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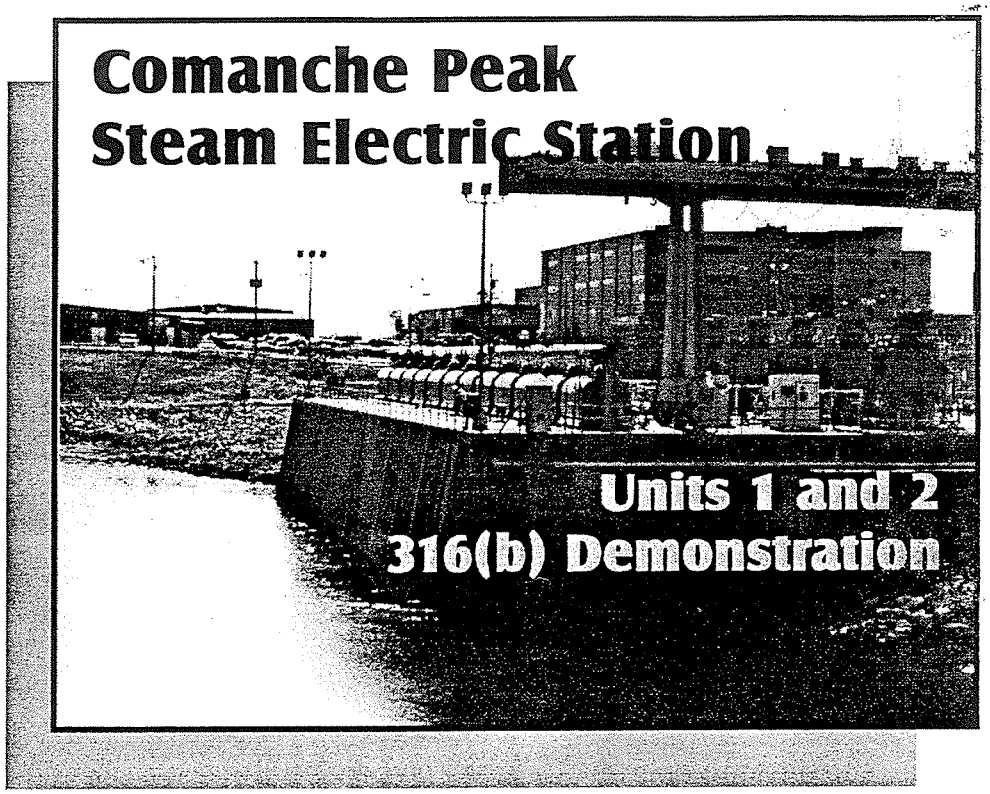

Texas Utilities Electric Company

Prepared by

FOSTER WHEELER ENVIRONMENTAL CORPORATION

September 1995

COMANCHE PEAK STEAM ELECTRIC STATION
316(b) DEMONSTRATION

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EXECUTIVE SUMMARY

This 316(b) Demonstration has been prepared in compliance with the terms and conditions of the National Pollutant Discharge Elimination System (NPDES) permit for Texas Utilities Electric Company's Comanche Peak Steam Electric Station (CPSES). The 316(b) Demonstration became a requirement of NPDES permits for power plants in 1972, with promulgation of the Clean Water Act (P.L. 92-500) amendments to the Federal Water Pollution Control Act. The amendments included Sections 316(a) and 316(b) relating to power plant circulating water system (CWS) impacts due to thermal discharge (316(a)) and/or cooling water intake (316(b)). As a requirement of the CPSES NPDES permit, following the completion and commercial start-up of Unit 2, this 316(b) Demonstration was prepared for the evaluation of impacts to the fish community of Squaw Creek Reservoir from entrainment and impingement due to the operation of the CPSES CWS. Entrainment refers to the withdrawal of fish eggs and larvae, too small to be retained by the traveling screens, directly into the CWS. [These withdrawal rates were estimated based on number of eggs, larvae and juveniles captured in sampling nets.] Juvenile and adult fish too large to be entrained through the 3/8 inch mesh traveling screens, but incapable of resisting the intake current, are retained against those screens and eventually washed off with debris into a sump. This is referred to as impingement.

Station Description

The CPSES is located near Glen Rose, TX and is owned and operated by Texas Utilities Electric Company (TUEC), Dallas, TX. The CPSES consists of two nuclear pressurized water reactors identified as Units 1 and 2. Maximum generating capacity of each unit is rated at 1150 MWe or 2300 MWe combined. CPSES Unit 1 was declared ready for commercial operation on August 13, 1990 and Unit 2 was declared ready for commercial operation on August 3, 1993. The plant is designed with a once-through CWS which provides non-contact cooling water for the condensers and heat exchangers for both units. The source of cooling water for the CWS is Squaw Creek Reservoir (SCR), an impoundment of Squaw Creek, which was completed in February 1977 and filled in May 1977. SCR is owned and maintained by TUEC. Both Unit 1 and 2 are serviced by a common CWS intake structure located on the shoreline of the SCR. The intake structure is located in an excavated recess of the SCR shoreline and consists of eight CWS pumps (four per unit) and twelve traveling screens (six per unit). The intake structure extends down to a depth of approximately fifty feet. At full operating capacity, the CWS withdrawals a volume equivalent to 6.4 % of the volume of SCR on a daily basis. Non-contact cooling water is discharged via a common outfall located across the peninsula from the CPSES intake. Approach velocity of water across the trash racks of the CWS intake averages 13.02

cm/sec (0.427 ft/sec) which is safely below the maximum guidance value of 15.2 cm/sec (0.5 ft/sec) recommended by the USEPA for minimizing impingement at steam electric stations.

Fish Communities of Squaw Creek Reservoir

SCR is a 1,306 hectare impoundment of Squaw Creek, formed by an earth and rock fill dam completed in February, 1977. The primary purpose of SCR is to provide a constant and reliable supply of non-contact cooling water for the CPSES CWS. It has, however, a good gamefish population, and is used extensively by anglers. Baseline studies, which employed multiple sampling techniques, documented up to twenty five species of fish in SCR. In general, the fish community can be classified into predatory species which include recreationally important species and forage species which support species higher in the aquatic food chain. Forage species include threadfin shad (*Dorosoma petenense*), inland silverside (*Menidia beryllina*), bluegill sunfish (*Lepomis macrochirus*) and gizzard shad (*Dorosoma cepedianum*). Predatory species include largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), white bass (*Morone chrysops*), smallmouth bass (*Micropterus dolomieui*) and hybrid striped bass (*Morone saxatilis* x *chrysops*). In addition to the fish populations present in Squaw Creek, the Texas Parks and Wildlife Department supplement the fish populations of SCR with stockings of game fish and forage fish species. Periodic stocking of select species has gone on since 1979. A qualitative creel survey of SCR fishermen revealed the most popular gamefish was the largemouth bass.

Selection of Representative Important Species (RIS) for this 316(b) Demonstration was based upon trophic guilds (ecological roles) in the SCR food chain; recreational importance as a game fish; representativeness of the SCR fish community; and susceptibility to entrainment and impingement by the CPSES CWS. Identified RIS were largemouth bass, channel catfish, white bass, bluegill sunfish, gizzard shad, inland silverside, threadfin shad and freshwater drum.

Impingement

Impingement sampling was conducted over a one year period from October 1993 through October 1994. A sampling basket was fabricated and inserted into the common debris sump in order to collect fish washed off the travelling screens. Impingement sampling was performed at weekly intervals from October 1993 through March 1994, and at two week intervals from April 1994 through August 1994. Weekly sampling resumed from September 1994 through October 1994. Sampling events were divided into equal twelve hour intervals (day/night). Fish were identified to species, weighed (grams), measured (total length), and subsampled if large numbers of any species were encountered. Impingement was estimated for daily, weekly, monthly, annual and seasonal periods.

An estimated 262,498 fish, representing thirteen species, were impinged by the CPSES CWS during this period. Threadfin shad accounted for 96 % (251,269 fish) of the annual impingement

total. Greatest impingement of this species occurred during the summer months. Game fish including largemouth bass, white bass, channel catfish and white crappie, accounted for less than one percent (combined) of the total annual impingement. Most game fish were young-of-the-year or juveniles. No hybrid striped bass were impinged during the monitoring program. Largemouth bass impingement was estimated to be about 900 fish per year, most of which were classified as juveniles. Compared to the overall total, largemouth bass accounted for only 0.35 % of all fish impinged. Results of the impingement monitoring program reveal that, like most other power plants of similar design and location, forage species such as threadfin shad dominate impingement losses due to their abundance in the local water body; their pelagic habit (open water existence); their tendency to move in large schools (i.e., exposure of large numbers of individuals to impingement at one time) and their increased risk of impingement at elevated temperatures (i.e., reduced physiological condition at high temperatures). Results of the SCR waterbody studies revealed that threadfin shad was one of the most abundant forage species present. Given the low number of game fish impinged on an annual basis, and the abundance and high reproductive capacity of threadfin shad, the total impingement numbers are not considered significant nor to be creating an unacceptable impact on the gamefish community of SCR.

Entrainment

Field sampling of ichthyoplankton directly upstream of the trash racks of Unit 1 and 2 was conducted for the period of April through August, 1994. Sampling apparatus consisted of triplicate, boat mounted nets towed in front of the trash racks at weekly intervals. Ichthyoplankton samples were returned to the laboratory and fish eggs, larvae, and in two cases (*Dorosoma* and *Lepomis*) juveniles were identified to the lowest practical taxon (genus for most taxa). The entrainment estimate, for conservative purposes, utilized data on all species and life stages captured in the net. Therefore the "juvenile" component of the total loss (entrainment plus impingement) for *Dorosoma* and *Lepomis* juveniles represents an overestimate of impact on their populations. Numbers of specific taxa were converted to mean densities (No./m^3) in SCR at the intake area. Daily, weekly, monthly, annual and seasonal estimates for entrainment of taxa identified were calculated based upon actual and maximum operating conditions of the CWS. Taxa collected during ichthyoplankton sampling included *Lepomis* (sunfish), *Dorosoma* (shads), *Morone* (white bass), *Menidia* (inland silverside), *Pomoxis* (crappies), *Aplodinotus* (f.w. drum) and the family Centrarchidae (sunfish and bass family).

Based on operation of both Unit 1 and 2 at full capacity, and assuming 100% mortality of eggs and larvae through the CWS, 30 million eggs/larvae were estimated to have been entrained by Unit 1, and 17 million by Unit 2 in 1994. The genus predicted to be entrained in the greatest number from the egg to juvenile stage is *Aplodinotus* (f.w. drum). Unit 1 was estimated to entrain 8.3 million *Aplodinotus* eggs/larvae, and Unit 2 was estimated to entrain 7.1 million *Aplodinotus* eggs/larvae. The second most abundant genus entrained was *Lepomis* (sunfish).

Unit 1 was estimated to entrain over 7.0 million larvae, and Unit 2 was estimated to entrain 3.5 million larvae of this genus. This difference is believed to be due to the circulation patterns in front of the intake structure. Combined, these two genera accounted for 50% of the eggs and larvae entrained by both units. The ratio of estimated numbers of ichthyoplankton entrained to the average fecundities (i.e., numbers of eggs/female produced) of the respective taxa provided a simple but relevant way to evaluate the relative impact on the population of these species in SCR. Summing these quotients results in an estimated loss of potential (or "equivalent") adults in the range of 1500 fish (all taxa combined). The genus *Dorosoma* (threadfin and gizzard shad) accounted for over half of the loss. Game fish losses attributable to entrainment were found to be minimal.

Conclusions

Based upon the results of the above field studies, the following conclusions regarding the impact of entrainment and impingement relative to the location, design, operation and capacity of the CPSES CWS were drawn:

- The CWS is located on an excavated recess of the SCR shoreline. Compared to the abundance of coves throughout SCR, the intake recess lacks the habitat complexity (i.e., submerged structure and cover) and littoral areas deemed more suitable to productive fish habitat. Thus, the location of the CPSES CWS appears to minimize the potential for risks of fish (especially game fish) being impinged or entrained;

- Under full CWS operation (eight CWS pumps), the average approach velocity across the entire intake structure was 13.02 cm/sec (0.427 ft/sec), which is below the USEPA guidance value of 0.5 ft/sec. Design options or modifications to the intake structure may arguably reduce impingement, but not necessarily survival of the dominant species impinged (shad). Such options were considered to be of little benefit to SCR gamefish populations given their low representation in both impingement and entrainment;

- Operation of the CPSES CWS was considered to have little effect given the characteristics of the CWS design and location. The operation of the CWS during impingement and entrainment monitoring was considered to be reflective of the normal operating conditions for the system in future operation. The monitoring revealed that 262,498 fish were impinged (96% of which were threadfin shad and less than 1 % were gamefish) and 1500 adult fish "equivalents" (all species combined) were estimated to have been entrained. Based upon these data, current operation of the CWS appears to minimize impacts to gamefish populations in SCR;

- Capacity of the CPSES CWS under full operation is equivalent to approximately 6.4 % (daily) of SCR. This capacity was judged to represent a "low impact potential intake".

Reduction in capacity of CWS can usually reduce entrainment (and sometimes impingement) losses, however, in evaluating best available technology (BAT) in the case of the CPSES, the low number of total fish (and especially game fish) entrained and impinged does not justify reducing the capacity of the CWS.

Given the low impact of the CPSES on game fish populations in SCR; the relatively low numbers of fish lost via entrainment; and limitation of impingement largely to forage species; the location, design, capacity and operation of the CPSES CWS intake structure appears to reflect the best technology available for minimizing adverse environmental impact to the fisheries of SCR.

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1.0 INTRODUCTION

This 316(b) Demonstration has been prepared in compliance with the terms and conditions of the National Pollutant Discharge Elimination System (NPDES) permit for Texas Utilities Electric Company's Comanche Peak Steam Electric Station (CPSES) located in Glen Rose, Texas. The 316(b) Demonstration became a requirement of NPDES permits for power plants in 1972, with promulgation of the Clean Water Act (P.L. 92-500) amendments to the Federal Water Pollution Control Act. The amendments included Sections 316(a) and 316(b) relating to power plant circulating cooling water system (CWS) impacts due to thermal discharge (316(a)) and/or cooling water intake (316(b)).

In the case of CPSES Unit 2 , the 316(a) was not a provision of the NPDES permit (Squaw Creek Reservoir was built for such cooling purposes), but the 316(b) was, given that there are a number of ways to design and operate a CWS intake.

Section 316(b) requires that:

> ***"....the location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact."***

Development of a 316(b) Demonstration requires collection and analysis of a large number of biological samples from both the intake screens and the source waterbody, in order to estimate how many organisms are "entrained" into/through the circulating cooling water system (i.e., small enough to pass through the protective screens upstream of the pumps), and how many are "impinged" on such protective screens. In either case, at the CPSES, the organisms so affected are not assumed to survive. The importance of such mortality must be judged relative to the population biology and community structure of the source waterbody's natural resources.

In the case of the CPSES, the NPDES permit (Appendix A) required that the 316(b) study would follow the startup of Unit No. 2, thus accounting for potential cumulative impacts of both units. The conditions of this permit relative to the 316(b) study scope of work reflected conclusions reached by the staff of the Nuclear Regulatory Commission (NRC) in its Final Environmental Statement (FES) for the CPSES Units 1 and 2 (USNRC, 1981).

The primary concern expressed by the NRC in the final environmental statement (FES), was that of intake water approach velocity. Estimated design velocities, at 100-percent load factor (all eight pumps operating) were presented in the FES as:

FLOW VELOCITY (M/S)

LOCATION	WATER SURFACE* (235 M)	WATER SURFACE* (236 M)
Through Trash Racks	0.31 (1.02 fps)	0.28 (0.92 fps)
Screen Approach	0.33 (1.09 fps)	0.30 (0.99 fps)
Through Screen	0.75 (2.47 fps)	0.66 (2.17 fps)

*reflects the range of SCR volume/depth

The velocities were double what EPA had been recommending as design approach velocities (i.e., ≤ 0.5 fps); a recommendation based largely on results of one pioneering study at the San Onofre (California) Nuclear Generating Station (NGS). All other things being equal, higher velocities generally result in higher impingement rates. The NPDES Permit and CPSES construction permit were approved on the basis of applicant/NRC staff arguments, correctly so, that the principal species expected to be impinged (shad) has a high reproductive potential, and that the intake area is not unique to Squaw Creek Reservoir (SCR). The FES (p. 5-13) in fact suggests that direct impingement or entrainment of game fish is the primary concern (vis., "Monitoring of impingement rates after startup will determine the game fish losses. . . "), and the NPDES permit also speaks primarily to game fishes.

The permit is very specific to the scope of work to be performed, although some of the original specifications were later subject to minor (negotiated) modifications to better reflect the design of the plant and/or the nature of the SCR populations. Basically, the plan as finalized and implemented in 1993 - 1995, required one year of impingement sampling (juvenile/adult fish); one (fish spawning) season of entrainment sampling (fish eggs, larvae, and some small juveniles); and two seasons of SCR sampling.

This 316(b) Demonstration presents the results of the required studies, consistent with the USEPA "Guidance for Evaluating the Adverse Impact of Cooling Water Intake Structures on the Aquatic Environment: Section 316(b) P.L. 92-500 "(USEPA, 1977).

The CPSES 316(b) is formatted to include sections on the plant characteristics; the local environmental characteristics; detailed population biology information for representative important species; impingement and entrainment study methods and materials, and results; interpretation of results relative to overall impacts and conclusions salient to the purpose of the 316(b); supporting data; bibliography; and qualifications of the participants in the study. This format has the "narrative" discussion and interpretation woven through several sections, in order that they build one upon the other to result in a clear, concise concluding statement addressing the suitability of the CPSES Units 1 and 2 intake design, location, construction, and capacity.

2.0 STATION LOCATION, DESCRIPTION AND OPERATION

2.1 LOCATION

The Comanche Peak Steam Electric Station (CPSES) is a two-unit, nuclear generating station owned and operated by Texas Utilities Electric Company (TUEC). The CPSES is located in north-central Texas (lat. 32.2983 deg. N; long. 97.7856 deg. W), five miles northwest of the city of Glen Rose, Somervell County, Texas. In relation to major Texas cities, the CPSES is approximately 55 miles south of Fort Worth and 65 miles southwest of Dallas (Figure 2-1). The station is situated on a peninsula bounded on the north, south and east by Squaw Creek Reservoir (SCR) (Figure 2-2). SCR is a man-made impoundment of Squaw Creek and has a surface area of approximately 1,324 hectares (3,272 acres). SCR is owned by TUEC and serves as the source of cooling water for the CPSES circulating water system (CWS). The CPSES is the only operating CWS on SCR.

2.2 DESCRIPTION OF THE CPSES FACILITY AND CIRCULATING WATER SYSTEM

The CPSES consists of two nuclear pressurized water reactors identified as Units 1 and 2. Maximum generating capacity of each unit is rated at 1150 MWe or 2300 MWe combined. CPSES Unit 1 was declared ready for commercial operation on August 13, 1990 and Unit 2 was declared ready for commercial operation on August 3, 1993 (CPSES FSAR 1987, Amendment 90 Dec. 17, 1993). The plant is designed with a once-through CWS. The purpose of the CWS is to supply a continuous and adequate supply of non-contact cooling water to the unit condensers and heat exchangers associated with condensation of steam vapor from the turbine plant cooling water systems during electrical generation. The source of cooling water for the CWS is SCR and heated water is discharged back into SCR from condensers in both units via a common discharge (CPSES Outfall 001) located on the south-southeast perimeter of the facility.

The CPSES CWS intake structure is located in a protected recess on the shoreline of the reservoir north of the facility (Figure 2-3); no offshore water withdrawal system is employed. The intake structure serves both units and houses four circulating water pumps and six traveling screens per unit (Figure 2-4). During construction of SCR, the intake areas was excavated and fallen trees and coarse debris were removed. Bottom substrates within the intake area consist of exposed bedrock and sand. Riparian vegetation along the shoreline was removed and replaced with rip-rap to control localized erosion. Figure 2-5 provides a cross section of the CPSES intake structure and identifies the various components of the intake system.

Water withdrawn from SCR first passes through a trash rack fitted with 10.1 x 1.3 cm (4 x 0.5 inch) steel bar. The trash rack structure is located on the exterior of the intake structure to prevent large floating suspended debris from entering the CWS. The trash rack extends the

entire length and height of the intake structure. The overall dimensions of the trash rack are 54.8 m (180 ft) x 21.8 m (71.7 ft) for an area of 1,194.6 m^2 (12,854 ft^2).

After passing through the trash rack structure, the cooling water continues through a series of stoplog guides before passing through the vertical traveling screens. The FMC-Linkbelt vertical traveling screens precede the pumps and are on timed rotation schedule for debris removal. Each unit of the CPSES is serviced by six traveling screens, or a total of twelve traveling screens for the entire intake structure. Each traveling screen consists of a series of panels linked together to form a continuous barrier rotated by an electric motor sprocket system for removal of fine debris and/or fishes not excluded by the trash rack. Each screen is 3.2 m (10.5 ft) in width and 19.8 m (65 ft) in total height. At the spillway water elevation (236 m, or 775 ft), the total submerged depth of the traveling screens is 15.24 m (50 ft).

Traveling screen panels are constructed of 1.25 cm (0.5 in.) square steel mesh for retaining fine debris. The traveling screens operate on a timed-wash cycle, where accumulated debris on the screens is washed clear of the panels during a rotation cycle. The screens are timed to rotate every four hours or can be set to rotate automatically based on screen pressure sensors for heavy debris loading periods. During each rotation cycle, the screens are rotated one and one half revolutions, during which the screens are power-washed of debris. Collected debris accumulated on the screens is washed into a common debris trough and channeled into a steel debris collection basket where excess water is removed and the debris is concentrated. Collected debris is then manually removed for proper disposal. There is no fish by-pass system or fish diversion system currently employed on the traveling screens.

After being strained through the traveling screens, the intake water in each unit passes through an intake crib before entering one of four pump intake bell housing forebays. Design of the unit intake cribs allows controlled passage of water from one unit intake system to the second. This allows operation of one unit using the combined CWS pumps for the two units. Each intake bell housing consists of a 2.3 m (90 in.) diameter steel intake pipe for withdrawal of water from the intake crib. The CWS pumps are General Electric powered Ingersoll-Rand vertical draft pumps. Each pump is rated at 2500 horsepower and produces a flow of 1,040.8 m^3 per minute (275,000 gallons per minute) at 257 revolutions.

Passing through the pump system, water enters into a 917.3 m^3 (32,390 ft^3) distribution crib which feeds into a 6.1 m (20 ft) diameter condenser intake tunnel leading to the condensers and heat exchangers for each unit. The condenser flow rate is 3,898.6 m^3 per minute (1.03×10^6 gallons per minute) for each unit. The design condenser temperature rise is estimated to be 9.4°C (15°F). Heated water piped from the Unit 1 and Unit 2 condensers converge into a common outflow tunnel and are discharged through the circulating water discharge structure (CWDS) identified as Outfall 001, and back into SCR. The CWDS is located at the southeastern perimeter of the CPSES (Figure 2-3). Under full operation conditions (4 CWS pumps/unit), the

CPSES would cycle a daily volume of water equivalent to 6.4 percent of the volume of SCR for cooling water purposes.

2.3 UNIT 1 AND UNIT 2 OPERATING HISTORY, OCTOBER 1993-OCTOBER 1994

During the entrainment and impingement sampling programs, field personnel kept records of Unit 1 and Unit 2 operations. The data collected included the number of CWS pumps in operation, the number of operating traveling screens for each unit, and daily discharge of spent cooling water from both units (Outfall 001 monitoring data). Daily discharge records for Outfall 001 for the CPSES are provided in Appendix B. These data were used to extrapolate the number of pumps in operation for calculating entrainment and impingement rates over weekly periods between sampling events based on actual operating conditions, and for projecting worst case operation scenarios for the impact assessment.

The largest continuous database on pump operation was collected during the period of impingement monitoring from October 1993 through October 1994. During this monitoring period, Units 1 and 2 were operated at various capacities. Figure 2-6 shows the total number of CWS pumps (Units 1 and 2 combined) recorded in operation during each of the impingement sampling events. For the sampling period of October 18, 1993 through June 18, 1994, the CPSES CWS (both units combined) was in operation at 50 to 87 percent capacity (4 to 7 CWS pumps total). The CPSES CWS went to full operating capacity (100 percent for both units, or 8 CWS pumps total in operation) for the monitoring period of June 29 through October 11, 1994. The number of CWS pumps for the station was reduced for the last sampling event to four (50 percent of total CWS capacity) on October 12, 1994.

CWS discharge monitoring records from Outfall 001 followed the total number of operating pumps closely and was found to be a reliable predictor of the total number of CWS pumps in operation for the station (Figure 2-7). Correlating the number of pumps in operation from impingement monitoring records with daily discharge records for Outfall 001 revealed that daily discharge per pump was approximately 1.5×10^6 m^3/day (3.96×10^8 gallons/day). Based on these data, total discharge from operation of four pumps (e.g., only one unit in operation) would be 5.99×10^6 m^3/day (1.584×10^9 gallons/day). At full capacity (both units in operation, or eight pumps total) daily discharge is 1.19×10^7 m^3/day (3.168×10^9 gallons/day). This equates to an individual pump intake rate of approximately 17.3 m^3/sec (4,571 gallons/sec). This estimated intake rate considers only cooling water for main condenser/heat exchanger use, as the service water system is supplied via a separate intake and discharge. The 17.3 m^3/sec withdrawal/discharge rate value was integrated into the entrainment and impingement estimates for both actual and projected worst case scenarios.

Unit 1

Operating history for Unit 1 during impingement sampling is shown in Figure 2-8. Operation of the Unit 1 CWS pumps was consistent during night and day sampling efforts. Unit 1 varied from no operating pumps (i.e., Unit 1 shutdown) to full capacity (all four Unit 1 pumps operating). From the impingement monitoring start-up, October 18, 1993, through November 29, Unit 1 was shut down with no pumps in operation. Two Unit 1 pumps (Nos. 2 and 3) were brought on line on November 30, and the Unit 1 CWS remained at this capacity through December 18. A third Unit 1 pump (No. 1) was brought on line by December 19. Pumps 1, 2 and 4 remained in operation until the January 6, 1994 sample date. In the interval between January 6 and January 13, Unit 1 pump No. 1 was taken off line and pump No. 4 brought on line. Pumps 2, 3 and 4 remained in operation until February 2, when pumps 2 and 4 were taken off line and pump No. 1 was brought back on line, leaving Nos. 1 and 3 in operation. Unit 1 continued to operate at only 50 percent capacity until February 5, at which time pump No. 2 was brought back on line. Unit 1 continued to operate at 75 percent capacity (three pumps in operation) until April 20. During this period, pumps 1, 2 and 4 were alternated in operation. During the interval of April 20-May 5, Unit 1 went into full operation with all four pumps. Unit 1 remained at full capacity throughout the remainder of the impingement sampling period until October 12, 1994.

Unit 2

Like Unit 1, the Unit 2 CWS was consistent with respect to day and night operation of the CWS pumps. One exception was noted on January 13, 1994, when the number of operating pumps was three during the day and four at night (Figure 2-9). For the entire monitoring period, Unit 2 was operated at 100 percent capacity more frequently than Unit 1.

From October 18, 1993 through January 6, 1994, Unit 2 was operated at 100 percent capacity (four CWS pumps in operation). For a brief interval, as described above, Unit 2 was powered down to three pumps during the day on January 13. On January 20, Unit 2 pumps 2 and 3 were taken off line, leaving the Unit 2 CWS at 50 percent of capacity with only pumps 1 and 4 in operation. The Unit 2 CWS remained at 50 percent capacity through March 17. During this period, the number of operating pumps remained constant, with pumps 1 and 4 alternating periodically with pumps 2 and 3. On March 18, pumps 2, 3 and 4 began operating together bringing the Unit 2 CWS up to 75 percent capacity, where it remained through April 20. Between April 20 and May 5, pump 4 was taken off line and pumps 2 and 3 remained in operation. The Unit 2 CWS remained at 50 percent operating capacity through May 25. On May 26, pump No. 4 was brought back on line, raising the Unit 2 CWS to 75 percent of capacity.

The Unit 2 CWS remained at 75 percent capacity from May 26 to June 21, 1994. Pump No. 3 was brought on line on June 22, 1994, bringing the Unit 2 CWS up to 100 percent operating capacity (four pumps in operation). Unit 2 remained at 100 percent capacity from June 22

through October 7, 1994. Between October 8 and October 12, 1994, selected pumps were taken off line, until the Unit 2 CWS was shut down on October 12, 1994, the last date for impingement sampling.

2.4 APPROACH VELOCITY PROFILES FOR CPSES UNIT 1 AND UNIT 2

Velocity data were collected to assess approach velocity profiles in the intake bay upstream of the CPSES CWS trash racks for both Units 1 and 2. These data were collected to evaluate potential impacts of approach velocities on impingement and to compare them to guidance values proposed by the USEPA and USFWS (Boreman, 1977), as discussed in the CPSES FES (U.S. NRC, 1981). Initial trial runs and other preliminary work, such as setting up measurement stations, were prepared on April 29, 1994. Velocity profile data were then collected on April 30 and May 1, 1994. During this period of time, CPSES Unit 1 was at 100 percent generating power with all four CWS pumps running. Unit 2, which was shut down for plant maintenance, had two CWS pumps running. A second set of data was collected on June 27 and 29, 1994. During this period both Unit 1 and Unit 2 were operating at 100 percent capacity with all eight CWS pumps running.

2.4.1 Velocity Measurement Methods

An Endeco Type 110 current meter (Ocean Surveys, Inc., Old Saybrook, CT) was used for velocity measurements. This is an axial flow, ducted impeller, remote reading current meter designed for measuring velocities ranging from 0 to 2.6 meters per second (mps) or (0 to 8.5 feet per second (fps)). The horizontal attitude of the instrument during deployment allows shallow depth operations and minimal hydrodynamic drag. Current speed is displayed directly on the deck unit, permitting real time measurements. The unit was battery operated and no external power source was required. An auxiliary 3/8 inch polypropylene support line was taped to the current meter cable, which was marked off every 5 feet and was used for depth measurements.

The deck readout meter was set up on the CWS structure operations deck. The lower unit was then lowered onto the boat. Prior to deploying the unit into the water, a series of weights was added to the auxiliary line to keep the lower unit in position. The deck unit was calibrated in accordance with the instrument instruction manual. The two-man boat crew deployed the lower unit into the water and adjusted the trim weights for 0 degree pitch as indicated on the unit level. The unit was lowered to the desired depth (utilizing the markings on the polypropylene line) and allowed to stabilize for a few minutes. The current velocity was then recorded from the deck unit. Current speeds were recorded twice at each sampling depth, once as the unit was lowered from the water surface to the bottom of the intake, and once again as the unit was raised to the surface.

When a vertical section was completed, the boat was positioned at the next station and the current monitoring was repeated at the new sample point.

Utilizing this procedure, current speeds were recorded at various locations and the profile information was developed. Current speeds were recorded at the following locations upstream of the Unit 1 trash racks.

X-HORIZONTAL (East-West Direction) (m): 0, 3.07, 6.15, 9.23, 10.78, 12.31, 15.38, 18.46, 21.54, 24.62, 27.39
Y-VERTICAL (Depth) (m): 0.92, 3.07, 6.15, 7.69, 9.23, 12.30, 14.46

Additionally, measurements were made in the Z direction (North-South) from the trash racks to the intrusion barrier located approximately 97.8 m (321 feet) upstream. The grid pattern utilized for the Unit 2 and Z directional measurements was larger in size than the grid pattern utilized upstream of the Unit 1 trash racks.

X-HORIZONTAL (East-West Direction) (m): 0, 9.23, 10.78, 18.46, 24.62, 27.13, 28.96
Y-VERTICAL (Depth) (m): 0.92, 3.07, 6.15, 7.69, 9.23, 12.30, 14.46

2.4.2 Approach Velocities for CPSES Unit 1 and Unit 2

Measurements of velocity in front of the Unit 1 and 2 trash racks are presented in Tables 2-1 and 2-2. Approach velocities in front of the Unit 1 and Unit 2 trash racks (X-Y Plane) were generally similar and generally displayed uniformity across the trash racks. The majority of the average readings were between 10.9 cm/sec (0.337 ft/sec) and 14.79 cm/sec (0.485 ft/sec). There were a few excursions as low as 4.42 cm/sec (0.145 ft/sec) and as high as 36.01 cm/sec (1.18 ft/sec).

Overall, velocities at near-bottom depths appear to be higher (10 - 35 percent) than velocities at the surface and at mid-depth. These excursions were associated only with the deepest near bottom measurements for both units (Figures 2-10 and 2-11). These near-bottom measurements may be associated with turbulence associated with the hard substrate in the vicinity of the intake trash racks. The grand average velocity across the entire intake structure, at the trash racks (Units 1 and 2, surface to bottom) was 13.02 cm/sec (0.427 ft/sec). Based on U.S. Environmental Protection Agency guidance documents, velocities under full CWS operation are approximately 14.6 percent lower than the recommended intake approach velocity of 15.24 cm/sec (0.5 ft/sec). Similarly, measurements show a decrease in velocities at increasing distances from the intake, moving toward the intrusion barrier.

3.0 ENVIRONMENTAL CHARACTERISTICS AND AQUATIC COMMUNITIES OF SQUAW CREEK RESERVOIR

Squaw Creek Reservoir (SCR) is a manmade impoundment of the mainstem creek basin of Squaw Creek near the city of Glen Rose, Texas. SCR was created by construction of a earth and rock fill dam designed to maintain a normal water elevation of 235-236 m (spillway elevation is 236.2 m or 775.0 ft). Construction of the basin and dam was completed in February 1977 and the basin was filled in May 1977 (Hellier et al., 1987). Squaw Creek was impounded 4.5 miles upstream from the confluence of Squaw Creek with the Paluxy River (CPSES FSAR, 1987). The reservoir catch basin tranverses the boundaries of Hood and Somervell Counties and has an estimated watershed area of 165.8 km^2 (64 sq. miles) (Hellier et al., 1987). In addition to Squaw Creek, several smaller branch tributaries of Squaw Creek discharge to SCR. These tributaries include the Panter Branch and Lollar Branch located on the northwest shore, Panther Branch on the southwest shore and Million Branch on the southeast shore. In addition to these surface water inflows, water levels within the SCR are supplemented via a manmade pipeline diverting water from Lake Granbury (Sellers, 1984). SCR serves as the primary source of cooling water for the CPSES CWS.

3.1 ENVIRONMENTAL SETTING AND CLIMATIC CONDITIONS

The CPSES and SCR are located in north-central Texas, on the Comanche Plateau, a subdivision of the Central Texas section of the Great Plains physiographic province. The general area is underlain by the geological formation known as the Fort Worth basin (CPSES FSAR, 1987). The general landform assemblage of the north-central Texas region may be characterized as irregular plains (McKnight, 1984). Local topography surrounding CPSES has been described as "flat with hills rising from the reservoir" and topography surrounding SCR as "rolling to hilly" terrain (CPSES FSAR, 1987). Land use within a five-mile radius of CPSES and SCR has been characterized as including agricultural, farm/ranch land, and range land (CPSES FSAR, 1987). The majority of the land use surrounding SCR and CPSES was classified as open, undeveloped range land. The 1987 population within a four-mile radius of CPSES was 520 people and was characterized as a low population density area (CPSES FSAR, 1987).

