIGURE 7

LITTLE CYPRESS BAYOU AT HIGHWAY 3Ø1

LIFE STAGE AND EVALUATION SPECIES

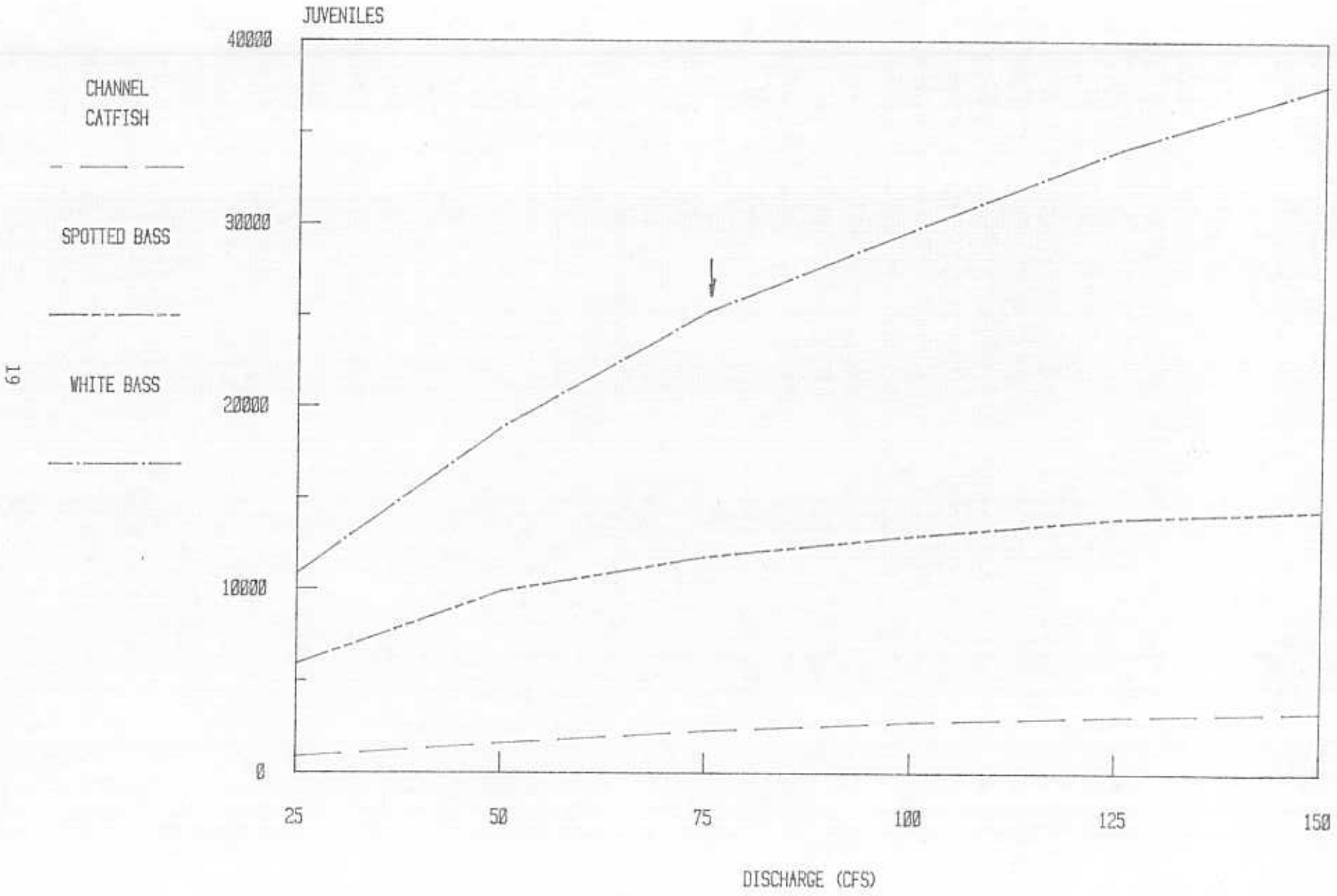
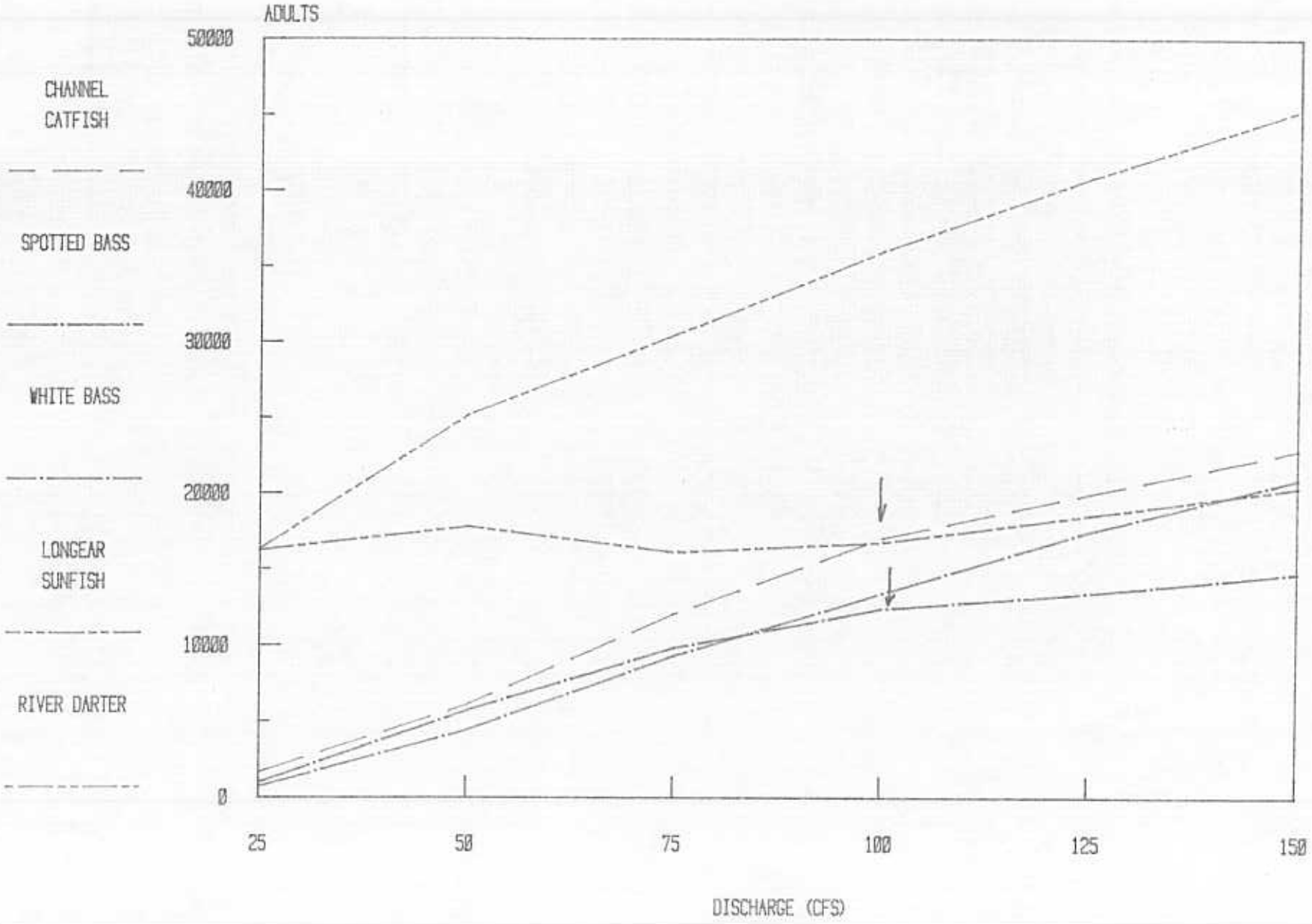


FIGURE 8

LITTLE CYPRESS AT HIGHWAY 3001

LIFE STAGE AND EVALUATION SPECIES



The variation in spawning flows required for spotted bass at Highways 154 and 3001 (50 and 100 cfs, respectively) is thought to result from differences in macrohabitat conditions at each study site. Habitat at Highway 154 is essentially pool (see Plate No. 6), and higher flows contribute little to increased habitat area, while increasing velocities which are less desirable for spawning. On the other hand, greater flows at Highway 3001 contribute substantially to increased habitat area due to the constricted nature of the stream channel (Plate No. 7). The range of flows simulated at Highway 3001 also probably tend to spread out more within the floodplain, which would hold velocities somewhat lower and permit enhanced spawning even during higher discharges.

Maintenance flows for Little Cypress, Highway 3001, are approximately 75 cfs for fry and juveniles (Figures 6 and 7) and 100 cfs for adult fish species (Figure 8). Inflection points are difficult to detect for the simulation at Highway 3001, since as previously discussed, each increment of discharge essentially increases aquatic habitat availability. Inflection points are most notable for spotted bass and white bass fry, white bass juveniles, and spotted bass and channel catfish adults. Discharge requirements for evaluation species were slightly higher at the Highway 3001 site than the Highway 154 site for the aforementioned reason, but not significantly so.

Results of the IFIM on Black Cypress Bayou are comparable to Little Cypress Bayou (Figures 9-12, Table 4). Streamflows required to maintain spawning ranged from about 75-100 cfs; fry 50-75 cfs; juveniles, 50-75 cfs; and adults 75-100 cfs. As can be observed from the figures, it appears that optimum flow for some evaluation species, such as spotted bass and channel catfish occurs within the simulated range of discharges. This may result from channel configuration of the Black Cypress study reach, which generally has higher banks and deeper water than the sites evaluated on Little Cypress Bayou (see Plate No. 8). These physical characteristics would not necessarily lead to greater amounts of aquatic habitat being provided with increased streamflows. Refined streamflow analyses, however, with additional flow and biological data would be required to confirm this conclusion.

Recommendations on monthly maintenance flows required for Little Cypress and Black Cypress Bayous are based upon the discharges identified in the IFIM and the seasonal occurrence of evaluation species' life history stages (Table 5). The seasonal periodicities of the evaluation species were determined from a variety of sources identified at the bottom of Table 5.

For the Cypress Bayou Basin, preference was given to the spawning requirements of white bass during the months of March and April, since these fish are early spawners and require relatively high flows for their upstream spawning run. Streamflow recommendations for May-June were weighted for the spawn of spotted bass and channel catfish. Flows recommended for the months of July-November were based on the habitat requirements of fry and juveniles of these three sport fish. Adult requirements were emphasized for the remaining months of the year.

FIGURE 9

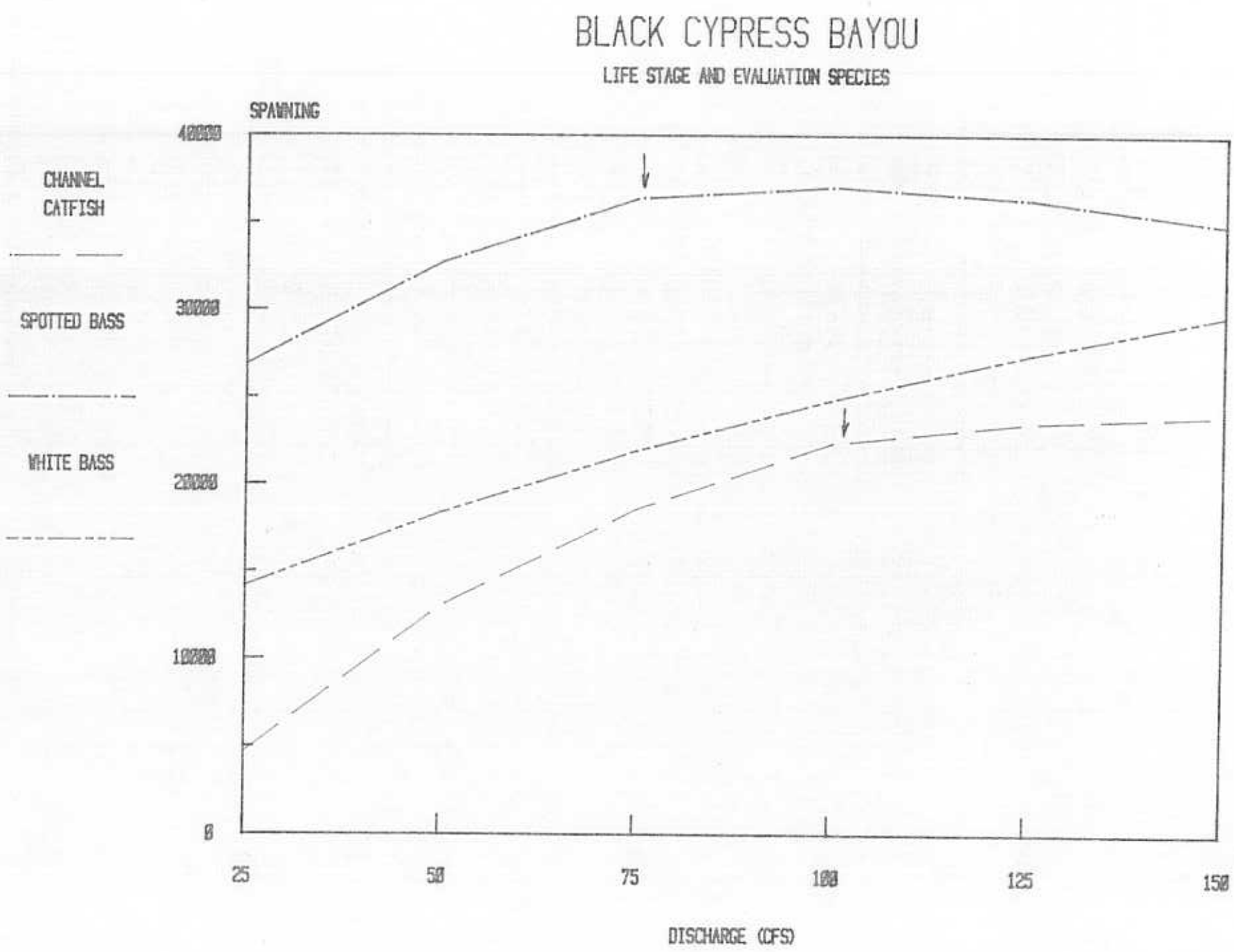

BLACK CYPRESS BAYOU
LIFE STAGE AND EVALUATION SPECIES
SPAWNING
CHANNEL CATFISH
SPOTTED BASS
WHITE BASS
400000
300000
200000
100000
0
25
50
75
100
125
150
DISCHARGE (CFS)