Climatic conditions of the north-central Texas region may be classified as a humid sub-tropical climate (McKnight, 1984). CPSES and SCR are located approximately 300 miles to the northwest of the Gulf of Mexico and experience a continental climate with marked diurnal and seasonal temperature extremes. Maritime tropical air masses almost completely dominate the weather in summer. During the winter, outbreaks of polar continental air are the most common frontal activity, while Pacific maritime cold fronts are more frequent in the spring and fall. Wide variations in precipitation amounts occur from year to year, including both drought and persistent rains (CPSES FSAR, 1987). On a regional scale, average annual precipitation for north-central Texas is generally 40-60 cm/year (15.7-23.6 inches) (McKnight, 1984). Typically, low

precipitation is associated with the winter months, and the wettest months are in summer. Average annual precipitation as measured in Glen Rose is approximately 88.9 cm/yr (34.9 inches/yr.), ranging from 58.6 to 139 cm (23.1-54.8 inches) (G. Spicer, Texas Utilities Services, Inc. person. comm.). Seasonal temperatures, though subject to annual variation, are generally characterized by hot summer, warm spring and fall, and cool, dry winter. On a regional basis, the annual temperature range for the region is 15-40°C (59-104°F) (McKnight, 1987).

3.2 DRAINAGE BASIN AND BATHYMETRY OF SQUAW CREEK RESERVOIR

The watershed of SCR extends into portions of Hood, Somervell and Erath Counties and covers an estimated area of 165.8 square kilometers (64 sq. miles). The SCR basin shape is typical of flooded river impoundments with large coves/bays formed by the irregular shape of the shoreline. These large coves/bays converge in the main river valley of Squaw Creek and form the contiguous open basin of the reservoir.

The bathymetry of the basin indicates a steady increase in depth in moving from the inflow to the base of the dam. Hellier et al. (1987) reported a mean depth of 14.1 m (46.3 ft) and a maximum depth of 41.2 m (135.2 ft). The greatest depths are typically associated with the main open areas of the reservoir and the vicinity of the dam. The irregular nature of the shoreline of most reservoirs creates significant littoral habitats in the subbasins of coves and bays. The substrates of SCR have been described as sandy and exposed bedrock. Much of the littoral regions of the reservoir are strewn with fallen trees and brush (G. Bauml University of North Texas, personal comm.).

3.3 LIMNOLOGICAL CHARACTERISTICS OF SQUAW CREEK RESERVOIR

Hellier et al. (1987) provided the following summary of morphometric characteristics for SCR:

	Metric	U.S.
• Surface Area[1]	1,306 hectares	3,228 acres
• Length of Shoreline[2]	112.6 km	70 miles
• Shoreline Development Index (unitless)[2]	5.0	5.0
• Maximum Depth[2]	41.2 m	135 ft
• Mean Depth[2]	14.1 m	46.3 ft
• Total Volume[1]	1.86×10^8 m^3	151,047 acre-ft

(Source:[1] CPSES FSAR, 1987, [2]Hellier et al. 1987)

The Shoreline Development Index (SDI) relates the length of the shoreline of the waterbody to the circumference of a circle equal in area to that of the waterbody. Thus the ratio results in a comparative index of shoreline/littoral complexity. A value of 5.0 is typically associated with systems formed by the inundation of river valleys (Wetzel, 1983). This relatively high value indicates that the SCR shoreline contains numerous small coves or bays and thus an abundance of littoral habitat (i.e., an abundance of shallow coves and bays important for fish habitat). The CPSES CWS intake is on a highly modified man-made recess in the shoreline perimeter of the SCR (see picture on cover). It's shoreline and featureless bottom are less conducive to development of the same kind of game fish productivity/habitation that other areas of the SCR offer.

Hellier et al. characterized SCR as being a longitudinally partitioned body of water with respect to physical measurements recorded during their survey. One physical parameter regarded was Secchi depth, which is a qualitative indicator of water transparency. Measurements decreased with movement away from the inflow of Squaw Creek toward the dam of the reservoir. The inflow region of the reservoir was described as turbid and well mixed. Hellier et al. further classified SCR as being monomictic (a complete mixing of the water column once per year) with the onset of overturn conditions associated with the fall months. Monitoring also revealed that the deeper open areas of the reservoir become vertically stratified in summer.

3.4 WATER QUALITY CHARACTERISTICS

Water temperature and dissolved oxygen (D.O.) data were recorded at the CPSES on each day of sampling for this 316(b) Demonstration. Day and night monitoring was conducted on each sampling date. Sampling occurred over a one-year period from October 1993 to October 1994. Several gaps are present in both the water temperature and D.O. data. These gaps were caused by equipment and/or weather related difficulties (i.e., storm warnings).

3.4.1 Temperature

Water temperatures recorded during the year-long sampling period ranged from 16°C to 35.8°C (61°F to 96°F) during the day and 15°C to 35.8°C (59°F to 96°F) during the night. Results of the year-long sampling effort are shown in Figure 3-1. Lowest water temperatures occurred during the fall and winter months (November to mid-March). During this period, recorded temperatures ranged from 16°C to 21°C (61°F to 69°F) during the day and 15°C to 20°C (59°F to 68°F) during the night. The lowest temperatures (16°C day, and 15°C night) were recorded on November 30, 1993 of the monitoring period. Highest water temperatures were observed during the summer months, from mid-June to the end of September. Recorded temperatures ranged from 30°C to 35.8°C (86°F to 96°F) during both the day and night. The highest day/night temperature (35.8°C both day and night) recorded during the program occurred on July 27, and

August 10, 1994. During Hellier et al's pre-heat load studies, the SCR temperature range was 8.0 to 30°C (46.4 to 86.0 °F).

3.4.2 Dissolved Oxygen

Dissolved oxygen concentration recorded during the year-long sampling period ranged from 7.0 mg/l to 11.8 mg/l during the day; and 5.5 mg/l to 9.8 mg/l during the night. Results of the year-long sampling are shown in Figure 3-2. D.O. concentrations remained fairly constant throughout the year, with slightly higher concentrations from January to the end of May. The highest D.O. concentration recorded during day sampling, 11.8 mg/l, occurred on May 4, 1994; and the highest concentration at night, 9.8 mg/l occurred on the February 16, 1994 sampling event.

From June to December, D.O. concentrations ranged from 7.0 mg/l to 8.9 mg/l during the day; and 6.5 mg/l to 8.8 mg/l during the night. The lowest concentration collected during day sampling, 7.0 mg/l, occurred on September 7, 1994; and the lowest night concentration, 5.2 mg/l, occurred on April 20, 1994. Although D.O. concentrations typically varied less than 1.0 mg/l between day and night samplings, lower concentrations of D.O. were typically observed at night. However, samples recorded on April 20, 1994 and May 4, 1994 displayed a greater than 4 mg/l difference between the day and night samples (Figure 3-2).

Percent oxygen saturation was determined for samples with the lowest and highest water temperature, and D.O. concentrations using an oxygen saturation nomogram (Wetzel and Likens, 1991). Samples with higher water temperature and D.O. concentrations were found to have high oxygen saturation samples, in most cases greater than 100% oxygen saturation. Samples with lower water temperature and D.O concentrations were determined to have lower oxygen saturation limits ranging from 80 to 100%. In several cases, oxygen saturation was determined to be at or below 80%. The lowest oxygen saturation was observed in the April 20, 1994 night sample, which had a water temperature of 26.0°C, D.O. of 5.2 mg/l, and an oxygen saturation of 60%.

Hellier et al. (1987) determined that SCR becomes thermally stratified during the summer. During summer stratification, the hypolimnion (bottom waters) becomes oxygen depleted. During fall overturn, bottom waters of the hypolimnion mix with upper waters and dissolved oxygen levels become uniform throughout the water column.

3.5 AQUATIC COMMUNITIES PRESENT IN SQUAW CREEK RESERVOIR

Lentic ecosystems (i.e., lakes, reservoirs, ponds) consist of a variety of communities interacting in a complex food web. Fish species depend on other communities both for cover, habitat, reproduction (e.g., aquatic macrophyte beds) and feeding (e.g., benthic macroinvertebrates).

Although aquatic macrophytes and benthic macroinvertebrates may not be impacted by the CPSES CWS, the nature and extent of these communities do affect distribution of fish species.

3.5.1 Aquatic Macrophytes and Benthic Communities

Submergent Macrophytes

Little information is available concerning species present or extent of macrophyte cover and benthic communities within SCR. Hellier et al. postulated that periphyton productivity may be a significant portion of the reservoir productivity, due in part to the abundance of submerged substrates (mostly dead trees and tree trunks). The filamentous algae *Spirogyra* has been reported to be present in shallow littoral areas of the reservoir during the recent 316(b) Demonstration Studies (G. Bauml, University of North Texas, personal comm.). Although no detailed study of macrophyte species and diversity within SCR has ever been done, cursory descriptions from other investigations provide some insight into this community. Sellers (1984) stated that aquatic vegetation appeared to be limited to littoral areas of the reservoir. Hellier et al. described stonewort (*Chara* sp.) as being a dominant submergent species. Other submerged macrophyte species present included pondweed species (*Potamogeton* sp.). Based upon the limited observations made by Hellier et al., stonewort (*Chara* sp.) appeared to be the predominant submergent macrophyte present in the baseline studies.

Emergent Macrophytes

Emergent macrophytes include broad leaf cattail (*Typha latifolia*) and sedge species (*Carex* sp.)(Hellier et al., 1987). Emergent macrophytes appear are limited to the immediate shoreline of the reservoir. Aquatic vegetation is an essential element in lentic communities, contributing substantially to overall primary productivity of the aquatic community. Aquatic vegetation provides important cover to larvae and juvenile fishes for feeding and for protection from larger piscivorous fish species (Conrow and Gregory, 1990; Savino and Stein, 1982) and it constitutes a portion of the diet of benthivore fish species such as carp, various sucker species, gizzard shad (adults) and other benthivore species (Carlander, 1977).

Macroinvertebrates

No information concerning benthic community composition or density was available for SCR. However, benthic communities present probably contain numerous taxa of Chironomidae (midges) and other aquatic insects, aquatic annelids (aquatic worms), aquatic gastropods (aquatic snails), amphipods (scuds) and other benthic taxa. Conversation with CPSES personnel did reveal that the Asian clam (*Corbicula fluminea*) has occasionally accumulated in the intake crib, requiring removal (A. DiSanto, Foster Wheeler Environ. Corp. personal comm.). Aquatic macroinvertebrates constitute a substantial diet component for benthivore species and juvenile

stages of other fish species, such as juvenile and adult sunfish (*Lepomis* sp.), carp, suckers and bullhead catfish (*Ameiurus* sp.) (Page and Burr, 1990; McClane 1977). Freshwater drum (*Aplodinotus grunniens*) are known to feed extensively on mollusks (both gastropods and bivalves), including *Corbicula fluminea* (Daiber, 1952).

3.5.2 Fisheries

Hellier et al. (1987) conducted an extensive fishery survey of SCR as part of a CPSES preoperational monitoring project. Using multiple collection methodologies (electrofishing, seining, gill netting and cove rotenone sampling), Hellier et al. documented the 25 fish species and hybrid striped bass listed in Table 3-1.

Hellier et al. categorized the predominant predatory and forage fish species based on percent abundance and composition data collected during the study and known feeding guild (i.e., dietary habits) characteristics. Major predatory species found during the CPSES preoperational studies within SCR included largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieui*), white bass (*Morone chrysops*), walleye (*Stizostedion vitreum*), channel catfish (*Ictalurus punctatus*) and hybrid striped bass (*Morone saxatilis x M. chrysops*). Combining the total catch for all collection methodologies used resulted in identification of the largemouth bass as the most abundant major predator present. With the exception of white bass and walleye, the remaining predatory species populations within SCR have been supplemented with periodic stocking of fish by the Texas Parks and Wildlife Department. Walleye were stocked once (1986) in SCR on an experimental basis, and there were no expectations that a viable population of this species would ever be developed (it is basically a cool water species).

In addition to abundance and composition data, Hellier et al. performed a cursory examination of stomach contents of smallmouth bass, largemouth bass, walleye, channel catfish and hybrid striped bass which aided in identification of forage species. Major forage species identified included inland silversides (*Menidia beryllina*), threadfin shad (*Dorosoma petenense*), bluegill sunfish (*Lepomis macrochirus*) and gizzard shad (*Dorosoma cepedianum*). Combining the total catch for all collection methodologies employed resulted in identification of the bluegill sunfish as the predominant forage species present in SCR. Hellier et al. postulated that sampling methodologies may have grossly underestimated the abundance of threadfin shad in SCR.

3.5.3 Historical and Current Fish Stocking Programs

Boat ramp access for fishing is through admission to Squaw Creek Park, located along the north shore of SCR across from CPSES. Stocking programs for SCR are funded by a pay-to-fish system. The maximum capacity of SCR for recreational fishing via boat is limited to 250 boats on the reservoir at any one time. There is a daily ramp/access fee for deploying private boats.

Part of the ramp fee provides the basis for funding stocking programs for the SCR. The stocking program is administered by the Texas Parks and Wildlife Department and stocking of various species of gamefish and forage fish species have occurred at one- to five-year intervals since 1979 (SCR Stocking History Table, undated).

Species stocked in SCR have included indigenous, non-indigenous and sterile hybrid fish species. Table 3-2 lists the species, number and year of stocking. Stocked which are species outside of their native range in the SCR include the smallmouth bass, the Florida black bass (*Micropterus salmoides floridanus*, a subspecies of largemouth bass), northern largemouth bass, walleye, and hybrid striped bass. The native range of threadfin shad and channel catfish includes Texas. The only fish species stocked known to be incapable of reproduction within SCR is the hybrid striped bass. This hybrid results from crossing the anadromous striped bass (*Morone saxatilis*) with the closely related white bass (*M. chrysops*), thereby producing offspring that are purportedly sterile. Hellier et al. (1987) concluded that striped bass hybrids within the SCR are sterile based upon examination of gonadal development in collected individuals. The inability to reproduce in natural environments requires supplemental stocking to sustain the population in SCR. The last stocking of hybrid striped bass in SCR was June 15, 1994 when 51,000 individuals were stocked (Table 3-2) (G.Bauml, University of North Texas, personal communication). Although not stated in the stocking table, it is assumed that all individuals stocked were juveniles for the species stocked.

According to the stocking table, only a single species of forage fish, threadfin shad, has been intentionally stocked in SCR. All other stocked species are considered as gamefish species for the recreational fishery present. Threadfin shad have been widely introduced in reservoirs throughout the southern portion of the United States. The prolific reproductive capability of this species makes it a very suitable forage base for larger piscivorous gamefish species. Other forage species present in SCR, such as the gizzard shad and inland silverside, probably originated from indigenous populations within the Squaw Creek drainage basin above the SCR.

4.0 REPRESENTATIVE IMPORTANT SPECIES

The Section 316(b) guidance document (USEPA, 1977) acknowledges that to consider all species potentially entrained or impinged by a CWS is not feasible or practical. Rather a select group of species termed critical aquatic organisms, or representative important species (RIS) should be identified from the aquatic community to represent different trophic levels or niches which holistically may be representative of the fish community present. The CPSES NPDES permit places emphasis on game fish present in SCR for preparation of the 316(b) Demonstration.

The 316(b) guidance provides the following guidelines for selection of RIS's for consideration in CWS intake studies:

"A. Representative important species to be selected are those species which would be involved with the intake structure and are:

1. representative, in terms of their biological requirements, of a balanced, indigenous community of fish, shellfish and wildlife;
2. commercially or recreationally valuable (e.g., among the top ten species landed--by dollar value);
3. threatened or endangered;
4. critical to the structure and function of the ecological system (e.g., habitat formers);
5. potentially capable of becoming localized nuisance species;
6. necessary in the food chain for the well-being of species determined in 1-4;
7. one of 1-6 and have high potential susceptibility to entrapment-impingement and/or entrainment; and
8. critical aquatic organisms based on 1-7, are suggested by the applicant, and are approved by the appropriate regulatory agencies."

The guidance document recommends that the RISs selected for a CWS 316(b) Demonstration number from five to fifteen species. Since the focus of the Comanche Peak NPDES Permit and (therefore) 316(b) investigation was on fish species, in particular game fishes, all RISs selected for this demonstration were fish species deemed representative of the SCR fish community and/or highly susceptible to entrainment/ impingement by the CPSES CWS.

4.1 FISH COMMUNITY STRUCTURE

As part of a preoperational monitoring program, Hellier et. al. (1987) conducted a fish community survey of the Squaw Creek Reservoir. The purpose of this survey was to determine the fish community structure of the reservoir prior to start-up of the CPSES.

4.1.1 Methods

Four methods, including electrofishing, seining, gill net sampling, and cove rotenone sampling were utilized in the collection of fish from the Squaw Creek Reservoir by Hellier et al. The selected methods were chosen to allow comparison with past studies conducted in the reservoir. Nighttime electrofishing was carried out using an electrofishing boat equipped with a 5000 watt Onan generator. Nighttime seining was conducted using a 26 ft x 6 ft (7.9 m x 1.8 m) seine with 0.25 inch (6.35 mm) mesh and a 6 ft (1.8 m) bag. A 100 ft (30.5 m) drag was made at each site. Gill net sampling was conducted by setting experimental gill nets in the late afternoon, and retrieving them the following morning in the same order in which they were set. The experimental gill nets were 200 ft (61 m) long and 8 ft (2.44 m) deep, with 25 ft (7.62 m) panels of bar mesh sizes (increasing by 0.5 inch (12.7 mm) increments) ranging from 0.5 to 4 inch (12.7 to 101.6 mm) mesh. In addition to the above methods, cove rotenone sampling was also conducted. A 0.75 inch (19 mm) mesh block net was floated across the mouth of each cove and lowered between 2200 hours and daylight on the day prior to the survey. Liquid rotenone (5% active ingredient) was mixed with water to a concentration of 1 ppm and applied to all depths using gravity flow and a small bilge pump. Areas inaccessible by bilge pump were sprayed with a small hand pump. Stunned fish were collected via hand net and block net.

4.1.2 Results

A total of 20,399 fish were collected utilizing all four sample methods. Twenty-six taxa were collected, comprising 25 species and a striped bass hybrid (Table 4-1). Overall, the two dominant taxa were the bluegill sunfish (*Lepomis macrochirus*) and the green sunfish (*Lepomis cyanellus*), comprising 43 percent and 22 percent of the total, respectively. Four additional species each comprised between 4.6 percent and 9.1 percent of the total (Figure 4-1). These were the black bullhead (*Ictalurus melas*), redear sunfish (*Lepomis microlophus*), largemouth bass (*Micropterus salmoides*), and longear sunfish (*Lepomis megalotis*). The remaining taxa each comprised less than 2 percent of the total. The dominant family collected from the Squaw Creek Reservoir is the warm water family Centrarchidae, represented in the reservoir by the sunfish, largemouth bass, smallmouth bass, and white crappie. The family Centrarchidae comprised approximately 82 percent of the total number of fish collected.

4.2 ECOLOGICAL ROLES OF SPECIES WITHIN SCR

In considering species for selection as RISs, the ecological role or niche occupied by each species must be examined for inclusion on the basis of function within the SCR ecosystem. An aquatic food chain may be viewed empirically as a pyramid defined by four distinct levels of functionality: Primary producers (aquatic plants and algae), primary consumers (planktivorous fish/zooplankton), secondary consumers (invertivores and small piscivorous species) and tertiary consumers (large piscivorous fish species). Ecological niches represent defined roles of interaction of a species within its environment and in interacting with other species. For the fish community of SCR, species were classified into general ecological roles based upon the fish community structure present in the reservoir. It is acknowledged that multiple niches may be occupied by a single species during various life stages.

Based upon the trophic guilds for fish species in Plafkin et al. (1989), identification of major predators and forage species within SCR by Hellier et al. (1987) and life history characteristics, fish species present in SCR were assigned to one of four general trophic guilds defined as:

Piscivore(Tertiary Consumers/Major Predators)-fish species dominate the diet (includes most of the recreational gamefish species)

Invertivore/Piscivore(Secondary Consumers/Predators)-macroinvertebrates and some fish species included in the diet (smaller predatory gamefish)

Invertivore(Consumer/Forage Species)-micro/macroinvertebrates dominate the diet (includes forage species for larger predators)

Omnivore(Secondary Consumer)-opportunistic feeding strategies with diet inclusive of both micro/macro-plant and animal matter

Table 4-2 presents the SCR fish species assignment to the above trophic guilds in considering selection of RIS for the CPSES 316(b) demonstration. So as to be representative of the trophic level structure of the SCR fishery, RIS selected should include a cross section of the above trophic guilds.

4.3 SPORT FISHERIES SIGNIFICANCE-CREEL SURVEY

Recreationally/commercially important fish species are identified as potential RIS candidates due in part to their economic significance and additional consideration of potential impacts to populations associated with recreational/commercial harvesting. No fish species within SCR is commercially harvested using commercial fishing techniques (i.e., gill netting, fyke nets, trawls, etc.). However, SCR does support a popular recreational fishery for private citizens holding a

Texas state fishing license. The fishery is actively managed using stocking by the Texas Parks and Wildlife Department. Only traditional angling methods are allowed. Fishing is permitted from both boat and shore, with boat access limited to a maximum of 250 boats at any one time.

As part of the 316(b) Demonstration, a qualitative creel census of recreational anglers was conducted to monitor trends in the recreational catch prior to and following the start-up of CPSES Unit 2. Additionally, the creel census data were used to identify fish species which were commonly caught and thus qualify those species as being recreationally important.

4.3.1 Creel Survey Methodology

SCR security personnel distributed a one-page questionnaire (Figure 4-2) to anglers entering/exiting the park. Participants were asked to complete the questionnaire to the best of their ability using actual measurements (if recorded or known) or a best-guess estimate. Completed questionnaires were returned to SCR security by participants upon leaving the park. The census was conducted during the period of October-December 1993 and April-June 1994, the periods typically associated with higher angling pressure on SCR. Additionally, the creel survey was conducted in July 1995 to sample recreational catch rates in Summer 1995. The questionnaire requested anglers to record number of hours spent fishing, species and number of individuals captured in addition to other information. The survey did not differentiate species-specific angling (i.e., anglers fishing solely for one species or gamefish) but did provide an index of the number of fish/species SCR anglers encountered. The number of anglers, number of fish/species captured and number of hours spent angling were transformed into an angling-catch rate (No. of fish/1000 hrs angling effort) for each of the monthly intervals sampled using the equation:

$$\text{No. of fish}_{species} \text{ per 1000 angling hours} = \{(\text{No. of fish}_{species} \text{ captured})_{month} \div (\text{Total man-angling hours})_{month}\}(1000)$$

Data from the census forms were transformed into standardized units of angling effort (catch/1000 man-angling hours) for each species identified. Species were ranked in order of highest to lowest angling effort/catch rates based on the collected data and the top five recreationally important species identified.

4.3.2 Creel Survey Results

A total of 286, 461 and 308 survey questionnaires were collected from SCR anglers for the periods of October-December 1993, April-June 1994 and July 1995, respectively. For both survey periods, the number of anglers surveyed varied between months. Distribution of the number of anglers surveyed by month was 128 in October 1993, 40 in November 1993, 118 in December 1993, 230 in April 1994, 115 in May 1994 and 116 in June 1994. Angling effort

(hrs/month) varied between months and between the three survey periods (Figure 4-3). In general, the monthly angling effort for the survey period of April through June 1994 was greater than the period of October through December 1993. Highest monthly angling effort (2,986 hrs/month) was associated with the July 1995 period of the survey. This high degree of angling effort was attributable to a larger number of anglers present (on average) in individual parties surveyed.

Table 4-3 summarizes the calculated catch per angling effort rates for the species identified from the survey. Two species identified by anglers as being captured, but did not appear in survey conducted by Hellier et al., included Kentucky bass (a subspecies of largemouth bass) and tilapia (an exotic fish species commonly raised in warmwater aquaculture). No visual confirmation of either species was made during the survey and their occurrence should be considered questionable pending additional confirmation.

Based on observed catch rates, largemouth and smallmouth bass typically represented the two greatest catch rates across all seven sample months (Table 4-3). Of both species, largemouth bass contributed to greater catch rates on a per-unit-effort of angling than smallmouth bass for all seven sample months. Rates for largemouth bass were greatest in the October 1993 survey (1,039 fish/1000 angling hours) and smallest in December 1993 (358 fish/1000 angling hours). Smallmouth bass were caught at rates three to ten times less than largemouth bass but displayed a more consistent catch rate than the latter species. Catch rates for smallmouth bass during the survey periods ranged from 28-162 fish/1000 angling hours. Greatest catch rates for this species were associated with the November 1993 (162 fish/1000 angling hours) and October 1993 (154 fish/1000 angling hours) survey periods (Table 4-3).

Depending on the survey month, channel catfish ranked either second or third highest in the catch rate by anglers. Catch rates for this species ranged from 36-181 fish/1000 angling hours. Highest catch rates for this species were associated with the July 1995 (181 fish/1000 angling hours) and October 1993 (151 fish/1000 angling hours) for the survey months (Table 4-3). Species including hybrid striped bass, white bass, white crappie, freshwater drum and sunfish species typically ranked fourth or fifth in catch rate during the survey months among SCR anglers interviewed (Table 4-3). The remaining species identified from the survey typically were captured at rates well below the top five species catch rates observed.

4.4 SELECTION OF REPRESENTATIVE IMPORTANT SPECIES (RIS)

Based upon the guidelines and the previous information on the SCR fishery, eight fish species were identified as potential RIS candidates for the CPSES 316(b) demonstration. No endangered or threatened fish species were identified from SCR, and therefore, no endangered or threatened species are considered as RISs for this demonstration. The species and basis for their selection are as follows:

Largemouth Bass

Hellier et al. (1987) identified this species as a dominant predatory species in Squaw Creek Reservoir. Unlike the hybrid striped bass stocked in the reservoir, this species can successfully reproduce in the reservoir, thus allowing for the potential entrainment of larvae or eggs and impingement of young-of-the-year individuals by the CPSES CWS. Additionally, results of the creel survey of Squaw Creek Reservoir fishermen indicated that this species is highly sought as a recreational gamefish. Additionally, the Texas Department of Fish and Wildlife has consistently stocked this species for recreational fishing in SCR.

Freshwater Drum

Freshwater drum are largely benthic feeders with largely opportunistic feeding strategies. A unique characteristic of this species is the buoyant nature of both the eggs and prolarvae which are commonly encountered near or at the surface of the water. This characteristic makes these developmental stages highly susceptible to surface currents, wind driven wave action and potentially the CPSES CWS zone of withdrawal (e.g., approach velocities to the intake structure).

Inland Silverside

This small fish species commonly forms medium to large schools of age-specific individuals. Large numbers of young-of-the-year fish may be susceptible to impingement by the CPSES CWS. Additionally, this species is a pelagic spawner with eggs being released directly in the water column near the surface typically in shallow water. Both eggs and larvae may be susceptible to entrainment by the CPSES CWS. Hellier et al. (1987) found that this species occurred in a large percentage of largemouth bass stomachs and concluded that this species may be subjected to heavy predation by that predatory species and other game fish in SCR.

Threadfin Shad

This small member of the herring family was stocked by the Texas Department of Fish and Wildlife as a potential forage base for game fish in the reservoir. Like the inland silverside, this species may form medium to large size schools of age-specific individuals which may be susceptible to impingement by the CPSES CWS. Additionally, this species is a pelagic spawner in shallow water and this characteristic of their spawning behavior may make eggs and larvae of this species susceptible to entrainment within the zone of influence of the CPSES CWS.

Gizzard Shad

This species of the herring family reaches a relatively large size relative to other members of this family. Although adults may be of limited value as a forage species, juveniles, larvae and eggs

of this species have been identified as potential prey species for juvenile and adult game fish species. Unlike other herring species, the diet of the gizzard shad includes a significant benthic component which creates an important role for this species in detrital processing within the reservoir community.

White Bass

Hellier et al. (1987) concluded that the apparent abundance of white bass in Squaw Creek Reservoir did not warrant their consideration of being a major predator in the fisheries. However, this species is considered a game fish, and is commonly captured by recreational fishermen on SCR. The role of this species within SCR ecosystem appears to be largely that of an intermediate predator.

Channel Catfish

Hellier et al. (1987) described this species as a major predator within the Squaw Creek Reservoir. Unlike many other catfish species, the diet of the channel catfish includes a large percentage of fish in addition to benthic macroinvertebrates. Hellier et al. (1987) compared relative catch percentages of this species for 1985 and 1986, and they concluded that this species appears to be increasing in population size within the reservoir and that it is one of the more successful species stocked by the Texas Department of Fish and Wildlife. This species is also extremely popular among recreational fishermen and results of the creel survey indicated that this species is commonly captured in the reservoir.

Bluegill Sunfish

Hellier et al. (1987) found that this species encompassed over 40 percent of all species abundance during their survey of the SCR fisheries. As a dominant species as well as a littoral species, the apparent abundance of this species creates potential for impingement of adults, juveniles and larvae; and entrainment of larvae appears to be a likely occurrence.

4.5 LIFE HISTORIES FOR REPRESENTATIVE IMPORTANT SPECIES (RIS)

The following life histories for the identified RISs are presented for a general overview and do not represent a exhaustive search of the scientific literature; rather, these summaries provide the general ecology, reproductive biology/fecundity and developmental biology for evaluation of susceptibility to the CPSES CWS.

4.5.1 Largemouth Bass (*Micropterus salmoides*, Rafinesque)

Species Description

The largemouth bass is a principal warmwater predatory fish in the United States and is, therefore, considered to be of ecological importance (Heidinger, 1975). The largemouth bass is a moderately large fish, its body less laterally compressed, but deeper, than a smallmouth bass. The two dorsal fins are joined, but easily distinguished from each other. The first dorsal fin is rather low, tapering in the front and rear, with ten stout spines. The last spine appears to be part of the second fin. The second dorsal fin is higher, having 12 to 14 rounded rays. The caudal fin is broad, shallow forked with rounded tips. The anal fin is shorter than second dorsal fin, typically having 1 to 12 (usually 11) soft, rounded rays. Three spines are usually present on the anal fin. The pelvic and pectoral fins are also short rounded rays, with the pelvic fin typically consisting of one spine and five short rays, and the pectoral fins consisting of 13 to 15 rays. The mouth is large and wide, with the lower jaw slightly longer than the upper jaw. The gape reaches to the middle of the eye. Fine brushlike teeth are present on both jaws (Scott and Crossman, 1973).

The head and dorsal aspect of an adult largemouth bass are bright green to olive. The sides are almost as dark, to lighter green or golden green. The ventral surface is milk-white to yellow. A pronounced wide, solid black lateral band, which sometimes continues across the operculum through the eye to the snout, is particularly prevalent in the young. The band is sometimes broken or inconspicuous to absent in adults. The sides of the head are olive to golden green with scattered black pigment. Eyes are typically brownish and the inside of the mouth is milk-white. Dorsal and caudal fins can be opaque, or green to olive. Anal and pelvic fins are also green to olive with some white, while pectoral fins are amber to clear (Scott and Crossman, 1973).

Range and Habitat

Largemouth bass have been introduced throughout most of the United States and the extreme southern parts of Canada. Largemouth bass can inhabit clear, vegetated freshwater natural and manmade impoundments, including lakes, ponds, swamps, and backwaters and pools of streams and small to large rivers (Page and Burr, 1991). It prefers nonflowing waters which contain aquatic vegetation (Emig, 1966). The bass' native range includes St. Lawrence-Great Lakes, Hudson Bay and Mississippi River basins, southern Quebec, Canada to Maine and south to Gulf drainages within southern Florida and northern Mexico. The eastern section of its range includes Atlantic drainageways from North Carolina to Florida (Page and Burr, 1991).

Significance of Fishery

Like the hybrid striped bass, largemouth bass are a major predator in the reservoir, and an important sport fish. Young-of-the-year are present within the reservoir, which implies that, unlike the hybrid stripe bass, the largemouth bass are reproducing rather successfully in the reservoir. Hellier et al. (1987) collected very few fish older than young-of-the-year during their preoperational monitoring program. From these data, Hellier et al. concluded that there was a "bottleneck" in recruitment to age class I and hypothesized that it is being caused by feeding competition with other young-of-the-year fish species and adult bullheads and channel catfish.

Spawning and Fecundity

Preparatory to spawning, males select a nest site within the littoral zone in water 0.33 to 1.33 m deep. Nests are often constructed to take advantage of protection offered by rocks, stumps or slopes, and are typically spaced 2 to 9 meters apart (Heidinger, 1975; Scott and Crossman, 1973). Spawning grounds vary from gravelly sand to marl, and soft muck in reed, bulrush, and water lilies (Scott and Crossman, 1973). Actual nests assume an almost circular shape with a diameter approximately two times the length of the bass (Heidinger, 1975). Nests are usually 2.5 to 20 cm deep (Scott and Crossman, 1973). Generally, nests built on hard substrate are shallower than those built on soft substrate.

Males begin preparing a nest several days before water temperatures reach 17.7°C. Ideal water temperatures for spawning activities range from 15°C to 25°C (Heidinger, 1975; Scott and Crossman, 1973) Due to critical spawning temperatures, largemouth bass typically spawn in late spring to midsummer, May to July, with peak spawning occurring in early to mid June (Lippson and Moran, 1974). In waters containing largemouth and smallmouth bass, the largemouth bass will spawn earlier, since largemouth bass spawning sites, located in shallower waters, warm to optimum temperatures sooner than the deeper rockier sites used by the smallmouth bass (Heidinger, 1975).

Males actively guard the nest from predators until the pre-larvae leave the nest. Males may guard the pre-larvae for several weeks after hatching (Heidinger, 1975). Multiple females may spawn in nests of several males (Heidinger, 1975; Scott and Crossman, 1973). The number of eggs per female varies with her size and weight. Egg numbers average from 2,000 to 109,314 per female, or 2,000 to 7,000 per pound of female (Scott and Crossman, 1973; Emig, 1966). The number of pre-larvae resulting from a single nest ranges from 751 to 11,457 with an average of 500 to 7000.

Early Life History and Development

Fertile largemouth bass eggs range in size from 1.4 to 1.8 mm and are amber to pale yellow in color. The eggs are spherical, with a thick membrane, and a single large oil gobule (Lippson and Moran, 1974; Scott and Crossman, 1973). As the water temperature increases, the number of hours required for the eggs to hatch decreases. For example, at 10°C, 317 hours are required for the eggs to hatch; at 18°C, 55 hours are required; and at 28°C, 49 hours are required. When the eggs first hatch, the pre-larvae obtain all their nutrients from the yolk sac. Pre-larval fish remain in the nest until the yoke sac is dissolved. The male bass continue to protect the pre-larval fish until they leave the nest (Lippson and Moran, 1974; Heidinger, 1975). Kramer and Smith (In Emig, 1966) studies of early life history of largemouth bass in Lake George, Minnesota, found that eggs were hatching in three to four days, with complete yolk sac absorption occurring in two days. The pre-larvae fry remained in the nest an additional five to eight days before rising and beginning to feed. The fry remained over or near the nest site for an additional four to five days, and were continued to be guarded by the male.

Hatchlings are transparent and range from 2.7 to 5.5 mm in total length (TL) (Lippson and Moran, 1974; Heidinger, 1975). The pre-larvae remain in the nest until they are approximately 5.9 to 6.3 mm TL. At that point, they leave the nest and form broods, or schools, for up to 31 days. Growth is rapid in the first year. Data collected in Lake Powell, Utah showed that fry grow most rapidly prior to August (Miller and Kramer, 1971), slowing through the latter parts of summer. By October, TL of post-larval fry may range from 51 to 127 mm (Scott and Crossman, 1973). Availability of food and water temperature affect the rate of growth for the largemouth bass. During the first growth season, young-of-the-year subsist entirely on zooplankton. Larger young-of-the-year, 20 mm TL or greater, will eat crustaceans and smaller fish (Miller and Kramer, 1971). At this stage, invertebrates comprised greater than 60 percent of the diet of the young-of-the-year.

Life History - Adults

Adult largemouth bass inhabit the littoral zones of warm, freshwater impounds including small shallow lakes, shallow bays of large lakes, and more rarely, larger slow moving rivers. Nonflowing waters which contain aquatic vegetation are preferred by largemouth bass (Emig, 1966). Bass are almost universally found in association with soft bottoms, stumps, and extensive growths of a variety of emergent and submergent vegetation, particularly water lilies, cattails, and various species of pondweed. Preferred water temperature ranges from 26.6°C to 27.7°C (Emig, 1966), and dissolved oxygen concentrations must be greater than 1.5 ppm.

Sexual maturity in largemouth bass is more related to size of fish than age. Female bass reach maturity when approximately 254 mm TL; males may be mature at a somewhat smaller size (Heidinger, 1975). Longer growing seasons in southern United States may result in bass

spawning before their second year. Successful spawning at age one has been reported from Alabama (Swingle and Smith, 1950 In Emig, 1966), Florida (Clugston, 1964 In Emig, 1966), Kentucky (Morgan, 1958 In Emig, 1966), and California (LaFaunce et al., 1964 In Emig, 1966).

Adult largemouth bass are largely fish-eating predators, but food type changes with fish size. Additional food sources include plankton, insects, fish, crayfish, and frogs. Bass are sight feeders, and often feed in small schools near the shore, usually close to vegetation. Feeding is restricted at water temperatures below 10°C, and decreases in winter and during spawning. Largemouth bass are usually surface feeders in the morning and evening, and feed along the substrate and in the water mass during the day.

Longevity of largemouth bass is greater in the northern regions of the United States (Heidinger, 1975; Bryant and Houser, 1971). Fifteen-year-old bass have been recorded in Wisconsin (Carlander, 1973 In Heidinger, 1975). In Louisiana, 11-year-old bass were observed; 6-year-old males, and 9-year-old females in Alabama; 6-year-old bass in Arkansas, and 8-year old bass in Missouri (Heidinger, 1975). The approximate life span of largemouth bass in northern United States is 14 to 16 years, while in southern and central United States, the life span is 9 to 12 years (Bennett, 1970). As the year-class becomes older, the number of male bass decreases (Heidinger, 1975). Natural mortality rates of largemouth bass were studied at Ridge Lake, Illinois for a period of 22 years (Bennett, 1970). Natural mortality of 1 to 3-year-old fish was determined to be 33.0 percent; 3-5 years was 13.4 percent; 5-6 was 14.6 percent; 7-8 was 39.0 percent; and more than 8 years 72.9 percent. The study shows that the natural mortality rate of largemouth bass is high for juvenile fish, 1-3 years, decreases and remains fairly constant for fish ages 3 to 6, the rate once again increases at 7-8 years, and at more than 8 years the mortality rate drastically increases. The drastic increase in mortality at 8 years and greater is expected, since the approximately life span of largemouth bass is 9 to 12 years in central United States.

4.5.2 Freshwater Drum (*Aplodinotus grunniens*, Rafinesque)

Species Description

This species is the only species of the family Scaenidae which is entirely freshwater in habit. Most other members of this family (e.g., black and red drums, weakfish) are coastal marine species. The body of the freshwater drum is laterally compressed with the anterior, dorsal outline forming a steep arc to the first of two dorsal fins. The upper snout slightly extends beyond the lower mandible forming a subterminal mouth (Scott and Crossman, 1973). The upper and lower jaws are armed with several rows of short blunt teeth. The pharyngeal teeth are well developed and heavy and armed with small crushing teeth (Scott and Crossman, 1973). The body is covered by catenoid scales. Large, catenoid scales are present on the top of the head, operculum and opercular cheek areas (Trautman, 1957).

The lateral line is arched and extends along the midpoint of the body from the base of the upper operculum to the end of the caudal peduncle. Scales in lateral series number 48 to 53 (Scott and Crossman, 1973). Although sometimes difficult to observe, the lateral line extends from the edge of the caudal muscles across the caudal fin (Page and Burr, 1991). There are two dorsal fins present, the first being short in length and consisting of eight to nine rays armed with sharp spines. The second dorsal fin is elongated, extending to the caudal peduncle and consists of 25 to 33 soft, branched rays with the first being armed by a single spine (Scott and Crossman, 1973). The caudal fin is not forked and is distinctly rounded in outline. The anal fin consists of two spines (before the rays), the second greatly enlarged and followed by seven soft branched rays. The pectoral fins consist of 17 branched rays with the first ray forming an extension into a narrow filament (Scott and Crossman, 1973). Like other members of the drum family, this species produces a low-pitched grunt similar to a drum strike during spawning or if threatened (McClane, 1974).

Overall coloration of adults consists of a silvery body with a dark green to olive-brown back fading to largely silvery sides. The belly is mostly white with the pelvic fins being white to cream in color and the remaining fins being dusky brown in color (Scott and Crossman, 1973).

Range and Habitat

The freshwater drum has one of the widest latitudinal ranges of freshwater fish in North America (Page and Burr, 1991). The native range for this species extends east of the Rocky Mountains to the St. Lawrence-Great Lakes and Hudson Bay region and south through the Mississippi River basin, throughout the Gulf drainages and north throughout the Atlantic drainages to southern Quebec (Page and Burr, 1991).

A species of large to medium sized rivers and large lakes and reservoirs, this species prefers deep water habitats of pools and washes in rivers and deeper basins of lentic habitats (Page and Burr, 1991; McClane, 1974).

Significance in Fishery

Although the creel census of the Squaw Creek anglers revealed that drum are commonly captured, the capture of drum was inadvertent to the pursuit of game fish species (e.g., largemouth bass, channel catfish, etc.). Although the eggs and larvae are subject to predation, the large size which the adults attain renders them inaccessible to predatory game fish species. The ability to extensively and successfully feed on shelled mollusks, and the overall generally omnivorous diet of this species provides an important trophic link between the benthic community and detrital pathway to higher trophic levels with respect to energy flow in the Squaw Creek food web. Additionally, this species possesses a planktonic egg and larvae which are susceptible to entrainment by the CPSES CWS.

Spawning and Fecundity

Surprisingly, very few details are known about the spawning habitat and habits of this species in comparison to other fish species. Populations from the Ohio River basin and Lake Erie have been studied to determine these characteristics by Trautman (1957) and Daiber (1953). During the period of July through September populations from these water bodies were observed to enter into the mouths of large rivers where spawning presumably takes place. Spawning within the open water column is also presumed to occur (Daiber, 1953). Spawning is in open water and no nests are constructed or defended. The "drumming" sound commonly associated with this species is the result of constriction of the protracted swim bladder by attached muscles and is believed to be associated with spawning (Scott and Crossman, 1973). Spawning within the water column has been documented over varying depths and substrates.

Daiber (1953) in his study of Lake Erie populations estimated the number of eggs in the ovaries of nine females. The range in the number of eggs per female was 43,000 to 508,000 eggs per female. The remaining seven individuals were found to contain between 209,000 to 341,000 eggs per individual.

Early Life History and Development

As stated previously, the life history characteristics of eggs and larvae are limited in geographic range to populations in the Ohio River drainage and Lake Erie. The egg of the freshwater drum is unique for freshwater species in that the egg is highly buoyant and is commonly collected at the surface of the water body. This planktonic existence renders the eggs highly susceptible to surface currents and prevailing winds. Daiber (1953) described the extruded eggs as 1.15 to 1.17 mm in diameter and possessing a large oil globule 0.64 to 0.72 mm in diameter. Hatching of fertilized eggs is estimated to be 25-30 hours at 22°C (Scott and Crossman, 1973). Like the eggs, the newly hatched prelarvae remain pelagic, floating at or near the water surface (Page and Burr, 1991). The Tennessee Valley Authority (TVA) described the prelarvae of this species from the Tennessee River as being approximately 3.5 mm TL at hatching (TVA, 1976). The large oil globule is still identifiable in the yolk sac and probably provides the highly buoyant characteristic of the prelarvae. Following absorption of the yolk sac, the larvae apparently become largely dermersal and remain in deeper portions of the water body. Fish (1932) described the characteristics of post-larvae drum collected from Lake Erie. The two stages described were a 13.3 mm and 15.6 mm individual, both collected from a depth of 17 m from Lake Erie. Both stages were opaque in coloration, although Fish noted that the larger stage did have scattered chromatophores present on the body. Beyond these descriptions, the characteristics of maturation of post-larvae to juvenile is not well documented. Scott and Crossman (1973) state that the diet of larvae consists of mostly zooplankton and chironomids; young drum (to 30 mm) eat entromostracans and benthic macroinvertebrates (e.g., mayflies, amphipods and chironomids). As drum grow, the occurrence of larger prey items (e.g., crayfish

and small fish) become increasingly important in the diet (Scott and Crossman, 1973). Juvenile drum probably become more benthic oriented with regard to habitats and feeding habits.

Adults - Life History

Adult freshwater drum are highly benthic oriented in habitats and feeding habits. Adults may occur in the deepest portions of a river pools and reservoir basins. Adults also move into shallow areas for feeding. Although adult may form small schools of individuals, the freshwater drum appears to be largely solitary in occurrence outside of spawning. Large numbers of individuals have been reported in the outlets of river apparently for spawning (Scott and Crossman, 1973). Although the rate of growth is rapid in the first year, growth slows considerably after the first year and the drum appears to be long lived. Edsall (1967 In Scott and Crossman 1973) in studying length/age and weight/age distributions in Lake Erie populations found the oldest individuals to be 12 years. For this population, mean total length of age (in years) I, III, V, VII, and VIV was determined to be 13.0 cm (5.1 in.), 25.7 cm (10.1 in.), 33.0 cm (13.0 in.), 38.8 cm (15.3 in.), and 42.4 cm (16.7 in.). Corresponding mean weights were 25.5, 189.9, 388.4, 585.0, and 805.0 grams. It is assumed that this species grows faster and attains larger sizes in more southern areas of its range. Hellier et al. (1987) reported a size range of 33.0 to 83.8 cm TL for adult drum in SCR during preoperational monitoring of the fisheries. Average weight of individuals collected from the reservoir was 2.5 kg. Scott and Crossman (1973) stated that very old individuals of this species can attain weights of 7.7 to 10.9 kg (17 to 24 lbs.).

Daiber (1952) studied the feeding habits and diet of adult freshwater drum in Lake Erie. In general, adult drum are benthic feeders consuming a variety of prey items collected from the bottom. The highly developed pharyngeal teeth of this species are very adaptive to the crushing of mollusk shells (e.g., snails and mussels). Although mollusks can represent a substantial portion of the diet in this species, this prey item appears to be more dominant in river populations than in lentic populations (Scott and Crossman, 1973). Other diet items include benthic macroinvertebrates (e.g., mayfly nymphs, crayfish, amphipods) and small fish. Daiber (1952) reported that darters and lake emerald shiners were a dominant food item in Lake Erie populations. No stomach analysis data are available for the drum population in SCR.

4.5.3 Inland Silverside (*Menidia beryllina*, Cope)

Species Description

As is common to other members of this genus, this species has a short, narrow body characterized by a narrow silver stripe extending from the operculum down to the edge of the caudal fin approximately at the midpoint of the body. The two dorsal fins are set back on the body and widely separated (Page and Burr, 1990; Bigelow and Schroeder, 1953). The first

dorsal fin is smaller than the second and consists of four rays armed with small spines. The first dorsal fin originates in front of the origin of the anal fin. The anal fin in this species is much shorter than other silverside species with anal rays numbering 16-18 (Page and Burr, 1990). Coloration of the back and upper sides is yellow-green giving way to a silvery-yellow coloration along the sides above and below the longitudinal silver stripe. Lateral scales in series number 36 to 44 in number (Page and Burr, 1990). Adults can range in size from 69 to 125 mm TL (Coorey et al., 1985; Simmons 1957). Hellier et al. (1987) reported the size of inland silversides collected from Squaw Creek to range from 76 to 100 mm.

Range and Habitat

The native range for this species extends along the Atlantic and Gulf slopes from Massachusetts to the Rio Grande drainage, from Texas to southeast New Mexico. It is found in the Mississippi drainage, extending into southern Illinois and eastern Oklahoma (Page and Burr, 1990).

The inland silverside is a euryhaline species largely occurring in coastal river drainages and marshes. Landlocked populations have been successfully established in freshwater impoundments where it has been introduced as a forage species for game fish (Page and Burr 1990). Successful landlocked populations have been established in Texas and other southwestern states (Simmons, 1957; Gunter, 1945).

Significance in Fishery

No stocking records for this species are present for the period of 1979-1990 for introduction into Squaw Creek Reservoir. The relatively small size of this species makes it highly vulnerable to predation by larger predatory species. Its introduction may have been via the supplemental inflow pipeline, from Lake Granbury populations. The inland silverside is a forage species for larger predatory species (i.e., largemouth bass, stripedxwhite bass hybrids, white crappie, etc.) within SCR.

Spawning and Fecundity

Although the inland silverside is a euryhaline species which typically spawns in estuaries and marine environments (Coorey, Able and Shisler, 1985), successful spawning of landlocked populations have been documented. Hubbs (1982) conducted a detailed study of a population in Lake Texoma, Texas. Hubbs found spawning took place between the hours of 0900-1000 hr each morning from March through July at temperatures ranging from 13 to 34°C. In Lake Texoma, males preceded females in spawning areas. No nests are built or defended and spawning typically occurs in the water column. Spawning grounds for this species in both freshwater and estuarine habitats are commonly restricted to shallow water habitats with sandy substrates and an abundance of submerged leaves, branches or roots.

The inland silverside is a prolific spawner with fecundity and multiple clutches appearing to be size related and repeat spawners being common (Weinstein, 1986). Hubbs (1982) reported fecundity values of 225 eggs/day for a 50 mm standard length (SL) female, 665 eggs/day for a 70 mm SL female and 1,700 eggs/day for a 90 mm SL female in Lake Texoma. Hubbs predicted a lifetime fecundity estimate (assuming a 90 day spawning period and a one year life span) may approach 20,000 to 170,000 eggs per female.

Early Life History and Development

Following extrusion and fertilization, eggs range in size from 0.75-0.87 mm in diameter and are characterized by a single enlarged adhesive thread accompanied by five smaller and finer threads. Eggs sink and become dermersal or become attached (via egg filaments) to submerged debris (Lippson and Moran, 1974). Hubbs et al. (1971 In Weinstein, 1986) found eggs to successfully develop at incubation temperatures between 17 and 34.0°C.

At hatching pre-larvae are 3.5-4.0 mm TL. Growth of larvae is rapid with post-larvae stage ranging in size from 4.7-12.0 mm (Lippson and Moran, 1974). In Lake Texoma, Mense (1967) found that average growth rate for developing larvae was approximately 0.79 mm/day. The late post-larvae and early juvenile stages are poorly defined and many researchers have subjectively applied a range of 36-41 mm as an arbitrary division point (Coorey, Able and Shisler, 1985; Weinstein, 1986). In general, post-larvae and juveniles are commonly associated with shallow water habitats, including shallow pools and backwaters with submerged aquatic vegetation, although habitat characteristics do broadly overlap with those of adults. Diet characteristics of post-larvae and juveniles appear to be similar with rotifers and smaller species of copepods consisting of 56-88 percent of the diet (Weinstein, 1986).

Life History - Adults

Adult and late juvenile stage fish form dense schools and become largely pelagic in existence with schools moving between deeper pelagic habitats and shallow littoral areas commonly associated with submerged aquatic vegetation (Hubbs et al.1971 In Weinstein 1986). Although this species may be encountered in deeper areas, the large schools are commonly found moving around near the surface. In Lake Texoma, Hubbs et al. (1971 In Weinstein 1986) found this species to be common in shallow areas during the spawning season and schools moved offshore following spawning activity. Their occurrence is highly correlated with hard bottom substrates (particularly sand) (Weinstein, 1986). Inland silversides are short lived with few individuals surviving to year II (Hubbs, 1982; Bigelow and Schroeder, 1953). The presence of only a few year II adults resulted in Hubbs et al. (1971 In Weinstein 1986) describing this species as an annual fish in Lake Texoma. Hubbs (1982) determined a weekly mortality rate of 19 percent for the population in Lake Texoma. High predation rates especially during the spawning season was assumed to be the major influence in the observed mortality rate.

Adult inland silversides may be characterized as daytime predators that primarily locate prey by sight (Weinstein, 1986). Diets of adults consist largely of zooplankton, emerging aquatic insects (adults and larvae) and some benthic organisms and algae. Coorey, Able and Shisler (1985) found that adults fed largely upon copepods, insect larvae and emerging adult insects, rotifers and algae. Presence of large amounts of detritus in individuals does suggest that some benthic feeding may occur (Weinstein, 1986; Coorey, Able and Shisler, 1985). Hellier et al. (1987) in an evaluation of the fisheries of SCR, found *Menidia* sp. represented less than 1 percent of the total catch using various collection methodologies. Hellier et al. did state that the sampling methodologies employed may have underestimated pelagic species such as the inland silverside in the reservoir.

4.5.4 Threadfin Shad (*Dorosoma petenense*, Gunther)

Species Description

Adults are similar to gizzard shad except in the snout and lower jaw length, coloration of the back and the pectoral, anal and ventral fins, and the presence of a dark spot on the body near the operculum in adults. The head is not bluntly rounded anteriorly, the mouth is terminal with lower jaw projecting slightly beyond the snout. Adults possess minute teeth in both the lower and upper jaw (Thompson, 1985; Page and Burr, 1990). The last ray of the dorsal fin is elongated into a thin thread-like projection. Adult coloration consists of a yellowish hue along the upper sides and back and the remaining body surface is silvery white with a yellow or violet iridescent reflection (Thompson, 1985). With the exception of the dorsal fin, the pectorals, anal and ventral fins are flushed with yellow (Thompson, 1985). The lateral line is not developed and scales in lateral series number 40-48 (Page and Burr, 1990). The dorsal fin consists of 11-14 rays and the anal fin consists of 17-27 rays in mature adults (Page and Burr, 1991). Average size of adults range 10.2-12.7 cm (4-5 inches) although some adults can reach up to 22.9 cm (9 inches) (Page and Burr, 1990; Thompson, 1985). Hellier et al. (1987) collected individuals of this species ranging in size from 7.6-10.1 cm (3-4 inches) in Squaw Creek Reservior. Adults commonly have a black to purple shoulder spot near the upper edge of the gill cover (Page and Burr, 1990; Thompson, 1985). Juvenile gizzard shad possess a similar spot although this commonly fades as the fish matures into an adult.

Range and Habitat

The native range of this species occurs largely in the southcentral-southeastern area of North America. The species range extends from the Ohio River drainage in Illinois and Indiana, extending south along the Mississippi River basin from southern Illinois to the Gulf of Mexico. The range extends east along the Gulf and Atlantic drainages of central Florida (Page and Burr, 1990).

The threadfin shad is a euryhaline species which occurs in a wide variety of habitats including marine habitats, coastal river drainages, freshwater impoundments and portions of brackish water estuaries. Unlike gizzard shad, this species prefers waters with a slight current. Being attracted to currents, threadfin shad frequently concentrate below dams and inlets and in circular eddies (Burns, 1966). This species has been widely introduced outside its native range into freshwater impoundments as a forage species for game fish, and has been successfully introduced into impoundments in California, Arizona and New Mexico (Burns, 1966). It is highly sensitive to low temperatures, and mass mortality of individuals at temperatures as low as 7.3°C has been documented (Parsons and Kimsey, 1954 In Burns, 1966).

Significance in Fishery

The prolific reproductive nature of the threadfin and rapid maturity promote the use of this species as forage base for game fish species. Additionally, the tolerance of this species to high water temperatures in its native range make it a highly desirable forage species for introduction into impoundments in arid environments. The small size of this species makes it highly vulnerable to predation by a variety of game fish including striped bass, largemouth bass, walleye, white bass, white crappie and others (Burns, 1966). Threadfin shad made up 82.2 percent of the diet of largemouth bass 15 to 25 cm TL and 66.5 percent of the diet of larger individuals in Pine Flat Lake Arizona (Goodson, 1965 In Burns, 1966). A less desirable characteristic is that the planktonic diet of larvae, juvenile and adult threadfin shad directly competes with young-of-the-year game fish species (Guest et al., 1990). In 1982, 12,000 individuals of this species were stocked in Squaw Creek Reservoir (Texas Dept. of Fish and Wildlife, unpublished). In the Squaw Creek ecosystem, this species functions as a forage species for larger game fish species in the food web (Hellier et al., 1987).

Spawning and Fecundity

Threadfin shad spawn in fresh water from mid-March through mid-August in lakes, large rivers and ponds (Burns, 1966; Lippson and Moran, 1974). Microhabitat characteristics of the spawning areas are not well documented nor defined. In well established populations, spawning occurs near the surface in shallow waters over algal mats or submerged vegetation (Lippson and Moran, 1974). No nests are constructed and eggs/larvae are not defended by adults. Temperature appears to be the determining factor in initiating spawning activity. Spawning occurs at 20°C (Thompson, 1985).

Fecundity for 10.2 cm threadfin shad range 6,700 to 12,400 eggs/female (Burns, 1966).

Early Life History and Development

Following extrusion and fertilization, eggs are 1.0 mm in diameter, creamy-yellow in coloration and are adhesive (Mansueti and Hardy, Jr., 1967; Burns, 1966). Eggs gradually sink in the water column and become largely dermersal or may remain suspended at a depth where the water equals their density (Burns, 1966). The incubation period for eggs at 27°C is approximately 72 hours and average length of pre-larvae (yolk-sac larvae) at hatching is 4.0 mm total length (TL) (Mansueti and Hardy, Jr., 1967; Kimsey, 1958 In Burns, 1966). The yolk sac is absorbed in approximately 72 hours after which the larvae begin to actively feed on planktonic organisms, especially microcrustaceans (Burns, 1966).

Post-larvae range in size from 8.2 to 17.4 mm TL (Lippson and Moran, 1974). Juveniles range in size from 25.0 to 38.1 mm TL. Growth of threadfin shad is rapid. Kimsey et al. (1958 In Burns, 1966) reported a growth rate of up to 2.54 cm per month. Larvae and juveniles occur throughout the water column although there appears to be a preference for shallow water vegetated by submerged aquatic vegetation (SAV). Such SAV areas appear to provide important nursery habitat for threadfin shad larvae and other species in southeastern lakes (Conrow et al., 1990). In the fall, juveniles and young adults form dense schools and move into open water where juveniles mature.

Feeding by pre-larvae threadfin shad commences after the third day and the diet consists largely of protozoans, rotifers and entomostracans. The diet of post-larvae and juveniles includes larger planktonic crustaseans (i.e., cladocerans, copepods) (Burns, 1966). Unlike juvenile gizzard shad, the diet of juvenile threadfin shad does not shift dramatically to benthic food items. Rather, as the juveniles mature, the diet includes ingestion of larger zooplankton species (Burns, 1966).

Life History - Adults

Threadfin shad typically mature during the first year ranging in size from 4.5 to 8.6 cm (Smith 1979; Kimsey, 1958 In Burns, 1966). It is common for first year fish to spawn the during the fall on the lowering temperature around 20 °C (Smith, 1979). Young adults form large schools and move off shore to lead a largely pelagic existence. Schools consisting of both juveniles and adults move from deeper open water habitats into shallow water areas sporadically during the non-breeding season for feeding. Adult threadfin shad are largely planktivores with diets comprised of both phytoplankton and zooplankton species. In adults examined from a variety of southwest impoundments, planktonic organisms comprised 50-100 percent of the diet (Burns, 1966). Large schools of threadfin shad congregate in shallow surface waters for spawning during the period of mid-March through mid-August and following spawning move back out into open water. Life span for adults is typically short (1 to 2 years), largely because of predation pressure by game fish species (Kimsey, 1958 In Burns, 1966). Hellier et al. (1987) found that threadfin shad represented less than 1 percent of the total number of individuals sampled for all

species. The aforementioned investigators did state that sampling methodologies employed may underestimate pelagic species such as the threadfin shad.

4.5.5 Gizzard Shad (*Dorosoma cepedianum*, LeSueur)

Species Description

Adults are characterized by a head bluntly rounded anteriorly, a subterminal mouth with the snout projecting over the lower jaw. Adults lack teeth in both the lower and upper jaw (Thompson, 1985; Scott and Crossman, 1973). The large silvery scales extend to the base of the forked caudal fin. Like the threadfin shad, the last ray of dorsal fin is elongated into a thin thread-like projection. Adult coloration consists of a deep slate gray or blue green along the upper sides and back and the remaining body surface is silvery white with a yellow or violet iridescent reflection (Thompson, 1985). The lateral line is not developed and scales in lateral series number 52-70 (Scott and Crossman, 1973). The dorsal fin consists of 10-13 rays and the anal fin consists of 25-36 rays in mature adults (Page and Burr, 1991; Scott and Crossman, 1973). Average size of adults range 22.9-35.6 cm (9-14 inches) total length (TL) (Thompson, 1985, Scott and Crossman, 1973). In Squaw Creek Reservior, Hellier, Jr. et al. (1987) collected individuals of this species ranging in size from 7.6 to 43.2 cm (3 to 17 inches) TL. The thick walled, elongated muscular structure of the stomach of this species resulted in the common name of "gizzard" shad (Thompson, 1985).

Range and Habitat

This species occurs across a wide geographic range in North America; it extends from the St. Lawrence-Great Lakes drainage, west to central North Dakota, south along the Mississippi River drainage extending west into New Mexico and Mexico. From this western boundary, the species range extends east along the Gulf coast drainages to central Florida and north along Atlantic coast drainages into Ontario, Canada (Thompson, 1985).

The gizzard shad occurs in a wide variety of habitats including coastal river drainages, freshwater impoundments and portions of brackish water estuaries. It is most common in deep pools of river drainages and deep open water impoundments. This species has been successfully introduced into impoundments outside its native range (Page and Burr, 1991).

Significance in Fishery

The herbivorous diet of adult gizzard shad make this species a very significant link in the fishery food web. The significance is related to the exclusive diet of aquatic algae and plant material of gizzard shad which provides a direct link of this energy resource to higher trophic level (predatory) species. The diet composition of larvae and juvenile gizzard shad does not appear

to directly compete with young-of-the-year game fish species (Guest et al., 1990). The wide geographic distribution of this species and broad range of environmental tolerances promotes its introduction into impoundments as a forage species for supporting sport fisheries. The large size of adults however, limit their value as forage fish to only the largest individuals of most predatory species (Scott and Crossman, 1973). In Squaw Creek Reservior this species is not sought as a gamefish species and largely functions as a forage species for larger predatory game fish species.

Spawning and Fecundity

Gizzard shad spawn in fresh water from mid-March through mid-August in lakes, large rivers and ponds (Scott and Crossman, 1973). Microhabitat characteristics of the spawning areas are not well documented nor defined. In well established populations, spawning occurs near the surface in shallow waters over a variety of substrates but may occur at the surface over 15 m of water (Jester and Jensen, 1972). Observations from Lake Erie populations have documented spawning occurring over a sand and gravel bar in 0.6-1.2 m of water (Bodola, 1966) and over shallow silt beds in 0.3-1.8 m of water (Jester, 1962). Considered a pelagic spawner, adults do not construct nests and eggs/larvae are not defended by adults. Temperature appears to be the determining factor in initiating spawning activity (Scott and Crossman, 1973). In observed populations, spawning occurs between 10 and 21°C on both rising and falling temperatures and is most intense at temperatures above 18°C (Scott and Crossman, 1973; Mansueti and Hardy, Jr., 1967).

Fecundity for gizzard shad ranges from 22,405 to 543,912 eggs/female and averages 59,480 eggs for group I females to 378,990 eggs for group II females (Mansueti and Hardy, Jr., 1967). Older individuals (group III and older groups) display lower fecundity than group I and II individuals. No historical data concerning spawning activity, habitat or timing for Squaw Creek Reservior are available for this species.

Early Life History and Development

Following extrusion and fertilization, eggs are 0.75 mm in diameter, creamy-yellow in coloration and are highly adhesive (Mansueti and Hardy, Jr., 1967). Eggs gradually sink in the water column and become largely dermersal. The incubation period for eggs at 27°C is approximately 36 hours and average length of pre-larvae (yolk-sac larvae) at hatching is 3.25 mm total length (TL) (Mansueti and Hardy, Jr., 1967).

Post-larvae range in size from 10.8-30.0 mm TL. Juveniles range in size from 35-114 mm TL and have well developed caudal and dorsal fins. During the juvenile stage of development, the number of gill rakers increases dramatically (up to 350 rakers per gill arch) providing for an increasing diet of detritus and algae (Scott and Crossman, 1973; Mansueti and Hardy, Jr., 1967).

In Lake Erie populations, both larvae and juvenile gizzard shad school in shallow surface waters generally < 5 m deep during the day but avoid areas close to the shoreline. At night, their distribution becomes more randomly dispersed (Bodola, 1966). Larvae and juveniles occur throughout the water column although the preference for shallow water areas vegetated by submerged aquatic vegetation (SAV) in southeastern aquatic habitats is apparent. Such SAV areas appear to provide important nursery habitat for gizzard shad larvae and other species in southeastern lakes (Conrow et al., 1990). Typically juveniles and sub-adults form dense schools (commonly of uniform ages of individuals) and move into open water in the later months of the year where juveniles and sub-adults mature.

Feeding by pre-larvae gizzard shad commences after the fifth day and the diet consists largely of protozoans and microcrustaceans. Larvae up to 22 mm have been found to contain cladocerans, copepods and ostracods (Scott and Crossman, 1973). As larvae develop into juveniles, the number of gill rakers increase substantially and the diet of juveniles begins to shift to benthic food items including filamentous algae, aquatic plants and periphyton (Scott and Crossman, 1973).

Life History - Adults

Juvenile gizzard shad typically mature during the second or third year at 178-279 mm TL, and possibly at 151 mm in TL (Mansueti and Hardy, Jr., 1967). Young adults (Group I) form large schools and move offshore to lead a largely pelagic existence. Schools consisting of either juveniles and sub-adults or adults only move from deeper open water habitats into shallow water areas sporadically during non-breeding seasons for feeding (Scott and, Crossman 1973). Adult gizzard shad are largely herbivorous with the primary diet items consisting of large amounts of microscopic benthic algae, filamentous algae and other aquatic plant material. Large numbers of gizzard shad congregate in shallow surface waters for spawning during the period of mid-March through mid-August and following spawning move back out into open water. Hellier, Jr. et al. (1987) found that gizzard shad represented only 1.59 percent of the total catch for all species during their investigation of the Squaw Creek fishery. The above investigators did state that the sampling methodologies employed in the study may underestimate pelagic species such as the gizzard and threadfin shad.

4.5.6 White Bass (*Morone chrysops*, Rafinesque)

Species Description

This temperate bass species is characterized by a robust, laterally compressed body shape with maximum body depth occurring mid-dorsally. The moderately sized mouth is terminal with the lower jaw slightly protruding beyond the snout. The anterior of the lower jaw extends to the middle of the eye or slightly beyond (Scott and Crossman, 1973). Small, sharp teeth are present

in multiple rows in both the upper and lower jaws with 1 to 2 patches of teeth present on the anterior surface of the tongue (Thompson, 1985; Scott and Crossman, 1973). Body scales are large and catenoid in shape and number 52-60 in lateral series (Scott and Crossman, 1973). The lateral line is well developed. Adult coloration typically is dark greenish-gray on the back fading to a silvery-white on the sides and to white on the belly. The silvery-white coloration of the sides is contrasted by 5-7 horizontal dark stripes running parallel to the dorsum and extending from the operculum to the base of the forked caudal fin. The yellow iris of the eye sharply contrasts with the dark pupil (Scott and Crossman, 1973). Two separate dorsal fins are present; the first possesses 9 rays with spines and the second possesses a single spine on the first of 12-14 branched rays. The anal fin possesses three spines and consists of 12-13 branched rays (Scott and Crossman, 1973). Adults average 20.3 to 25.4 cm (8-10 inches) TL but can attain up to 45 cm (17.5 inches) (Page and Burr, 1990; Thompson, 1985). Individuals sampled from Squaw Creek reservoir range in size from 17.8 to 35.6 cm (7 to 14 inches) TL (Hellier, Jr. et al., 1987).

Range and Distribution

Although largely considered a freshwater species, white bass do occur in oligohaline portions of tidal rivers throughout its range. The species range extends from the St. Lawrence-Great Lakes area south throughout the Mississippi River basin from Quebec and Manitoba, Canada and continues south to Louisiana. The species also occurs in Gulf slope drainages from the Mississippi River in Louisiana west to the Rio Grande River in Texas and New Mexico (Page and Burr, 1990). This species has been widely introduced into freshwater impoundments throughout the southeast and southwest United States (Thompson, 1985; McClane, 1974).

Significance in Fishery

The occurrence of large schools of individuals of this species and a rapid growth rate in southern U.S. impoundments make this species highly prized as a gamefish (Thompson, 1985). Adults are piscivorous, feeding upon forage species including shads, silversides and herring and can be important in controlling population sizes of forage species. This relationship has been well documented with gizzard shad in southwestern and southeastern reservoirs (Chadwick et al., 1966). Data from the creel census conducted during the 316 (b) field work of anglers fishing SCR indicated that white bass are commonly captured. Hellier, Jr. et al. (1987) concluded that relative to other predators such as largemouth bass and channel catfish, the population of white bass present in Squaw Creek reservoir is not large enough to substantially affect forage species populations.

Spawning and Fecundity

The spawning period throughout the range of the white bass extends from April through June at water temperatures ranging from 14.5 to 24°C (Chadwick et al., 1966). Toole (1952) reported that white bass populations in Texas typically spawn in tributaries of impoundments or along wind swept shoals with spawning activity taking place during the period of March - April and maximum reproduction occurs in impoundments with tributaries. Bonn (1953) reported that white bass in Lake Texoma, TX commonly spawn in the lakes, tributaries or along wind-swept shoals of the lake itself. Males and females form large unisexual schools and move from deeper water habitats into shallow areas for spawning. Most fisheries researchers believe white bass require firm substrates (i.e., gravel, riprap, sand) for successful spawning (Chadwick et al., 1966). White bass are pelagic spawners with spawning occurring in water 0.61 to 1.23 m (2 to 4 ft) in depth in shoals along the Lake Texoma shoreline (Chadwick et al., 1966). No nests are constructed, nor are eggs or young defended by adults.