FIGURE 10

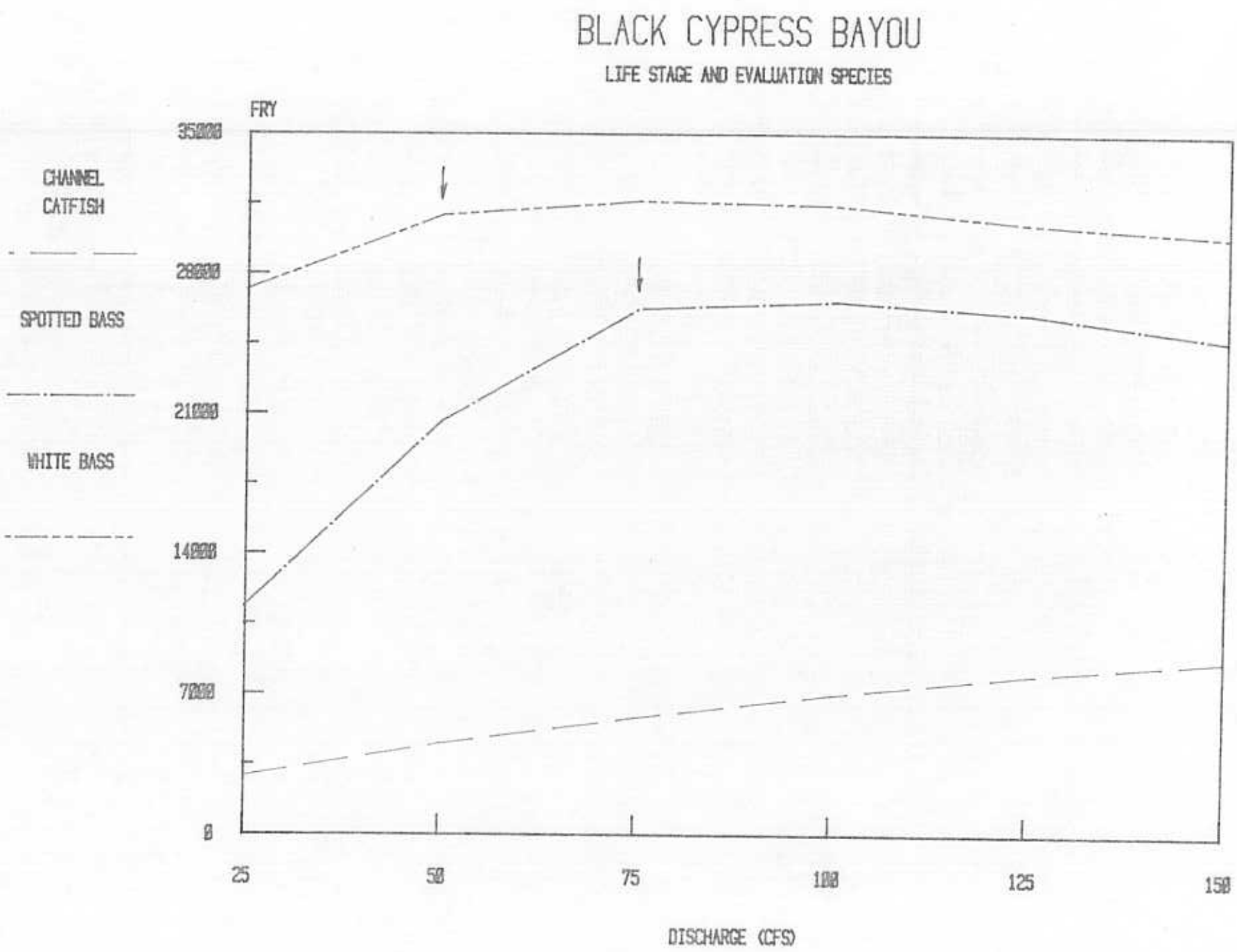

BLACK CYPRESS BAYOU
LIFE STAGE AND EVALUATION SPECIES
FRY
CHANNEL CATFISH
SPOTTED BASS
WHITE BASS
35000
28000
21000
14000
7000
0
25
50
75
100
125
150
DISCHARGE (CFS)

FIGURE 11

BLACK CYPRESS BAYOU

LIFE STAGE AND EVALUATION SPECIES

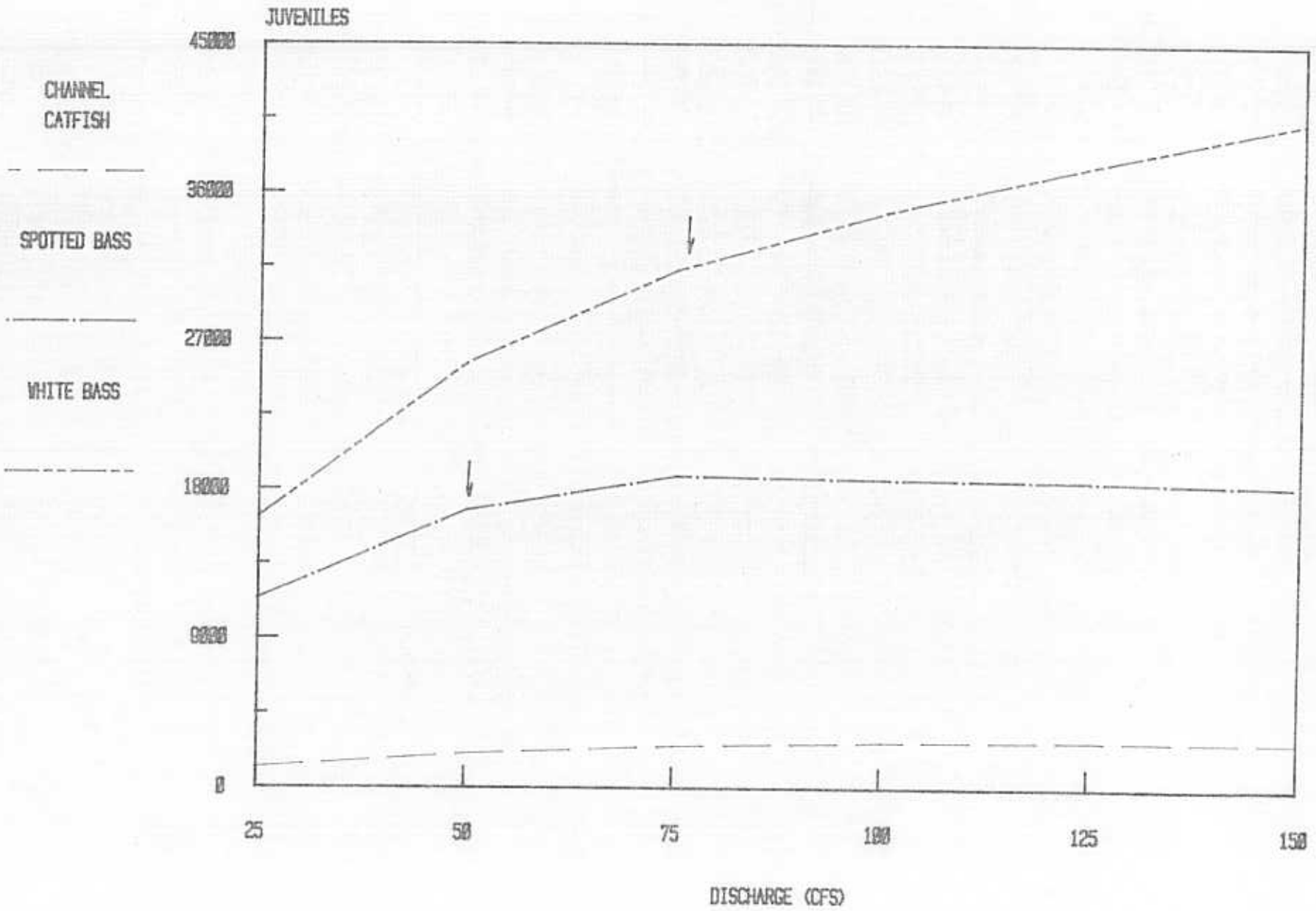


FIGURE 12

BLACK CYPRESS BAYOU

LIFE STAGE AND EVALUATION SPECIES

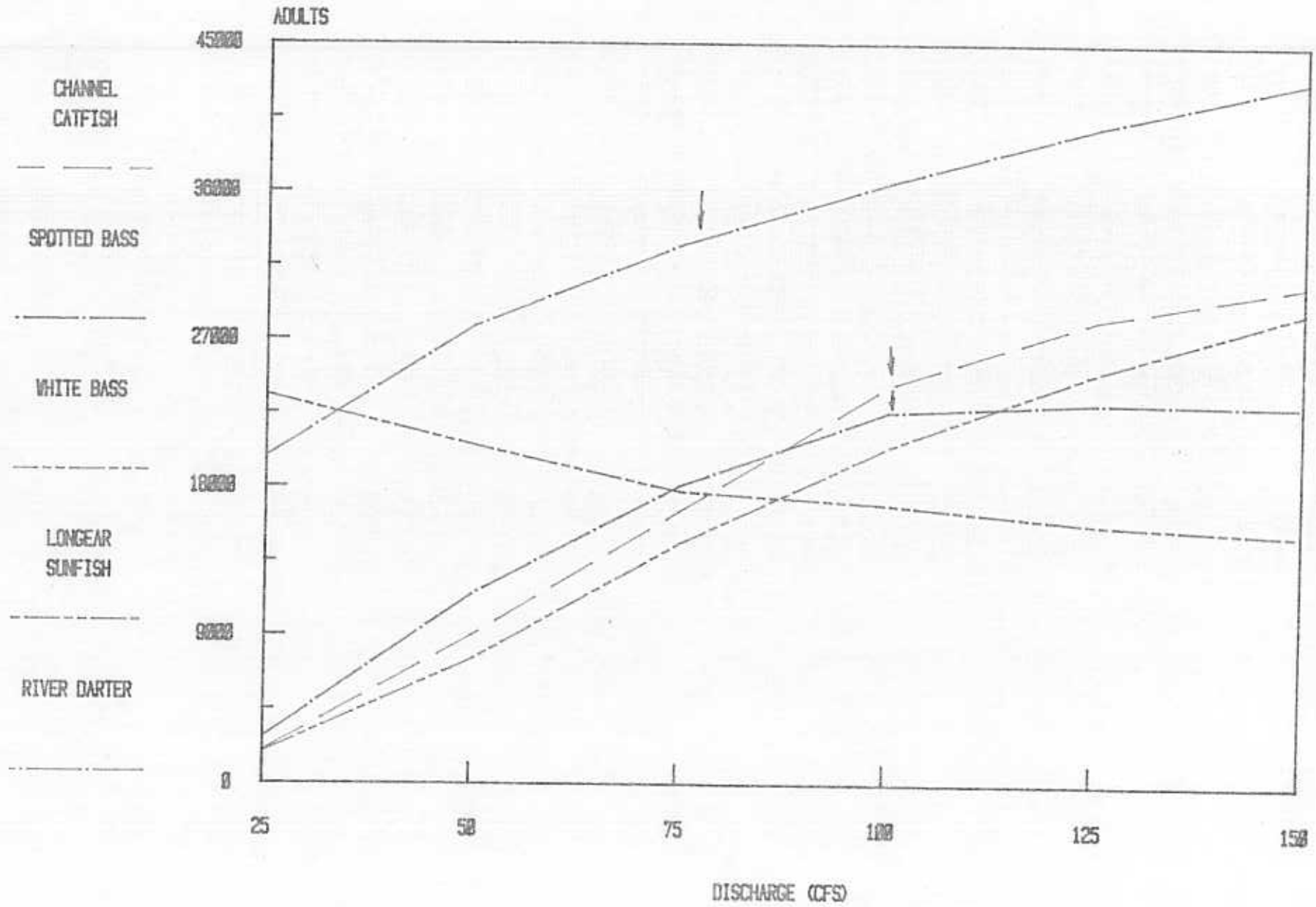


Table 5. Seasonal periodicity of evaluation species by life history stage.

Species	Life History Stage	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Channel catfish	Spawning					X	X	X					
	Fry					X	X	X	X				
	Juvenile	X	X	X	X	X	X	X	X	X	X	X	X
	Adult	X	X	X	X	X	X	X	X	X	X	X	X
White bass	Spawning			X	X								
	Fry			X	X	X							
	Juvenile				X	X	X	X	X	X	X	X	
	Adult	X	X	X	X	X	X	X	X	X	X	X	X
Spotted bass	Spawning				X	X							
	Fry				X	X	X						
	Juvenile	X	X	X	X	X	X	X	X	X	X	X	X
	Adult	X	X	X	X	X	X	X	X	X	X	X	X
Longear sunfish	Spawning					X	X	X	X				
	Fry						X	X	X	X			
	Juvenile	X	X	X			X	X	X	X	X	X	X
	Adult	X	X	X	X	X	X	X	X	X	X	X	X
River darter	Spawning				X	X							
	Fry				X	X	X						
	Juvenile						X	X	X	X	X	X	
	Adult	X	X	X	X	X	X	X	X	X	X	X	X

Source: Bennett 1971, Berra and Gunning 1972, Houser and Bryant 1970, Lee et al. 1980, McMahon and Terrell 1982, Oklahoma Dept. of Wildlife Conservation 1970, Pflieger 1975, Ryan 1968, Starostka and Nelson 1974, Texas Parks and Wildlife Dept. 1971, Thomas 1970, Vogele 1975.

The recommended monthly maintenance flows for both Little Cypress and Black Cypress Bayous are 100 cfs for the months December-June and 75 cfs from July-November (Table 6). This represents an average annual discharge requirement of 90 cfs. The recommended maintenance flow is approximately 17% and 32% of the average annual mean flow and median flow, respectively, for Little Cypress Bayou over the period of record. The 90 cfs flow comprises 27% and 49% of the average annual mean flow and median flow of Black Cypress Bayou.

As displayed in Table 6, recommended flow regimes are substantially less than naturally occurring spring and winter high flows. Similarly, the recommended flows are greater than the summer low flows. Any reservoir plan considered for either the Little Cypress or Black Cypress sites should include a storage and operation plan to meet these seasonal differences. Such a plan is necessary to mitigate the direct loss of stream habitats from impoundment and alterations in flow regimes downstream of the impoundment. Operation of the project in conjunction with Caddo Lake or any other in-channel water transfer technique could possibly meet instream flow needs for fisheries.

Finally, it is noted that the recommended flows do not include a recommendation for flushing. Flushing flows are important to stream ecosystems because of their role in nutrient exchange and the removal of sediment and debris from riffles and pools. The IFIM, as currently used, does not include information for the development of flushing flow recommendations (Orth and Maughan 1981). Hydraulic measurements would be required at much higher flows, and in the case of the Cypress Bayou Basin, would probably be infeasible from a channel morphology and safety standpoint. For this study, it is assumed that normally high, spring runoff would provide sufficient flushing action for the stream channel.

Recreation Supply and Demand

Results of the stream and reservoir sport fishing recreation supply-demand analyses for the study area are displayed in Tables 7 and 8. As noted in the methodology section of this report, the mandays supply of fishing was estimated from the amount (i.e., surface acreage) of aquatic habitat multiplied by the resource capacity of the water body in angler days.
Resource capacity was computed from the formula presented by Wood (1961):

$$\text{Resource Capacity} = \frac{\text{Total Productivity} \times A_t^h \text{ value}}{\text{Harvest Ratio}} : \text{Catch/Angler day},$$

Where, Total productivity = standing crop (pounds);

A_t^h = annual yield of harvestable fish in percent of standing crop

Harvest Ratio = percent of harvestable fish subject to capture; and

Catch/Angler day = allocation of one pound per day at the medium level of satisfaction for fisherman success.

Maximum resource capability for streams and reservoirs evaluated in the Cypress Basin averaged 45 mandays per acre. Creel surveys for Lake Cypress

Table 6. Historic and recommended monthly maintenance streamflows (cfs) for the Cypress Bayou Basin, Texas.

Stream and Flow Regime	Month												Avg. Annual
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Little Cypress Bayou													
Mean Flow	666	869	895	1073	1092	471	117	52	121	115	310	543	527
Median Flow	428	659	700	566	556	142	31	10	11	16	75	227	285
Recommended Flow	100	100	100	100	100	100	75	75	75	75	75	100	90
Black Cypress Bayou													
Mean Flow	467	575	653	656	438	321	55	56	64	71	234	404	333
Median Flow	334	473	509	353	268	135	25	6	3	13	89	249	184
Recommended Flow	100	100	100	100	100	100	75	75	75	75	75	100	90

Table 7. Estimated recreation resource requirements (M.D.'s x 1,000) for stream fishing in the Cypress Bayou Basin, Texas.

County	1980			1985			2000		
	Supply	Demand	Need	Supply	Demand	Need	Supply	Demand	Need
Cass	11.8	4.9	---	11.8	5.4	---	11.8	7.3	---
Gregg	8.1	5.7	---	8.1	6.4	---	8.1	8.8	0.7
Harrison	13.9	89.5	75.6	13.9	100.2	86.3	13.9	137.8	123.9
Marion	8.9	217.5	208.6	8.9	243.5	234.6	8.9	334.8	325.9
Upshur	10.7	0.5	---	10.7	0.5	---	10.7	0.7	---
Totals	53.4	318.1	284.2	53.4	356.0	320.9	53.4	489.4	450.5

Table 8. Estimated recreation resource requirements (M.D.'s x 1,000) for fishing in freshwater lakes ≥ 250 surface acres in the Cypress Bayou Basin, Texas.

County	1980			1985			2000		
	Supply	Demand	Need	Supply	Demand	Need	Supply	Demand	Need
Cass	456.8	7.9	---	456.8	8.8	---	456.8	11.8	---
Gregg	179.4	23.6	---	179.4	26.5	---	179.4	36.4	---
Harrison	571.5	358.9	---	571.5	401.8	---	571.5	552.4	---
Marion	1442.2	857.1	---	1442.2	959.6	---	1442.2	1319.4	---
Upshur	36.0	5.5	---	36.0	6.1	---	36.0	8.4	---
Totals	2685.9	1253.0	---	2685.9	1402.8	---	2685.9	1928.4	---

Springs during 1973-74 noted an actual expenditure of 14.5 mandays per acre (Toole 1975).

When the supply of stream fishing is compared to demand figures provided by Texas Parks and Wildlife Department for the years 1980, 1985 and 2000, there is a notable need for stream fishing in Harrison and Marion Counties (Table 7). This demand is anticipated to increase in the future as human populations continue growing and stream habitats are further impacted by development activities. However, much of this demand could be satisfied by providing access facilities to the study area streams. Currently, public access is available only at major road crossings, and facilities such as boat ramps, parking, fish cleaning tables, etc. are not available (TPWD 1970).

It appears a surplus of reservoir fishing opportunity exists in all counties of the study area (Table 8). Biologically speaking, study area reservoirs are capable of meeting the current and foreseeable demand for lake fishing recreation. Any needs for lake fishing could be provided through development of additional facilities such as boat ramps, fishing piers, and marinas on existing reservoirs (TPWD 1981).

A preliminary estimate of the sport fishing potential of alternative reservoir sites on Little Cypress and Black Cypress Bayous is provided in Table 9. Anticipated stream fishing losses as a result of impoundment of the sites are also given.

Table 9. Preliminary estimate of potential sport fishing gains and losses (M.D.'s x 1000) from alternative reservoir sites in the Cypress Bayou Basin, Texas.

Alternative Site	Conservation Pool Elevation (ft.msl)	Conservation Pool Area (Acres)	Reservoir Fishing Supply (M.D.'s)	Stream Fishing Losses (M.D.'s)
Little Cypress Bayou:				
Marshall #1	267	40,800	1,836.0	4.1
Marshall #2	267	40,800	1,836.0	4.1
Marshall #3	241	19,800	891.0	2.3
Marshall #4	223	9,450	425.3	1.8
Black Cypress Bayou:				
Black Cypress #1	262	29,200	1,314.0	2.8
Black Cypress #2	262	29,200	1,314.0	2.8
Black Cypress #3	242	14,500	652.5	2.6
Black Cypress #4	229	8,500	382.5	2.4

The gains and losses in sport fishing opportunity are based on the maximum resource capability of the water bodies calculated from the formula presented by Wood (1961). These figures reflect the highest possible use of

the reservoirs and streams based upon their biological productivity and estimated levels of harvest.

Actual demands for reservoir fishing would not be as great as the projections displayed in Table 9, however, since there is currently a surplus of reservoir fishing opportunity on other nearby lakes. Fishing on newly-created impoundments would be primarily "transfer-of-use" from the existing reservoirs, rather than new use or demand.

If a specific project plan is selected for future evaluation by the Corps of Engineers, detailed human use and economic studies would be conducted for alternative project futures to further define use-levels and monetary values of fish and wildlife recreation. Procedures developed by the U.S. Fish and Wildlife Service could prove useful for such evaluations (U.S. FWS 1980).

RECOMMENDATIONS

Preliminary aquatic studies indicate several features which should be considered during the Corps of Engineers' feasibility investigations into the water resources of Cypress Bayou Basin.

1. Monthly maintenance flows of 100 cfs from December-June and 75 cfs from July-November should be provided in Little Cypress Bayou or Black Cypress Bayou, if an impoundment is constructed on either of these sites. To meet these flow levels, consideration should be given to reserving or acquiring water rights in the reservoir for downstream release.

2. The feasibility of in-channel, downstream water transfers could be explored as an alternative for maintaining instream flows, in lieu of specific mitigation storage. Since instream flows for fish and wildlife are non-consumptive, capture of the water supply storage at Caddo Lake or other downstream points could meet instream needs without adversely interfering with the water supply function of a project.

3. Alternative project futures should provide stream access as well as traditional reservoir recreation facilities. Stream facilities are needed to satisfy some of the large stream-oriented recreation demands now occurring in the study area.

4. Hydrological and biological studies should be continued on Little Cypress and Black Cypress Bayous in order to refine the seasonal requirements and quantity of instream flows necessary to meet fisheries management objectives.

5. Future studies should consider the effects of any project on the unique fisheries resources and wetland habitats of Caddo Lake, and appropriate mitigatory features developed. Such an analysis is not possible until a specific development plan is available for evaluation.

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APPENDIX A

Composite checklist of fish species collected from Big, Little and Black Cypress Bayous, and small tributary streams within the Cypress Bayou Basin, Texas. [1]

Common Name	Species	Little Cypress	Big Cypress	Black Cypress	Small[2] Tributary Streams
Chestnut lamprey	Ichthyomyzon castaneus	X			
Spotted gar	Lepisosteus oculatus	X			
Longnose gar	Lepisosteus osseus	X	X		
Bowfin	Amia calva				X
Gizzard shad	Dorosoma cepedianum	X	X	X	
Threadfin shad	Dorosoma petenense		X		
Grass pickerel	Esox americanus vermiculatus	X	X	X	X
Chain pickerel	Esox niger	X	X	X	
Black buffalo	Ictiobus niger	X			
Smallmouth buffalo	Ictiobus bubalus	X			
Spotted sucker	Minytrema melanops	X	X	X	X
Golden shiner	Notemigonus crysoleucas		X	X	X
Pugnose minnow	Notropis emiliae			X	
Emerald shiner	Notropis atherinoides	X	X	X	
Ribbon shiner	Notropis fumeus			X	
Redfin shiner	Notropis umbratilis	X	X	X	X

Common Name	Species	Little Cypress	Big Cypress	Black Cypress	Small Tributary Streams
Ironcolor shiner	Notropis chalybaeus	X	X	X	
Weed shiner	Notropis texanus	X	X	X	
Pallid shiner	Notropis amnis		X		
Blacktail shiner	Notropis venustus	X	X	X	
Red shiner	Notropis lutrensis	X	X		
Sand shiner	Notropis stramineus	X	X		
Blackspot shiner	Notropis atrocaudalis	X	X	X	X
Striped shiner	Notropis chrysocephalus				X
Silvery minnow	Hybognathus nuchalis	X	X	X	X
Cypress minnow	*Hybognathus hayi*	X	X	X	
Bullhead minnow	*Pimephales vigilax*	X	X		
Creek chubsucker	*Erimyzon oblongus*				X
Channel catfish	*Ictalurus punctatus*	X	X		
Blue catfish	*Ictalurus furcatus*		X		
Black bullhead	*Ictalurus melas*			X	
Yellow bullhead	*Ictalurus natalis*	X		X	
White catfish	*Ictalurus catus*		X		

Common Name	Species	Little Cypress	Big Cypress	Black Cypress	Small Tributary Streams
Flathead catfish	Pylodictis olivaris			X	
Tadpole madtom	Noturus gyrinus			X	
Freckled madtom	Noturus nocturnus		X		
American eel	Anguilla rostrata	X			
Golden topminnow	Fundulus chrysotus	X		X	
Starhead topminnow	Fundulus notti			X	X
Blackstripe topminnow	Fundulus notatus	X	X	X	X
Blackspotted topminnow	Fundulus olivaceous	X	X		X
Mosquitofish	Gambusia affinis	X	X	X	X
Pirate perch	Aphredoderus sayanus	X	X	X	X
Brook silversides	Labidesthes sicculus	X	X	X	
White bass	Morone chrysops		X		
Yellow bass	Morone mississippiensis	X			
Spotted bass	Micropterus punctulatus	X	X	X	
Largemouth bass	Micropterus salmoides	X	X	X	
Warmouth	Lepomis gulosus	X	X	X	X
Green sunfish	Lepomis cyanellus	X	X		X

Common Name	Species	Little Cypress	Big Cypress	Black Cypress	Small Tributary Streams
Spotted sunfish	*Lepomis punctatus*	X	X	X	
Bantam sunfish	*Lepomis symmetricus*			X	
Redear sunfish	*Lepomis microlophus*	X	X	X	X
Bluegill	*Lepomis macrochirus*	X	X	X	X
Orangespotted sunfish	*Lepomis humilis*			X	
Redbreast sunfish	*Lepomis auritus*		X	X	
Longear sunfish	*Lepomis megalotis*	X	X	X	X
Dollar sunfish	*Lepomis marginatus*	X		X	
White crappie	*Pomoxis annularis*	X	X		
Black crappie	*Pomoxis nigromaculatus*	X	X	X	
Flier	*Centrarchus macropterus*		X		X
Banded pygmy sunfish	*Elassoma zonatum*	X		X	
Black side darter	*Percina maculata*	X		X	
Dusky darter	*Percina sciera*		X	X	
River darter	*Percina shumardi*		X		
Scaly sand darter	*Ammocrypta vivax*		X	X	
Bluntnose darter	*Etheostoma chlorosomum*		X	X	X
Slough darter	*Etheostoma gracile*	X	X	X	

Common Name	Species	Little Cypress	Big Cypress	Black Cypress	Small Tributary Streams
Cypress darter	*Etheostoma proeliare*	X		X	
Goldstripe darter	*Etheostoma parvipinne*	X		X	
Freshwater drum	*Aplodinotus grunniens*	X	X	X	
Totals	71 species	46	48	46	21

[1] Source: Kemp 1954a; 1954b; Bonn 1956; CSW 1980.
[2] Other small tributary streams surveyed were Beckum Creek, Rainey Creek, Grays Creek, and an unnamed creek (CSW 1980).

APPENDIX B

Checklist of aquatic plants, Cypress Bayou Basin, Texas. [1]

Common Name	Scientific Name
American lotus	*Nelumbo lutea*
Arrowhead	*Sagittaria papillosa*
Bladderwort	*Utricularia* sp.
Bulrush	*Scirpus* sp.
Cattail	*Typha* sp.
Coontail	*Ceratophyllum demeraum*
Duckweed	*Lemna* sp.
Duckpotato	*Sagittaria latifolia*
False loosestrife	*Ludwigia leptocarpa*
Fanwort	*Cabomba caroliniana*
Water primrose	*Ludwigia peploides*
Frogbit	*Linmobium spongia*
Pennywort	*Hydrocotyle* sp.
Pondweed	*Potamogeton* spp.
Lizard's tail	*Saururus* sp.
Maidencane	*Panicum hemitomon*
Spikerush	*Elecoharis* sp.
Parrotfeather	*Myriphyllum brasiliense*
Smartweed	*Polygonum* sp.
Rush	*Juncus* spp.
Cyperus	*Cyperus* spp.
Cutgrass	*Zizaniopsis milacea*

Common Name	Scientific Name
Elodea	*Elodea densa*
Water hyacinth	*Eichornia crassipes*
Waterleaf	*Hydrolea sp.*
Watermeal	*Wolffia sp.*
White waterlily	*Nymphaea odorata*
Wild celery	*Vallisneria americana*
Yellow waterlily	*Nuphar luteum*
Watershield	*Brasenia schreberi*
Baldcypress	*Taxodium distichum*
Buttonbush	*Cephalanthus occidentalis*
Waterlocust	*Gleditsia aquatica*
Black willow	*Salix nigra*
Filamentous algae	Chlorophyta
Blue-green algae	Cyanophyta
Muskgrass	*Chara sp.*
Sawgrass	*Cladium mariscoides*
Water milfoil	*Myriophyllum spicatum*

[1] Source: Toole 1981, 1983a, 1983b

APPENDIX C

Composite checklist of fish species collected from reservoirs within Cypress Bayou Basin, Texas. [1]