White bass are gregarious during spawning, with males outnumbering females (Chadwick et al., 1966). Females and males release eggs and sperm into the water column, where fertilization occurs. As soon as the fish are spent, they return to deeper water habitats (Chadwick et al. 1966). Fecundity of ripe females varies widely among individuals. In Indiana populations, Riggs (1955 In Scott and Crossman, 1973) reported that the number of eggs per female varied from 242,000 to 933,000 and averaged 565,000 eggs per female. Riggs stated that number of eggs presumably varies directly with the size of the female.

Early Life History and Development

Upon extrusion and fertilization, eggs are 0.8 mm in diameter, heavy and adhesive, and on sinking, become attached to gravel, boulders or submerged debris (Scott and Crossman, 1973). Size of pre-larvae at hatching is approximately 3.5 mm. Post-larvae have been described between the sizes of 3.7-18.5 mm (Fish, 1932 In Scott and Crossman, 1973). Typically, post-larvae and juveniles remain in shallow waters during the summer months and schools of sub-adults and juveniles form and move out into open water in the fall (Scott and Crossman, 1973). Growth of white bass in southern reservoirs is rapid. Young white bass may attain total lengths of 12.7-16.2 cm by the fall of their first year (Scott and Crossman, 1973). This rapid growth rate continues throughout the first three years of life. McClane (1974) gave relative lengths of individuals age 1-6 as 19.0, 30.5, 36.8, 40.6, 43.1 and 45.7 cm for southern waters. Young white bass feed primarily upon crustaceans and aquatic insects (adults and larvae) (Chadwick et al., 1966). As individuals increase in size (i.e., juveniles to adults) fish begin to represent larger percentages of the diet.

Life History - Adults

Adults sexually mature by age 3 in Lake Erie at average total lengths of 27.7 cm (Scott and Crossman, 1973). Young adults and some juveniles form large schools in the shallow areas where they were spawned and move into open water where they lead a largely pelagic existence. Adults form schools that are commonly seen near the surface and are largely considered as sight predators (Chadwick et al., 1966). Large schools may sporadically move in and out of shallow water in pursuit of forage fish species but typically prefer deeper open water habitats. Adults are entirely predaceous, feeding largely upon smaller forage species. In Lake Texoma, TX, Bonn (1953) found that both sub-adults and adults fed primarily on gizzard shad with other forage species also occasionally taken. Other forage species in the lake which were also taken by white bass included threadfin shad and inland silversides. Large schools of white bass congregate in shallow waters over suitable spawning habitats for extended periods but spent individuals move back out into deeper open water areas following spawning.

White bass are relatively short lived when compared to other predatory gamefish. Jenkins and Elkin (1957 In Chadwick et al., 1967) found only three percent of white bass sampled in 33 water bodies were more than 3 years old, whereas 1 to 3 year old fish were more abundant in Oklahoma reservoirs. The rapid growth rate and relatively large size of individuals makes this species highly desirable as a gamefish.

4.5.7 Channel Catfish (*Ictalurus punctatus*, Rafinesque)

Species Descriptions

Unlike the closely related bullhead catfishes (*Ameiurus* sp.), the overall body shape of the channel catfish is streamlined with the posterior caudal muscles tapering to the base of deeply forked caudal fin. The head is broad and flattened dorsally with the wide inferior and terminal mouth bordered by a pair of elongated barbels. Four pairs of barbels are present on the lower mouth with each pair increasing in size towards the maxillary joints. A single pair of short barbels are present on the dorsum of the upper jaw (McClane, 1974; Scott and Crossman, 1973). The skin is scaleless and smooth and lacking any roughness associated with scales. The lateral line is complete and is positioned at the approximate midpoint of the side of the body and extends along the entire length of the body (Scott and Crossman, 1973). The dorsal fin is located anterior of the midpoint of the body and consists of six soft rays, with the first ray attached to a stout spine. The anal fin is elongated and triangular in shape with square or rounded edges. The 23-26 soft rays are noticeably elongated near the anterior of the anal fin. The pectoral fins consist of 8-9 soft rays with the first ray attached to a stout spine extending approximately 75 percent of the first soft ray. Like most catfishes, this species commonly displays the defensive behavior of extending and locking the dorsal and pectoral fins and spines if threatened.

Coloration of channel catfish varies among individuals and age groups. This catfish varies in color from bluish or olivaceous-silver along the back and sides, shading to silver-white on the lower sides and belly. Older individuals may be dark blue or black on the back and upper sides shading to silver-whitish color on the lower sides and belly (McClane, 1974). This species may also have scattered black spots along its sides in younger individuals (McClane, 1974). Although the average size of channel catfish ranges from 28.0 to 76.2 cm (11 to 30 inches) TL, this species can attain total lengths of up to 127 cm (50 inches) (Page and Burr, 1991; McClane, 1974).

Range and Habitat

This species has been widely introduced into impoundments and lakes as a gamefish across the United States. It is also intensively farmed in aquaculture industries, especially in the southern United States. The native range of the species extends from the St. Lawrence-Great Lakes area and Hudson Bay drainage to the Mississippi-Missouri River basins from southern Quebec to southern Manitoba and Montana south to the Gulf drainages. The range also extends into the Atlantic drainages of the eastern United States (Page and Burr, 1990).

Significance in Fishery

The channel catfish is one of the few species of catfish which commonly feeds on smaller fishes in addition to benthic fauna and detritus. This predatory/omnivorous diet makes this species highly adaptive to individual prey abundances and an important link as a secondary consumer in the SCR fish community. The large size which this species attains also makes this species an important gamefish for recreational anglers. Results of the creel survey of recreational anglers using the reservoir revealed that channel catfish were commonly captured by individuals fishing the Squaw Creek system.

Spawning and Fecundity

Channel catfish typically spawn during the period of late May through mid-July throughout their range. Spawning in southern impoundments typically occurs earlier than in northern systems (McClane, 1974). The minimum and maximum water temperatures during which spawning has been documented to occur (throughout this species' native range) are 21.8 and 29.7°C (Clemens and Sneed, 1957 In Miller, 1966). The channel catfish is a cavity nester, preferring a submerged cavity for use as a nest to deposit eggs. Nesting cavities may include those formed by submerged snags, submerged boulder or debris piles, submerged buckets or tires. Intensive aquaculture farming commonly employs submerged clay pots as nesting cavities (Miller, 1966). Males select and clean the nest cavity and defend the cavity from other males. The male often secretes and applies mucus to the bottom of the nest prior to the female depositing eggs. Following deposition and fertilization of eggs, the male defends the nest from predators and

cleans and aerates the eggs as they develop (Miller, 1967). Following hatching, the male commonly protects the hatched larvae for several days. Larvae commonly form a dense cluster of individuals protected by the male (McClane, 1974; Miller, 1966). Once the post-larvae begin to actively feed, the male abandons the nest cluster and the young are no longer defended.

Fecundity of the channel catfish has been linked to size (in terms of body mass) of the female. Clemens and Sneed (1957 In Miller, 1966) reported that two to four pound females produce about 4,000 eggs per pound of body weight. Larger fish were reported to produce approximately 3,000 eggs per pound of body weight. If using the two to four pound range for estimating purposes, the fecundity of a female channel catfish within this body mass range would produce 8,000 eggs/female (two pound body mass) to 16,000 eggs/female (four pound body mass). Scott and Crossman (1973) gave fecundity estimates of 4,000 eggs/female for individuals of one to four pounds body mass and 34,500 eggs for a 66.0 cm female.

Early Life History and Development

Upon extrusion and fertilization the demersal eggs are 3.5 to 4.0 mm in diameter, yellowish in coloration and are highly adhesive (Scott and Crossman, 1973; Mansueti and Hardy, Jr., 1967). As the embryo develops, the egg turns a yellow-brownish color and hatching typically occurs in six to nine days at 27.0 to 28.0°C (Mansueti and Hardy, Jr., 1967). Minimum length of pre-larvae at hatching is 6.4 mm TL and duration of the pre-larvae stage is three to six days. Newly hatched pre-larvae are golden yellow in coloration and with growth, the coloration changes to a steel blue as yolk sac is absorbed (Mansueti and Hardy, Jr., 1967). The pre-larvae stage encompasses the size range of 6.4 to approximately 15.0 mm. Pre-larvae typically remain within the nest near the bottom of the cavity until the yolk sac is absorbed and the larvae can move freely in and out of the nesting cavity. The post-larvae stage encompasses the size range of approximately 16 to 30 mm TL and the larvae are steel blue in coloration and possess fully formed barbels and fins. Throughout the early period of the post-larvae stage, individuals remain in a tight cluster being guarded by the male. Post-larvae and juveniles feed near the surface in shallow areas and the diet consists largely of insect larvae (Scott and Crossman, 1973). Feeding by the larvae cluster/juveniles occurs during both day and night. The minimum and maximum size range described for the juvenile stage of development is 32.6 and 257 mm TL (Mansueti and Hardy, Jr., 1967). By the early juvenile stage, the cluster of individuals disperses and the adult male no longer defends the immature fish. Juveniles lose the steel blue coloration of the larvae stage and become lighter in coloration with distinct darkened spots along the entire length of the body. These spots become more apparent in larger juveniles (Mansueti and Hardy, Jr., 1967). The diet of juveniles remains largely aquatic insects (e.g., diptera, trichoptera, ephemeroptera) although aquatic plants, algae and fish eggs become increasingly important in larger juveniles (McClane, 1974; Scott and Crossman, 1973). Growth of channel catfish during the first year is rapid. In Lake Texoma, Texas channel catfish a total length of 13.7 cm TL attained by the first year based on annulus studies.

Life History - Adults

In southern areas of the United States, channel catfish sexually mature by the second to fifth year and in some southern states (e.g., Texas) have been to sexually mature in eighteen months (Scott and Crossman, 1973). Adults are common to cool, deep areas of aquatic habitats and tend to be non-phototrophic in habits. Unlike the closely related bullheads, channel catfish appear to prefer cool, clear deeper waters with sand, gravel or rubble bottoms with little or no submerged vegetation (Scott and Crossman, 1973). In general, adults tend to be solitary outside of the spawning season when competition for nesting cavities may result in aggregations of competing males or spawning adults. In general adults tend to be very local in movement and home range characteristics and may include the entering of fast water into impoundment tributaries (Scott and Crossman, 1973). Increases in movement and feeding activity are usually associated with sunrise and sunset periods. Feeding by adults has been observed to occur during both daylight and night hours. Unlike many other catfish species, this species appears to be highly variable in feeding periods and feeding is probably controlled by abundance of available prey.

The diet of adult channel catfish has been found to be inclusive of a larger percentage of fish than other catfish species (McClane, 1974). The percentage of fish prey appears to be highly variable from population to population and locality. Kimsey et al. (1957 In Miller, 1966) reported that channel catfish consumed in order of abundance pondweed, centrarchids and crayfish in Lake Havasu on the Colorado River. Stevens (1959 In Miller, 1966) reported that fish were the most important prey item found in the stomachs of adult channel catfish in the Santee-Cooper Reservoir, South Carolina. Fish species identified in order of importance included catfish (species not specified), herring, bluegill, eel, gizzard shad, crappie, mullet, hickory shad and yellow perch. Bailey and Harrison (1948 In Miller, 1967) observed that forage fish were heavily consumed by channel catfish during clear conditions in the water column.

Available stocking records for channel catfish in SCR indicate that 17,501 individuals were stocked in 1986. Hellier et al. (1987) in preoperational monitoring of fish populations in Squaw Creek found that channel catfish represented 0.51 percent of the fish captured. The size range of channel catfish collected from the reservoir was 5.08 to 68.5 cm TL. Hellier et al. (1987) based upon their data that the channel catfish population in the reservoir appeared to be healthy and free of any parasites/diseases and appeared to have increased in size from previous investigations.

4.5.8 Bluegill Sunfish (*Lepomis macrochirus*, Rafinesque)

Species Description

The bluegill is the largest member of the group of species collectively known as the freshwater sunfishes. Like other sunfish, the body is deep and compressed laterally, the two dorsal fins are large and are connected by a joining soft ray (Scott and Crossman, 1973). The body shape is distinctly circular with the posterior tail muscles forming a narrow, muscular tail to the caudal fin. The caudal fin is moderately forked with distinctly rounded fin tips. The pectoral fins, anal fin, first dorsal fin and pelvic fins possess one or multiple spines. The mouth is terminal and the lower jaw extends to the anterior of the eye (Scott and Crossman, 1973). Brush-like teeth are present on the jaws and vomer, and pharyngeal teeth are present on the inner mouth of the lower jaw. The first dorsal fin is long and moderately high, with 10-11 spines and 9-10 rays. The second soft dorsal fin is spineless and consists of 10-12 rays and is definitively rounded on the posterior end. The anal fin is long with the first three of 11 rays armed with sharp spines. The upper portion of the operculum is shaped into a distinct narrow lobe, often darkly colored (Scott and Crossman, 1973).

The bluegill is one of the most colorful of sunfish species. The back is either a dark green to almost brown shading into brownish-orange coloration on the sides. The sides are marked by three to four dark vertical bars extending from the back and fading near the belly. The belly is often similar in coloration to the sides, although appearing lighter in overall coloration. As the common name implies, the lower operculum is colored distinctly bluish in tone. The breast portion of the belly beneath the head is yellow to copper-orange in coloration. Coloration of the breast area of the belly and lower operculum is very prominent in males during the spawning season. The narrow lobe located on the upper operculum is often black in color. A large, black spot is often apparent on the second dorsal fin (posterior end). Adults typically average 10.2 to 25.4 cm (4-10 inches) TL although large individuals may reach 38.1 cm (15 inches) TL (Thompson, 1985; McClane, 1974; Scott and Crossman, 1973)

Range and Habitat

The bluegill occurs within a wide range in the United States and tolerates a wide range of environmental conditions. This freshwater species occurs in natural and manmade impoundments including lakes, ponds, reservoirs, rivers and streams. The range of this species extends from the St. Lawrence-Great Lakes and Mississippi River basins from Quebec, Canada and New York to Minnesota and south to the Gulf. The eastern section of the range extends south along the Atlantic and Gulf slope drainages throughout the southern states of Florida, Alabama and Louisiana west to the Rio Grande River basin of Texas and New Mexico (Page and Burr, 1991).

Significance in Fishery

The large size which this panfish species attains and prolific reproductive ability make this species a common catch for many sportsmen. Although not specifically identified as an individual species in the creel census for SCR, the group collectively identified as "sunfish" is inclusive of this species. Sunfish were commonly captured by recreational fishermen utilizing SCR. Younger age fish are common prey for larger predatory species of game fish, especially largemouth bass. In stocking programs for many states, bluegills are commonly stocked as a forage species for largemouth bass in ponds and lakes (Bennett, 1970). Although bluegills can be found in open water habitats of lakes and reservoirs, they are most frequently found in shallow, littoral habitats which are easily fished from shoreline areas.

Spawning and Fecundity

Bluegills spawn during the late spring through early summer (late May - August) throughout their range. In the southern portion of the U.S., Swingle and Smith (1950) documented the beginning of spawning activity for bluegills during the month of April in Alabama populations. Water temperatures during spawning within the range of the bluegill have been from 19.6-26.8°C throughout their range in the U.S. (Emig, 1966). Bluegills are benthic nesters with nesting occurring in water 0.61-1.8 m deep (Emig, 1966). Bluegills are often colonial nesters with upwards of several hundred nests densely crowded in the littoral areas (Swingle and Smith, 1950). Microhabitat characteristics of the nest colonies include sandy or gravel substrates with little or no submerged vegetation. Males arrive before females and excavate an 8-in. diameter nest approximately 5 cm deep in the substrates. The resulting nest is usually excavated to gravel or firmer substrates. Males vigorously defend the nests from other fish species and competing males. Multiple females often mate and deposit eggs in nests of several different males. Following spawning, males defend the nests to hatching and often defend the pro-larvae for several days following hatching (Emig, 1966). Following this short period after hatching, males abandon the nests and the larvae are no longer defended (McClane, 1974).

Fecundity of bluegill varies widely depending on size of the female (Scott and Crossman, 1973). Morgan (1951) gave fecundity estimates for female bluegills of 10.1, 13.3, 18.4, 20.3, and 23.5 cm SL from an Ohio population. The corresponding mean number of eggs for these individuals were 2,540, 10,040, 13,615, 21,891, 29,769 and 49,400 eggs/individual. Mayhew (1956 In Scott and Crossman, 1973) reported a fecundity range of 7,200-38,184 eggs/female for individuals between the sizes of 14.0 to 18.3 cm SL.

Early Life History and Development

Following extrusion and fertilization, the eggs are 0.9-1.4 mm in diameter, amber in coloration and are highly adhesive (Lippson and Moran, 1974; Scott and Crossman, 1973). Hatching

typically takes place three to five days following fertilization (Scott and Crossman, 1973). Size of pre-larvae at hatching range from 2.0 to 3.0 mm TL (Lippson and Moran 1974). After hatching and abandonment of the nest by the male, larvae commonly seek submerged aquatic vegetation (SAV) or submerged debris to avoid predators. The use of a single nest by multiple females results in large numbers of pre-larvae being produced per each individual nest. Scott and Crossman (1973) gave estimates of the number of pre-larvae produced per nest to range from 4,670 to 224,900 individuals.

The size range of the pre-larvae stage of development is from hatching size (2-3 mm) up to approximately 5.0 mm, the size at which the yolk sac has been fully absorbed (Lippson and Moran, 1974). Post-larvae range in size from approximately 5.0 mm to 9.0 mm. After attaining the size of 9.0 mm, the post-larvae have formed all fin rays and enter the juvenile stage of development. Diets of larvae and juvenile bluegills consist of zooplankton and aquatic insects. During the juvenile stage, the diet consists of larger quantities of aquatic insects, crustaceans (amphipods, isopods), snails and annelids. Like the larvae, juveniles commonly form small schools (5-10 individuals) and are commonly associated with SAV or submerged debris and structure. Growth during the first year is rapid. Trautman (1957) reported that young-of-the-year individuals range 1.7 to 8.1 cm TL. Although the bluegill are reproductively prolific in the annual production of larvae and juveniles, predation by larger species is considered very high. Natural mortality rates (i.e., predation by game fish) for bluegill range 37.5 to 66.6 percent of the annual production (Emig, 1966). Savino and Stein (1982) found that predation of bluegills by largemouth bass decreased significantly in the presence of submerged aquatic vegetation or debris. This was linked to the general increase in cover and habitat complexity that provided bluegill with a more effective means of evading predators.

Life History - Adults

Bluegill usually mature in 2 or 3 years (Mayhew, 1956 In Emig, 1966). Sexual maturity may be attained by the first year. Swingle and Smith (1950) reported that some individuals in populations in Alabama spawned at ages < 1 year of age. In general, adult bluegill during the non-spawning seasons are largely found in the littoral areas of lakes and reservoirs and slow water areas of rivers and streams. Although more commonly encountered in the littoral regions of lakes and reservoirs, during extremely warm temperatures adult bluegill may descend to depths of 6.1 m (Scott and Crossman, 1973). Adults commonly form small schools (3-5 individuals) and remain in the shallows particularly among SAV areas. This schooling behavior may be linked to survival strategies against larger fish predators. Savino and Stein (1982) found that bluegills in small schools were less successfully predated upon by largemouth bass than isolated individuals. As adults, bluegills are highly local in their movements with individuals being commonly encountered within the same general area on a daily basis. Ball (1947 In Emig, 1966) found that 60 percent of tagged bluegill in Third Sister Lake, Michigan were recaptured within

30 yards of the release point. Fisher (1953 In Emig, 1966) found that the mean distance traveled from point of release to point of recapture was 1.4 miles in Millerton Lake, California.

The diet of adult bluegill consists largely of aquatic insects (especially chironomids), snails, annelids, isopods, amphipods, algae and small numbers of fish (Scott and Crossman, 1973). The fish component of the diet generally increases in significance with the size of the individual. In the presence of increased competition or lack of prey, bluegill have been found to cannibalize their own nests or consume bluegill larvae (Emig, 1966). Congregation of large numbers of adults and excavation of benthic nests during the late spring-early summer period make this species highly visible to the shoreline observer. The prolific reproductive potential of the bluegill make this species one of the dominant littoral species in lentic communities. In sampling the fish population of SCR, Hellier et al. (1987) found bluegill to represent 43 percent of the total number of fish collected throughout the reservoir. The highly local movements of bluegill populations in the shallow portions of lentic environments make this species highly susceptible to fish collection methods.

5.0 CPSES UNITS 1 AND 2 IMPINGEMENT

The objective of this analysis is to estimate the total number and weight per fish species or genus impinged during a given period (day, night, seasons, year) at Units 1 and 2 combined during a 12-month period.

5.1 IMPINGEMENT SAMPLING AND ESTIMATION METHODOLOGIES

The field program for impingement monitoring was a systematic sampling effort extending over a 12-month period from October 18, 1993 through October 22, 1994. Impingement sampling was conducted at weekly intervals from October 1993 through March 1994 and continued at semimonthly intervals (every 2 weeks) from April 1994 through August 1994. Weekly sampling resumed from September 1994 through October 22, 1994. At the end of the field sampling effort, a total of eighty (40 day and 40 night) samples had been collected. For standardization purposes, the 12 hours from 0800 to 2000 (8 am to 8 pm) was designated as "day", and the 12 hours from 2000 to 0800 the next morning was designated as "night."

For sample identification, each sampling event was assigned an event number in ascending order (1,2,3...etc.) and a day (identified by a 1) or night (identified by a 2) sample identifier following a decimal, e.g., event 1.1(day) and 1.2 (night).

Sample Collection

Following a wash and rotation cycle, traveling screens for both Units 1 and 2 deposit collected debris and fish into a common debris trough which directs collected material into a debris basket located adjacent to the intake structure. Design of the impingement sampling program took advantage of the common debris trough and basket system for sampling. A sampling basket designed to be inserted into the debris collection basket was constructed for collecting impinged fish washed from the traveling screens. The sampling basket was constructed of a steel frame and galvanized wire mesh screening (1.3 cm mesh screening). The sampling basket was designed to effectively strain out fish and debris which accumulated on the traveling screens. The sampling basket was lowered into place by means of a hand winch. The general design and structure of the basket sampler is shown in Figure 5-1A.

Twelve hours prior to the collection of the first impingement sample (typically this was the night sample), the traveling screens underwent a complete wash and rotation cycle. Collected debris was removed from the debris basket and the basket sampler was lowered into place. The basket sampler was left inside the debris basket, collecting both debris and impinged fish from the traveling screens for a 12-hour period (Figure 5-1B). At the end of the 12-hour day or night sample collection, the basket sampler was removed and the collected fish sorted from other debris in the basket. Prior to sample processing, the field team completed Form 1 of 2 for each

event (Figure 5-2). This form identified the date, time of sampling, day or night sample, time and date of last basket cleaning (start of impingement sampling for said event) and operational profiles, including number of pumps and traveling screens in operation for each unit. In addition to these data, field observations/measurements of weather conditions, air and water temperature, conductivity and dissolved oxygen were also recorded.

Sample Identification and Enumeration

Collected fish were identified and sorted by species. If the total number of individuals collected for a species was less than or equal to 25, all individuals were weighed to the nearest gram using a digital balance or spring scale and measured for total length (mm). If a species group contained 26 or more individuals, the number, length and weight were estimated by subsampling. If the species group to be subsampled consisted of adults and juveniles, individuals were sorted into two discrete size classes (identified as large and small groups) prior to subsampling. If no discrete size classes were apparent, no sorting of individuals was conducted. In situations where there were 26-30 individuals, subsampling was not deemed necessary and length and weight for all individuals were recorded.

If a fish species could not be sorted by size, the total weight of the individuals collected was recorded and a representative subsample was processed. The subsampling process consisted of recording the length and weight of a minimum of 30 individuals of the collected species. Total weight of the subsample was used to estimate the total number of individuals of a particular species to be present within the sample. If the species was separated by size group and a group contained 25 or fewer individuals, length and weight were recorded for each individual (Figure 5-3). Where possible, individuals were sexed based upon external dimorphic characteristics (i.e., coloration or patterns).

Estimation of Impingement

Based upon the plant operating status at the time of sampling and the number of fish impinged by species, a daily impingement estimate for both units combined was determined. Impingement is often a function of CWS volume (i.e., number of CWS pumps), all things being equal, the impingement data were normalized to the number of CWS pumps in operation and unit time of sampling effort for each event:

$$IM_{Total\ Daily} = (Fish/hr/pump)_{day}(NP_{day})(CP_{day}) + (Fish/hr/pump)(NP_{night})(CP_{night}) \qquad \text{(Equation 1)}$$

Where:

$IM_{Total\ Daily}$	=	Total number of fish impinged on sampling day
$(Fish/hr/pump)_{day}$	=	Fish impingement (day sample) normalized by CWS pump operation and sampling effort
$(Fish/hr/pump)_{night}$	=	Fish impingement (night sample) normalized by CWS pump operation and sampling effort
NP_{day}	=	Total number of CWS pumps in operation (both units combined) during daytime sample period
NP_{night}	=	Total number of CWS pumps in operation (both units combined) during evening sample period
CP_{day}	=	Sampling effort (hrs.) for impingement during the day time event
CP_{night}	=	Sampling effort (hrs.) for impingement during the evening event

This daily impingement rate was used as the basis for extrapolating weekly, monthly and seasonal impingement for the CPSES CWS. Weekly impingement rates were calculated based upon the following assumptions:

1. The rate of impingement remains constant across the interval between sampling periods the sampling days' impingement was assumed to be representative of the seven, or fourteen day interval between events.

2. If the weekly discharge volume remained stable during the week between sampling dates, it was assumed that pump operating conditions recorded on the sample day remained constant over the weekly interval.

Based upon the above assumptions, weekly impingement estimates were calculated as the sum of the daily impingement estimates over a seven-day period between sampling events using the formula:

$$IM_{weekly} = \sum_{i=1}^{7} IM_{day\ i} \qquad \text{(Equation 2)}$$

where (given the systematic sampling design)

$$IM_{day\ 1} = IM_{day2} \ldots = IM_{day\ 7}$$

(i.e., the actual sample day/wk collection is assumed representative of a 7 day period)

Monthly impingement was calculated as the sum of the four consecutive weekly estimates plus three daily estimates for individual months (assuming 31 days/month) during the impingement monitoring period using the equation:

$$IM_{monthly} = (IM_{week\ 1}) + (IM_{week\ 2}) + (IM_{week\ 3}) + (IM_{week\ 4}) \qquad \text{(Equation 3)}$$

Seasonal estimates of impingement were calculated as the sum of individual weekly estimates for the temporal boundaries of the four seasons. Seasonal boundaries were demarcated by the vernal and autumnal equinox and summer and winter solstice dates. Thus on a temporal time line, spring was from March 21 through June 20; summer was June 21 through September 22; fall was September 23 through December 21 and winter was December 22 through March 20.

5.2 ESTIMATES OF IMPINGEMENT FOR ALL SPECIES

Impingement data collected during sampling are summarized in Appendix C. Daily estimates (Table 5-1) were extrapolated to the weekly (Table 5-2), monthly (Table 5-3), annual and seasonal estimates (Table 5-4). Impingement extrapolations were calculated as a total (all species) and as RIS specific estimates.

5.2.1 Daily Impingement Rates

Daily impingement of fish by the CPSES CWS was highest during the mid to late summer, from July 13 to September 7 (Figure 5-4). The highest daily impingement occurred on July 28, 1994 (9,194 fish impinged). The second greatest daily impingement occurred on August 10 (6,347 fish impinged). Daily impingement was lowest from mid-winter to late spring (January 13-March 30). The lowest daily impingement occurred on March 2, when a total of 8 fish were impinged. Overall, more fish were impinged by the CPSES CWS during the nighttime than daytime. Notable exceptions to this trend occurred on July 28 and September 7. The daytime impingement on July 28 and September 7 exceeded the nighttime impingement by 3,478 fish and 891 fish, respectively. On March 2 and March 9, no fish were impinged by the CPSES CWS during the daytime.

The species experiencing the greatest daily impingement was the threadfin shad. The greatest daily impingement of this species occurred on July 28, when an estimated 8,927 threadfin shad were impinged. Threadfin shad comprised 97 percent of the fish impinged on that date.

5.2.2 Weekly Impingement Rates

Weekly impingement of fish by the CPSES CWS was highest during the late summer, from July 28 to September 13 (Figure 5-5). The highest weekly impingement occurred during the period July 28 to August 9 (119,522 fish impinged). The second highest weekly impingement occurred

the following period, from August 10 to August 23 (88,928 fish impinged). Approximately 80 percent of the total impingement for the year occurred during these two intervals. Overall, weekly impingement was lowest during the late winter (January 21-February 22). Weekly impingement was lowest from November 9 to November 15 and March 9 to March 15. A total of 49 fish were estimated to have been impinged during both of these intervals (Figure 5-5).

The species experiencing the greatest impingement was the threadfin shad, with 251,269 fish estimated to have experienced impingement during the course of the year (96 percent of the total). The greatest weekly impingement of this species occurred from July 28 to August 9 (116,051 fish impinged) and August 10 to August 23 (88,200 fish impinged). Threadfin shad comprised 98 percent of the fish that were impinged during these periods. Of the total number of threadfin shad experiencing impingement during the year, approximately 81 percent were impinged during these two time intervals. Impingement was lowest for shad from February 2 to February 8 and from March 30 to April 5. The impingement of threadfin shad during each of these intervals was only seven individuals.

5.2.3 Monthly Impingement Rates

Overall, the rate of impingement of fish by the CPSES CWS was highest during the late summer (July 27-September 28), and peaked during the month of July 27 to August 27 (Figure 5-6). A total of 210,757 fish were estimated to have been impinged during this monthly period, accounting for 80 percent of the total impingement for the year. Impingement was lowest during the late winter (January 21-March 22). The lowest monthly rate of impingement occurred during the period of January 21 to February 21, when 366 fish were impinged by the CPSES CWS. Excluding these periods of highest and lowest impingement, the range in estimated monthly impingement was between 400 and 35,000 fish.

The species experiencing the greatest monthly impingement overall was the threadfin shad. The greatest monthly impingement for this species occurred during the period of July 27 to August 27 (208,857 fish impinged). Impingement was lowest for the shad during the period of February 22 to March 22 (142 fish impinged). The species experiencing the next highest monthly impingement was the bluegill sunfish, experiencing an average impingement of 386 fish per month. Combined, threadfin shad and bluegill sunfish accounted for approximately 98 percent of the annual impingement by the CPSES CWS. All other species combined represented less than 2 percent of the total annual impingement, and game fish (i.e., bass) impingement averaged <1% over the year.

5.2.4 Annual Impingement

An annual impingement estimate was calculated as the sum of the weekly/bimonthly interval estimates for all species. Combining these values results in an estimated total impingement of 262,498 fish over the 1993-1994 sampling year. This is considered to be a conservative estimate, in that, no attempt was made to statistically account for the one or two "peak" impingement events associated with shad, as will be evident in the following discussion of RIS-specific impingement.

5.2.5 Seasonal Impingement Rates

Seasonal impingement of fish by the CPSES CWS was greatest during the summer (251,218 fish) (Figure 5-7). The summer season was defined as the period from June 21, 1994 to September 22, 1994. The remaining seasons were defined as follows: fall was defined as the period from October 22, 1993 to December 20, 1993; winter was defined as the period from December 21, 1993 to March 19, 1994; and spring was defined as the period from March 20, 1994 to June 20, 1994. Approximately 96 percent of the annual impingement occurred during the summer. Impingement was lowest during the winter, representing less than 1 percent of the annual impingement (1,999 fish impinged). Impingement of approximately equal numbers of fish occurred during the spring and fall. Impingement during each of these seasons represented slightly less than 2 percent of the total annual impingement.

The species experiencing the greatest impingement during all four seasons was the threadfin shad. The threadfin shad represented 97 percent of the total summer impingement; 67 percent of the total fall impingement; 65 percent of the total winter impingement; and 47 percent of the total spring impingement. After the threadfin shad, the bluegill sunfish experienced the greatest impingement in all seasons except the summer, representing 23 to 27 percent of the total impingement during fall, winter, and spring. The inland silverside species experienced the second greatest summer impingement rate.

5.3 RIS - SPECIFIC IMPINGEMENT RATES

5.3.1 Daily Impingement Rates

Daily impingement of RIS by the CPSES CWS was highest during mid-summer to late summer, from July 13 to September 7. The highest daily impingement of RIS occurred on July 28 (9,157 fish impinged). The second greatest daily RIS impingement occurred on August 10 (6,336 fish impinged). RIS comprised 99.6 percent and 99.8 percent, respectively, of the total impingement on these two dates. RIS comprised 67 percent to 100 percent of the daily impingement by the CPSES CWS. RIS comprised 100 percent of the daily impingement during all of November and December, 1993, late January and late February, 1994, and in early May and June, 1994. Daily

RIS impingement was lowest from mid-winter to late spring (January 13-March 30, 1994). The lowest daily RIS impingement occurred on February 2, when a total of 7 RIS individuals were impinged. The lowest relative daily RIS impingement occurred on March 9. RIS comprised 67 percent of the total impingement on this date. Overall, more RIS were impinged by the CPSES CWS during the nighttime. Notable exceptions to this trend occurred on July 28 and September 7. On these dates, the daytime RIS impingement comprised 69 percent and 86 percent, respectively, of the total daily RIS impingement. On March 2 and March 9, no RIS were impinged by the CPSES CWS during the daytime. The greatest nighttime RIS impingement occurred on August 10 (5,118 fish impinged). RIS comprised 99.8 percent of the total impingement that evening. The greatest daytime RIS impingement occurred on July 28 (6,323 fish impinged). RIS comprised 99.7 percent of the total impingement on that date.

Overall, the RIS experiencing the greatest daily impingement was the threadfin shad. The greatest daily impingement of this species occurred on July 28, when 8,927 threadfin shad were impinged. Threadfin shad comprised 97 percent of the fish impingement that occurred on that date, and 97 percent of the RIS impinged on that date. Threadfin shad usually were impinged in greater numbers during the nighttime. Notable exceptions to this trend occurred on July 28 and September 7. On these dates, the daytime impingement of threadfin shad comprised 70 percent and 87 percent, respectively, of the total daily threadfin shad impingement. The RIS experiencing the second highest daily impingement was the bluegill sunfish.