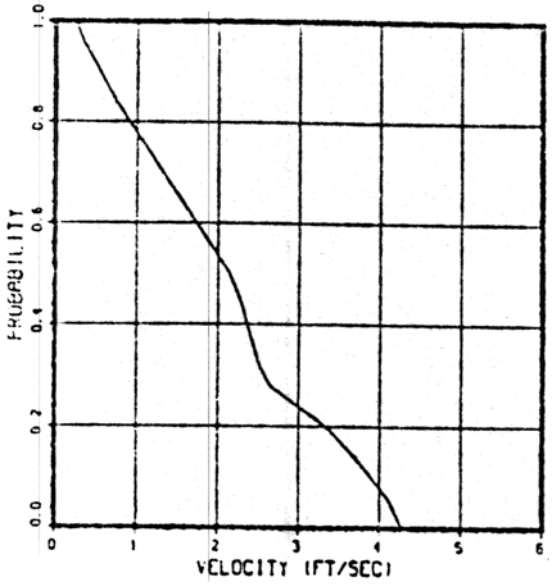
Common Name	Scientific Name
Chestnut lamprey	Ichthyomyzon castaneus
Spotted gar	Lepisosteus oculatus
Longnose gar	Lepisosteus osseus
Shortnose gar	Lepisosteus platostomus
Alligator gar	Lepisosteus spatula
Bowfin	Amia calva
Gizzard shad	Dorosoma cepedianum
Threadfin shad	Dorosoma petenense
Grass pickerel	Esox americanus vermiculatus
Chain pickerel	Esox niger
Carp	Cyprinus carpio
Golden shiner	Notemigonus crysoleucas
Blackspot shiner	Notropis atrocaudalis
Ironcolor shiner	Notropis chalybaeus
Red shiner	Notropis lutrensis
Blacktail shiner	Notropis venustus
Weed shiner	Notropis texanus
Pallid shiner	Notropis amnis
Sand shiner	Notropis stramineus
Mimic shiner	Notropis volucellus
Taillight shiner	Notropis maculatus
Pugnose minnow	Notropis emiliae
Silvery minnow	Hybognathus nuchalis
Bullhead minnow	Pimephales vigilax
Lake chubsucker	Erimyzon sucetta
Bigmouth buffalo	Ictiobus cyprinellus
Smallmouth buffalo	Ictiobus bubalus
River carpsucker	Carpiodes carpio
Spotted sucker	Minytrema melanops
Black bullhead	Ictalurus melas
Yellow bullhead	Ictalurus natalis
Channel catfish	Ictalurus punctatus
Blue catfish	Ictalurus furcatus
Tadpole madtom	Noturus gyrinus
Freckled madtom	Noturus nocturnus
Flathead catfish	Pylodictis olivaris
Pirate perch	Aphredoderus sayanus
Golden topminnow	Fundulus chrysotus
Blackstripe topminnow	Fundulus notatus
Mosquitofish	Gambusia affinis
Brook silverside	Labidesthes sicculus

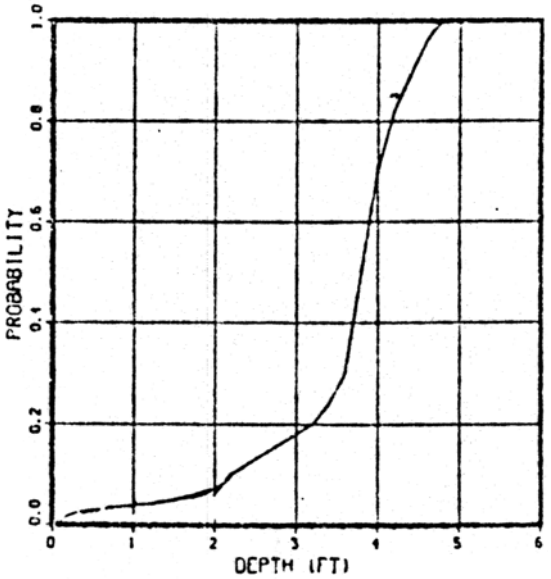
Common Name	Scientific Name
Inland silverside	*Menidia beryllina*
White bass	*Morone chrysops*
Yellow bass	*Morone mississippiensis*
Hybrid striped bass	*Morone chrysops* x *M. saxatilis*
Warmouth	*Lepomis gulosus*
Bluegill	*Lepomis macrochirus*
Redbreast sunfish	*Lepomis auritus*
Green sunfish	*Lepomis cyanellus*
Dollar sunfish	*Lepomis marginatus*
Longear sunfish	*Lepomis megalotis*
Redear sunfish	*Lepomis microlophus*
Spotted sunfish	*Lepomis punctatus*
Bantam sunfish	*Lepomis symmetricus*
Spotted bass	*Micropterus punctulatus*
Largemouth bass	*Micropterus salmoides*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Flier	*Centrarchus macropterus*
Scaly sand darter	*Ammocrypta vivax*
Bluntnose darter	*Etheostoma chlorosomum*
Slough darter	*Etheostoma gracile*
Swamp darter	*Etheostoma fusiforme*
Cypress darter	*Etheostoma proeliare*
Log perch	*Percina caprodes*
Freshwater drum	*Aplodinotus grunniens*

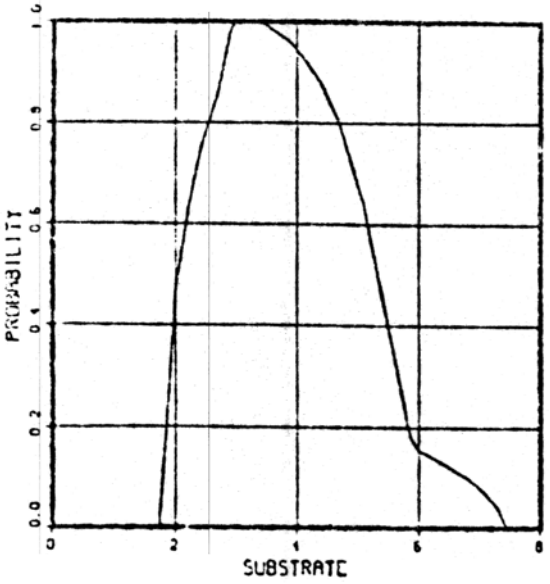
[1] Source: Bonn 1956; Toole 1981, 1983a, 1983b

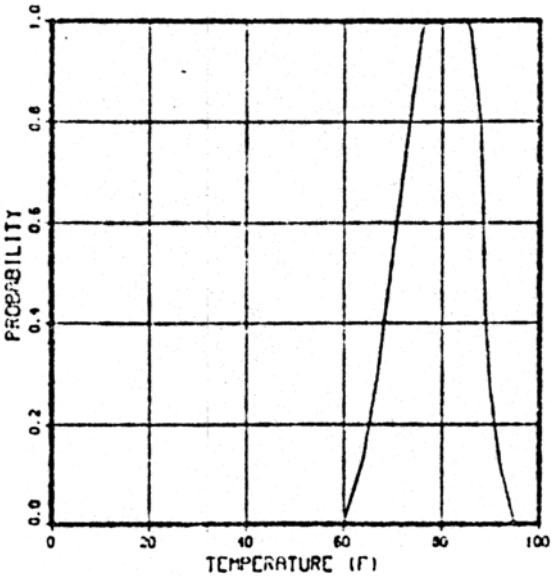
CHANNEL CATFISH

ADULTS 78/06/23.



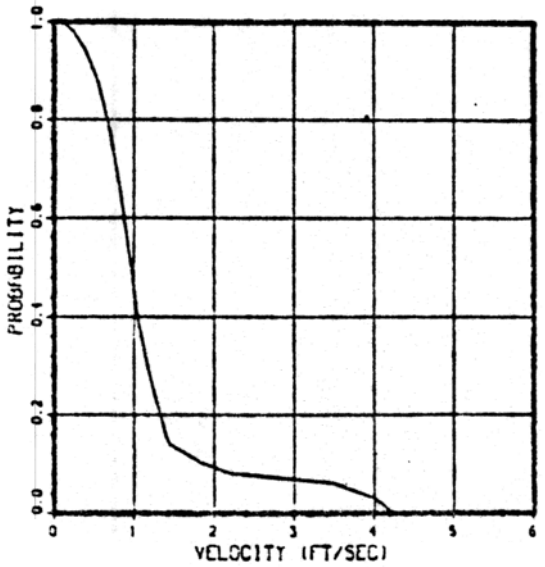


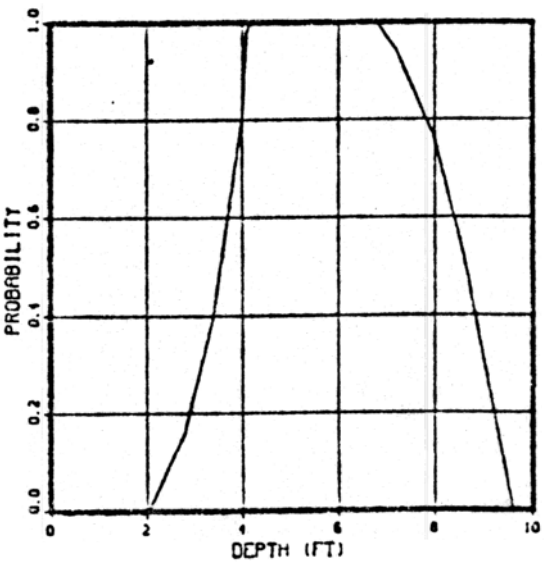


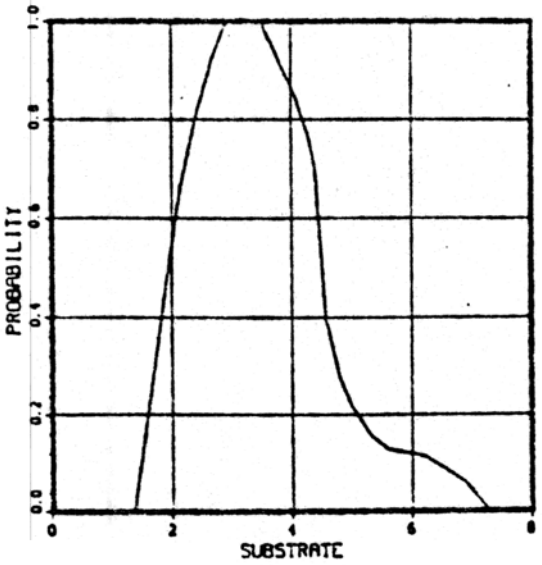


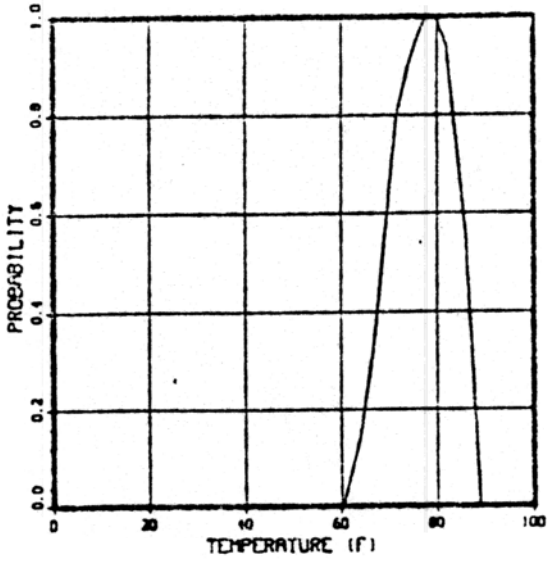
CHANNEL CATFISH

30110 SPAWNING 78/06/20.









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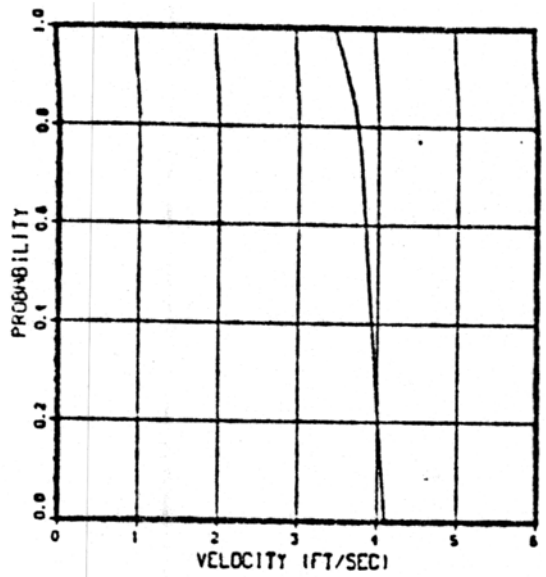
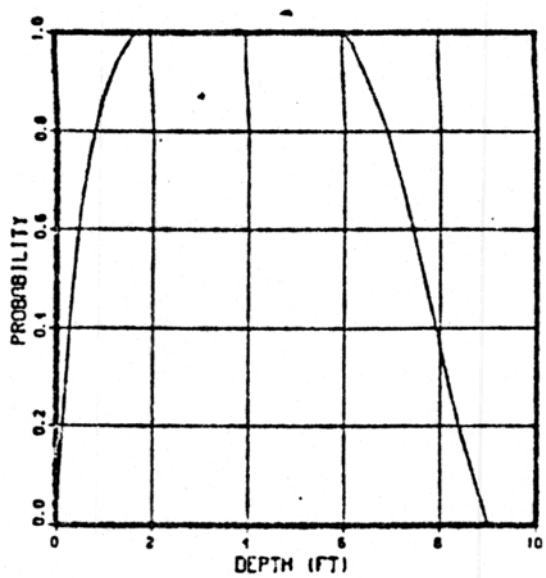
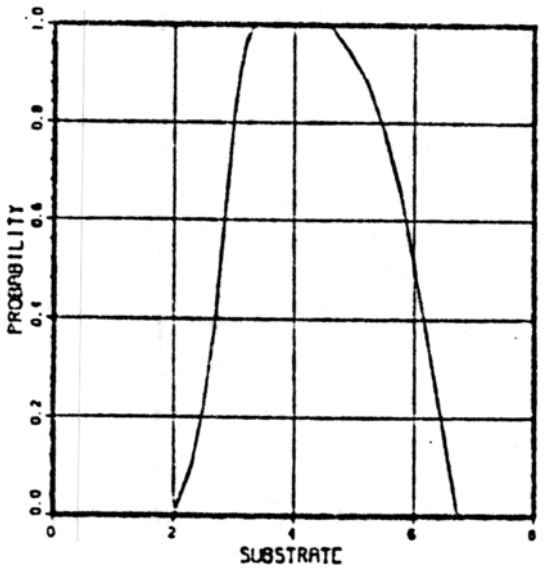
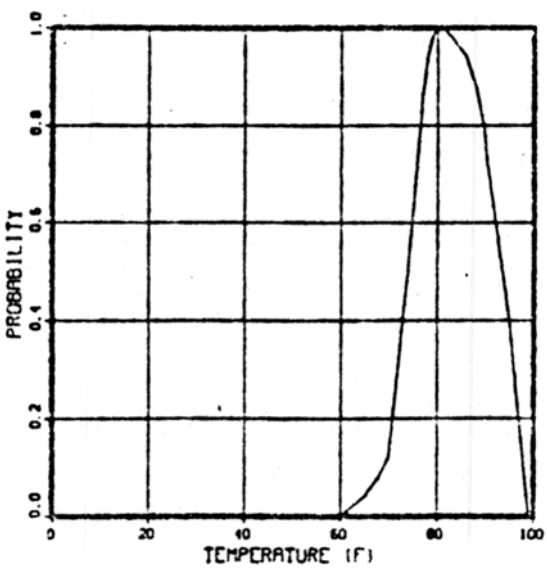
30100 FRY 78/06/20.



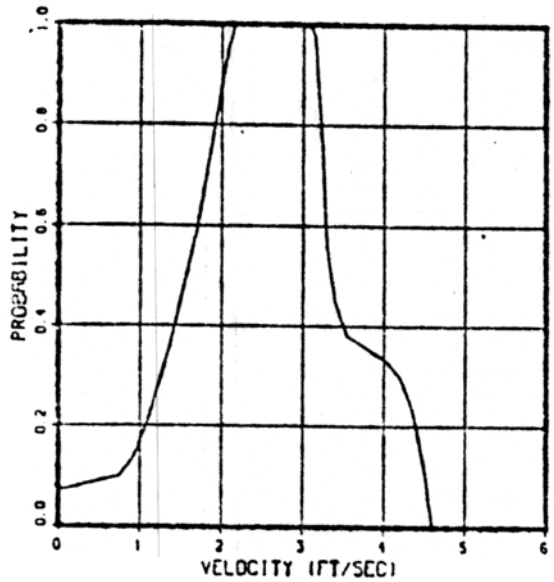


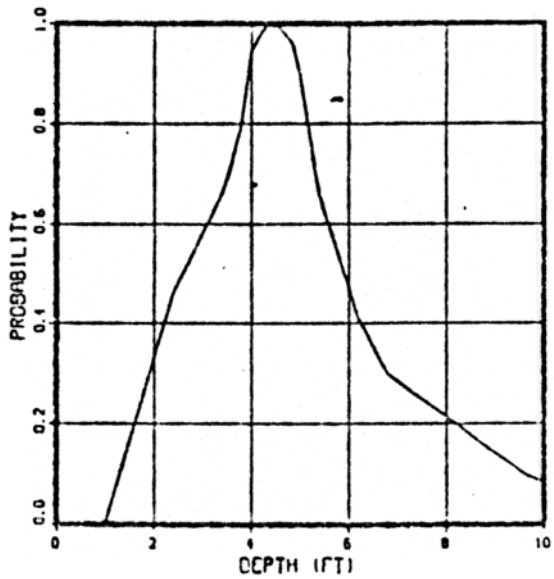


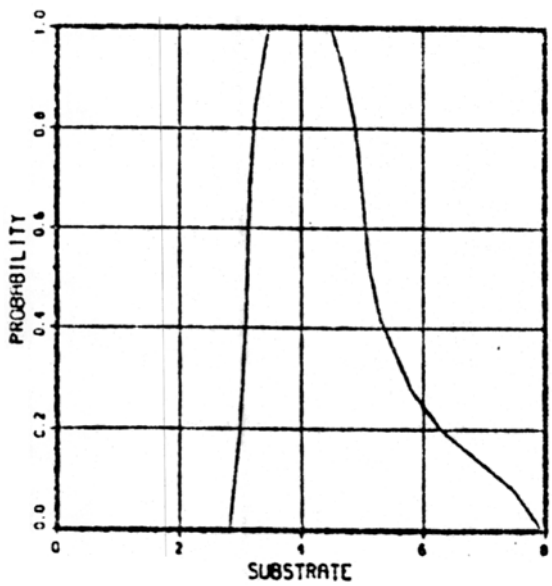


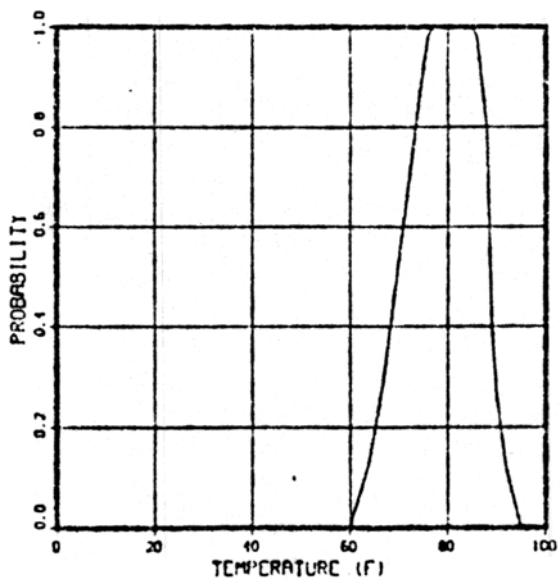
CHANNEL CATFISH

30101 JUVENILES 78/06/20.



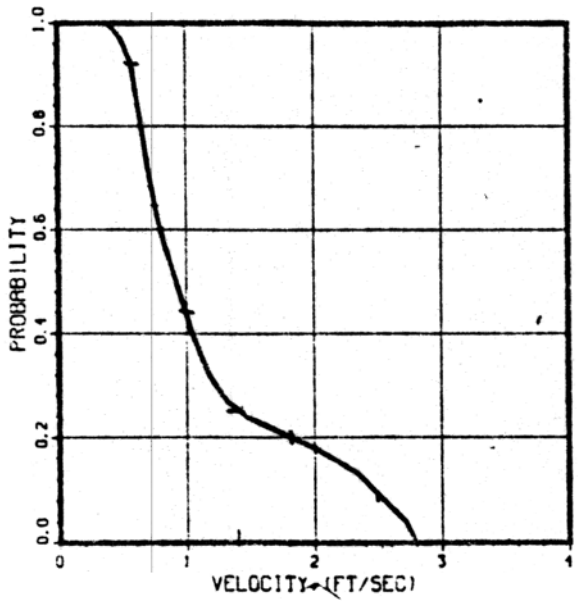


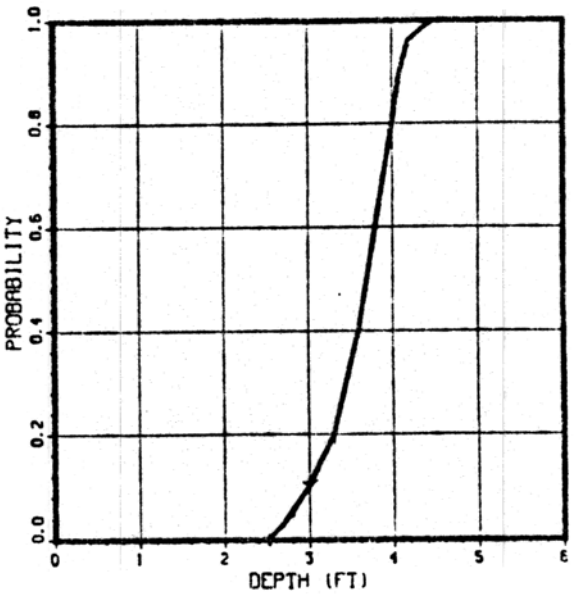


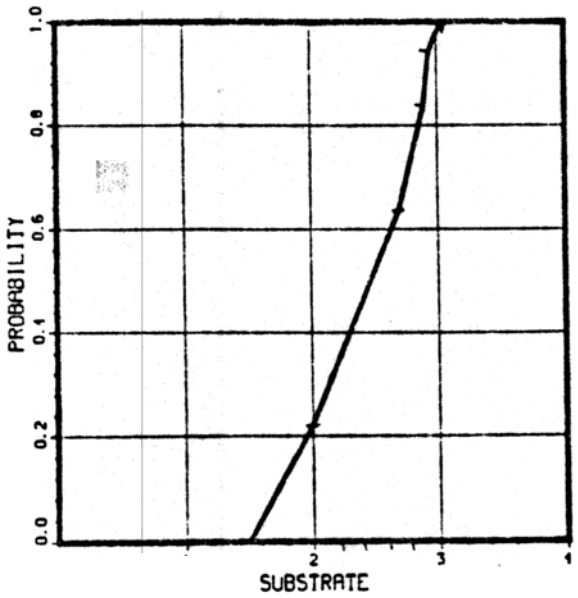


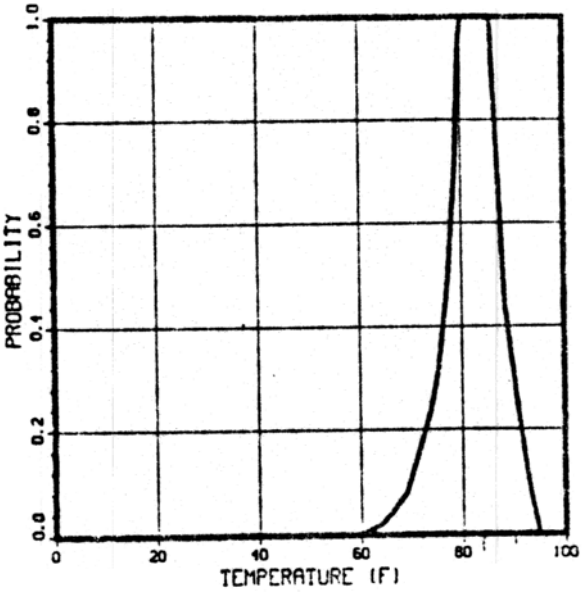
SPOTTED BASS

20202 ADULTS 79/06/22.



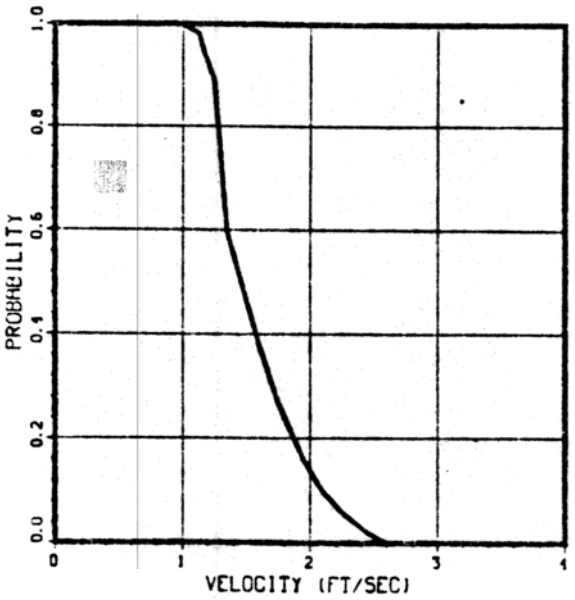


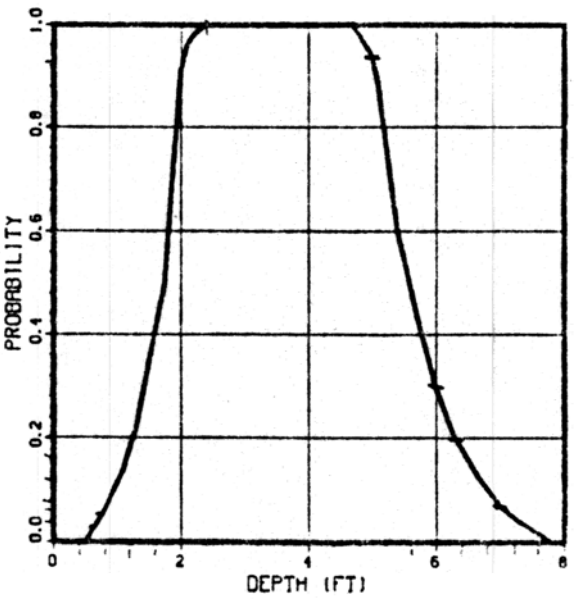


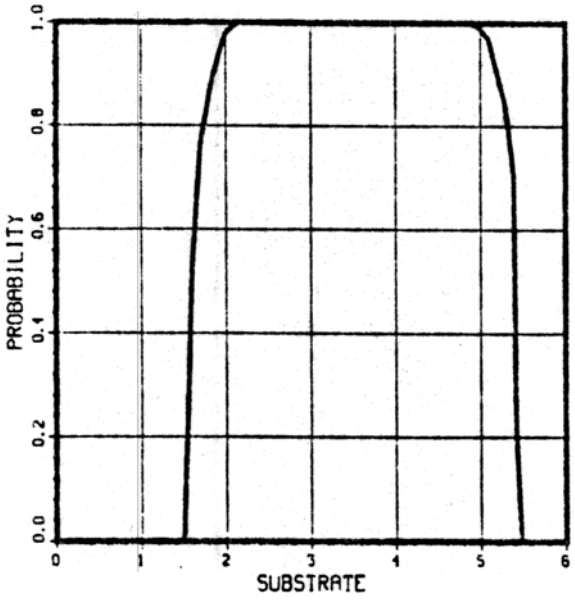


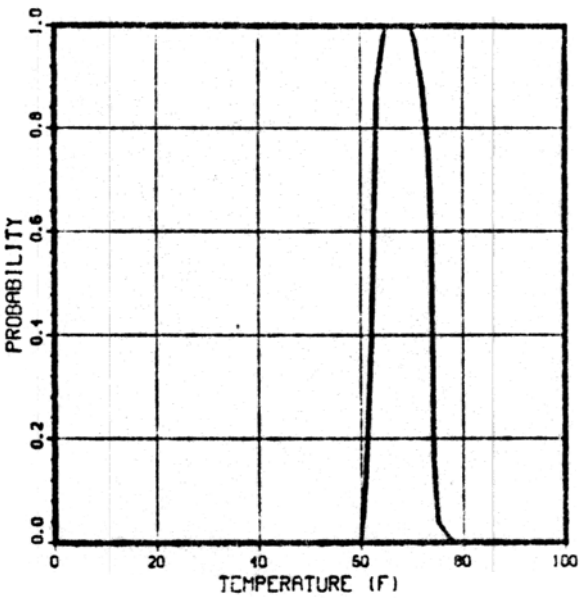
SPOTTED BASS (TURBID WATER)