5.3.2 Weekly Impingement Rates

Impingement of RIS by the CPSES CWS represented greater than 99 percent of the total annual number of fish of all species impinged by the CPSES CWS. This is because threadfin and gizzard shad were defined as RIS for this demonstration. The RIS impingement during any weekly period represented no less than 77 percent of the total impingement during that period. Impingement of RIS ranged from 77 percent-100 percent of the weekly impingement during the year. RIS impingement was highest during the late summer, from July 28 to September 13 (Figures 5-8 and 5-9). RIS impingement represented 99 percent to 100 percent of the total weekly impingement of all species during this interval. A total of 243,131 RIS individuals were impinged during this period, representing approximately 93 percent of the total annual impingement of all species and approximately 93 percent of the total annual RIS impingement. The greatest weekly RIS impingement occurred during the period July 28 to August 9 (119,028 fish impinged). RIS represented 99 percent of the total fish of all species impinged during this interval. The second highest weekly RIS impingement occurred the following period, from August 10 to August 23 (88,774 fish impinged). RIS impingement represented 99 percent of the total impingement of all species during this interval. Approximately 80 percent of the total annual RIS impingement occurred during these two intervals, representing approximately 80 percent of the total annual impingement of all species. Relative impingement of RIS was greatest from November 9, 1993 to January 5, 1994. RIS impingement represented 100 percent of the total

weekly impingement of all species during this interval. RIS impingement also represented 100 percent of impinged fish from January 20 to February 1, from February 9 to February 15, from May 4 to May 17, and from September 14 to September 20. Relative RIS impingement was also high from July 13 to September 13, representing 99 percent of the total impingement for all species during this period.

Weekly RIS impingement was lowest during the late winter to early spring (January 13-April 5, 1994). RIS impingement represented 77 percent to 100 percent of the total weekly impingement of all species during this interval. A total of 1,004 RIS individuals were impinged during this period, representing less than 1 percent of the total annual impingement of all species and less than 1 percent of the total annual RIS impingement. The lowest weekly RIS impingement occurred from March 9 to March 15. A total of 42 RIS individuals were impinged during this interval. RIS represented 86 percent of the total fish of all species impinged during this interval. Relative impingement of RIS was lowest from March 2 to April 5. RIS impingement represented 84 percent of the total impingement of all species during this period. The lowest relative weekly RIS impingement occurred from March 23 to March 29. RIS species represented 77 percent of the total impingement of all species during this weekly interval.

The dominant RIS were the threadfin shad and bluegill sunfish, comprising approximately 96 percent and 2 percent, respectively of the total RIS that were impinged during these periods. These two species together comprise approximately 98 percent of the total RIS impinged. The remaining RIS (white bass, freshwater drum, channel catfish, gizzard shad, largemouth bass, and inland silverside) comprised less than 2 percent of the total RIS impinged. The RIS experiencing the greatest weekly impingement was the threadfin shad, averaging 6,282 individuals impinged weekly (range = 7-116,051 fish). Threadfin shad represented from 2 percent to 99 percent of the weekly RIS impingement, averaging approximately 60 percent. The greatest weekly impingement of this species occurred from July 28 to August 9 (116,051 fish impinged) and August 10 to August 23 (88,200 fish impinged). Of the total number of threadfin shad experiencing impingement during the year, approximately 81 percent were impinged during these two time intervals. Threadfin shad experienced the greatest relative impingement from August 10 to August 23 and August 31 to September 6, representing 99 percent of the RIS impingement during these periods. Impingement was lowest for the shad from February 2 to February 8 and from March 30 to April 5. The impingement of threadfin shad during each of these intervals was seven individuals, representing 14 percent and 8 percent, respectively, of the total RIS impingement during each of these intervals. Threadfin shad experienced the least relative impingement from April 6 to April 19, representing less than 2 percent of the total RIS impingement during this period. Threadfin shad experienced the highest relative RIS impingement during 29 of the 40 weekly intervals estimated.

Bluegill sunfish experienced the greatest relative RIS impingement during the following periods: January 27 to February 15, February 23 to March 1, March 23 to April 19, June 1 to June 14,

and October 22. Bluegill sunfish impingement represented 37 percent to 89 percent of the total RIS impingement during these periods. Relative RIS impingement for the bluegill sunfish was greatest from April 6 to April 19, representing 89 percent of the total RIS impingement which occurred during this period. Gizzard shad experienced the greatest relative impingement from May 4 to May 17, representing 82 percent of the total RIS impingement during this period. The RIS experiencing the least weekly impingement was the white bass. This RIS was impinged during seven of the weekly intervals, representing less than 1 percent to 11 percent of the RIS impingement during these periods.

5.3.3 Monthly Impingement Rates

Impingement of RIS (Representative Important Species) represented greater than 99 percent of the total annual number of fish impinged by the CPSES CWS, again, because shad were included in RIS. [Thus, the RIS defined herein are representative of the bulk of the SCR community.] During any monthly interval, impingement of RIS represented 90 percent to 100 percent of the total impingement for that interval. Impingement of RIS by the CPSES CWS was highest during the late summer (July 27-September 28), and peaked during the month of July 27 to August 27 (Figure 5-10). 210,578 RIS were impinged during this period, representing 81 percent of the total RIS impingement for the year. RIS impingement was lowest during the late winter (January 21-March 22). The lowest RIS impingement occurred during the period of January 21 to February 21, when 353 RIS individuals were impinged by the CPSES CWS. RIS impingement, relative to total impingement, was lowest from February 22 to June 25, representing 92 percent of the total impingement during this period. During the periods between the high and low extremes, the estimated monthly RIS impingement was approximately between 400 and 35,000 fish.

The RIS experiencing the greatest monthly impingement was the threadfin shad, representing 96 percent of the total annual RIS impingement. The greatest monthly impingement for this RIS occurred during the period of July 27 to August 27 (206,857 fish impinged). Impingement was lowest for the shad during the period of February 22 to March 22 (142 fish impinged). The RIS experiencing the next highest impingement was the bluegill sunfish, representing approximately 2 percent of the RIS impingement. The threadfin shad and bluegill sunfish represent approximately 98 percent of the annual RIS impingement by the CPSES CWS. The other RIS which experienced impingement together represented less than 2 percent of the total annual RIS impingement.

5.3.4 Annual Impingement Rates

On an annual basis, threadfin shad accounted for 96 percent (251,269) of the total number of fish impinged. The second and third ranked species were bluegill sunfish and inland silverside, which accounted for 2 percent (4,626 fish) and 1.2 percent (3,100 fish), respectively. Gamefish

species which were impinged included the largemouth bass (908 fish), channel catfish (177 fish) and white bass (70 fish). These three species combined accounted for less than one percent of the total annual impingement.

5.3.5 Seasonal Impingement Rates

Seasonal impingement of RIS by the CPSES CWS was greatest during the summer when 250,334 RIS were impinged (Figure 5-11). The summer season was defined as the period from June 21, 1994 to September 22, 1994. The remaining seasons were defined as follows: fall was defined as the period from October 22, 1993 to December 20, 1993; winter was defined as the period from December 21, 1993 to March 19, 1994; and spring was defined as the period from March 20, 1994 to June 20, 1994. Impingement of the RIS accounted for over 99 percent of the total annual fish impingement by the CPSES CWS. Approximately 96 percent of the annual impingement of the RIS occurred during the summer. The impingement of the RIS relative to the total number of fish impinged by the CPSES CWS was lowest during the spring, representing 93 percent of the total spring impingement. Total seasonal impingement of the RIS was lowest during the winter, representing less than 1 percent of the annual RIS impingement. Impingement of approximately equal numbers of the RIS fish occurred during the spring and fall. Impingement during each of these seasons represented slightly less than 2 percent of the total annual RIS impingement.

The RIS experiencing the greatest impingement during all four seasons was the threadfin shad. The threadfin shad represented 98 percent of the total RIS summer impingement (244,780 threadfin shad impinged), 69 percent of the total fall RIS impingement (2,873 threadfin shad impinged), 68 percent of the total winter RIS impingement (1,306 threadfin shad impinged), and 50 percent of the total spring RIS impingement (2,448 threadfin shad impinged). After the threadfin shad, the RIS experiencing the greatest impingement was the bluegill sunfish, in all seasons except the summer, representing 24 percent-29 percent of the total impingement during fall, winter, and spring. Among the RIS, the inland silverside species experienced the greatest summer impingement after the threadfin shad.

5.3.6 Length/Frequency Relationships of RIS Impingement

So as to provide a qualitative characterization of age classes of RIS being impinged by the CPSES CWS, length frequencies of RIS individuals were plotted to identify particular stages (i.e., young-of-the-year, juvenile, adult) which are being impinged. Length frequencies of each RIS were compared to length classes for juveniles and adults given in the life history section of this report. Age determinations of impinged fish were not part of CPSES 316(b) scope of work. However, the length-frequency data provide insight into the potential age group selectivity of impingement for each of the RIS being considered.

Figure 5-12 displays the size frequency for largemouth bass impinged by the CPSES CWS for the monitoring year. An estimated 908 largemouth bass were impinged during the entire monitoring period from October 1993 through October 1994. Eighty-five percent of the largemouth bass impinged by the CWS were less than 75 mm TL (Figure 5-12). The remaining 15 percent represented impinged fish ranging in size from 76 to 150 mm TL. The largest size interval of largemouth bass impinged was within the 51 to 75 mm size range. This interval accounted for 59 percent of the largemouth bass impinged by the CWS. The life history profile for this species indicates that young-of-the-year range in size from 51 to 137 mm TL (Scott and Crossman, 1973); therefore, all the largemouth bass impinged by the CPSES during monitoring were young-of-the-year fish. Monitoring data indicated that no adult largemouth bass were impinged, attesting to its ability to resist the low intake velocities, and/or the lack of optimal habitat in the intake cove.

On an annual basis, the CWS impinged an estimated 85 individuals of freshwater drum during the monitoring period. All of the individuals collected during the monitoring period were greater than 225 mm TL (Figure 5-13). The largest numbers of drum collected during the monitoring period were evenly divided between size intervals of 226 through 250 mm TL and 301 through 325 mm TL. Each range represented 28.6 percent, for a total of 57.2 percent of the drum sampled. The largest drum impinged during monitoring was 366 mm TL. Based on the age-length relationships given by Edsall (1967 In Scott and Crossman 1973) for Lake Erie populations, the large size of the individuals sampled from impingement monitoring indicate that all the individuals were adults.

The inland silverside was the third most impinged species. An estimated 3,100 individuals were impinged during the monitoring period. Of the individuals collected during the monitoring period, 75 percent were less than 75 mm TL. Individuals which were less than 50 mm TL represented only 15 percent of the total collected. The most abundant size interval impinged by the CWS was 51-75 mm TL (Figure 5-14). The size interval which represented the largest specimens collected during impingement monitoring was 101-125 mm TL. This size interval accounted for 9.5 percent of the total number of silversides collected. Coorey et al. (1985) and Simmons (1957) described adults of this species as ranging from 69-125 mm. Additionally, this fish has been described as an annual fish within SCR because they rarely reach their second year (Hellier et al. 1987). Therefore, most of the inland silversides impinged by the CPSES CWS appear to be both juveniles and adults.

Threadfin shad was the fish species most impinged by the CPSES CWS. The estimated annual impingement for the monitoring period was 251,269 individuals. Four distinct size intervals of fish dominated the impingement samples. Two size intervals, 41 to 50 mm TL and 51 to 60 mm TL, represented 24 and 25 percent (or 49 percent combined) of the total number of threadfin shad impinged (Figure 5-15). The third and fourth most significant size intervals present were 71 to 80 mm TL and 81 to 90 mm TL. These two intervals represented 11 and 18 percent,

respectively, of the total number of shad sampled (Figure 5-15). The largest size interval observed from impingement sampling was the 121-130 mm TL interval. Threadfin shad greater than 90 mm TL represented only 3.5 percent of the total number of individuals of this species sampled. Adult threadfin shad range in size from 76 to 101 mm TL (Page and Burr, 1990). Juveniles range in size from 25 to 38.1 mm TL (Lippson and Moran, 1974). Based upon these benchmarks, it appears that the CPSES CWS probably impinges both juvenile (41-60 mm TL) and adult (71-90 mm TL) threadfin shad, depending on season and (therefore) impingement (low swimming speed capability), but adults became more susceptible in summer when higher water temperatures decreased their sustained swimming speed.

An estimated 829 gizzard shad were impinged during the monitoring period. There was a wide range in size intervals of individuals impinged by the CPSES CWS (Figure 5-16). The wide range in size classes impinged suggests that both juvenile and adult gizzard shad are impinged by the CWS. In general, the frequency distribution for size for this species can be characterized into two distinct ranges. The first distinct peak occurs within the range of 26 to 125 mm TL and the second between 125 and 401 mm TL (Figure 5-16). The dominant size class within this first peak was the 51-75 mm TL interval. This size interval represented 51 percent of the total number of individuals sampled during monitoring. Scott and Crossman (1973) describe juvenile gizzard shad as ranging in size from 35 to 114 mm TL. Clearly, the first peak in the frequency distribution represents juvenile or young-of-the-year gizzard shad (Figure 5-16). The second portion of the size frequency distribution includes size intervals inclusive of sub-adults and adult gizzard shad. Individuals > 250 mm TL represented 21.4 percent of the individuals sampled. Like the threadfin shad, the CPSES appears to impinge both juvenile and adult gizzard shad, depending on season.

Like the freshwater drum, the size frequency distribution for white bass impinged by the CPSES CWS was skewed towards larger individuals (Figure 5-17). On an annual basis, an estimated 70 white bass are impinged by the CWS. All the white bass sampled were > 226 mm TL. Two distinct peaks in the distribution are apparent. The first peak is dominated by the 251 to 275 mm TL size interval and the second is dominated by the 301 to 325 and 326 to 350 mm TL size intervals (Figure 5-17). Page and Burr (1990) describe adult white bass as ranging in size from 203 to 254 mm TL with some individuals as large as 450 mm TL. The frequency distribution of white bass impinged by CPSES indicates that all of the fish impinged were adults.

Annual impingement of channel catfish by the CPSES CWS was estimated to be 177 fish. The size frequency distribution of channel catfish impinged by the CPSES CWS displayed wide variability (Figure 5-18). Channel catfish impinged ranged in size from 25 to 250 mm TL. From the frequency distribution, four distinct peaks are apparent. The first peak is dominated by the 26 to 50 and 51 to 75 mm TL size intervals. This first peak accounted for 18 percent of the individuals impinged. The second peak is dominated by the 101 to 125 mm TL class and presented 18 percent of the individuals impinged. The third peak represented the greatest percentage of individuals sampled. This peak was dominated by the 151 to 176 mm TL interval

which accounted for 28 percent of the individuals sampled. The fourth peak in the distribution was dominated by the 226 to 250 mm TL size interval (Figure 5-18). The minimum and maximum sizes for the juvenile stage of channel have been given as 32.6 and 257 mm TL (Mansueti and Hardy, Jr. 1967). Page and Burr (1990) give the average size of channel catfish to range 280 to 762 mm TL. Based upon the frequency distribution of impinged individuals, the CPSES CWS appears to impinge both juvenile and adult channel catfish.

Bluegill sunfish was the second most commonly impinged fish by the CPSES CWS. From the monitoring data, an estimated 4,626 bluegill sunfish were impinged during the year. Size frequency distribution of impinged bluegills reveal a major peak occurring between the size intervals of 0 to 25 and 51 to 75 mm TL (Figure 5-19). This major peak inclusive of the given size intervals accounted for 56 percent of bluegill sunfish impinged. The remaining bluegill sunfish (44 percent) measured greater than 75 mm TL (Figure 5-19).

6.0 CPSES UNITS 1 AND 2 ENTRAINMENT

Results of the entrainment field program and subsequent laboratory analysis are summarized in Appendix D. These data were used to calculate an instantaneous daily entrainment value for both Units 1 and 2. Weekly, monthly, annual and seasonal estimates were subsequently estimated from these daily values. Entrainment estimates were derived for both total ichthyoplankton and RIS specific estimates.

6.1 ENTRAINMENT SAMPLING AND ESTIMATION METHODOLOGIES

The field program for entrainment monitoring extended from April 6 through August 24, 1994. This period coincides with spawning activity for most of the RIS present in SCR. The field sampling program consisted of weekly sampling events for the collection of ichthyoplankton (fish eggs and larvae) in front of the CWS intake structure. At the conclusion of the field program, a total of 270 entrainment samples had been collected. Originally, the field program consisted of sampling in front of the intake structure for both Units 1 and 2. A scheduled outage for Unit 2 resulted in Unit 2 going off line for the sampling events of May 4 to June 22. Given the Unit 2 shutdown, the field program was immediately modified to include collection of entrainment samples at different depths in front of Unit 1 to determine spatial distribution of eggs and larvae. Therefore, in addition to the 0.92 m (3 ft) sample, samples were collected from 7.7 m (25 ft) and 15.4 m (50 ft), respectively. Following the Unit 2 outage, the original sampling program (0.92 m or 3 ft for both intakes) was resumed from June 29 to the end of the sampling program in August. The spatial distribution of eggs and larvae in front of the CWS intake was an added component of the investigation which was not required by the NPDES permit, but given the opportunity, was thought to be valuable to ensure that entrainment would neither be overestimated or underestimated based on potential bathymetric differences in ichthyoplankton distribution and abundance.

Sample Collection

Triplicate 0.5 m diameter by 2.2 m plankton nets with 500 micron net mesh were deployed from a 16-ft jonboat in front of one screen from both Unit 1 and 2 for each sampling event. The plankton nets were supported by a small buoy at a constant depth of 0.92 m (3 ft) in front of the screens of both units (Figure 6-1A). Position of the nets was held constant by tying off the jonboat to the intrusion barrier of the intake channel and the use of guide ropes attached to the trash racks (Figure 6-1B). The total distance between the net mouths and the trash racks of each of the units was approximately 2.5 m (7 ft) (Figure 6-1A). Following collection of samples from one unit/screen, the samples were preserved using a 10 percent formalin and rose bengal stain solution, and the nets were washed and redeployed in front of the second unit screen. The nets were fished for a consistent period of 0.5 hour in front of each unit intake. Field data were

recorded on an entrainment field collection form for each sample collected from Units 1 and 2 (Figure 6-2).

The volume of water filtered for each net sample was determined through use of a General Oceanics flow meter (Model 2030R) attached to the net bridle. Metered counts from each of the replicate nets were recorded at the start and end of a sampling event. The volume filtered was calculated using an equation provided by General Oceanics:

$$\text{Volume Filtered } (m^3) = ((C/D)(2.61) + 3.47/(100)(AD) \qquad \text{(Equation 4)}$$

Where:

C = Number of counts read from flow meter
D = Sample duration (sec.)
A = Area of net opening (m^2)

Sample Identification and Enumeration

Calculated volumes for each of the replicates were used to determine ichthyoplankton densities for data analysis and entrainment estimation. Collected ichthyoplankton samples were concentrated in the plankton net bucket and the sample preserved with a 10 percent formalin and rose bengal stain solution. Samples were returned to the laboratory at the University of North Texas, and the fish eggs and larvae were sorted from other debris and identified to the lowest practical taxon. Sorting order and completion of sorting were recorded as samples were processed. Taxonomic keys used in the identification of eggs and larvae included Hogue et al. (1976), Snyder et al. (1977), Jones et al. (1978) and Hardy, Jr. (1978). Laboratory identification and enumeration data for fish eggs and larvae were recorded for each sample using an identification bench sheet. Eggs or larvae which were damaged or infertile, rendering them unidentifiable, were classified as infertile eggs or damaged eggs/larvae. Where possible, identified larvae were classified as either pre-larvae (yolk sac intact) or post-larvae (yolk sac absorbed) stages.

Data Validation

At the completion of the laboratory identification process, the laboratory identification and enumeration data were subjected to laboratory QA/QC program for verification of laboratory consistency. The QA/QC program consisted of random selection of 10 percent of the entrainment samples, which were then subjected to reidentification and reenumeration of fish eggs and larvae present. The QA/QC program was conducted by a second biologist with similar or more experience as the original identifier. All data were recorded on QA/QC benchsheets and compared to the original benchsheet for the sample. Any discrepancies between the original benchsheet and the QA/QC benchsheet were to be documented and the error corrected to the

data set prior to any data analysis. Results of the QA/QC program for the entrainment samples revealed no discrepancies between the original identifier and the QA/QC identifier.

Estimation of Entrainment

Instantaneous daily entrainment was calculated from the mean of the three replicates for each individual sampling event for entrainment monitoring. The daily estimate formed the basis for calculation of total entrainment at weekly and monthly intervals. Calculation of entrainment was determined given the following conditions and assumptions based upon collected data and plant operating records:

1. There are four cooling water intake pumps per each unit for the facility with total number equalling eight.
2. Discharge from both units of the facility are joined to form a single common discharge point, Outfall 001.
3. All eight cooling water intake pumps are in full operation when both units are being operated.
4. Four to six cooling water intake pumps are in operation when only a single unit is being operated.
5. The mean density (as the mean of three replicates) of ichthyoplankton in front of the trash racks is represented by the density (No./unit volume) being entrained by the individual units.
6. Based upon discharge monitoring records and pump operation records during entrainment sampling, the average withdrawal rate for each pump under normal operation is 17.3 m^3/sec.
7. Entrainment of ichthyoplankton is proportional to the number of pumps in operation and the total volume withdrawn on a daily basis.

Given the above conditions and assumptions, the following entrainment equation was utilized in calculating total entrainment on the day of sampling:

$$ET_{Total\ Daily} = CWS_{Unit\ 1} + CWS_{Unit\ 2} \qquad \text{(Equation 5)}$$

$$CWS_{Unit\ 1} = (D_1)_{day}(NP1)_{day}(17.3\ m^3/sec)(43{,}200\ sec) + (D_1)_{night}(NP1)_{night}(17.3\ m^3/sec)(43{,}200\ sec) \qquad \text{(Equation 6)}$$

$$CWS_{Unit\ 2} = (D_2)_{day}(NP2)_{day}(17.3\ m^3/sec)(43{,}200\ sec) +$$

$$(D_2)_{night}(NP2)_{night}(17.3\ m^3/sec)(43{,}200\ sec) \qquad \text{(Equation 7)}$$

Where:

$ET_{Total\ Daily}$ = Estimated number of eggs/larvae entrained on sampling day
$CWS_{Unit\ 1}$ = Number of eggs/larvae entrained by Unit 1 cooling water system on sampling day
$CWS_{Unit\ 2}$ = Number of eggs/larvae entrained by Unit 2 cooling water system on sampling day
$(D_1)_{day}$ = Mean density (No./m^3) of eggs/larvae in front of Unit 1 CWS during daylight hours
$(D_1)_{night}$ = Mean density (No./m^3) of eggs/larvae in front of Unit 1 CWS during evening hours
$(D_2)_{day}$ = Mean density (No./m^3) of eggs/larvae in front of Unit 2 CWS during daylight hours
$(D_2)_{night}$ = Mean density (No./m^3) of eggs/larvae in front of Unit 2 CWS during evening hours
$(NP1)_{day}$ = Number of CWS pumps running during daylight sampling for Unit 1
$(NP1)_{night}$ = Number of CWS pumps running during evening sampling for Unit 1
$(NP2)_{day}$ = Number of CWS pumps running during daylight sampling for Unit 2
$(NP2)_{night}$ = Number of CWS pumps running during evening sampling for Unit 2

Constants for Equations 5, 6 and 7 are:

17.3 m^3/sec = average withdrawal rate for one CWS pump
43,200 sec = 0.5 day in units of seconds

The above equations were used to determine an instantaneous daily entrainment value for the CPSES CWS. Since entrainment sampling events were conducted at weekly intervals, instantaneous daily values were used to extrapolate weekly entrainment for the period between sample dates. Weekly entrainment estimates were calculated through integration of daily discharge records from Outfall 001 discharge monitoring reports (DMR's), and the mean density of ichthyoplankton in front of the intake screens at the beginning of each weekly sampling event. Equation number one was applied to each of the seven 24-hour intervals and summed for the weekly entrainment estimate. The following assumptions were made for calculation of the weekly estimate:

1. In concert with the pump operation data recorded during sampling, if the daily discharge volume over the seven-day period remained consistent, it was assumed that the number of operating CWS pumps for each unit remained constant as that recorded during the entrainment sampling event at the start of the week.

2. Ichthyoplankton abundance (day and night) as determined on the i th sampling event was applied over the weekly interval between sampling events.

Based on the above assumptions, weekly entrainment estimates were calculated as the sum of the instantaneous daily estimates across a seven day period between sampling events using the formula:

$$ET_{weekly} = \sum_{i=1}^{7} ET_{day\ i} \qquad \text{(Equation 8)}$$

where: (given the systematic sampling design)

$$ET_{day\ 1} = ET_{day2} = \ldots\ldots ET_{day\ 7}$$

i.e., the actual sample day/week collection is assumed representative of a seven day period.

Monthly entrainment was calculated as the sum of the four consecutive weekly estimates plus three daily estimates for individual months (assuming 31 days/month) during the entrainment sampling period using the equation:

$$ET_{monthly} = (ET_{weekly})_{week\ 1} + (ET_{weekly})_{week\ 2} + \ldots + (ET_{weekly})_{week\ 4} \qquad \text{(Equation 9)}$$

Where:

$ET_{monthly}$ = Estimated monthly entrainment
$(ET_{weekly})_{week\ no.}$ = Estimated total weekly entrainment for the week

Calculation of seasonal entrainment for the sampling period followed the same general approach as monthly estimates. Since the entrainment sampling period encompassed the period of April through August, the seasonal estimates were based upon the seasons of spring and summer. The first day of summer, June 21, was used as the division point in the data set. Applying this approach to the entrainment database defined the spring season as April 6 (first sample event) through June 21, 1994 and the summer season as June 22 through August 24 (last sample event). Seasonal entrainment was calculated as the sum of monthly entrainment estimates plus weekly estimates during the week of the first day of summer using the equations:

$$ET_{Spring} = (ET_{monthly})_{month\ 1} + (ET_{monthly})_{month\ 2} + (ET_{weekly})_{week\ 10} + (ET_{weekly})_{week\ 11} \qquad \text{(Equation 10)}$$

Where:

ET_{Spring} = Estimated entrainment of ichthyoplankton for the period April 6-June 21, 1994
$(ET_{monthly})_{month\ 1}$ = Monthly entrainment estimate for the period April 6-May 6, 1994
$(ET_{monthly})_{month\ 2}$ = Monthly entrainment estimate for the period May 7-June 7, 1994

$(ET_{weekly})_{week\ 10}$ = Weekly entrainment estimate for the period June 8-June 14, 1994
$(ET_{weekly})_{week\ 11}$ = Weekly entrainment estimate for the period June 15-June 21, 1994

A similar approach was applied to estimate the total seasonal entrainment for the summer using the equation:

$$ET_{Summer} = (ET_{weekly})_{week\ 12\text{-}13} + (3)(ET_{daily})_{July\ 6\text{-}8} + (ET_{monthly})_{month\ 4} + (ET_{monthly})_{month\ 5} \quad \text{(Equation 11)}$$

Where:

ET_{Summer} = Estimated entrainment of ichthyoplankton for the period June 22 - August 30, 1994
$(ET_{weekly})_{week\ 12\text{-}13}$ = Estimated weekly entrainment of ichthyoplankton for week's 12 and 13
$(3)(ET_{daily})_{July\ 6\text{-}8}$ = Three times the estimated daily entrainment for the period July 6-7, 1994
$(ET_{monthly})_{month\ 4}$ = Monthly entrainment estimate for the period of July 9 - August 9, 1994
$(ET_{monthly})_{month\ 5}$ = Entrainment estimate for the period of August 10 - 30, 1994 (0.5 month)

6.2 RELATIVE ABUNDANCE OF ICHTHYOPLANKTON IN VICINITY OF THE INTAKE

Relative abundances of ichthyoplankton in the CPSES CWS intake cove varied temporarily and to some extent spatially (i.e., surface to bottom; or Unit 1 vs. 2). Fish eggs were detected from April 6 through June 15, 1994. The largest percentage of eggs were classified as damaged or infertile. The remaining eggs were represented by only two genera *Aplodinotus* (f.w. drum) and *Menidia* (silversides). In considering entrainment of fish eggs, only those densities of identifiable eggs were considered for this evaluation since these represented fertilized and viable eggs potentially representing recruits to the population.

Larvae were collected on most of the entrainment sample dates. Samples collected in April and May were dominated by *Dorosoma* (gizzard and threadfin shad) and *Menidia*. These genera were later replaced in dominance by the genera *Aplodinotus, Lepomis* (sunfishes), family Centrarchidae (sunfish and bass) and *Pomoxis* (white crappie) during the period of June through July 1994. Monitoring during August revealed *Lepomis, Pomoxis, Menidia* and *Morone* (white bass) to dominate within the area of the CPSES CWS intake. A small percentage of the larvae collected were classified as damaged and could not be identified to even the family level. Since these represented such a small percentage of the larvae sampled, these individuals were not considered for the impact assessment. All the *Morone* collected were identified as white bass as the only other *Morone* related species, the hybrid striped bass, are incapable of reproducing within SCR (Hellier et al., 1987).

Sampling at mid- and bottom depths in front of the Unit 1 intake during the Unit 2 shut-down period revealed that larvae were more abundant at bottom depths. However, analysis of

variance (ANOVA) showed that this difference in densities across the depths sampled was not statistically significant ($p<0.05$). Therefore to evaluate impacts of entrainment, the largest continuous data base, 0.92 m or "surface" of ichthyoplankton, was used to assess entrainment of fish eggs and larvae by the CPSES Unit 1 and Unit 2 CWSs.

6.3 ESTIMATION OF TOTAL ENTRAINMENT FOR ALL SPECIES

Using the equations and methodologies outlined in the previous sections, entrainment of fish eggs and larvae for all taxa collected was estimated by week, month, and season. Condenser mortality was assumed to be 100%, or "worst case". The following sections outline total entrainment for the various time periods during the entrainment sampling period. (Note that in each instance the terminology "were entrained" is used, it should be understood to mean "were estimated to have been entrained.")

6.3.1 Daily Entrainment Estimates

Applying the sampling results to Equations 2, 3 and 4 results in an estimated instantaneous daily entrainment rate for each of the sampling events. Daily instantaneous entrainment was calculated for both Unit 1 and Unit 2 based upon unit operation and density data at the time of sampling. Calculated instantaneous daily entrainment of ichthyoplankton by Unit 1 is summarized in Table 6-1 and for Unit 2 in Table 6-2. For the period during the Unit 2 shutdown, two to three Unit 2 pumps remained in operation to supplement cooling water supplies for Unit 1 generation. During this time period, entrainment monitoring focused on Unit 1, including collection of samples at other depths in the water column. To determine Unit 2 effects, the density of ichthyoplankton collected from Unit 1 at 0.92 m was applied to Unit 2 operational data to estimate entrainment by the Unit 2 CWS.

Eggs entrained by both Unit 1 and Unit 2 were limited to two distinct fish taxa, and others classified collectively as "damaged." The two taxa which were identified from collected samples were *Aplodinotus* and *Menidia*. Both *Menidia* and *Aplodinotus* eggs were collected from the start-up of entrainment sampling in April through late June, after which no identifiable eggs were collected from the samples. Damaged eggs were collected as late as mid-August during sampling. With only few exceptions as noted, day and night sampling of ichthyoplankton density revealed no significant difference as determined from analyses of variance (ANOVA) presented in Appendix E.

6.3.2 Total Weekly Entrainment Estimates

Table 6-3 summarizes total entrainment of fish eggs, larvae and juveniles for Unit 1 and Table 6-4 summarizes total entrainment of fish eggs, larvae and juveniles for Unit 2 during the entrainment monitoring period. Fish eggs were consistently entrained at weekly intervals for the

monitoring period of April 6-May 24 for Unit 2 (Figure 6-3). Unit 1 displayed a similar trend with the exception of the week of April 20 during which no eggs were entrained by this Unit. No eggs were entrained by either unit for the three weeks encompassing the period May 25-June 14. Eggs were entrained by both Units during the week of June 15 and entrainment of eggs was limited to Unit 1 during the following week of June 22 (Figure 6-3).

With the exception of the weeks of April 6-12 and April 20-26, Unit 1 consistently entrained a greater number of eggs than Unit 2. Total weekly egg entrainment by Unit 1 ranged from a minimum of zero up to a maximum of five million eggs/week. The maximum value of 5 million was observed for the week of April 27-May 3 (Figure 6-3). Weekly entrainment of eggs by Unit 2 ranged from a minimum of zero to a maximum value of 2.5 million eggs. As observed in the Unit 1 data, the maximum value of 2.5 million eggs was observed during the week of April 27-May 3 (Figure 6-3).

Entrainment of fish larvae by both units extended throughout the entrainment monitoring period of April 6-August 30. As observed with egg entrainment, Unit 1 typically entrained a greater proportion of larvae than Unit 2 (Figure 6-4). Total weekly entrainment of fish larvae ranged from a minimum of zero to a maximum of 7 million for Unit 1. For Unit 2, the weekly minimum was zero to a maximum of 3.5 million larvae. The maximum of 3.5 million for Unit 2 occurred during the week of August 10-16 (Figure 6-4). The minimum estimate of fish larvae entrainment by both units occurred during two 2-week periods whether no larvae were captured in the ichthyoplankton nets (May 25-June 7 and July 20-August 2).

In general, weekly entrainment of fish larvae was estimated to have increased during the period of August 3-30, for both units. During this period, abundance of larvae in front of both units was greater than observed during previous weeks within the monitoring period. It is also within this period that the maximum daily entrainment of larvae occurred at both Units (Figure 6-4).

6.3.3 Monthly Entrainment Estimates

Table 6-5 summarizes monthly entrainment of fish eggs for Units 1 and 2 and Table 6-6 summarizes monthly entrainment of fish larvae and juveniles for Units 1 and 2. Occurrence of fish eggs in the entrainment samples extended over the sampling period of April 6 through July 8 on a monthly basis (Figure 6-5). On a monthly basis, Unit 1 entrained more fish eggs than Unit 2 during the monitoring period in which eggs were collected. Overall, monthly entrainment of eggs displayed a decreasing trend for both Unit 1 and 2 as the sampling program progressed into the later months. Maximum monthly entrainment for both units occurred during the period of April 6-May 6 when monthly egg entrainment was 6.3 million eggs for Unit 1 and 4.7 million eggs for Unit 2 (Figure 6-5). Total egg entrainment decreased for both units during the monthly interval of May 7 through June 7 and June 8 through July 8. The minimal monthly entrainment

of fish eggs was associated with the June 8 through July 8 period when Unit 1 entrained 3.8 million eggs and Unit 2 entrained 2.0 million eggs (Figure 6-5).

Fish larvae/juveniles were collected throughout the entrainment monitoring period which extended for the total of 5.6 months of monitoring. As observed in egg entrainment, Unit 1 entrained more fish larvae than Unit 2 on a monthly basis. Unlike egg entrainment, monthly larvae/juvenile entrainment increased as sampling progressed into the later months (Figure 6-6). Minimum monthly entrainment of larvae/juveniles by both Unit 1 and 2 was associated with the monthly interval of May 7 through June 7. The minimum number of larvae/juveniles entrained on a monthly basis was 1.1 million for Unit 1 and 550,000 for Unit 2. Maximum entrainment of larvae/juveniles by both units occurred during the monthly interval of August 10 through 30. This period represents only 0.66 months or 20 days of the monthly interval employed. Maximum entrainment of larvae/juveniles during this period was 13.9 million for Unit 1 and 4.7 million for Unit 2 (Figure 6-6).

6.3.4 Annual Entrainment Estimate

Annual entrainment was calculated as the sum of the weekly estimates for the period of April-August. Unit 1 entrained an estimated 5.6 million eggs (excluding those identified as damaged). Unit 2 entrained an estimated 6.4 million eggs (excluding those identified as damaged). Unit 1 entrained an estimated 24 million larvae during the monitoring period. Unit 2 entrained an estimated 10.5 million larvae during the same period. From these observations total egg entrainment is slightly greater for Unit 2 than for Unit 1. However, entrainment of fish larvae was dominated by Unit 1, which entrained almost twice the number of larvae as Unit 2.

6.3.5 Seasonal Entrainment Estimates

The entrainment monitoring program extended from April 6-August 30, 1994. The duration of the program included the seasonal period of mid to late spring and most of the summer season. Entrainment of fish eggs was largely confined to the spring for both units (Figure 6-7). Estimated entrainment of fish eggs by Unit 1 was 13.5 million eggs and 8.4 million eggs for Unit 2. Summer estimates for egg entrainment were well below those observed during the spring. The absence of eggs from samples collected during the summer resulted in zero eggs entrained by Unit 2 during that season (Figure 6-7). Entrainment of eggs by Unit 1 was reduced to 724,000 eggs, well below the spring estimate (Figure 6-7).

Entrainment of larvae and juveniles displayed the opposite trend as egg entrainment for both units, as would be expected with growth and development. Greater entrainment of larvae and juveniles was associated with the summer than with the spring season (Figure 6-8). As observed in egg entrainment, Unit 1 entrained more larvae and juveniles than Unit 2 during both the spring and summer season. Entrainment of larvae and juveniles by Unit 1 was 6.6 million

larvae in spring and 23.6 million larvae in summer. In contrast to these numbers, Unit 2 entrained a total of 2.6 million larvae in spring and 8.8 million larvae in summer (Figure 6-8).

6.4 RIS SPECIES - SPECIFIC ENTRAINMENT ESTIMATE

The taxonomic identification of fish eggs and larvae collected in the entrainment samples was carried out to the lowest practical taxon. In most cases this was to the genus level, although certain groups of fish larvae, because of poorly developed generic characteristics, could only be identified to family level. Certain larvae of the family Centrarchidae were identified as *Lepomis* sp., but other larvae could only be identified to the family level with certainty. Therefore larvae/juveniles identified only as Centrarchidae may actually represent several genera, including *Lepomis* (sunfish) and *Micropterus* (warmwater basses).

Several genera identified from the entrainment samples represented multiple species found within SCR. Examples of genera collected with multiple species associated with SCR populations are *Dorosoma* (*D. petenense*, *D. cepedianum*) and *Lepomis* (*L. macrochirus*, *L. megalotis*, *L. microlophus*). Therefore, these groups were collectively identified as the shads and sunfishes in the entrainment analysis. Some genera that were identified from the samples represent a single reproducing species within SCR, i.e., *Morone* (*M. chrysops*), *Aplodinotus* (*A. grunniens*), *Menidia* (*M. beryllina*) and *Pomoxis* (*P. annularis*). Eggs which were damaged could not be identified to a specific taxon due to ruptured cell walls, various stages of decomposition, or ruptured or damaged internal structures (e.g., myromeres, oil globules). Damage may be the result of natural causes or abrasion from the plankton net during sampling; however, for the most part, the exact cause, whether natural or sampling related, could not be determined.

6.4.1 Daily Entrainment Estimate

Total daily RIS icthyoplankton entrainment comprised 62 percent and 65 percent, respectively, of the individuals entrained by Unit 1 and Unit 2. Total daily RIS icthyoplankton entrainment was greater for Unit 1 (4,264,062 RIS individuals entrained-eggs, larvae, and juveniles) than for Unit 2 (1,887,718 individuals entrained). Those eggs and larvae which could not be identified due to damage were classified simply as "damaged eggs" and "damaged larvae", and were assumed conservatively to be RIS species. Nighttime RIS entrainment was greater than daytime RIS entrainment for both Units 1 and 2. This reflects typical diurnal differences in ichthyoplankton behavior within a water column. Daytime and nighttime RIS entrainment by Unit 1 averaged 78,902 and 124,149 individuals entrained, respectively, over all sample periods (April 6 through August 10, 1994). Daytime and nighttime RIS entrainment by Unit 2 averaged 41,119 and 48,772 individuals entrained, respectively. Daily RIS entrainment by Unit 1 of the CPSES CWS was lower during the Spring sampling events (April 6, through June 15, 1994) than during the summer sampling events (June 22 through August 24, 1994). The average RIS entrainment by Unit 1 during the Spring sampling events was 153,014 individuals entrained, and the average

RIS entrainment by Unit 1 during the Summer sampling events was 258,090 individuals entrained. The average daily RIS entrainment by Unit 2 was also lower during the Spring sampling events (82,237 individuals entrained) than during the summer sampling events (98,311 individuals entrained). The average RIS entrainment by Unit 1 during the Spring sampling events was 153,014 individuals, and the average RIS entrainment by Unit 1 during the Summer sampling events was 258,090 individuals.

The greatest daily RIS entrainment by Unit 1 occurred on June 22, 1994 (701,561 individuals entrained). The greatest daily RIS entrainment by Unit 2 occurred on August 10, 1994 (401,063 individuals entrained). No individuals were entrained by either Unit on several of the sampling events (May 25, June 1, July 20, and July 27, 1994). The greatest daytime RIS entrainment by Unit 1 occurred on August 17, 1994 (518,667 individuals entrained). The greatest daytime RIS entrainment by Unit 2 occurred on August 10, 1994 (382,947 individuals entrained). No RIS individuals were entrained during the daytime by either Unit on several of the sampling events (May 25, June 1, June 29, July 20, and July 27, 1994). In addition, no RIS individuals were entrained during the daytime by Unit 2 on June 22, 1994. The greatest nighttime RIS entrainment by Unit 1 and Unit 2 occurred on June 22, 1994 (666,158 and 164,419 individuals entrained, respectively). No RIS individuals were entrained during the nighttime by either Unit on several of the sampling events (April 1, July 6, and July 27, 1994). In addition, no RIS individuals were entrained during the nighttime by Unit 1 on April 8, April 20, and July 10, 1994, and no RIS individuals were entrained by Unit 2 on July 13, 1994.

The RIS which experienced greatest daily entrainment was *Dorosoma*. 424,500 shad larvae were entrained by Unit 1 on April 6, 1994. The RIS experiencing daily entrainment in the greatest numbers after the shad was larvae of the family *Centrarchidae*. 391,617 of these larvae were entrained by Unit 1 on June 22, 1994. The life stage experiencing the greatest daily entrainment was larvae, since *Centrarchidae* eggs are spawned/protected in nests. The RIS entrained most frequently was *Aplodinotus*, a species which broadcasts its eggs in a pelagic (open water) habitat. Drum were entrained on eight of the twenty-one sampling events by Units 1 and 2. The RIS entrained least frequently was *Morone*. This RIS was entrained on one sample event by Unit 2 and on four sample events by Unit 1. *Dorosoma* and *Menidia* were most commonly entrained at night, while *Lepomis* was most commonly entrained during the day. *Aplodinotus* and *Morone* were entrained during both nighttime and daytime with equal frequency. *Aplodinotus*, however, was entrained in greater numbers at night, while *Morone* was entrained in greater numbers during the day.

6.4.2 Weekly Entrainment Estimate

Fish eggs collected from in front of both Unit 1 and Unit 2 were limited to two taxa, *Aplodinotus* and *Menidia*, and eggs identified as damaged. For both units, egg stages were collected during the weeks between April 6- June 29. Both genera whose eggs were identified were RIS for this

demonstration. Damaged eggs were also identified from collections from both the Unit 1 and Unit 2 intake. *Aplodinotus* eggs were entrained with greater frequency and in larger numbers than *Menidia*. Weekly entrainment of *Aplodinotus* eggs followed similar trends for both Unit 1 and 2 (Figures 6-9 and 6-10). Three distinct entrainment peaks for this taxon are observed. These weekly peaks in *Aplodinotus* egg entrainment occurred during the weekly intervals of May 4-10, May 18-24 and June 15-21. Maximum weekly entrainment for both units was associated with the period of May 18-24. During this period, the weekly entrainment of *Aplodinotus* eggs was 2,176,314 eggs by Unit 1 and 1,088,157 eggs by Unit 2. The secondary peaks in entrainment of this taxon on May 4-10 and June 15-21 were 1,185,044 eggs and 799,739 eggs for Unit 1 and 592,207 eggs and 599,529 eggs for Unit 2. Each unit displayed a fourth peak in *Aplodinotus* egg entrainment although this peak occurred at different weekly intervals for both units. For Unit 1, 251,111 *Aplodinotus* eggs were entrained during the interval of April 13-14 (Figure 6-9). For Unit 2, this fourth peak is far more apparent, with 765,422 *Aplodinotus* eggs entrained during April 6-12, the first week of entrainment sampling for CPSES (Figure 6-10).

Menidia eggs displayed less temporal similarity than *Aplodinotus* in comparing Unit 1 and 2 entrainment data. Entrainment of *Menidia* eggs was highly variable during the monitoring period for both Unit 1 and Unit 2. Three distinct peaks are apparent in *Menidia* egg entrainment by Unit 1. Weekly intervals of entrainment were identified as April 13-19, May 11-17 and June 22-28 (Figure 6-9). The maximum observed for *Menidia* egg entrainment was 272,041 eggs for Unit 1 during the interval of May 11-17 (Figure 6-19). Three distinct peaks are apparent from the Unit 2 monitoring . These three peaks are associated with the weekly intervals of April 6-12, April 20-26, and May 11-17 (Figure 6-10). Maximum weekly entrainment of *Menidia* eggs by Unit 2 was 136,017 eggs for the period of May 11-17. The remaining weekly entrainment numbers ranged from a low of 66,962 eggs (April 29-May 3) to 134,498 eggs (April 6-12) for the remaining periods.

Damaged eggs were collected throughout the period of April 6-June 28. Weekly maxima for both units were associated with the interval of April 27-May 3. The weekly maximum for Unit 1 during this period was 4,974,130 eggs and 2,487,065 eggs for Unit 2 (Figures 6-9 and 6-10). A prominent second peak in weekly entrainment of damaged eggs is apparent for Unit 2 during the period of June 15-21 (Figure 6-10). Weekly entrainment of damaged eggs for Unit 2 during this period was 1,453,319 eggs.

Weekly entrainment of fish larvae was highly variable with each genera displaying multiple peaks in entrainment during the field program. *Dorosoma* (shads; inclusive of *D. petenense* and *D. cepedianum* in SCR) larvae were entrained weekly from Unit 1 and 2 during the period of April 6-May 31. Maximum weekly entrainment of *Dorosoma* larvae by Unit 1 was observed during the weekly interval of April 6-12 (Figure 6-11). Weekly entrainment of *Dorosoma* by Unit 1 during this period was 2,971,500 larvae. During this same weekly period, Unit 2 entrained an estimated 701,540 larvae (Figure 6-12). Both Unit 1 and 2 weekly estimates displayed a secondary peak

during the period of May 10-31 (Figure 6-11 and 6-12). Weekly entrainment maxima during this period was 460,376 larvae for Unit 1 and 230,188 larvae for Unit 2. Maximum weekly entrainment for both units during this secondary peak was the period of May 4-10. No *Dorosoma* larvae were entrained after the week of May 25-31.

Aplodinotus (drum; represented by the single species *A. grunniens* in SCR) larvae were entrained during two distinct peaks in weekly entrainment by both Unit 1 and Unit 2. For Unit 1, the first peak occurs during the weeks enclosed between June 1 through July 5 (Figure 6-11). The second peak in weekly entrainment was associated with the weeks between July 27 through August 16. Although both units displayed the same periods of weekly entrainment maxima, Unit 2 entrained fewer *Aplodinotus* larvae and lacked the distinct peaks associated with Unit 1 weekly estimates. The Unit 1 weekly maximum for the first peak was 242,739 larvae, and 1,445,990 larvae was the weekly maximum for the second peak observed (Figure 6-11). Weekly maximum in *Aplodinotus* larvae entrainment by Unit 2 displayed a much smaller first peak than observed in Unit 1. Weekly maximum for the first peak was 182,056 larvae during the period of June 15 through 21. The weekly maximum for the second peak, 981,435 larvae, was observed during August 3 through 9 and was the greatest weekly entrainment of *Aplodinotus* larvae by Unit 2 (Figure 6-12).

Lepomis (sunfish; inclusive of *L. macrochirus*, *L. micropholus* and *L. megalotis* in SCR) also displayed two distinct peaks during entrainment monitoring for both units. Weekly maxima for both periods of peak entrainment for this genus were associated with the latter weeks of the monitoring program. For Unit 1, the first peak in *Lepomis* larvae entrainment observed was associated with the period of June 29 through July 26. The second peak observed in the weekly entrainment estimates occurred during the period of August 3 through to the end of the entrainment monitoring program on August 24 (Figure 6-11). Maximum weekly entrainment during each of these peak periods occurred during the weeks of July 6-July 12 and August 17-23. Maximum weekly entrainment of *Lepomis* larvae was 1,014,916 larvae for the first peak observed and 2,069,592 larvae during the second peak. Like Unit 1, Unit 2 entrainment of *Lepomis* larvae displayed two major peaks in weekly entrainment. However, entrainment during both periods were well below that observed for Unit 1. One peak extended across the weekly intervals from June 29 through July 20. Entrainment during this period remained relatively consistent with the maximum weekly number of *Lepomis* entrained ranging 117,180-129,528 larvae weekly. A second peak in weekly entrainment was observed during the period of August 3 through August 24. The maximum weekly entrainment observed during this peak was 1,820,567 larvae for the interval of August 10-16 (Figure 6-12).

Menidia (silversides; a single species, *M. beryllina* occurring in SCR) larvae were entrained during three weekly periods by Unit 1 and a single weekly period by Unit 2. *Menidia* larvae were entrained by Unit 1 during the periods of April 6-12, May 4-10 and June 22-28 (Figure 6-11). Corresponding weekly entrainment of *Menidia* larvae during the above period were 219,723,

153,391 and 170,128. Weekly entrainment of *Menidia* by Unit 2 was limited to the weekly interval of May 4-10 (Figure 6-12). Maximum weekly entrainment of this genus by Unit 2 for this period was 76,377 larvae.

Morone (temperate basses; inclusive of a single species, *M. chrysops*, reproducing in SCR) larvae displayed two weekly entrainment peaks for Unit 1 and only a single weekly peak for Unit 2. *Morone* larvae were first entrained by Unit 1 during the week of June 22 through 28 (Figure 6-11). Weekly entrainment was estimated as 170,128 larvae during this period. A second peak in weekly *Morone* larvae entrainment occurred during the period of August 10-23 (Figure 6-11). The maximum weekly entrainment by Unit 1 was 1,625,953 larvae and occurred during the weekly interval of August 17 through 23. For Unit 2, weekly entrainment of *Morone* larvae was isolated to the period of August 10-16 (Figure 6-12). Maximum weekly entrainment of *Morone* larvae during this interval was 986,874 larvae, respectively.

Larvae identified as belonging to the family Centrarchidae (includes all sunfishes and warmwater basses) were entrained in larger numbers by Unit 1 than by Unit 2. A major peak in weekly entrainment was observed in Unit 1 during the period of June 22-28 (Figure 6-11). Weekly entrainment of individuals identified to this family was 2,741,319 larvae during this peak in weekly entrainment. Similarly, a peak in weekly entrainment of Centrarchidae by Unit 2 was observed during the period of June 22-28 (Figure 6-12). Weekly entrainment by Unit 2 during this peak was 1,031,660 larvae.

6.4.3 Monthly Entrainment Estimate

The duration of the entrainment monitoring program extended a total of 4.5 months. Fish eggs were entrained during the first three months of the monitoring program. The only genera identified from the eggs collected were *Aplodinotus* and *Menidia*. For both units, *Aplodinotus* eggs were consistently entrained in greater numbers per monthly interval than *Menidia*. Peak monthly entrainment of *Aplodinotus* eggs by both units occurred during the monthly interval of May 7-June 7 (Figures 6-13 and 6-14). Highest monthly maximums for *Aplodinotus* egg entrainment was 3,349,845 eggs, which was approximately double the maximum observed for Unit 2 for the same period. Based on these data, spawning of freshwater drum in SCR appears to occur during the month of May.

Menidia eggs were entrained for the same duration as *Aplodinotus* eggs. Monthly entrainment of eggs by Unit 1 remained fairly consistent during the monitoring period (Figure 6-13) Monthly entrainment for *Menidia* eggs by Unit 1 ranged from 169,498 to 272,041 eggs. The maximum monthly entrainment period was associated with the period of May 7-June 7. Unit 2 monthly entrainment of eggs from this genus displayed a steady decrease in monthly entrainment over the three monthly intervals they were observed. Maximum monthly entrainment by Unit 2 was

304,225 eggs during the period of April 6 - May 6. Monthly entrainment of eggs by Unit 2 declined to 136,017 eggs for the monthly interval of May 7 - June 7 (Figure 6-14).

RIS larvae displayed distinct patterns in monthly entrainment for both Unit 1 and Unit 2. *Dorosoma* and *Menidia* larvae were entrained during the first two months of the program by both Unit 1 and 2 (Figure 6-15 and 6-16). Peak monthly entrainment for *Dorosoma* by Unit 1 was associated with the period of April 6-May 6. Total entrainment of *Dorosoma* larvae was estimated to be 4,741,529 larvae. Entrainment of *Dorosoma* by Unit 2 for the same period was estimated to be 1,773,498 larvae. *Menidia* larvae were entrained in much lower numbers than *Dorosoma*. Similar to the shads, *Menidia* were entrained in largest number during the period of April 2 - May 6. Maximum entrainment was 285,462 larvae for Unit 1 and 32,733 larvae for Unit 2.

The remaining RIS entrained by the CPSES CWS were largely entrained around the mid-point or later months of the monitoring program. With regards to the former, *Aplodinotus* and individuals identifiable as Centrarchidae were entrained by both units during the periods of June 8-July 8 and July 9-August 9 (Figure 6-15 and 6-16). Entrainment of both genera was greater for Unit 1 than for Unit 2. Maximum monthly entrainment of *Aplodinotus* larvae by Unit 1 was 2,041,753 larvae for the interval of June 8-July 8. Maximum monthly entrainment of *Centrarchidae* by Unit 1 was 2,741,319 larvae. Although Unit 2 entrained both of these genera during the same period, monthly entrainment of both was lower than Unit 1. Maximum monthly entrainment of *Aplodinotus* larvae Unit 2 was 981,435 larvae for the period of July 9-August 9. Maximum monthly entrainment of *Centrarchidae* by Unit 2 was 1,031,660 larvae for the interval of June 8-July 8.

Monthly entrainment of *Lepomis* and *Morone* larvae was limited to the last two periods for both units. Maximum monthly values for both of these genera occurred during the partial monthly interval of August 10-August 30 (Figure 6-15 and 6-16). Maximum monthly entrainment of *Lepomis* larvae by Unit 1 was 5,388,467 larvae (includes juveniles). The monthly maximum for Unit 2 for the same period was 3,126,354 larvae. As observed with *Lepomis*, monthly entrainment of *Morone* larvae was concentrated during the period of August 10-August 30. Total monthly entrainment of *Morone* by Unit 1 was 4,208,205 larvae. Monthly entrainment of this genus by Unit 2 was 986,874 larvae.

6.4.4 Annual Entrainment Estimate

Assuming that the period of April through August represents that portion of the year during which entrainment will occur (i.e., spawning of most species within SCR), five genera of RIS and one family of fish were entrained by the CPSES. As observed previously, Unit 1 entrained more larvae than Unit 2. However, Unit 2 entrained a greater number of fish eggs than Unit 1. Most of the eggs entrained were either damaged or *Aplodinotus*. Eggs and larvae of *Aplodinotus* and

Menidia were entrained by both Unit 1 and Unit 2. Unit 1 entrained 4.9 million *Aplodinotus* eggs and 721,945 *Menidia* eggs. In comparison, Unit 2 entrained 5.7 million *Aplodinotus* eggs and 722,372 *Menidia* eggs. Excluding those eggs identified as damaged beyond identification, these were the only RIS taxa which had eggs and larvae entrained by both units. *Aplodinotus* larvae were entrained by both Units 1 and 2. Total entrainment of larvae was 3.5 million for Unit 1 and 1.5 million for Unit 2. Unit 1 entrained an estimated total of 543,242 *Menidia* larvae. Unit 2 was estimated to entrain 152,761 *Menidia* larvae.

Total entrainment for *Dorosoma* larvae was estimated to be 5.8 million for Unit 1 and 3.2 million for Unit 2. Total entrainment of *Lepomis* larvae was estimated to be 6.7 million larvae for Unit 1 and 3.5 million larvae for Unit 2. Total entrainment of *Morone* larvae was estimated to be 4.4 million for Unit 1 and 986,874 larvae for Unit 2. Larvae identified to the family Centrarchidae (sunfish and warmwater basses) were entrained in greater number by Unit 1 than by Unit 2. On an annual basis, Unit 1 entrained approximately twice the number of larvae of this family as Unit 2. Unit 1 entrained an estimated total of 3.1 million *Centrarchidae* larvae compared to Unit 2 which entrained 1.3 million larvae. Overall, total entrainment of RIS eggs was dominated by Unit 2 and RIS larvae entrainment was dominated by Unit 1.

6.4.5 Seasonal Entrainment Estimate

The entrainment monitoring was conducted during the latter period of spring and the early part of summer. Entrainment of individual RIS eggs and larvae displayed a high degree of seasonality for both Unit 1 and Unit 2. Both *Aplodinotus* and *Menidia* eggs were almost exclusively entrained during the Spring with no *Aplodinotus* eggs being entrained during the summer period by either Unit 1 or Unit 2 (Figure 6-17 and 6-18). Approximately 31 percent of the *Menidia* eggs entrained by Unit 1 were associated with the early part of the summer season (Figure 6-17). No *Menidia* eggs were entrained by Unit 2 during the summer. Based upon these observations, spawning by freshwater drum and inland silversides appears to occur exclusively during early to mid spring in SCR.

Distinct seasonality of RIS larvae entrainment was apparent by both Unit 1 and Unit 2. The only RIS which displayed a restrictive occurrence during either season was the genus *Dorosoma*. Entrainment of *Dorosoma* larvae by both Unit 1 and 2 occurred exclusively during the spring (Figures 6-19 and 6-20). Although entrained in relatively low numbers as compared to the other genera, *Menidia* displayed a seasonal pattern of being entrained during late spring and early summer. Entrained during both seasons, greater numbers (69 percent of total for Unit 1 and 100 percent for Unit 2) of this genus were entrained during the spring. *Aplodinotus* larvae displayed the opposite trend as *Menidia*. The greatest percentage of entrained larvae were associated with the summer season. For Unit 1, 89 percent of *Aplodinotus* larvae entrainment occurred during the early summer (Figure 6-19). For Unit 2, 79 percent of drum larvae were entrained during the early part of summer (Figure 6-20). The remaining larvae of genera entrained by both

Unit 1 and Unit 2, including *Lepomis*, *Morone* and the family Centrarchidae, were exclusively entrained during the summer (Figures 6-19 and 6-20). Larvae of all three of these taxa were entrained in the greatest number during the last two weeks of the monitoring program.

7.0 IMPACT ASSESSMENT

The 316(b) guidance document acknowledges that some degree of impact is to be associated with operation of a power plant CWS. However, the degree of impact must be evaluated on a case-by-case basis because of the many factors to be considered in impingement and entrainment studies. The language of section 316(b) of P.L. 92-500 requires cooling water intakes to "minimize adverse environmental impact." Some level of intake damage can be acceptable if that damage represents a minimization of environmental impact.

The guidance document provides the following description and definition of the phase "adverse environmental impact".

> "Adverse aquatic environmental impacts occur whenever there will be entrainment or impingement damage as a result of the operation of a specific cooling water intake structure. The critical question is the magnitude of any adverse impact.
>
> The magnitude of an adverse impact should be estimated both in terms of short term and long term impact with reference to the following factors:
>
> 1. Absolute damage (# of fish impinged or percentage of larvae entrained on a monthly or yearly basis);
>
> 2. Percentage damage (% of fish or larvae in existing populations which will be impinged or entrained, respectively);
>
> 3. Absolute and percentage damage to any endangered species;
>
> 4. Absolute and percentage damage to any critical aquatic organism;
>
> 5. Absolute and percentage damage to commercially valuable and/or sport fisheries yield; or
>
> 6. Whether the impact would endanger (jeopardize) the protection and propagation of a balanced population of shellfish and fish in and on the body of water from which the cooling water is withdrawn (long term impact)."

As part of the CPSES 316(b) demonstration, impacts associated with the operation of the CPSES CWS were evaluated both in terms of absolute damage (short term impacts) and for long term effects (SCR studies). Absolute damages associated with impingement and entrainment were presented as total number of fish impinged or eggs or larvae entrained per unit time based upon operating conditions observed during the monitoring program. Impingement sampling

represented a direct measurement of individuals impinged per unit time and thus is considered a real time impact in the assessment. Entrainment requires a more rigorous approach in assessment because of the temporal differences in ichthyoplankton abundance and the variable nature of ichthyoplankton distribution and abundance. Additionally, the limited motor ability of most larvae render these stages more susceptible to the CWS zone-of [withdrawal] influence in SCR. This is directly related to the total number of CWS pumps in operation as well as density of ichthyoplankton in front of the intakes. Therefore, to fully assess a worst case scenario for entrainment, ichthyoplankton densities observed during this monitoring program were extrapolated to potential population impacts using maximum withdrawal rates (i.e., rated capacities, or 8 CWS pumps) for both units for the entire spawning period. Under this worst case scenario, entrainment of fish eggs and larvae by both Unit 1 and Unit 2 was evaluated. One hundred percent (100%) condenser passage mortality was assumed, in order to be conservative.

7.1 METHODS FOR THE IMPACT ASSESSMENT

Three methodologies for assessment of impacts, both short and long term, were applied. For evaluation of the fisheries community structure and relative abundance of species within SCR, a series of community structure surveys were conducted. The underlying purpose of these surveys was to provide current data concerning the community structure and abundance of fish species in SCR as compared to previous preoperational surveys conducted by Hellier et al. (1987). The surveys employed sampling methods similar to those used by Hellier et al. (1987). Five stations were sampled which closely corresponded to those sampled previously by Hellier et al. (Figure 7-1).

The objective of these surveys was to evaluate plant-induced mortality, due to entrainment and impingement, on the fish populations of SCR. Collection methods for these surveys included the use of gill nets and electroshocking. Experimental gill nets 61.5 m (200 ft.) in length, 2.5 m (8 ft.) in depth with panels of varying mesh size (0.5 to 4 inches) were deployed at each of the five sampling stations identified (Figure 7-1). At all five locations, gill nets were deployed overnight for a total set time of 12 hours. All nets were retrieved the following morning and the fish identified to species, measured for total length and weighed. Electroshocking surveys were conducted at or near the same five stations sampled using gill nets. A boat mounted Colfelt AC unit generator was employed for sampling. Each station was sampled using a standard period of shocking effort (per unit time). Like the gill net samples, all fish collected during shocking were identified to species, measured to total length and weighed. Species, length and weight data collected during the survey were recorded on a standard fisheries field sheet. Surveys were conducted in November 1993, June 1994 and February, June and August, 1995.

In addition to the community structure surveys conducted, the 1994 creel survey of anglers was repeated during the period of April-June 1995. Results of the creel surveys were used to semi-quantitatively evaluate potential impacts (if any) of the CWS on recreational angling in SCR.

7.2 COMPARISON OF RIS ABUNDANCE IN SCR TO ENTRAINMENT AND IMPINGEMENT LOSSES

A worst case entrainment scenario was applied as discussed above for evaluation of entrainment losses. Using Equation 1 and the ichthyoplankton density data collected during the monitoring program, a daily entrainment estimate of ichthyoplankton was calculated for both Unit 1 and Unit 2 at 100 percent capacity (4 CWS pumps per unit, or 8 total). Daily entrainment estimates were extrapolated to weekly estimates using Equation 4 and weekly estimates were summed for total projected entrainment for the period of April through August. That projected number is not equivalent to the number of fish potentially lost to the population, however, because most of the species subject to entrainment by the CPSES spawn thousands of eggs just to produce one adult. To approximate the number of "equivalent" adults actually necessary to have produced the number if ichthyoplankton estimated to have been entrained by the CPSES, the species-specific entrainment estimates were divided by the reported fecundities (numbers of eggs/female) of each species. Thus for example, 1,000,000 eggs/larvae entrained of a species with a fecundity of 100,000 could have been produced by 10 "equivalent" adults.

Annual impingement losses attributed to the operation of the CPSES CWS were compared to impingement losses of nuclear generating plants of similar generating capacities, cooling water intake design, cooling water source waters and monitoring periods. These data were acquired from the Argonne National Laboratory survey of fish impingement at power plants publication (Freeman, III and Sharma 1977). Total annual losses of fish (i.e., actual impingement losses and equivalent adults from entrainment) were evaluated for the CPSES CWS. It is acknowledged that separation and assignment of impingement losses to either unit is not possible due to the common traveling screen cleaning system which did not differentiate between Unit 1 and Unit 2 screen washings. Using the SCR surveys data, total losses of fish due to the effects of impingement and entrainment were compared to RIS abundance in SCR.

7.2.1 RIS Abundance in Water Body versus Impingement and Entrainment Characteristics

The two techniques utilized to sample the fish community in the SCR (electrofishing and gill nets) are each, to some extent, selective for certain species and/or age groups (Hubert, 1983). The use of gill nets is a passive sampling technique, and will tend to yield greater numbers of pelagic schooling species (i.e., gizzard shad, white bass, young largemouth and smallmouth bass) and benthic species (i.e., carp, channel catfish, fw drum). Electroshocking is an active technique that yields greater numbers of littoral species, such as sunfish, largemouth bass and threadfin shad (Reynolds, 1983).

A total of 2,039 fish of twenty species were collected from the sampling stations during the surveys. Table 7-1 summarizes the species collected from SCR during the fishery surveys. Complete data summaries of the fishery surveys are provided in Appendix G of this demonstration.

November 1993 Sampling

Gill Net Survey

A total of 198 fish of eleven species were collected from the SCR in November, 1993 utilizing gill nets (Figure 7-2). Overall, the dominant taxa was the channel catfish (*Ictalurus punctatus*), comprising 29 percent (60 fish collected) of the total. Gizzard shad (*Dorosoma cepedianum*), white bass (*Morone chrysops*), and carp (*Cyprinus carpio*) were the most common taxa other than the channel catfish, comprising 13 percent (26 fish collected), 12 percent (24 fish collected), and 17 percent (36 fish collected) of the total, respectively. The remaining seven species each comprised between 10 percent and 1 percent of the total (Figure 7-2). These were the largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis annularis*), freshwater drum (*Aplodinotus grunniens*), threadfin shad (*Dorosoma petenense*), black crappie (*Pomoxis nigromaculatus*), smallmouth bass (*Micropterus dolomieui*), and bluegill sunfish (*Lepomis macrochirus*).

Electroshocking Survey

A total of 199 fish were collected from the SCR in November, 1993 utilizing electroshocking. Ten taxa were collected (Figure 7-3). Overall, the dominant taxa was the bluegill sunfish (*Lepomis macrochirus*) , comprising 62 percent (125 fish collected) of the total. The fish collected in the greatest abundance other than the bluegill was the green sunfish (*Lepomis cyanellus*), comprising 11 percent (23 fish collected) of the total. The remaining eight taxa each comprised between 6 percent and 1 percent of the total number of fish collected. These were channel catfish (*Ictalurus punctatus*), longear sunfish (*Lepomis megalotis*), inland silversides (*Menidia beryllina*), threadfin shad (*Dorosoma petenense*), largemouth bass (*Micropterus salmoides*), gizzard shad (*Dorosoma cepedianum*), carp (*Cyprinus carpio*), and blacktail shiner (*Notropis venustis*). The dominant family collected from the Squaw Creek Reservoir by electrofishing in November, 1993 was the family Centrarchidae, represented in the reservoir by the sunfish and the warm water basses. The family Centrarchidae comprised approximately 82 percent of the total number of fish collected.

June 1994 Sampling

Gill Net Survey

A total of 149 fish were collected from the SCR in June, 1994 utilizing gill nets. Eleven taxa were collected (Figure 7-4). Overall, the dominant taxa was the channel catfish (*Ictalurus punctatus*), comprising 41 percent (63 fish collected) of the total. Gizzard shad (*Dorosoma cepedianum*), and carp (*Cyprinus carpio*) were the most common taxa other than the channel catfish, comprising 19 percent (28 fish collected), and 12 percent (18 fish collected) of the total, respectively. The remaining eight species each comprised less than 10 percent of the total (Figure 7-4). These were the smallmouth bass (*Micropterus dolomieui*), freshwater drum (*Aplodinotus grunniens*), white bass (*Morone chrysops*), largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis annularis*), bluegill sunfish (*Lepomis macrochirus)*, threadfin shad (*Dorosoma petenense*), and blacktail shiner (*Notropis venustis*).

Electroshocking Survey

A total of 468 fish were collected from the SCR in June, 1994 utilizing electroshocking. Five taxa were collected (Figure 7-5). Overall, the dominant taxa was the threadfin shad (*Dorosoma petenense*), comprising 76 percent (358 fish collected) of the total. The fish collected in the greatest abundance other than the threadfin shad was the inland silverside (*Menidia beryllina*), comprising 19 percent (87 fish collected) of the total. The remaining three taxa each comprised between 4 percent or less of the total number of fish collected. These were channel catfish (*Ictalurus punctatus*), green sunfish (*Lepomis cyanellus*), and yellow bullhead (*Ameiurus natalis*).

February 1995 Sampling

Gill Net Survey

A total of 187 fish were collected from SCR using gill nets during the February 1995 survey. The total catch comprised eleven taxa. Dominant taxa collected included channel catfish (*Ictalurus puntatus*) (70 fish collected) and gizzard shad (*Dorosoma cepedianum*) (67 fish collected) which combined accounted for 73 percent of all individuals collected (Figure 7-6). White bass (*Morone chrysops*) (25 fish collected) comprised 13 percent of all individuals collected during the survey. Largemouth and smallmouth bass (*Micropterus salmoides* and *Micropterus dolomieui*) combined represented 5 percent of the individuals collected during the survey. Other species collected included bluegill sunfish (*Lepomis macrochirus*), carp (*Cyprinus carpio*), f.w. drum (*Aplodinotus grunniens*), threadfin shad (*Dorosoma petenese*) and black and white crappie (*Pomoxis nigromaculatus* and *Pomoxis annularis*). Combined, these six species represented 8 percent of all individuals collected during the February survey (Figure 7-6).

Electroshocking Survey

A total of 264 fish representing eight species were collected from the SCR during the February 1995 electroshocking survey. The sample was dominated by threadfin shad (*Dorosoma petenese*) (233 fish collected) which accounted for 88 percent of the total catch (Figure 7-7). The species collected in the second greatest abundance was the bluegill sunfish (*Lepomis macrochirus*) (16 fish collected) which represented 6 percent of all fish collected. Other species collected included gizzard shad (*Dorosoma cepedianum*), carp (*Cyprinus carpio*), green sunfish (*Lepomis cyanellus*), channel catfish (*Ictalurus puntatus*), inland silverside (*Menidia beryllina*) and golden shiner (*Notemigonus crysoleucas*). Combined, these other species accounted for 6 percent of the total catch during the June 1995 survey.