20204 SPAWNING 79/06/22.



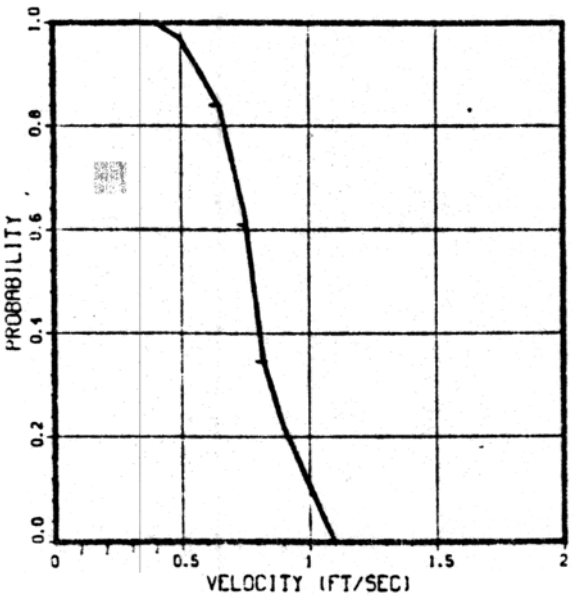


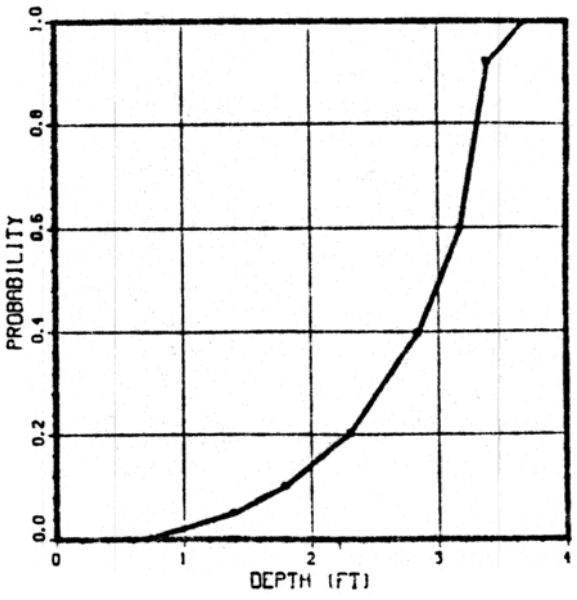


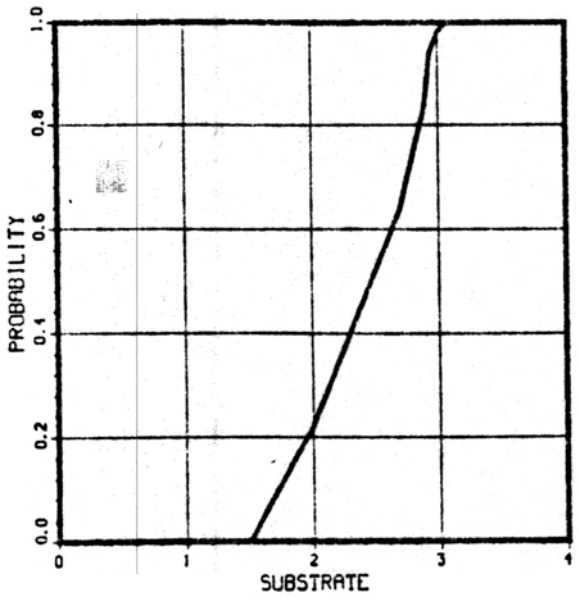


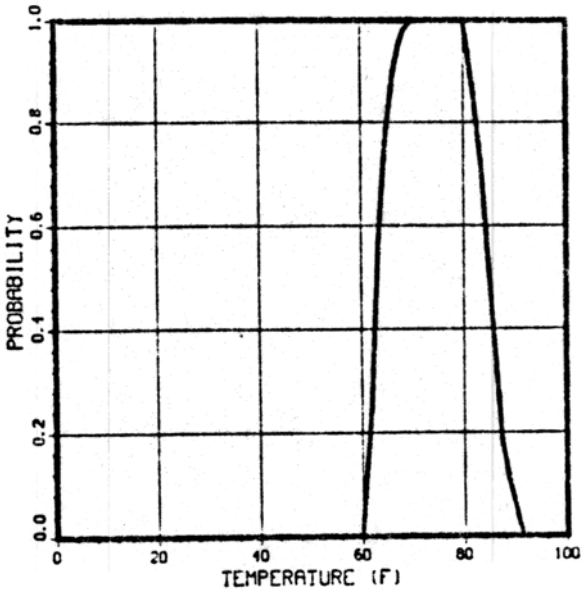
SPOTTED BASS

20200 FRY 79/06/22



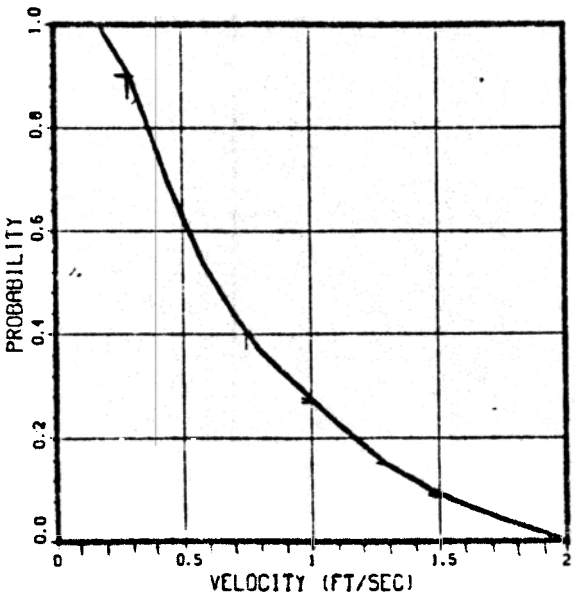


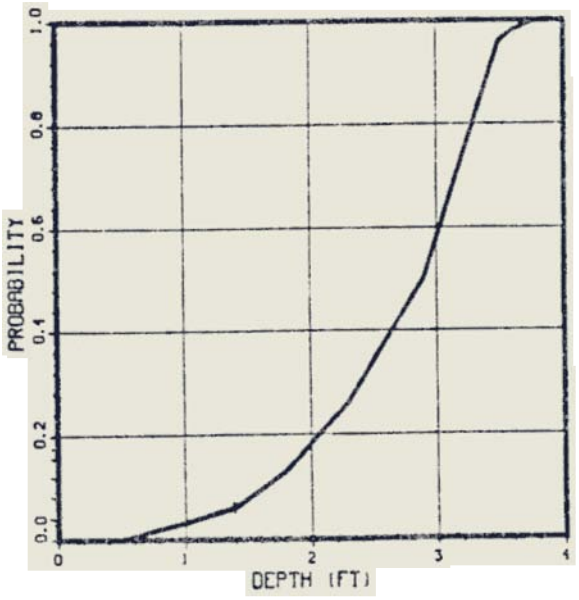


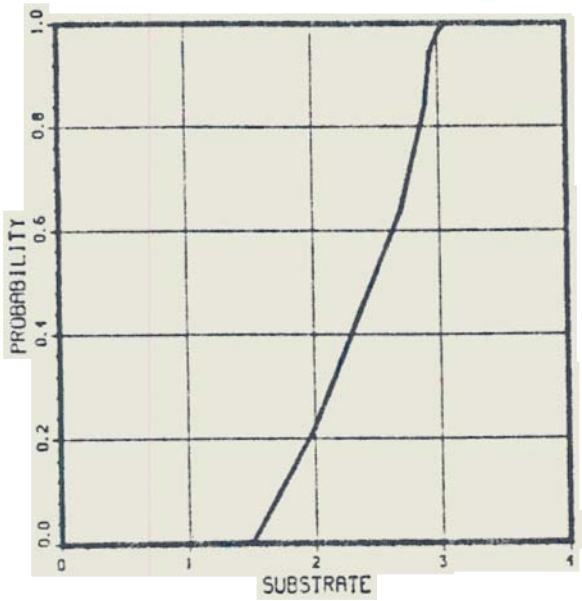


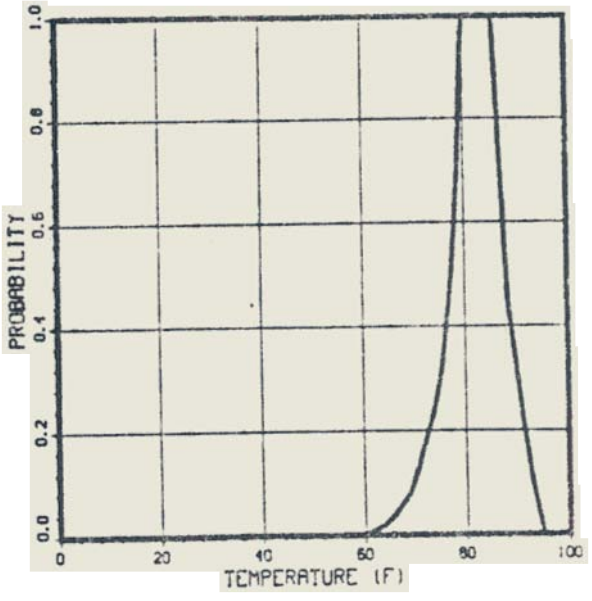
SPOTTED BASS

20201 JUVENILES 79/06/22.



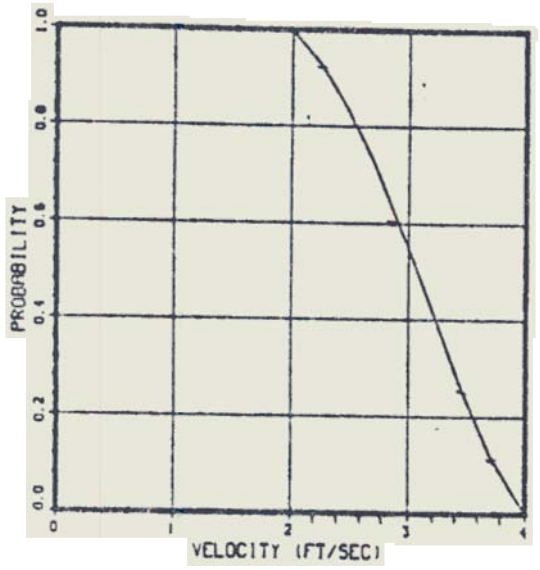


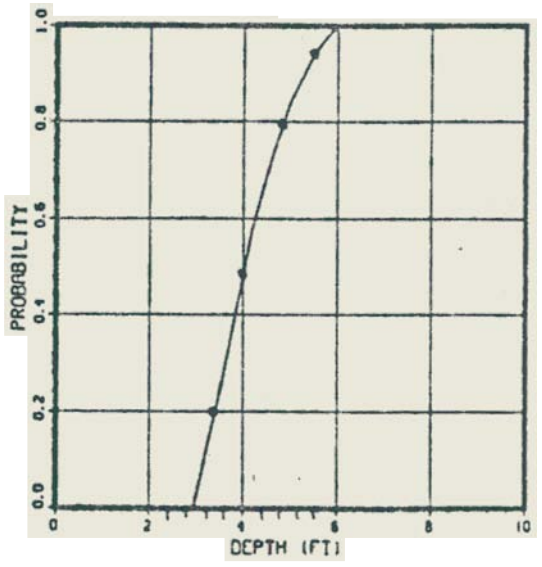


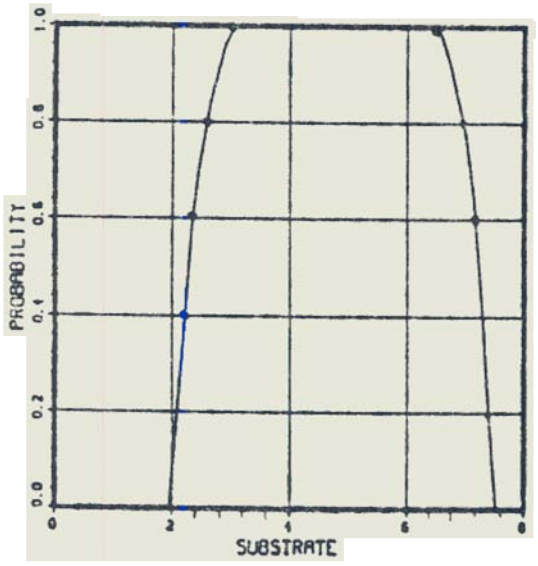


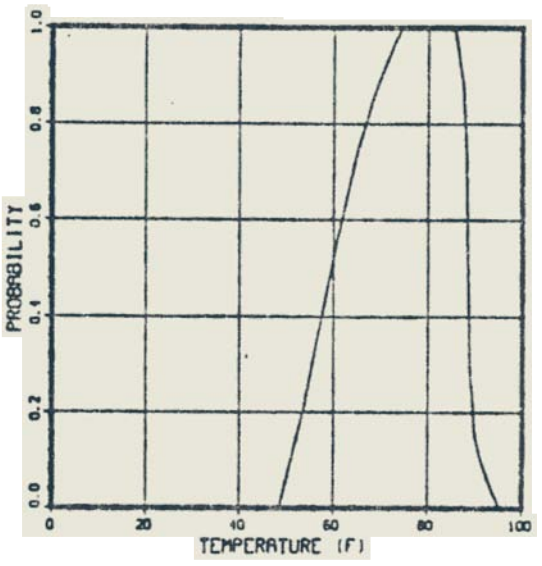
WHITE BASS

80002 ADULTS 78/07/13.