June 1995 Sampling

Gill Net Survey

A total of 180 fish representing thirteen species were collected from SCR during the June 1995 gill net survey. The sample was dominated by gizzard shad (*Dorosoma cepedianum*)(72 fish collected) and channel catfish (*Ictalurus puntatus*)(58 fish collected). These two species accounted for 41 percent and 32 percent of the total June 1995 gill net catch (Figure 7-8). Smallmouth bass (*Micropterus dolomieuii*), largemouth bass (*Micropterus salmoides*) and white bass (*Morone chrysops*) each accounted for 6 percent (11 fish for each species) or 18 percent combined of the total catch. Other species collected during the survey included f.w. drum (*Aplodinotus grunniens*), threadfin shad (*Dorosoma petenese*), carp (*Cyprinus carpio*), bluegill sunfish (*Lepomis macrochirus*), redbreast sunfish (*Lepomis auritus*), green sunfish (*Lepomis cyanellus*), blacktail shiner (*Cyprinella venusta*) and blue catfish (*Ictalurus furcatus*). Combined these eight other species accounted for 9 percent of the total catch.

Electroshocking Survey

Only 35 fish representing eight species were collected during the June 1995 electroshocking survey. Channel catfish (*Ictalurus puntatus*) (13 fish collected) and inland silverside (*Menidia beryllina*)(7 fish collected) were the two most abundant fish collected during this survey (Figure 7-9). Threadfin shad (*Dorosoma petenese*) (5 fish collected) and bluegill sunfish (*Lepomis macrochirus*) (3 fish collected) accounted for 14 percent and 9 percent of the catch from the survey. The blacktail shiner (*Cyprinella venusta*), largemouth bass (*Micropterus salmoides*) and green sunfish (*Lepomis cyanellus*) each accounted for 6 percent (2 fish collected for each species) of the total catch (Figure 7-9). Gizzard shad (*Dorosoma cepedianum*)(1 fish collected) accounted for only 3 percent of the total catch from the survey.

August 1995 Sampling

Gill Net Survey

A total of 252 fish of ten species were collected by gill net during the August 1995 survey. The most abundant species collected were the channel catfish (*Ictalurus puntatus*) (86 fish collected) and gizzard shad (*Dorosoma cepedianum*)(67 fish collected). These two species accounted for 34 percent and 27 percent of the total number of individuals collected (Figure 7-10). Bluegill sunfish (*Lepomis macrochirus*) (46 fish collected), largemouth bass (*Micropterus salmoides*) (25 fish collected) and f.w. drum (*Aplodinotus grunniens*) (20 fish collected) represented 18, 10 and 8 percent of the total catch. Other species which were captured at a frequency of < 1 percent (less than 4 fish per species collected) individually included blue catfish (*Ictalurus furcatus*), carp (*Cyprinus carpio*), flathead catfish (*Pylodictis olivaris*), smallmouth bass (*Micropterus dolomieui*) and white bass (*Morone chrysops*). Combined, these five species accounted for only 3 percent of the total catch during this survey period.

Electroshocking Survey

A total of 89 fish representing eight species were collected during the August electroshocking survey. Relative abundance was dominated by channel catfish (62 fish collected) which represented 70 percent of the total catch collected during this survey. Gizzard shad (*Dorosoma cepedianum*) and threadfin shad (*Dorosoma petenese*) represented 10 and 8 percent of the total catch (Figure 7-11). The remaining five species including bluegill sunfish (*Lepomis macrochirus*), redbreast sunfish (*Lepomis auritus*), inland silverside (*Menidia beryllina*), yellow bullhead (*Ameriurus natalis*) and green sunfish (*Lepomis cyanellus*) individually represented less than 3 percent and combined, represented 12 percent of the total catch from the August survey.

Table 7-2 provides the overall abundance data for each of the species collected from SCR during the surveys. Overall abundance as determined by pooling both the gill net and electroshocking data from the surveys. Pooling of these data revealed that forage species and select game fish species dominated the SCR fish community. Eight species accounted for 90 percent of the total abundance. These eight species included threadfin shad (*Dorosoma petenese*), channel catfish (*Ictalurus puntatus*), gizzard shad (*Dorosoma cepedianum*), bluegill sunfish (*Lepomis macrochirus*), inland silverside (*Menidia beryllina*), largemouth bass (*Micropterus salmoides*), carp (*Cyprinus carpio*) and white bass (*Morone chrysops*) (Figure 7-12). The remaining twelve species accounted for less than 3 percent individually.

Threadfin shad (*Dorosoma petenese*) was the dominant species overall accounting for 31 percent of all fish collected (Figure 7-12). In addition to be the numerically dominant species observed, this species also represented the most abundant forage species present in SCR. Other forage species including bluegill sunfish (*Lepomis macrochirus*), gizzard shad (*Dorosoma*

cepedianum) and inland silverside (*Menidia beryllina*) accounted for 5 to 13 percent of the total abundance (Figure 7-12). Combined, forage species accounted for over 60 percent of the fish collected during the surveys.

The most dominant game fish species collected were channel catfish (*Ictalurus puntatus*), largemouth bass (*Micropterus salmoides*) and white bass (*Morone chrysops*). Combined, these game fish species accounted for 28 percent of the overall abundance from the surveys. Channel catfish (*Ictalurus puntatus*) was the dominant game fish collected, accounting for 22 percent of the total fish collected. Both largemouth bass (*M. salmoides*) and white bass (*Morone chrysops*) accounted for 3 percent individually of the total catch. Based upon these surveys, forage species dominated by threadfin shad are the most numerically abundant fish species present in SCR. This numerical abundance is somewhat expected given their position in the SCR food chain as primary prey for supporting the abundant channel catfish and largemouth bass as well as other piscivorous fish species in SCR.

The overwhelming dominance of threadfin shad (*Dorosoma petenese*) in the impingement monitoring directly reflects the numerical dominance of this species observed in the SCR fishery. In-contrast, abundant game fish species such as channel catfish (*Ictalurus puntatus*) and largemouth bass (*Micropterus salmoides*), although numerically abundant in the water body, do not appear to be highly susceptible to impingement by the CWS.

Length frequencies of RIS considered in this demonstration revealed a wide range of size intervals occurring in SCR. Size intervals of individuals collected for most of the RIS include juvenile and adult size classes. Figure 7-13 through 7-20 present the size frequencies for the RIS's sampled from SCR during the gill net and electroshocking surveys.

Adult and sub-adult age classes represent the potential brood stock for supporting the populations in SCR and contributing new year classes to the fishery. For several RIS's, the impingement of larger adult and sub-adult individuals by the CWS can not be considered significant, due in part to their local abundance within SCR and the small number (relative to the entire SCR population) of individuals impinged. RIS's which can be considered in this group include white bass, freshwater drum, channel catfish, bluegill sunfish, threadfin shad. In the case of the threadfin shad the overwhelming dominance of this forage species within the SCR fishery reveals that entrainment and impingement effects appear to be negligible on the population overall.

Other RIS's displayed a selected age group, to be impinged in greater number than adult or sub-adult individuals by the CWS. Species which displayed such selectivity in impingement relative to the population were largemouth bass and gizzard shad. This selectivity in age group impingement is not uncommon given the apparent abundance of juveniles (age I year class) following the spawning season.

7.2.2 Annual Entrainment, Fecundity and Susceptibility of RIS to Entrainment by CPSES CWS

Table 7-3 provides the daily entrainment estimates for Unit 1 applying the 100 percent capacity scenario. Table 7-4 provides the daily entrainment estimates for Unit 2 applying the 100 percent capacity scenario. Using Equation 4, daily estimates for the projected 100 percent capacity scenario were extrapolated to weekly estimates. Weekly estimates are summarized in Table 7-5 for Unit 1 and Table 7-6 for Unit 2.

Weekly estimates were summed for the period of April through August for calculation of an annual entrainment of fish eggs, larvae and juveniles by the CPSES CWS. Table 7-7 provides the total predicted entrainment of RIS eggs, larvae and juveniles. Total estimated entrainment indicates that Unit 1 will entrain more ichthyoplankton over the monitoring period than Unit 2. In terms of life stage entrainment, Unit 1 will entrain greater numbers of larvae and juveniles and Unit 2 will entrain greater numbers of eggs (Table 7-7). The dominant life stage entrained by both units and for all fish species was larvae.

The genus predicted to be entrained in the greatest number from egg to juvenile stages is *Aplodinotus*. Unit 2 is estimated to entrain over 5.6 million eggs and almost 1.5 million larvae of this genus. By comparison, Unit 1 is estimated to entrain 4.9 million eggs and over 3.4 million larvae if this genus. The genera which will have an egg stage entrained were *Aplodinotus* and *Menidia*. Of the two, *Aplodinotus* eggs will be entrained in greater numbers, comprising 88 % of the total eggs entrained by both units. *Menidia* eggs were entrained in comparable number by both units. Both units were predicted to entrain 722,000 eggs of this genus (Table 7-7). The dominance in the number of *Aplodinotus* eggs in the entrainment estimates is not unexpected given the highly buoyant nature of this species eggs.

The second highest genus entrained by both units was *Lepomis* sp (Table 7-7). As with most of the genera observed, Unit 1 was estimated to entrain a greater proportion of the *Lepomis* larvae and juveniles than Unit 2. Unit 1 was estimated to entrain over 6.6 million larvae and 439,000 juveniles of this genus. Unit 2 was estimated to entrain 3.5 million larvae and no juveniles of this genus. *Dorosoma* was the third most entrained genus by both units. Unit 1 was estimated to entrain a total of 6.1 million larvae and juveniles (combined) of this genus. In comparison, Unit 2 was estimated to entrain a total of 3.5 million larvae and juveniles of this genus (Table 7-7). *Morone* larvae were estimated to be entrained in significantly greater numbers by Unit 1 than by Unit 2. Unit 1 was estimated to entrain over 4.3 million larvae of this genus. In contrast, Unit 2 was estimated to entrain less than 1.0 million (Table 7-7). This difference is attributable to the greater densities of this genus observed in-front of the Unit 1 screens as compared to Unit 2 screens.

To provide a basis for comparing relative losses of adult fish from entrainment of eggs and larvae by the CPSES CWS, at full plant capacity, a comparison between total entrainment and fecundity characteristics of the RIS species was made. This ratio of fecundity (number of eggs per female) to entrainment losses can be used as a rough approximation of the number of fully mature females it would take to produce the same number of eggs/larvae entrained by the CPSES CWS. This kind of comparison is conservative because it assumes that the eggs/larvae would have all survived to adulthood (and successfully spawn) had it not been for the power plant. Fecundity within a species is highly dependent upon age or size of an individual female. This relationship varies considerably among the species considered as RIS for this study. Therefore, to allow for this variability in fecundity, a range and average fecundity estimate were identified from the scientific literature for each RIS. This allows for an estimate of a "equivalent adults" (needed to produce so many eggs/larvae) within the range of fecundity for each species considered. Table 7-8 summarizes a minimum, maximum and average fecundity for the RIS's.

Table 7-9 summarizes the results of the fecundity ratios for each of the RIS's entrained by unit. The results of the comparison reveal that *Dorosoma* accounts on average for the largest number of equivalent adults than other species for both units. The fecundity range given for threadfin shad was employed for a conservative estimate of equivalent adults for the genus *Dorosoma*. The range in the fecundity ratios for *Dorosoma* was 490 to 907 individuals for Unit 1 and 279 to 517 for Unit 2 (Table 7-9). For both units, *Lepomis* displayed the greatest range in equivalent adults. The fecundity characteristics for bluegill sunfish were used for the fecundity ratio calculations for *Lepomis*. The range for Unit 1 was 144 to 2,797 individuals and for Unit 2 was 71 to 1,376 individuals. *Aplodinotus* represented the third highest range in equivalent adults for both units. The range observed in equivalent adults for both units were very similar. The average fecundity ratio for Unit 1 for this genus was 31 individuals and the average for Unit 2 was 26 individuals (Table 7-9). Additionally, *Morone* fecundity ratios were also similar for Units 1 and 2. This genus had the smallest range in equivalent adults of the RIS. The range in equivalent adults for this genus was 5 to 18 individuals for Unit 1 and one to four individuals for Unit 2. The average value for *Morone* equivalent adults for Units 1 and 2 were seven and two, respectively (Table 7-9).

In total, the number of eggs and larvae estimated to have been entrained by the CPSES in 1994, is roughly equivalent to the number of eggs which could have been produced by only 1,500 adult females (962 by Unit 1; 535 by Unit 2). Most of these were non-game, prolific forage fish as the FES originally predicted and most would not otherwise have reached adulthood, given that many eggs are never fertilized and natural mortality takes its toll of those which are fertile.

7.2.3 Comparison of Comanche Peak CWS Impingement to Other Power Plants in Similar Environments

Thirteen species of fish were collected during impingement sampling of the CPSES CWS. Table 7-10 summarizes the actual annual impingement of fish species by the CPSES CWS. Total annual impingement (all species) was estimated to be 262,498 fish. Threadfin shad accounted for 96 percent of all fish impinged by the CWS. Length frequency analysis of fish impinged revealed that both juvenile and adult threadfin shad are impinged by the CWS. Bluegill sunfish was the second most commonly impinged species by the CPSES CWS, accounting for two percent of all fish impinged. Length frequency analysis for impinged individuals revealed that both adult and juvenile bluegill sunfish were impinged by the system. The third most commonly impinged species was the inland silverside which represented 1.2 percent of the total fish impinged. The individuals of this species impinged were largely classified as adults. These three fish species accounted for 99 percent of all fish impinged by the CPSES CWS. All remaining species (including game fishes) accounted for less than 1.0 percent combined of the total (Table 7-10).

It should be noted that impingement of gamefish species was limited to largemouth bass, channel catfish, white bass and white crappie. Combined, these species represented < 1 percent of all the fish impinged. In addition, gamefish also constituted a similarly minute percentage of species entrained. Other gamefish species including smallmouth bass, walleye and hybrid striped bass were not impinged by the CPSES CWS.

So as to provide a benchmark to compare the impacts attributable to CPSES impingement, the CPSES CWS impingement data were compared to historical impingement data from other generating facilities of similar location, design, and capacity. Historical impingement data were summarized from Freeman and Sharma (1977). In addition to design and size characteristics, the length of the monitoring period for impingement sampling was also considered. From Freeman and Sharma (1977) two comparable facilities displayed design characteristics similar to those for CPSES. The two facilities selected were Arkansas Nuclear One owned and operated by Energy Operations, Inc. (formerly Arkansas Power and Light Co.), and Brown's Ferry Nuclear Plant owned and operated by the Tennessee Valley Authority (TVA). Table 7-11 contrasts the characteristics of both facilities with that of CPSES. The biggest difference noted between these SES was that of the average approach velocity. Both Arkansas Nuclear One and Brown's Ferry have approach velocities well in excess of the CPSES approach velocity profile (Table 7-11). Other than velocity, these generating facilities are similar in respect to other design and/or operating parameters which can influence impingement rates. All three facilities have similar numbers of operating units. All three facilities primarily employ a once-through cooling system. One of the two units at Arkansas Nuclear One utilizes a closed cycle cooling system, but all three facilities have shoreline intakes and draw from man-made impoundments designed and permitted to provide cooling water, although the CPSES intake cove probably constitutes

less favorable habitat for most RIS (especially game fish). Fish communities potentially exposed to the operating CWS's of all three facilities are very similar. Species which are identified as common to all three water bodies include: threadfin shad, gizzard shad, bluegill sunfish, other sunfish species, largemouth bass, white bass, black and white crappie, bullhead catfish, carp, freshwater drum and channel catfish.

A comparison of the estimated yearly impingement of fish by these three facilities indicates that the CPSES impinges fewer fish (262,498 estimated total annual impingement) than either Brown's Ferry (691,778 estimated total annual impingement) or Arkansas Nuclear One (16,456,486 estimated annual total impingement) (Table 7-12). The total annual impingement estimate for CPSES is 38 percent and 2 percent, respectively, of the total annual impingement estimates for Brown's Ferry and Arkansas Nuclear One. Among the species impinged by these facilities, shad and herring are impinged in the greatest numbers, comprising 93 percent of the total annual impingement at Brown's Ferry, 98 percent of the total annual impingement at Arkansas Nuclear One, and 96 percent of the total annual impingement at the CPSES. Yet, the gamefish populations in their respective source waterbodies survive. The total annual estimated impingement of shad/herring by the CPSES is 39 percent and 2 percent, respectively, of the total annual shad/herring impingement estimates for Brown's Ferry and Arkansas Nuclear One. As compared to these facilities, CPSES impinges fewer fish than other electric generating plants of similar capacity and design.

7.3 CONCLUSIONS

The purpose of a 316(b) Demonstration is to evaluate (through field investigation and/or historical data) the impact of cooling water intake on aquatic communities. Part of this evaluation is the consideration of whether the CWS intake design selected by a utility or industrial user for the facility is reflective of the best available technology (BAT) to minimize adverse environmental impact. The 316(b) guidance manual states that evaluation of existing CWS intakes must include "reliable quantitative estimates of damage that is or may be occurring and projecting the long-range effect of such damage to the extent reasonably possible."

For the CPSES 316(b) Demonstration, the investigations conducted included the evaluation of absolute losses of fish through quantitative sampling and analysis of impingement and entrainment, and studies of pre- and post- operational fisheries of the SCR. These studies included the collection of post-operational fishery data and creel census data. Post-operational fishery data (i.e., abundance and community structure data) were compared to pre-operational data collected by Hellier et al. (1987).

7.3.1 Evaluation of Location, Design and Capacity of Comanche Peak Units 1 and 2

The 316(b) guidance manual states that the BAT requirement applies to a set of characteristics to be considered for each intake structure on a case-by-case basis. These characteristics consist of the following:

1. Location: the physical setting and location of an intake structure relative to the waterbody including depth, size, occurrence near unique or significant aquatic habitat (i.e., spawning grounds or nursery areas)

2. Design: the engineering aspects of the intake structure including the approach velocities, traveling screen mesh, rotation cycles, etc.

3. Capacity: the total volume of cooling water withdrawn from the source waterbody, relative to the source waterbody's overall hydrologic capacity

4. Operation: operational regimes of the intake structure relative to individual units, CWS intake traveling screen and pump operation and expected generation needs for projected future operational regimes.

These four characteristics are considered for evaluation of BAT for each CWS intake on a case-by-case basis. Therefore, the location, design, capacity and operation of the CPSES have been evaluated relative to the above characteristics.

Location

The CPSES CWS intake structure is located in a man-made recess north of the plant island on the shoreline of the SCR. The excavated recess was created specifically for the CWS, which deepened the basin to a depth of 15.38 m (50 ft) below mean water elevation (775 ft). The excavation included the removal of submerged trees and other structures, rendering the basin of the intake area virtually featureless. In addition to having the submerged structures removed, riparian vegetation was also removed and replaced with rip-rap for control of localized erosion. Removal of submerged structures and deepening of the basin decreased the potential value of this area as a nursery, feeding, or shelter area. This in contrast to the many other naturally occurring coves around the SCR, as reflected in the Shoreline Development Index of 5.0.

Thus, there are no better sites along the SCR shoreline to locate an intake, and an offshore intake for CPSES would not be recommended on the basis of cost, safety, or need to mitigate impingement or entrainment.

Design

Screen area and mesh size are design parameters which (in tamden with operation) determine approach velocities in the intake. The CPSES CWS operates (at full capacity) with eight General Electric powered Ingersol-Rand vertical draft pumps with each pump rated at 2500 horsepower and producing a flow of 1,040.8 m^3 per minute (275,000 gallons per minute). A field survey of approach velocities at the trash rack during full operation of the intake (8 pumps) revealed a mean approach velocity of 13.02 cm/sec (0.427 ft/sec) across the entire intake structure (Units 1 and 2 combined). The average range of approach velocities was 10.9 cm/sec to 14.79 cm/sec (0.337 to 0.485 ft/sec). These values are below the approach velocity guidance value of 15.24 cm/sec (0.5 ft/sec) recommended by the USEPA for minimizing entrainment and impingement impacts (Boreman 1977). Given the low rate of impingement, there is no reason to overdesign the CPSES intake or limit operations to reduce velocities further.

There are other design options or modifications which could (arguably) result in a reduction in the impingement rate, but not measurably benefit SCR. These include such options as additions of fish buckets to the outside of the traveling screens, or addition of high and low pressure screen washes (for debris vs. fish removal). However, neither wash treatment is of value without a fish return system. At CPSES, a fish return would have to be of considerable length to avoid reimpingement at the intake, and it is highly unlikely that fish (mostly shad) returned through such a system would survive in transit. Additionally, the traveling screens would have to be rotated continuously. Such an operation would require operation and maintenance costs disproportionately higher than the ecological benefits.

Capacity

The CPSES utilizes a once through cooling water system. Under full operation (8 CWS pumps), the intake withdrawals an estimated 1.20×10^7 m^3 per day, a volume equivalent to approximately 6.4% of SCR. This relationship, based upon the 316(b) guidance manual, would be classified as a "low impact potential intake." Additionally, actual monitoring of impingement and entrainment revealed that relative to other facilities of similar capacity, the CPSES CWS does impinge fewer fish. This appears to be the result of the location (lack of significant submerged structure and cover) of the intake cove and design (i.e., less than 0.5 ft/sec approach velocity) of the intake structure. Therefore, the once through cooling water system employed by the CPSES must be judged to have low impact (due to entrainment and impingement) on the fishery resources of SCR.

Reduction in capacity of CWS can always reduce entrainment (and sometimes impingement) losses, but the BAT analysis (especially for nuclear generating stations) must also consider safety and cost-effectiveness. In the case of the CPSES, the low number of total fish (and especially gamefish) entrained and impinged do not justify reducing the overall capacity of the

CWS by converting the CPSES to a closed cycle system. At most, if absolutely necessary, CPSES could be operated at reduced generating capacity during periods of peak entrainment or impingement.

Operation

Operation of both Unit 1 and Unit 2 is subject to routine maintenance and refueling outages. The assumption of a 100 percent capacity year round is considered as conservative due (in-part) to the need and requirement for proper maintenance and safety in operation of the plant. Operation during the monitoring period was considered to be representative of the normal scheduled operation of Unit 1 and 2. Based upon the results of the monitoring program, it appears that given the location and design of the intake structure, normal operation of CWS is considered to be consistent with minimization of impacts due to impingement and entrainment.

Other than operating the CPSES at reduced output (and therefore CWS capacity), the only other operating parameters to be considered are screen rotation and use of physical or behavioral barriers to impingement as deemed necessary in periods of peak fish activity. As noted above, operating the travelling screens more frequently than currently prescribed will not decrease impingement mortality without a fish return system of questionable benefit. Nets, bubble curtains or other physical or behavioral deterrents to fish entrance to the intake area could be deployed at the security fence area outside the intake, however, results of this study do not indicate that benefits of these deterrents would exceed their cost or safety concerns.

7.3.2 Recommendations

CPSES Unit 1 has been in operation since 1990, and there is no evidence that it's operation has impacted the fisheries of SCR. The increase in entrainment resulting from addition of Unit 2 capacity is approximately two thirds that associated with operation of Unit 1, and is apparently due to the circulation pattern in the intake area. In total, the combined CPSES entrainment and impingement loss is very low for a power plant of this capacity. Based on the studies performed as part of this 316(b) Demonstration, such losses do not appear to be adversely affecting the sustainable yield of RIS in SCR. Therefore the CPSES CWS location, design, capacity and operation is considered to represent BAT for this particular cooling/source water reservoir and its indigenous biota.

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Table 2-1 . Intake water velocity (cm/sec) profiles across the Unit 1 trash rack.

	Distance Across Unit 1 Trash Racks										Grand
Depth	0 m	3.07 m	6.15 m	9.23	10.78 m	12.31 m	15.38 m	18.46 m	21.54 m	24.62 m	Mean
0.92 m	15.43	12.86	11.04	11.58	11.58	12.86	11.58	11.58	11.58	12.86	
	14.15	12.86	9.94	11.58	11.58	11.58	12.86	12.86	12.86	11.58	
Sum	29.58	25.72	20.98	23.15	23.15	24.44	24.44	24.44	24.44	24.44	
Ave.	**14.79**	**12.86**	**10.49**	**11.58**	**11.58**	**12.22**	**12.22**	**12.22**	**12.22**	**12.22**	**12.24**
3.07 m	14.15	12.86	9.94	10.29	11.58	12.86	14.15	14.15	14.15	15.43	
	14.15	14.15	11.04	11.58	12.86	12.86	14.15	14.15	12.86	15.43	
Sum	28.30	27.01	20.98	21.87	24.44	25.72	28.30	28.30	27.01	30.87	
Ave.	**14.15**	**13.51**	**10.49**	**10.93**	**12.22**	**12.86**	**14.15**	**14.15**	**13.51**	**15.43**	**13.14**
6.15 m	12.86	11.58	11.04	12.86	10.29	10.29	10.29	10.29	9.00	15.43	
	12.86	12.86	9.94	14.15	11.58	11.58	11.58	12.86	11.58	12.86	
Sum	25.72	24.44	20.98	27.01	21.87	21.87	21.87	23.15	20.58	28.30	
Ave.	**12.86**	**12.22**	**10.49**	**13.51**	**10.93**	**10.93**	**10.93**	**11.58**	**10.29**	**14.15**	**11.79**
7.69 m	11.58	12.86	9.94	11.58	10.29	11.58	10.29	11.58	11.58	12.86	
	12.86	14.15	8.84	12.86	10.29	11.58	11.58	14.15	12.86	15.43	
Sum	24.44	27.01	18.78	24.44	20.58	23.15	21.87	25.72	24.44	28.30	
Ave.	**12.22**	**13.51**	**9.39**	**12.22**	**10.29**	**11.58**	**10.93**	**12.86**	**12.22**	**14.15**	**11.94**
9.23 m	11.58	11.58	8.84	12.86	11.58	12.86	11.58	14.15	10.29	14.15	
	12.86	12.86	9.94	12.86	11.58	11.58	14.15	12.86	11.58	12.86	
Sum	24.44	24.44	18.78	25.72	23.15	24.44	25.72	27.01	21.87	27.01	
Ave.	**12.22**	**12.22**	**9.39**	**12.86**	**11.58**	**12.22**	**12.86**	**13.51**	**10.93**	**13.51**	**12.13**
12.3 m	10.29	11.58	7.73	11.58	10.29	10.29	7.72	10.29	5.14	10.29	
	10.29	12.86	5.52	14.15	9.00	11.58	9.00	11.58	6.43	10.29	
Sum	20.58	24.44	13.25	25.72	19.29	21.87	16.72	21.87	11.58	20.58	
Ave.	**10.29**	**12.22**	**6.63**	**12.86**	**9.65**	**10.93**	**8.36**	**10.93**	**5.79**	**10.29**	**9.79**
14.46 m	19.29	24.44	4.42	28.30	14.15	24.44	14.15	36.01	5.14	16.72	
Sum	19.29	24.44	4.42	28.30	14.15	24.44	14.15	36.01	5.14	16.72	
Ave.	**19.29**	**24.44**	**4.42**	**28.30**	**14.15**	**24.44**	**14.15**	**36.01**	**5.14**	**16.72**	**18.71**

Note: Only a single measurement of velocity was recorded at the 14.46 m depth. At all other depths, two velocity measurements were recorded.

Table 2-2 . Intake water velocity (cm/sec) profiles across the Unit 2 trash rack.

Depth	Distance Across Unit 2 Trash Racks											Grand Mean
	0 m	3.07 m	6.15 m	9.23 m	10.78	12.31 m	15.38 m	18.46 m	21.54 m	24.62 m	27.39 m	
0.92 m	14.15	14.15	16.72	15.43	15.43	14.15	14.14	12.86	14.15	15.43	15.43	
	12.86	14.15	15.43	15.43	14.15	14.15	14.15	12.86	14.15	15.43	14.15	
Sum	27.01	28.30	32.15	30.87	29.58	28.30	28.30	25.72	28.30	30.87	29.58	
Ave.	**13.51**	**14.15**	**16.08**	**15.43**	**14.79**	**14.15**	**14.15**	**12.86**	**14.15**	**15.43**	**14.79**	**14.50**
3.07 m	15.43	15.43	15.43	14.15	14.15	12.86	14.15	11.58	14.15	15.43	14.15	
	14.15	14.15	14.15	12.86	14.15	12.86	15.43	14.15	14.15	15.43	14.15	
Sum	29.58	29.58	29.58	27.01	28.30	25.72	29.58	25.72	28.30	30.87	28.30	
Ave.	**14.79**	**14.79**	**14.79**	**13.51**	**14.15**	**12.86**	**14.79**	**12.86**	**14.15**	**15.43**	**14.15**	**14.21**
6.15 m	14.15	11.58	12.86	12.86	10.29	12.86	10.29	10.29	12.86	11.58	11.58	
	14.15	12.86	12.86	11.58	10.29	11.58	10.29	11.58	11.58	11.58	11.58	
Sum	28.30	24.44	25.72	24.44	20.58	24.44	20.58	21.87	24.44	23.15	23.15	
Ave.	**14.15**	**12.22**	**12.86**	**12.22**	**10.29**	**12.22**	**10.29**	**10.93**	**12.22**	**11.58**	**11.58**	**11.87**
7.69 m	15.43	12.86	12.86	10.29	10.29	11.58	10.29	10.29	10.29	11.58	11.58	
	16.72	11.58	14.15	12.86	10.29	11.58	11.58	10.29	12.86	10.29	11.58	
Sum	32.15	24.44	27.01	23.15	20.58	23.15	21.87	20.58	23.15	21.87	23.15	
Ave.	**16.08**	**12.22**	**13.51**	**11.58**	**10.29**	**11.58**	**10.93**	**10.29**	**11.58**	**10.93**	**11.58**	**11.87**
9.23 m	15.43	12.86	14.15	14.15	11.58	11.58	11.58	12.86	11.58	11.58	10.29	
	15.43	11.58	11.58	12.86	11.58	11.58	12.86	12.86	11.58	11.58	11.58	
Sum	30.87	24.44	25.72	27.01	23.15	23.15	24.44	25.72	23.15	23.15	21.87	
Ave.	**15.43**	**12.22**	**12.86**	**13.51**	**11.58**	**11.58**	**12.22**	**12.86**	**11.58**	**11.58**	**10.93**	**12.39**
12.3 m	11.58	9.00	10.29	10.29	7.72	10.29	10.29	10.29	7.72	10.29	9.00	
	11.58	9.00	10.29	9.00	9.00	9.00	10.29	10.29	6.43	10.29	9.00	
Sum	23.15	18.01	20.58	19.29	16.72	19.29	20.58	20.58	14.15	20.58	18.01	
Ave.	**11.58**	**9.00**	**10.29**	**9.65**	**8.36**	**9.65**	**10.29**	**10.29**	**7.07**	**10.29**	**9.00**	**9.59**
14.46 m	20.58	15.43	28.30	16.72	12.86	15.43	30.87	14.15	15.43	18.01	10.29	
Sum	20.58	15.43	28.30	16.72	12.86	15.43	30.87	14.15	15.43	18.01	10.29	
Ave.	**20.58**	**15.43**	**28.30**	**16.72**	**12.86**	**15.43**	**30.87**	**14.15**	**15.43**	**18.01**	**10.29**	**18.01**

Note: Only a single measurement of velocity was recorded at the 14.46 m depth. At all other depths, two velocity measurements were recorded.

Table 3-1. Fish Species of Squaw Creek Reservoir.[1]

Common Name	Scientific Name[2]
Largemouth Bass	*Micropterus salmoides*
Hybrid Striped Bass	*Morone chrysops x M. saxatilis*
White Bass	*Morone chrysops*
Smallmouth Bass	*Micropterus dolomieui*
Black Bullhead	*Ameiurus melas*
Yellow Bullhead	*Ameiurus natalis*
Channel Catfish	*Ictalurus punctatus*
Gizzard Shad	*Dorosoma cepedianum*
River Carpsucker	*Carpoides carpio*
Carp	*Cyprinus carpio*
Longear Sunfish	*Lepomis megalotis*
Bluegill Sunfish	*Lepomis macrochirus*
Redear Sunfish	*Lepomis microlophus*
Walleye	*Stizostedion vitreum*
Inland Silverside	*Menidia beryllina*
Warmouth Sunfish	*Lepomis gulosus*
Freshwater Drum	*Aplodinotus grunniens*
Redhorse Sucker	*Moxostoma congestum*
Golden Shiner	*Notmigonus crysoleucas*
Redbreast Sunfish	*Lepomis auritus*
Green Sunfish	*Lepomis cyanellus*
Threadfin Shad	*Dorosoma petenense*
Bluntnose Darter	*Etheostoma chlorosomum*
White Crappie	*Pomoxis annularis*
Logperch	*Percina macrolepida*
Slough Darter	*Etheostoma gracile*

[1] Source: Hellier et al. (1987)
[2] Scientific name as given by Page and Burr (1991)

Table 3-2. Squaw Creek Park Stocking History[1]

Type of Fish	Amount Stocked	Year Stocked
Hybrid Striped Bass	99,900	1979
Small Mouth Bass	100,000	1979
Small Mouth Bass	12,844	1980
Small Mouth Bass	37,111	1980
Hybrid Striped Bass	100,000	1981
Threadfin Shad	12,000	1982
Small Mouth Bass	59,875	1982
Hybrid Striped Bass	99,000	1983
Threadfin Shad	3,900	1984
Channel Catfish	17,501	1986
Walleye	4,860,000	1986
Florida Black Bass	164,654	1990
Hybrid Striped Bass[2]	51,000	1994

[1] SCR Stocking Table undated

[2] G. Bauml, University of North Texas, personal communication

Table 4-1. Percent abundance of fish collected from the Squaw Creek Reservoir during the preoperational monitoring program (Hellier et al. 1987)[1].

Species	Percent Abundance
Largemouth Bass	4.97
Hybrid Striped Bass	0.35
White Bass	0.19
Smallmouth Bass	0.08
Black Bullhead	9.14
Yellow Bullhead	1.87
Channel Catfish	0.51
Gizzard Shad	1.59
River Carpsucker	0.21
Carp	1.53
Longear Sunfish	4.62
Bluegill Sunfish	43.4
Redear Sunfish	5.92
Walleye	0.26
Inland Silverside	0.83
Warmouth Sunfish	1.14
Freshwater Drum	0.03
Redhorse Sucker	0.01
Golden Shiner	0.22
Redbreast Sunfish	0.08
Green Sunfish	21.7
Threadfin Shad	0.08
Bluntnose Darter	0.04
White Crappie	0.35
Logperch	0.85

[1] Results are for all sampling methods combined, excluding beach seines.

Table 4-2. Trophic Guilds for Fish Species of Squaw Creek Reservoir.