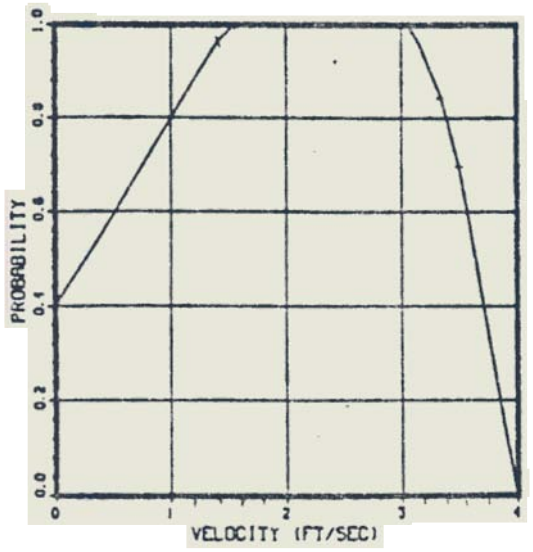


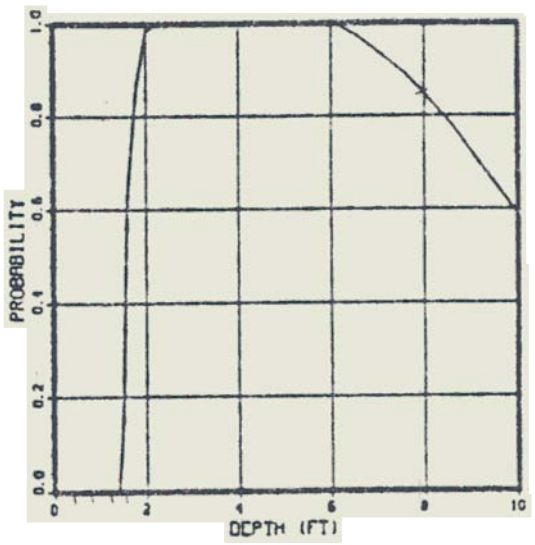


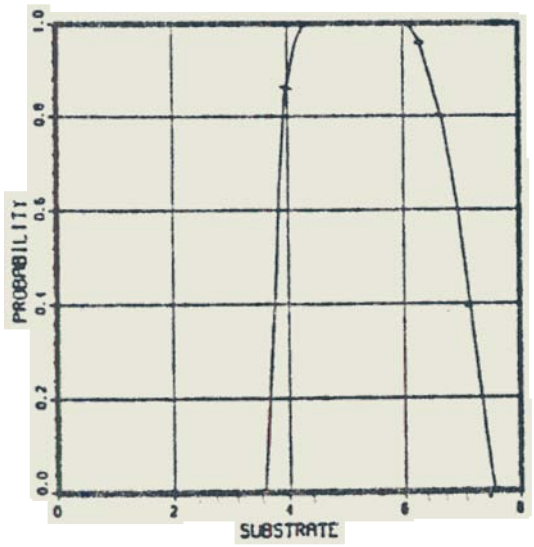


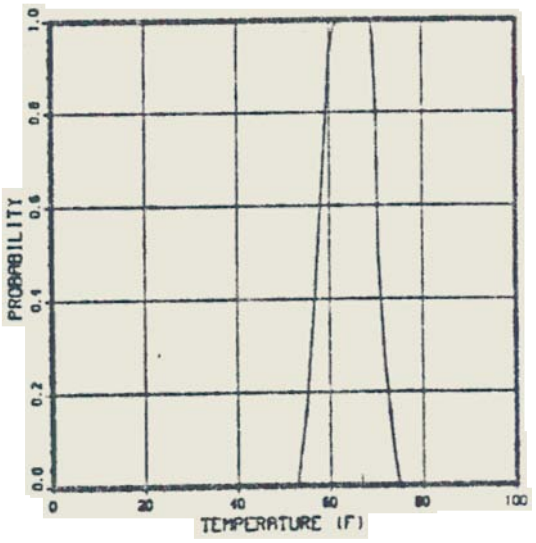
WHITE BASS

80010 SPAWNING 78/06/26.



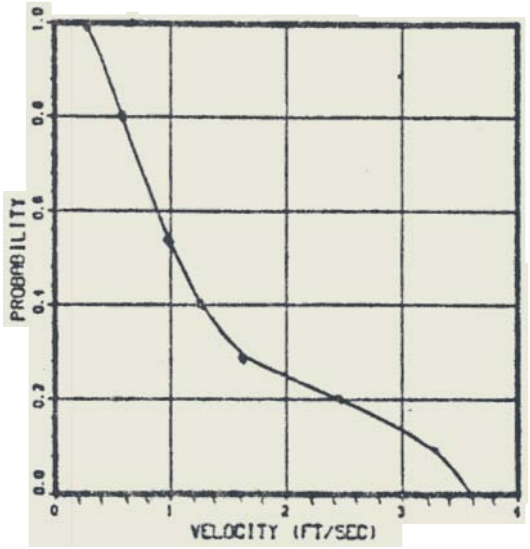


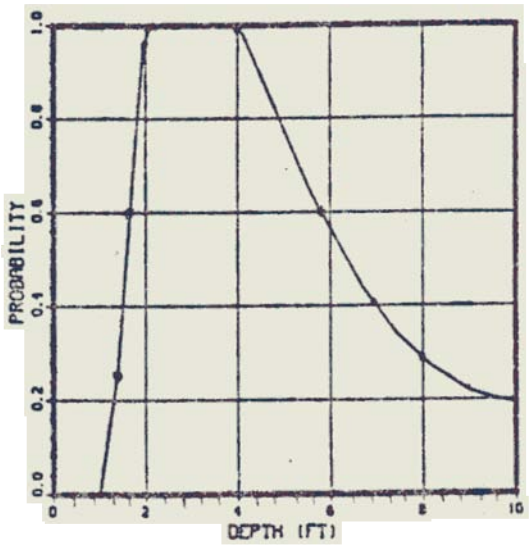


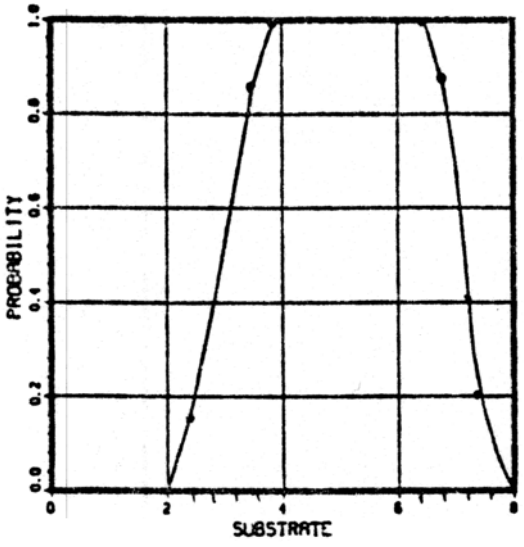


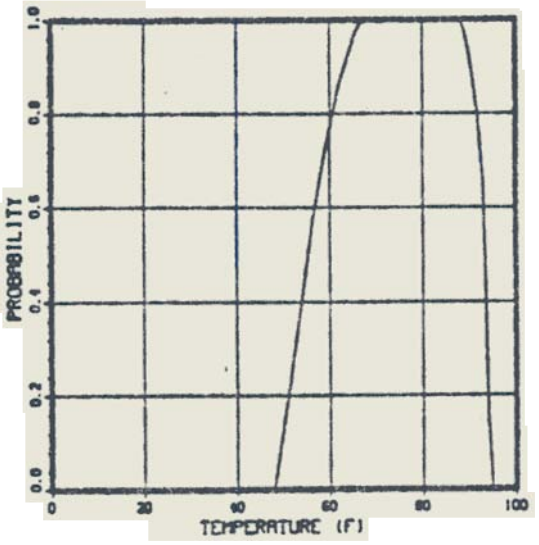
WHITE BASS

80000 FRY 78/07/13.









WHITE BASS

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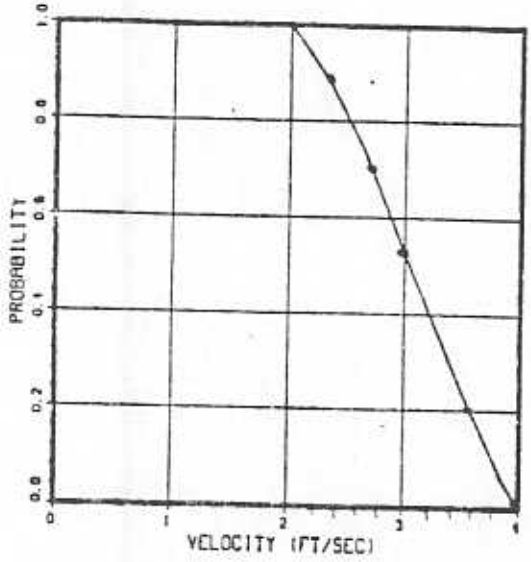
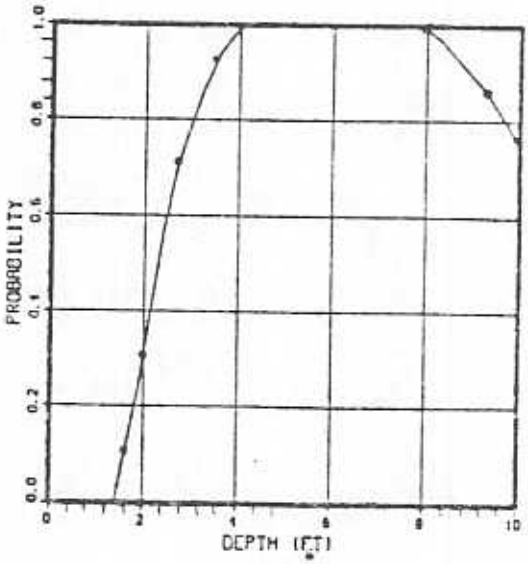
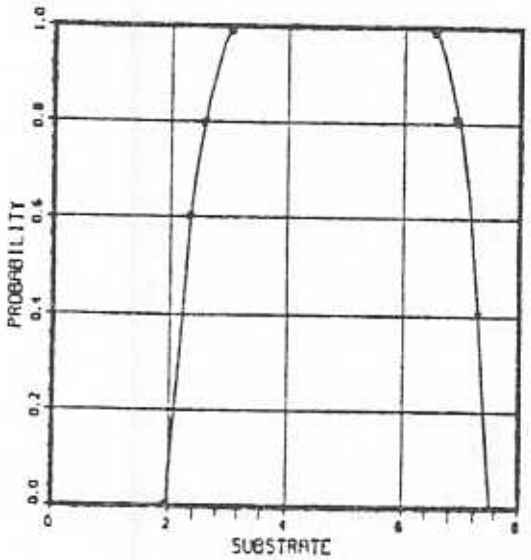
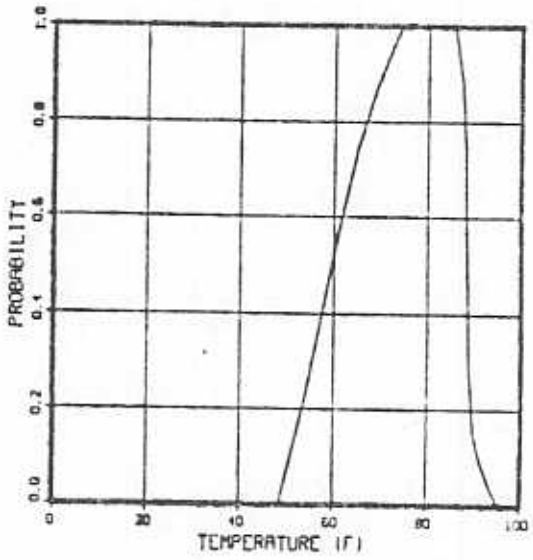
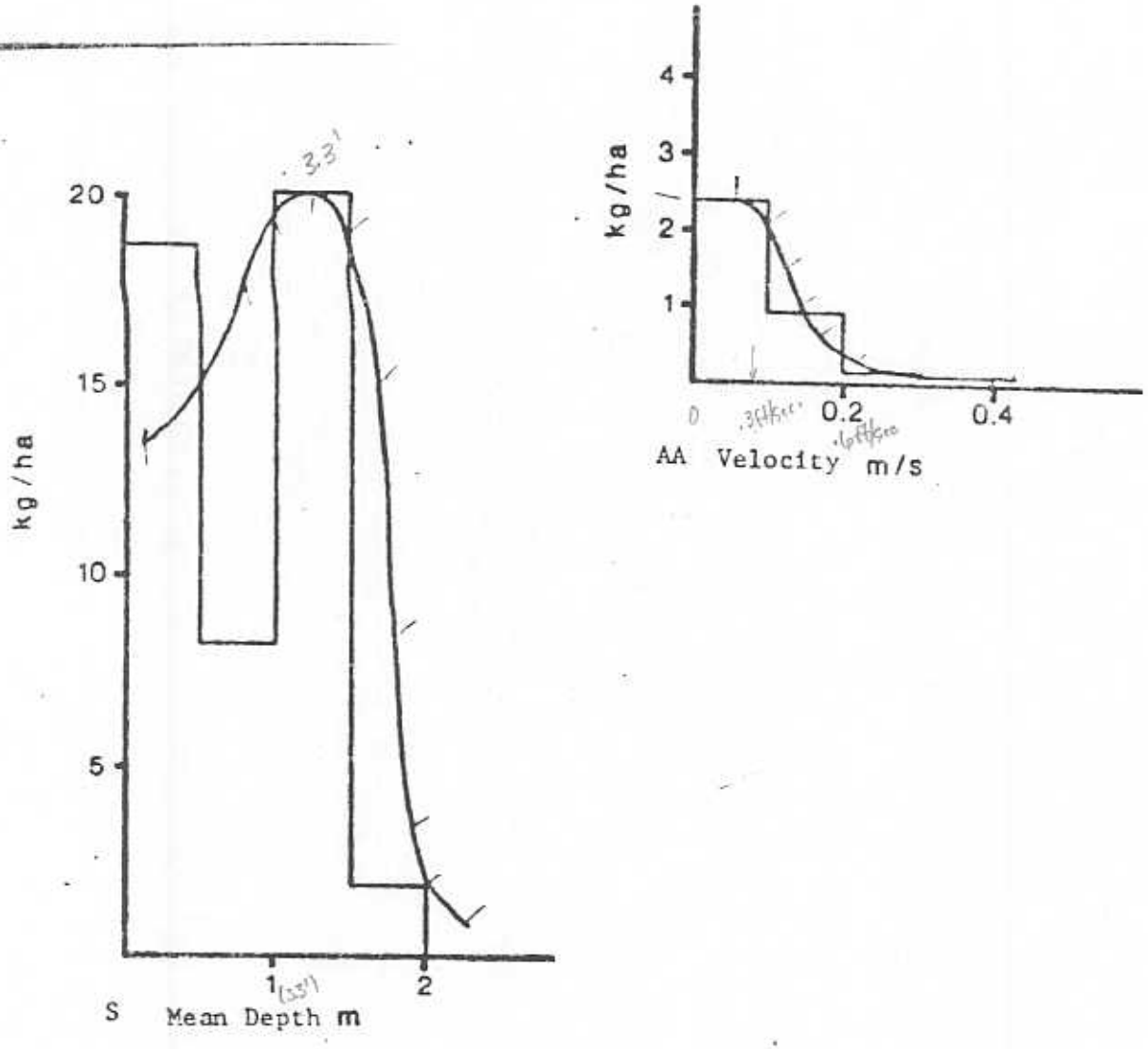


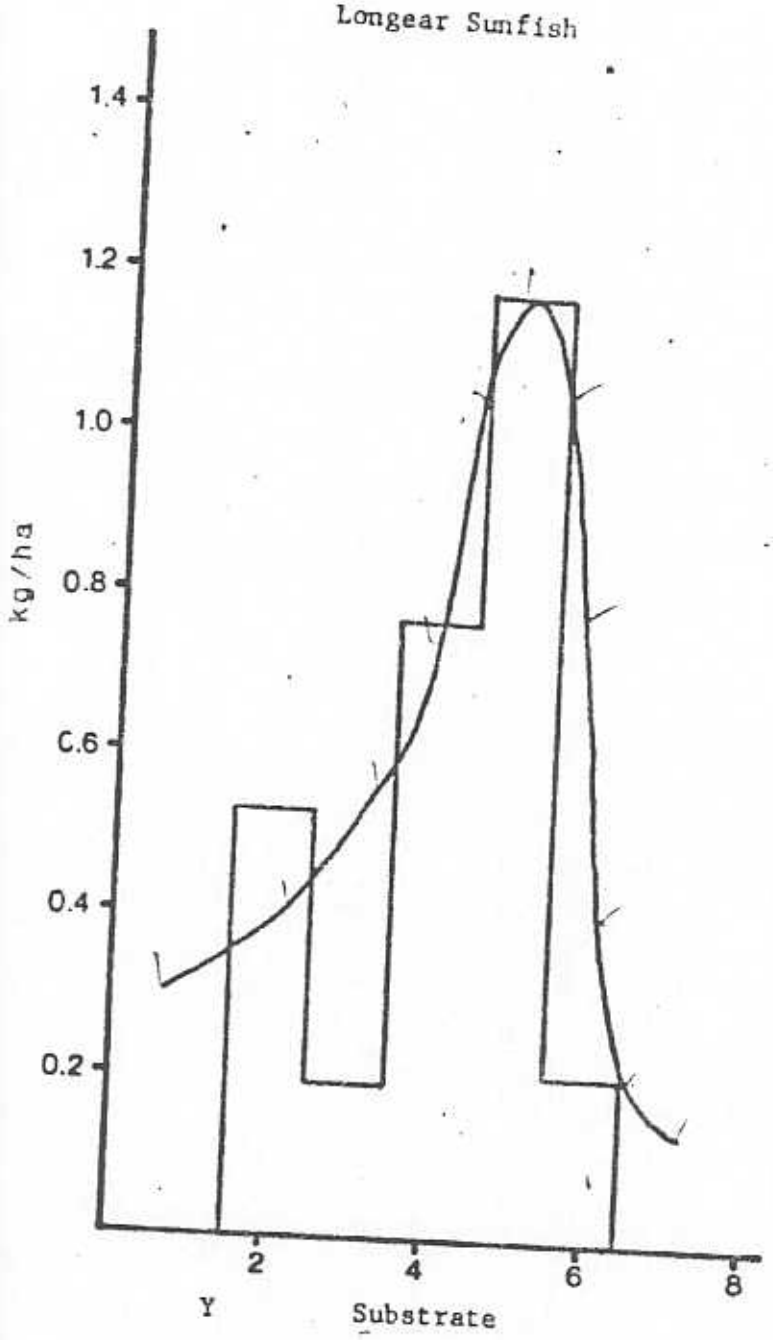






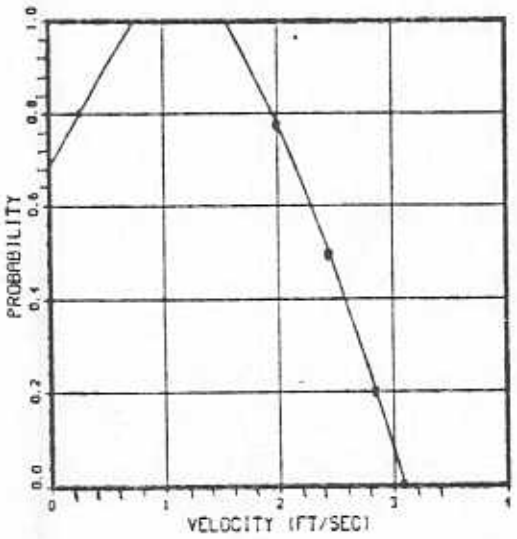
Longear Sunfish

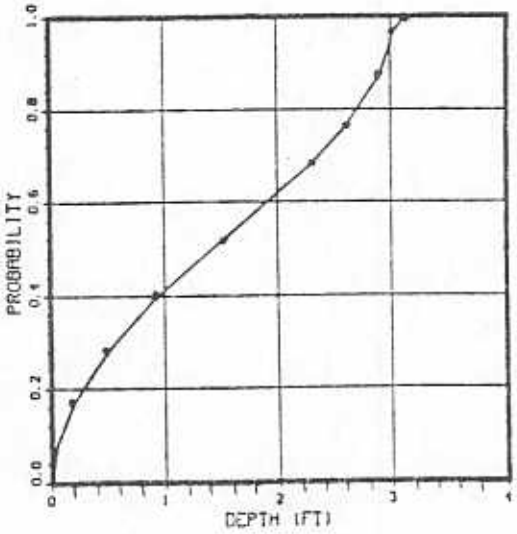


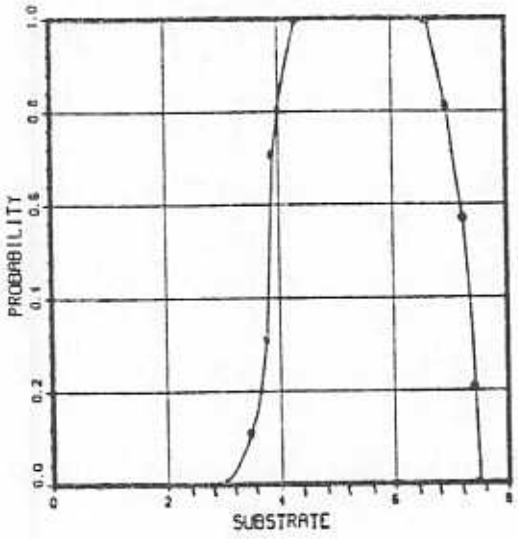

Longear Sunfish
1.4
1.2
1.0
0.8
0.6
0.4
0.2
kg/ha
2
4
6
8
Y
Substrate

RIVER DARTER

51602 ADULT 78/10/23.



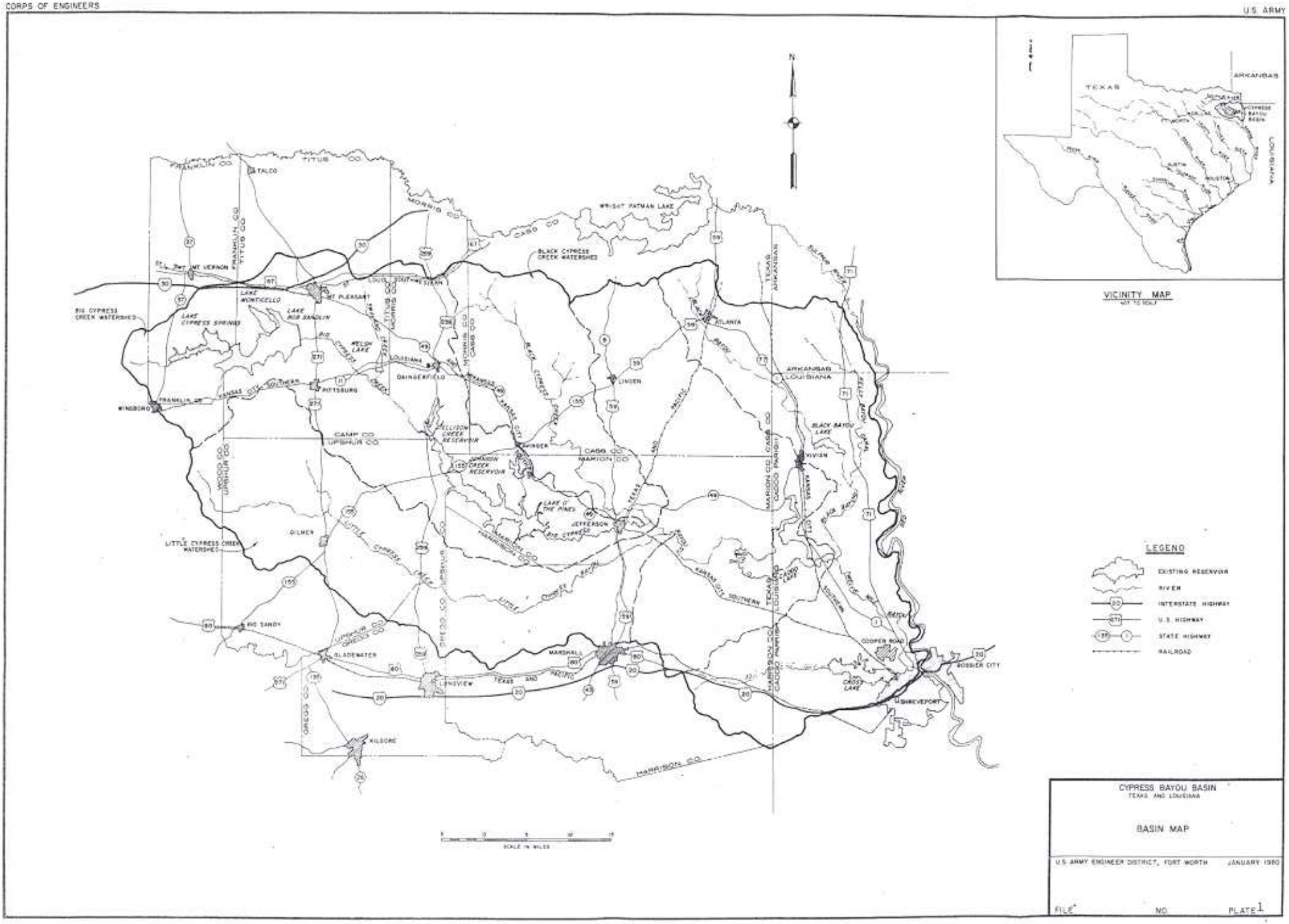




158.35

CORPS OF ENGINEERS

U.S. ARMY



VICINITY MAP

NOT TO SCALE

LEGEND

- EXISTING RESERVOIR
- RIVER
- INTERSTATE HIGHWAY
- U.S. HIGHWAY
- STATE HIGHWAY
- RAILROAD

CYPRESS BAYOU BASIN
TEXAS AND LOUISIANA

BASIN MAP

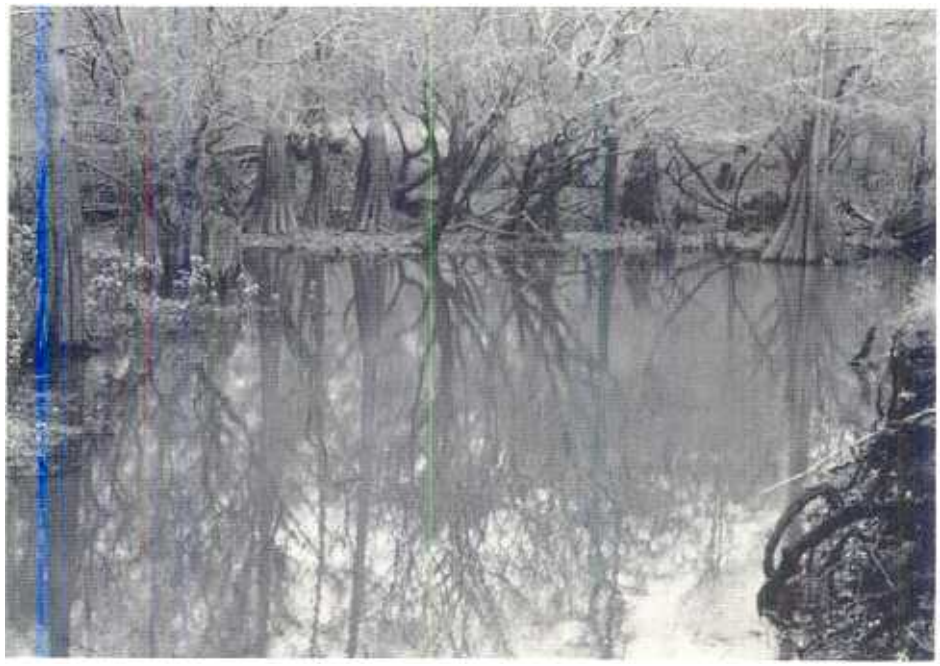
U.S. ARMY ENGINEER DISTRICT, FORT WORTH JANUARY 1980

FILE NO PLATE 1

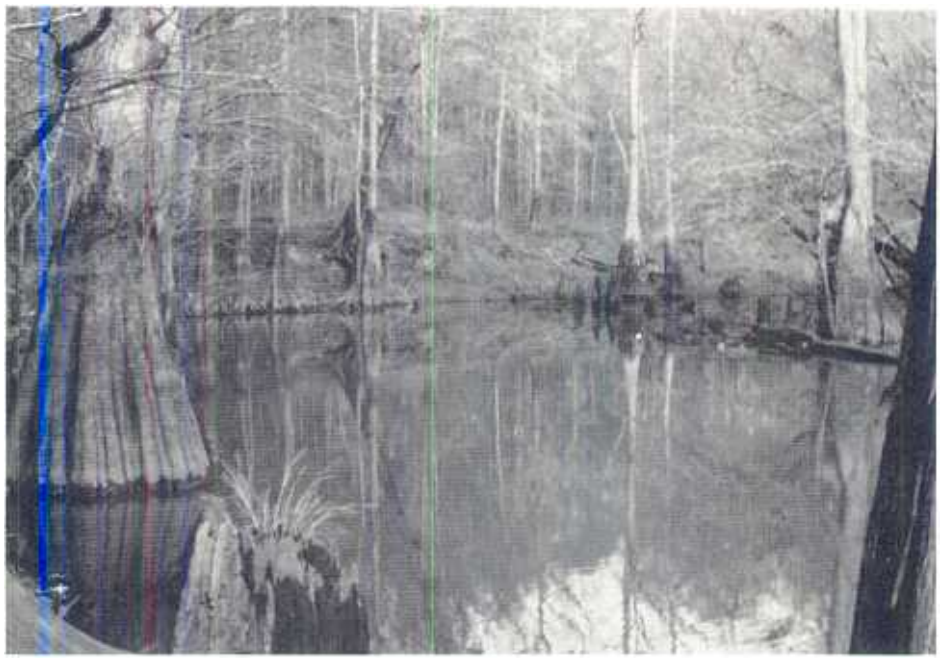
A. Riffle-run sequence, Black Cypress Bayou near Berea, Marion County, TX. 12-1-83.

B. Stream run with abundant bank and overhanging cover, Little Cypress Bayou, near FM 450, Harrison County, TX. 12-1-83.

Plate 2. Stream habitat features of Cypress Bayou Basin, Texas.



A. Open pool on Little Cypress Bayou, near Highway 3001, Harrison County, TX. 12-1-83.



B. Backwater off main channel of Little Cypress Bayou, near Highway 134, southeast of Jefferson, Marion County, TX. 12-1-83.

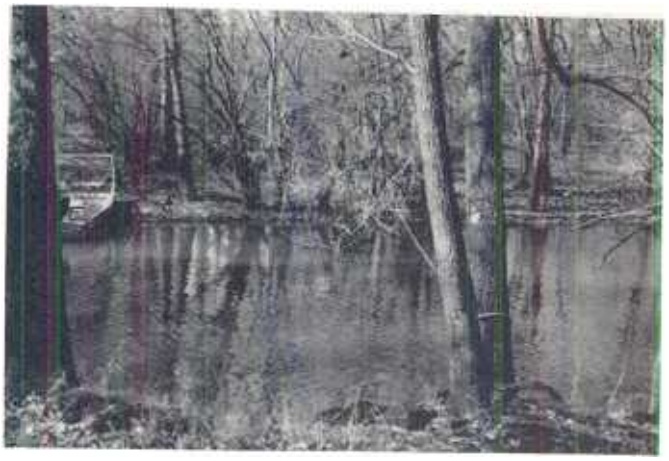
Plate 3. Stream habitat features of Cypress Bayou Basin, Texas.

Plate 4. Canopy and instream cover provided by woody vegetation, Big Cypress Bayou, TX. 4-19-84.

A. Stream cross-section data (depths and widths) obtained for each transect.

B. Stream velocities measured across transect

Plate 5. Techniques used in gathering stream hydrologic data, Cypress Bayou Basin, Texas.



A. Transect number 2, streamflow approximately 75 cfs. 1-31-84.

B. Study reach looking downstream, water muddy from runoff, approximately 250 cfs. 4-16-84.

Plate 6. Streamflow study reach on Little Cypress Bayou, immediately downstream from Highway 154, Harrison Co., Texas

A. Study reach looking upstream, streamflow approximately 40 cfs. 12-1-83.

B. Study reach looking upstream, streamflow about 250 cfs, water muddy from runoff. 4-17-84.

Plate 7. Streamflow study reach on Little Cypress Bayou, upstream from Highway 3001, Harrison Co., Texas.

A. Pool area immediately upstream of study transects estimated streamflow 40 cfs. 12-1-83.

B. Transect number 1, streamflow 100 cfs. 2-2-84.

Plate 8. Streamflow study reach on Black Cypress Bayou, near Berea, Marion Co., Texas.

A. Electrofishing is used to collect fish in representative stream habitats; collection locations are marked by buoy for habitat parameter measurements.

B. Pertinent data (e.g., length, weight, sex) are gathered to determine life history stage and condition factors.

Plate 9. Field techniques being used on the Cypress Bayou Basin Cooperative Fishery Study to collect additional fisheries data and develop species preference curves.

A. Trail boat collects habitat data (velocity, depth, substrate, cover) at location of collection site.

B. Hydrolab and other instrumentation is used to collect water quality data at study reaches.

Plate 10. Field techniques being used on the Cypress Bayou Basin Cooperative Fishery Study to collect additional fisheries data and develop species preference curves.