Common Name	Trophic Guilds[1]
Largemouth Bass	Piscivore
Hybrid Striped Bass	Piscivore
White Bass	Piscivore
Smallmouth Bass	Piscivore
Black Bullhead	Invertivore
Yellow Bullhead	Invertivore
Channel Catfish	Piscivore
Gizzard Shad	Omnivore
River Carpsucker	Omnivore
Carp	Omnivore
Longear Sunfish	Invertivore
Bluegill Sunfish	Invertivore
Redear Sunfish	Invertivore
Walleye	Piscivore
Inland Silverside	Invertivore
Warmouth Sunfish	Invertivore
Freshwater Drum	Invertivore
Redhorse Sucker	Invertivore
Golden Shiner	Omnivore
Redbreast Sunfish	Invertivore
Green Sunfish	Invertivore
Threadfin Shad	Omnivore
Bluntnose Darter	Invertivore
White Crappie	Invertivore/piscivore
Logperch	Invertivore
Slough Darter	Invertivore

[1] Sources: Hellier et al. (1987), Plafkin et al. (1989)

Table 4-3 . Recreational angler catch rates (fish/1000 angling hours) as determined from the SCR creel survey. (Bolded values identify the species with the five greatest catch rates for each survey period.)

Species	Oct. 93	Nov. 93	Dec. 93	Apr. 94	May. 94	Jun. 94	Jul. 95
Striped Bass	0	1	**11**	1	1	1	4
Largemouth Bass	**1039**	**401**	**358**	**441**	**638**	**400**	**402**
Smallmouth Bass	**154**	**162**	**104**	**117**	**152**	**91**	**28**
White Bass	38	0	**14**	7	**9**	10	0
Walleye	0	0	0	0	0	0	0
White Crappie	**49**	0	2	3	4	**104**	18
Sunfish(a)	13	**2**	1	**13**	2	**245**	**68**
Channel Catfish	**151**	**36**	**89**	**141**	**127**	**112**	**181**
Bullhead Catfish(b)	0	0	0	1	2	2	3
FW Drum	**41**	**6**	9	**32**	**79**	54	**52**
Carp	1	0	1	3	2	30	2
Kentucky Bass(c)	1	0	0	0	0	0	0
Tilapia(c)	0	0	0	1	0	0	0
Total (All Species)	**1487**	**608**	**589**	**760**	**1016**	**1049**	**758**

(a) Inclusive of all sunfish species in SCR.
(b) Inclusive of yellow and black bullhead catfish.
(c) Species identified by anglers but not idenitifed by Hellier et al. (1987) as being present.

Table 5-1. Daily impingement of fish by the CPSES CWS.

Event[1]	Date	Species	Species Specific Daily[2]
1	10/19/93	Bluegill Sunfish	2
		Threadfin Shad	3
		White Bass	1
		Gizzard Shad	3
		Green Sunfish	1
		Total	**10**
2	10/26/93	Bluegill Sunfish	5
		Inland Silversides	2
		Threadfin Shad	11
		White Bass	1
		Gizzard Shad	3
		Green Sunfish	1
		Total	**23**
3	11/2/93	Inland Silversides	1
		Threadfin Shad	13
		Bluegill Sunfish	10
		Gizzard Shad	1
		Green Sunfish	2
		Total	**27**
4	11/9/93	Gizzard Shad	1
		Threadfin Shad	6
		Total	**7**
5	11/16/93	Bluegill Sunfish	4
		Threadfin Shad	18
		White Bass	2
		Total	**24**
6	11/23/93	Threadfin Shad	16
		Bluegill Sunfish	1
		Largemouth Bass	1
		Total	**18**
7	11/30/93	Bluegill Sunfish	6
		Gizzard Shad	1
		Threadfin Shad	12
		Total	**19**
8	12/9/93	Gizzard Shad	4
		Inland Silverside	1
		Threadfin Shad	55
		Bluegill Sunfish	4
		Total	**64**

Notes: [1] Sample event / day and night combined.
[2] Sum of day and night samples.

Table 5-1. Daily impingement of fish by the CPSES CWS.

Event[1]	Date	Species	Species Specific Daily[2]
9	12/16/93	Bluegill Sunfish	4
		Threadfin Shad	26
		Gizzard Shad	3
		Total	**33**
10	1/6/94	Bluegill Sunfish	13
		Threadfin Shad	78
		Green Sunfish	1
		Total	**92**
11	1/13/94	Bluegill Sunfish	3
		Threadfin Shad	10
		Warmouth Sunfish	1
		Total	**14**
12	1/20/94	Bluegill Sunfish	5
		Threadfin Shad	15
		Channel Catfish	1
		Total	**21**
13	1/27/94	Bluegill Sunfish	6
		Threadfin Shad	2
		Gizzard Shad	1
		Total	**9**
14	2/2/94	Bluegill Sunfish	6
		Threadfin Shad	1
		Warmouth Sunfish	1
		Total	**8**
15	2/9/94	Bluegill Sunfish	6
		Threadfin Shad	4
		Total	**10**
16	2/16/94	Bluegill Sunfish	2
		Threadfin Shad	5
		Channel Catfish	1
		Green Sunfish	1
		Largemouth Bass	1
		Total	**10**
17	2/23/94	Bluegill Sunfish	11
		Green Sunfish	2
		Inland Silversides	3
		Threadfin Shad	4
		Total	**20**

Notes: [1] Sample event / day and night combined.

[2] Sum of day and night samples.

Table 5-1. Daily impingement of fish by the CPSES CWS.

Event[1]	Date	Species	Species Specific Daily[2]
18	3/2/94	Bluegill Sunfish	3
		Freshwater Drum	1
		Green Sunfish	1
		Inland Silversides	3
		Threadfin Shad	4
		White Bass	1
		Total	**13**
19	3/9/94	Bluegill Sunfish	1
		Gizzard Shad	2
		Green Sunfish	1
		Threadfin Shad	3
		Total	**7**
20	3/16/94	Bluegill Sunfish	4
		Golden Shiner	3
		Inland Silversides	3
		Threadfin Shad	8
		Total	**18**
21	3/23/94	Bluegill Sunfish	5
		Green Sunfish	3
		Threadfin Shad	5
		Total	**13**
22	3/30/94	Gizzard Shad	2
		Threadfin Shad	1
		Bluegill Sunfish	10
		Warmouth Sunfish	1
		Green Sunfish	2
		Total	**16**
23	4/6/94	Bluegill Sunfish	49
		Channel Catfish	1
		Green Sunfish	1
		Inland Silverside	3
		Longear Sunfish	1
		Threadfin Shad	1
		Gizzard Shad	1
		Warmouth Sunfish	1
		Total	**58**
24	4/20/94	Bluegill Sunfish	5
		Gizzard Shad	3
		Threadfin Shad	44
		White Crappie	1
		Green Sunfish	2
		Total	**55**

Notes: [1] Sample event / day and night combined.
[2] Sum of day and night samples.

Table 5-1. Daily impingement of fish by the CPSES CWS.

Event[1]	Date	Species	Species Specific Daily[2]
25	5/4/94	Bluegill Sunfish	1
		Gizzard Shad	9
		Threadfin Shad	1
		Total	**11**
26	5/18/94	Gizzard Shad	3
		Threadfin Shad	87
		Largemouth Bass	9
		Bluegill Sunfish	8
		White Bass	1
		Green Sunfish	7
		Inland Silverside	3
		Longear Sunfish	1
		Freshwater Drum	1
		Total	**120**
27	6/1/94	Bluegill Sunfish	26
		Gizzard Shad	5
		Green Sunfish	10
		Inland Silverside	9
		Largemouth Bass	15
		Threadfin Shad	16
		Total	**81**
28	6/15/94	Bluegill Sunfish	9
		Channel Catfish	2
		Inland Silverside	6
		Largemouth Bass	4
		Threadfin Shad	18
		Freshwater Drum	1
		Total	**40**
29	6/29/94	Bluegill Sunfish	23
		Freshwater Drum	1
		Green Sunfish	1
		Inland Silverside	6
		Largemouth Bass	3
		Threadfin Shad	46
		Warmouth Sunfish	1
		Total	**81**

Notes: [1] Sample event / day and night combined.
[2] Sum of day and night samples.

Table 5-1. Daily impingement of fish by the CPSES CWS.

Event[1]	Date	Species	Species Specific Daily[2]
30	7/13/94	Bluegill Sunfish	19
		Channel Catfish	1
		Freshwater Drum	1
		Inland Silverside	5
		Threadfin Shad	250
		Largemouth Bass	3
		Warmouth Sunfish	1
		Total	**280**
31	7/28/94	White Bass	1
		Freshwater Drum	1
		Warmouth Sunfish	6
		Redear Sunfish	6
		Bluegill Sunfish	52
		Channel Catfish	6
		Largemouth Bass	14
		Inland Silverside	156
		Threadfin Shad	8,927
		Green Sunfish	25
		Total	**9,194**
32	8/10/94	Green Sunfish	10
		White Crappie	1
		Bluegill Sunfish	13
		Inland Silverside	20
		Threadfin Shad	6,300
		Gizzard Shad	1
		Largemouth Bass	7
		Total	**6,352**
33	8/24/94	Largemouth Bass	2
		White Crappie	2
		Bluegill Sunfish	5
		Green Sunfish	12
		Gizzard Shad	23
		Threadfin Shad	589
		Inland Silverside	2
		Total	**635**
34	8/31/94	Bluegill Sunfish	10
		Green Sunfish	4
		Inland Silverside	4
		Threadfin Shad	3,167
		Gizzard Shad	4
		Total	**3,198**

Notes: [1] Sample event / day and night combined.

[2] Sum of day and night samples.

Table 5-1. Daily impingement of fish by the CPSES CWS.

Event[1]	Date	Species	Species Specific Daily[2]
35	9/7/94	Gizzard Shad	5
		Inland Silverside	11
		Bluegill Sunfish	20
		Green Sunfish	10
		Threadfin Shad	1,205
		Total	**1,251**
36	9/14/94	Largemouth Bass	1
		Bluegill Sunfish	13
		White Bass	1
		Channel Catfish	1
		Gizzard Shad	3
		Inland Silverside	18
		Threadfin Shad	148
		Total	**185**
37	9/21/94	Channel Catfish	1
		Gizzard Shad	3
		Freshwater Drum	1
		Bluegill Sunfish	23
		Green Sunfish	5
		Threadfin Shad	114
		Total	**147**
38	9/28/94	Channel Catfish	1
		Green Sunfish	2
		Bluegill Sunfish	34
		Threadfin Shad	72
		Gizzard Shad	5
		Total	**114**
39	10/5/94	Longear Sunfish	1
		Green Sunfish	4
		Bluegill Sunfish	31
		Threadfin Shad	93
		Channel Catfish	1
		Gizzard Shad	1
		Total	**131**
40	10/22/94	Threadfin Shad	8
		Green Sunfish	2
		Bluegill Sunfish	32
		Total	**42**

Notes: [1] Sample event / day and night combined.
[2] Sum of day and night samples.

Table 5-2. Estimated weekly impingement of fish by the CPSES CWS.

Week Number	Daily Interval	Species	Species Specific Weekly
1	Oct.18-25,1993	Bluegill Sunfish	14
		Threadfin Shad	21
		White Bass	7
		Gizzard Shad	21
		Green Sunfish	7
		Total	**70**
2	Oct.26-Nov.1,1993	Bluegill Sunfish	35
		Inland Silversides	14
		Threadfin Shad	77
		White Bass	7
		Gizzard Shad	21
		Green Sunfish	7
		Total	**161**
3	Nov.2-8,1993	Inland Silversides	7
		Threadfin Shad	91
		Bluegill Sunfish	70
		Gizzard Shad	7
		Green Sunfish	14
		Total	**189**
4	Nov.9-15,1993	Gizzard Shad	7
		Threadfin Shad	42
		Total	**49**
5	Nov.16-22,1993	Bluegill Sunfish	28
		Threadfin Shad	126
		White Bass	14
		Total	**168**
6	Nov.23-29-1993	Threadfin Shad	112
		Bluegill Sunfish	7
		Largemouth Bass	7
		Total	**126**
7	Nov.30-Dec.8,1993	Bluegill Sunfish	54
		Gizzard Shad	9
		Threadfin Shad	108
		Total	**171**
8	Dec.9-15,1993	Gizzard Shad	28
		Inland Silverside	7
		Threadfin Shad	385
		Bluegill Sunfish	28
		Total	**448**
9	Dec.16,1993-Jan.5,1994	Bluegill Sunfish	84

Table 5-2. Estimated weekly
impingement of fish by the CPSES CWS.

Week Number	Daily Interval	Species	Species Specific Weekly
		Threadfin Shad	546
		Gizzard Shad	63
		Total	**693**
10	Jan.6-12, 1994	Bluegill Sunfish	91
		Threadfin Shad	546
		Green Sunfish	7
		Total	**644**
11	Jan.13-19,1994	Bluegill Sunfish	21
		Threadfin Shad	70
		Warmouth Sunfish	7
		Total	**98**
12	Jan.20-26,1994	Bluegill Sunfish	35
		Threadfin Shad	105
		Channel Catfish	7
		Total	**147**
13	Jan.27-Feb.1,1994	Bluegill Sunfish	36
		Threadfin Shad	12
		Gizzard Shad	6
		Total	**54**
14	Feb.2-8,1994	Bluegill Sunfish	42
		Threadfin Shad	7
		Warmouth Sunfish	7
		Total	**56**
15	Feb.9-15,1994	Bluegill Sunfish	42
		Threadfin Shad	28
		Total	**70**
16	Feb.16-22,1994	Bluegill Sunfish	14
		Threadfin Shad	35
		Channel Catfish	7
		Green Sunfish	7
		Largemouth Bass	7
		Total	**70**
17	Feb.23-Mar.1,1994	Bluegill Sunfish	77
		Green Sunfish	14
		Inland Silversides	21
		Threadfin Shad	28
		Total	**140**
18	Mar.1-8,1994	Bluegill Sunfish	24
		Freshwater Drum	8

Table 5-2. Estimated weekly impingement of fish by the CPSES CWS.

Week Number	Daily Interval	Species	Species Specific Weekly
		Green Sunfish	8
		Inland Silversides	24
		Threadfin Shad	32
		White Bass	8
		Total	**104**
19	Mar.9-15,1994	Bluegill Sunfish	7
		Gizzard Shad	14
		Green Sunfish	7
		Threadfin Shad	21
		Total	**49**
20	Mar.16-22,1994	Bluegill Sunfish	28
		Golden Shiner	21
		Inland Silversides	21
		Threadfin Shad	56
		Total	**126**
21	Mar.23-29,1994	Bluegill Sunfish	35
		Green Sunfish	21
		Threadfin Shad	35
		Total	**91**
22	Mar.30-Apr.5,1994	Gizzard Shad	14
		Threadfin Shad	7
		Bluegill Sunfish	70
		Warmouth Sunfish	7
		Green Sunfish	14
		Total	**112**
23	Apr.6-19,1994	Bluegill Sunfish	686
		Channel Catfish	14
		Green Sunfish	14
		Inland Silverside	42
		Longear Sunfish	14
		Threadfin Shad	14
		Gizzard Shad	14
		Warmouth Sunfish	14
		Total	**812**
24	Apr.20-May 3,1994	Bluegill Sunfish	75
		Gizzard Shad	45
		Threadfin Shad	660
		White Crappie	15
		Green Sunfish	30
		Total	**825**
25	May 4-17,1994	Bluegill Sunfish	14

Table 5-2. Estimated weekly impingement of fish by the CPSES CWS.

Week Number	Daily Interval	Species	Species Specific Weekly
		Gizzard Shad	126
		Threadfin Shad	14
		Total	**154**
26	May 18-31,1994	Gizzard Shad	42
		Threadfin Shad	1218
		Largemouth Bass	126
		Bluegill Sunfish	112
		White Bass	14
		Green Sunfish	98
		Inland Silverside	42
		Longear Sunfish	14
		Freshwater Drum	14
		Total	**1680**
27	Jun.1-14,1994	Bluegill Sunfish	364
		Gizzard Shad	70
		Green Sunfish	140
		Inland Silverside	126
		Largemouth Bass	210
		Threadfin Shad	224
		Total	**1134**
28	Jun.15-28,1994	Bluegill Sunfish	126
		Channel Catfish	28
		Inland Silverside	84
		Largemouth Bass	56
		Threadfin Shad	252
		Freshwater Drum	14
		Total	**560**
29	Jun.29-Jul.12,1994	Bluegill Sunfish	322
		Freshwater Drum	14
		Green Sunfish	14
		Inland Silverside	84
		Largemouth Bass	42
		Threadfin Shad	644
		Warmouth Sunfish	14
		Total	**1,134**
30	Jul.13-27,1994	Bluegill Sunfish	285
		Channel Catfish	15
		Freshwater Drum	15
		Inland Silverside	75
		Threadfin Shad	3750
		Largemouth Bass	45
		Warmouth Sunfish	15
		Total	**4,200**

Table 5-2. Estimated weekly impingement of fish by the CPSES CWS.

Week Number	Daily Interval	Species	Species Specific Weekly
31	Jul.28-Aug.9,1994	White Bass	13
		Freshwater Drum	13
		Warmouth Sunfish	78
		Redear Sunfish	78
		Bluegill Sunfish	676
		Channel Catfish	78
		Largemouth Bass	182
		Inland Silverside	2028
		Threadfin Shad	116051
		Green Sunfish	325
		Total	**119,522**
32	Aug.10-23,1994	Green Sunfish	140
		White Crappie	14
		Bluegill Sunfish	182
		Inland Silverside	280
		Threadfin Shad	88200
		Gizzard Shad	14
		Largemouth Bass	98
		Total	**88,928**
33	Aug.24-30,1994	Largemouth Bass	14
		White Crappie	14
		Bluegill Sunfish	35
		Green Sunfish	84
		Gizzard Shad	161
		Threadfin Shad	4123
		Inland Silverside	14
		Total	**4,445**
34	Aug.31-Sep.6,1994	Bluegill Sunfish	70
		Green Sunfish	28
		Inland Silverside	28
		Threadfin Shad	22169
		Gizzard Shad	28
		Total	**22,323**
35	Sep.7-13,1994	Gizzard Shad	35
		Inland Silverside	77
		Bluegill Sunfish	140
		Green Sunfish	70
		Threadfin Shad	8435
		Total	**8,757**
36	Sep.14-20,1994	Largemouth Bass	7
		Bluegill Sunfish	91
		White Bass	7

Table 5-2. Estimated weekly impingement of fish by the CPSES CWS.

Week Number	Daily Interval	Species	Species Specific Weekly
		Channel Catfish	7
		Gizzard Shad	21
		Inland Silverside	126
		Threadfin Shad	1036
		Total	**1,295**
37	Sep.21-27,1994	Channel Catfish	7
		Gizzard Shad	21
		Freshwater Drum	7
		Bluegill Sunfish	161
		Green Sunfish	35
		Threadfin Shad	798
		Total	**1,029**
38	Sep.28-Oct.4,1994	Channel Catfish	7
		Green Sunfish	14
		Bluegill Sunfish	238
		Threadfin Shad	504
		Gizzard Shad	35
		Total	**798**
39	Oct.5-21,1994	Longear Sunfish	7
		Green Sunfish	28
		Bluegill Sunfish	217
		Threadfin Shad	651
		Channel Catfish	7
		Gizzard Shad	7
		Total	**917**
40	Oct.22,1994	Threadfin Shad	56
		Green Sunfish	14
		Bluegill Sunfish	224
		Total	**294**

Table 5-3. Estimated monthly impingement of fish by the CPSES CWS.

Month	Monthly Interval	Species	Monthly Species Specific
1	Oct.18-Nov.18,1994	Bluegill Sunfish	131
		Threadfin Shad	285
		White Bass	20
		Gizzard Shad	56
		Green Sunfish	28
		Inland Silverside	21
		Total	**541**
2	Nov.19-Dec.19,1993	Bluegill Sunfish	121
		Threadfin Shad	781
		White Bass	8
		Largemouth Bass	7
		Gizzard Shad	49
		Inland Silverside	7
		Total	**973**
3	Dec.20,1993-Jan.20,1994	Bluegill Sunfish	185
		Threadfin Shad	1,073
		Gizzard Shad	51
		Warmouth Sunfish	7
		Green Sunfish	7
		Channel Catfish	1
		Total	**1,324**
4	Jan.21-Feb.21,1994	Bluegill Sunfish	162
		Threadfin Shad	167
		Channel Catfish	12
		Gizzard Shad	6
		Warmouth Sunfish	7
		Green Sunfish	6
		Largemouth Bass	6
		Total	**366**
5	Feb.22-Mar.22,1994	Bluegill Sunfish	138
		Threadfin Shad	142
		Channel Catfish	1
		Green Sunfish	30
		Largemouth Bass	1
		Inland Silverside	66
		Freshwater Drum	8
		White Bass	8
		Golden Shiner	14
		Gizzard Shad	21
		Total	**429**
6	Mar.23-Apr.23,1994	Bluegill Sunfish	811
		Green Sunfish	57
		Threadfin Shad	232

Table 5-3. Estimated monthly impingement of fish by the CPSES CWS.

		Gizzard Shad	56
		Warmouth Sunfish	21
		Channel Catfish	14
		Inland Silverside	42
		Longear Sunfish	14
		White Crappie	4
		Total	**1,251**
7	Apr.24-May 24,1994	Bluegill Sunfish	120
		Gizzard Shad	177
		Threadfin Shad	1,063
		White Crappie	10
		Green Sunfish	69
		Largemouth Bass	63
		White Bass	7
		Inland Silverside	21
		Longear Sunfish	7
		Freshwater Drum	7
		Total	**1,544**
8	May 25-Jun.25,1994	Gizzard Shad	91
		Threadfin Shad	1,031
		Largemouth Bass	317
		Bluegill Sunfish	191
		White Bass	7
		Green Sunfish	189
		Inland Silverside	213
		Longear Sunfish	7
		Freshwater Drum	18
		Channel Catfish	22
		Total	**2,086**
9	Jun.26-Jul.26,1994	Bluegill Sunfish	615
		Channel Catfish	20
		Inland Silverside	172
		Largemouth Bass	210
		Threadfin Shad	4,198
		Freshwater Drum	31
		Green Sunfish	14
		Warmouth Sunfish	28
		Total	**5,288**
10	Jul.27-Aug.27	Bluegill Sunfish	897
		Channel Catfish	79
		Freshwater Drum	14
		Inland Silverside	2,321
		Threadfin Shad	206,857
		Largemouth Bass	291
		Warmouth Sunfish	79

Table 5-3. Estimated monthly impingement of fish by the CPSES CWS.

		White Bass	13
		Redear Sunfish	78
		Green Sunfish	513
		White Crappie	22
		Gizzard Shad	106
		Total	**211,270**
11	Aug.28-Sept.28,1994	Largemouth Bass	13
		White Crappie	6
		Bluegill Sunfish	514
		Green Sunfish	171
		Gizzard Shad	179
		Threadfin Shad	34,277
		Inland Silverside	237
		White Bass	7
		Channel Catfish	15
		Freshwater Drum	7
		Total	**35,426**
12	Sept.29-Oct.31,1994	Channel Catfish	13
		Green Sunfish	60
		Bluegill Sunfish	741
		Threadfin Shad	1,163
		Gizzard Shad	37
		Longear Sunfish	7
		Total	**2,021**

Table 5-4. Seasonal differences in fish species impingement by the CPSES CWS.

Species	Fall	Rank	Winter	Rank	Spring	Rank	Summer	Rank
Threadfin Shad	**2,873**	**1**	**1,306**	**1**	**2,448**	**1**	**244,780**	**1**
Gizzard Shad	**165**	**3**	**65**	**3**	**311**	**4**	265	
Inland Silverside	28		**57**	**4**	255		**2,760**	**2**
Bluegill Sunfish	**1,050**	**2**	**465**	**2**	**1,422**	**2**	**1,919**	**3**
Longear Sunfish	7		0		28		0	
Warmouth Sunfish	0		14		21		107	
Green Sunfish	**94**	**4**	**43**	**5**	**287**	**5**	**671**	**4**
Redear Sunfish	0		0		0		78	
Golden Shiner	0		12		9		0	
White Crappie	0		0		15		28	
White Bass	**28**	**5**	8		14		20	
Largemouth Bass	7		7		**360**	**3**	**420**	**5**
Channel Catfish	19		14		26		118	
Freshwater Drum	5		8		20		52	
Total	**4,276**		**1,999**		**5,216**		**251,218**	

Notes:
Fall=Oct. 22-Dec. 22
Winter=Dec. 21-Mar. 19
Spring=Mar. 20-Jun. 20
Summer=Jun. 21- Sept. 22

Table 6-1. Total daily entrainment of ichthyoplan .all genera) for date of sampling collections at Unit 1.

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
Apr. 6, 1994	D	Damaged Eggs	0.0092	4	747360	27,503
					Sum	**27,503**
	N	Dorosoma Larvae	0.1420	4	747360	424,500
					Sum	**424,500**
	N	Menidia Larvae	0.0105	4	747360	31,389
					Sum	**31,389**
Apr. 13, 1994	D	Aplodinotus Eggs	0.0120	3	747360	26,905
					Sum	**26,905**
	N	Dorosoma Larvae	0.0586	3	747360	131,386
					Sum	**131,386**
	N	Menidia Eggs	0.0070	3	747360	15,695
					Sum	**15,695**
	N	Damaged Eggs	0.0076	3	747360	17,040
					Sum	**17,040**
Apr. 20, 1994	D	Dorosoma Larvae	0.0203	3	747360	45,514
					Sum	**45,514**
	N	Empty	0	3	747360	-
Apr. 27, 1994	D	Damaged Eggs	0.0167	4	747360	49,924
	N	Damaged Eggs	0.2210	4	747360	660,666
					Sum	**710,590**
	N	Menidia Eggs	0.0064	4	747360	19,132
					Sum	**19,132**
	N	Dorosoma Larvae	0.0064	4	747360	19,192
					Sum	**19,192**
	N	Dorosoma Juveniles	0.0064	4	747360	19,192
					Sum	**19,192**
May 4, 1994.	D	Aplodinotus Eggs	0.0053	4	747360	15,934
	N	Aplodinotus Eggs	0.0513	4	747360	153,358
					Sum	**169,292**
	D	Damaged Eggs	0.0063	4	747360	18,744

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 1
Constant = (17.3 m3/sec)(43,200 sec.)

Table 6-1. Total daily entrainment of ichthyoplank ,all genera) for date of sampling collections at Unit 1.

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
	N	Damaged Eggs	0.0073	4	747360	21,823
					Sum	**40,567**
	N	Damaged Larvae	0.0360	4	747360	107,620
					Sum	**107,620**
	N	Dorosoma Juveniles	0.0073	4	747360	21,913
					Sum	**21,913**
	N	Dorosoma Larvae	0.0220	4	747360	65,768
					Sum	**65,768**
	N	Menidia Larvae	0.0073	4	747360	21,913
					Sum	**21,913**
	N	Pomoxis Larvae	0.0073	4	747360	21,823
					Sum	**21,823**
May 11, 1994.	D	Aplodinotus Eggs	0.0065	4	747360	19,491
	N	Aplodinotus Eggs	0.0172	4	747360	51,418
					Sum	**70,910**
	D	Damaged Eggs	0.0092	4	747360	27,622
	N	Damaged Eggs	0.0200	4	747360	59,789
					Sum	**87,411**
	N	Dorosoma Larvae	0.0176	4	747360	52,614
					Sum	**52,614**
	D	Menidia Eggs	0.0130	4	747360	38,863
					Sum	**38,863**
May 18, 1994.	D	Aplodinotus Eggs	0.0401	4	747360	119,877
	N	Aplodinotus Eggs	0.0639	4	747360	191,025
					Sum	**310,902**
	D	Dorosoma Larvae	0.0098	4	747360	29,326
					Sum	**29,326**
May 25, 1994.	D	Empty	0	4	747360	-
	N	No Sample	NA	NA	NA	-
Jun. 1, 1994	D	Empty	0	4	747360	-

D/N = Day/Nite Collection

Density = Mean Density (N=3) in Front of Unit 1

Constant = (17.3 m3/sec)(43,200 sec.)

Table 6-1. Total daily entrainment of ichthyoplank .all genera) for date of sampling collections at Unit 1.

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
	N	Empty	0	4	747360	-
Jun. 8, 1994	D	Aplodinotus Larvae	0.0067	4	747360	19,880
					Sum	**19,880**
	N	Empty	0	4	747360	-
Jun. 15, 1994	D	Aplodinotus Larvae	0.0116	4	747360	34,678
					Sum	**34,678**
	N	Aplodinotus Eggs	0.0382	4	747360	114,197
					Sum	**114,197**
	N	Damaged Eggs	0.0926	4	747360	276,822
					Sum	**276,822**
Jun. 22, 1994	D	Aplodinotus Larvae	0.0057	4	747360	17,100
	N	Aplodinotus Larvae	0.0736	4	747360	220,023
					Sum	**237,122**
	N	Centract. Larvae	0.1310	4	747360	391,617
					Sum	**391,617**
	D	Damaged Eggs	0.0057	4	747360	17,100
					Sum	**17,100**
	N	Mendia Larvae	0.0081	4	747360	24,304
					Sum	**24,304**
	N	Menidia Eggs	0.0081	4	747360	24,214
					Sum	**24,214**
	N	Morone Larvae	0.0081	4	747360	24,304
					Sum	**24,304**
Jun. 29, 1994	D	Empty	0	4	747360	-
	N	Lepomis Larvae	0.0136	4	747360	40,656
					Sum	**40,656**
Jul. 6, 1994	D	Lepomis Larvae	0.0485	4	747360	144,988
					Sum	**144,988**
	N	Empty	0	4	747360	-

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 1
Constant = (17.3 m3/sec)(43,200 sec.)

Table 6-1. Total daily entrainment of ichthyoplank. (all genera) for date of sampling collections at Unit 1.

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
Jul. 13, 1994	N	Centrarc. Larvae	0.0137	4	747360	40,955
					Sum	**40,955**
	D	Lepomis Larvae	0.0139	4	747360	41,553
					Sum	**41,553**
	D	Pomoxis Larvae	0.0313	4	747360	93,569
	N	Pomoxis Larvae	0.0279	4	747360	83,405
					Sum	**176,975**
Jul. 20, 1994	D	Empty	0	4	747360	-
	N	Empty	0	4	747360	-
Jul. 27, 1994	D	Empty	0	4	747360	-
	N	Empty	0	4	747360	-
Aug. 3, 1994	D	Aplodinotus Larvae	0.0422	4	747360	126,154
	N	Aplodinotus Larvae	0.0269	4	747360	80,416
					Sum	**206,570**
	N	Centrarc. Larave	0.0052	4	747360	15,665
					Sum	**15,665**
	D	Lepomis Larvae	0.0060	4	747360	17,996
					Sum	**17,996**
	N	Pomoxis Larvae	0.0108	4	747360	32,286
					Sum	**32,286**
Aug. 10, 1994	D	Lepomis Larvae	0.0590	4	747360	176,377
	N	Lepomis Larvae	0.0253	4	747360	75,633
					Sum	**252,010**
	D	Morone Larvae	0.0473	4	747360	141,401
	N	Morone Larvae	0.0255	4	747360	76,231
					Sum	**217,631**
	D	Pomoxis Larvae	0.0392	4	747360	117,186
	N	Pomoxis Larvae	0.0063	4	747360	18,684
					Sum	**135,870**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 1
Constant = (17.3 m3/sec)(43,200 sec.)

Table 6-1. Total daily entrainment of ichthyoplan[illegible] all genera) for date of sampling collections at Unit 1.

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
Aug. 17, 1994	N	Damaged Larvae	0.0081	4	747360	24,304
					Sum	**24,304**
	D	Lepomis Juveniles	0.0210	4	747360	62,778
					Sum	**62,778**
	D	Lepomis Larvae	0.0748	4	747360	223,610
	N	Lepomis Larvae	0.0241	4	747360	72,046
					Sum	**295,656**
	D	Morone Larvae	0.0777	4	747360	232,279
					Sum	**232,279**
	N	Pomoxis Juveniles	0.0078	4	747360	23,318
					Sum	**23,318**
	D	Pomoxis Larvae	0.1130	4	747360	337,807
	N	Pomoxis Larvae	0.0157	4	747360	46,934
					Sum	**384,741**
Aug. 24, 1994	D	Damaged Eggs	0.0180	4	747360	53,810
					Sum	**53,810**
	D	Damaged Larvae	0.0106	4	747360	31,688
					Sum	**31,688**
	D	Lepomis Larvae	0.0296	4	747360	88,487
	N	Lepomis Larvae	0.0237	4	747360	70,850
					Sum	**159,337**
	D	Morone Larvae	0.0211	4	747360	63,077
	N	Morone Larvae	0.0295	4	747360	88,188
					Sum	**151,266**
	D	Pomoxis Larvae	0.0229	4	747360	68,458
					Sum	**68,458**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 1
Constant = (17.3 m3/sec)(43,200 sec.)

Table 6-2. Total daily entrainment of ichthyoplan ,all genera) for date of sampling collections at Unit 2.

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
Apr. 6, 1994	D	Aplodinotus Eggs	0.0402	3	747360	90,132
	N	Aplodinotus Eggs	0.0086	3	747360	19,215
					Sum	**109,346**
	D	Damaged Eggs	0.0253	3	747360	56,725
	N	Damaged Eggs	0.0095	3	747360	21,300
					Sum	**78,024**
	N	Dorsoma Larvae	0.0447	3	747360	100,221
					Sum	**100,221**
	N	Menidia Eggs	0.0086	3	747360	19,215
					Sum	**19,215**
Apr. 13, 1994	D	Damaged Eggs	0.0118	3	747360	26,457
					Sum	**26,457**
	D	Dorsoma Larvae	0.0068	3	747360	15,313
	N	Dorsoma Larvae	0.0380	3	747360	85,199
					Sum	**100,512**
Apr. 20, 1994	D	Damaged Eggs	0.0071	3	747360	16,008
					Sum	**16,008**
	D	Dorsoma Larvae	0.0066	3	747360	14,686
					Sum	**14,686**
	N	Menidia Eggs	0.0066	3	747360	14,686
					Sum	**14,686**
Apr. 29, 1994(a)	D	Damaged Eggs	0.0167	2	747360	24,962
	N	Damaged Eggs	0.221	2	747360	330,333
					Sum	**355,295**
	N	Menidia Eggs	0.0064	2	747360	9,566
					Sum	**9,566**
	N	Dorosoma Larvae	0.0064	2	747360	9,566
					Sum	**9,566**
	N	Dorosoma Juveniles	0.0064	2	747360	9,566
					Sum	**9,566**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 2
Constant = (17.3 m3/sec)(43,200 sec.)
(a)=density of ichthyoplankton infront of Unit 1 used for period of Unit 2 outage.

Table 6-2. Total daily entrainment of ichthyoplank. ll genera) for date of sampling collections at Unit 2.

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
May 4, 1994(a)	D	Aplodinotus Eggs	0.0053	2	747360	7,922
	N	Aplodinotus Eggs	0.0513	2	747360	76,679
					Sum	**84,601**
	D	Damaged Eggs	0.0063	2	747360	9,417
	N	Damaged Eggs	0.0073	2	747360	10,911
					Sum	**20,328**
	N	Damaged Larvae	0.0360	2	747360	53,810
					Sum	**53,810**
	N	Dorosoma Juveniles	0.0073	2	747360	10,911
					Sum	**10,911**
	N	Dorosoma Larvae	0.0220	2	747360	32,884
					Sum	**32,884**
	N	Menidia Larvae	0.0073	2	747360	10,911
					Sum	**10,911**
	N	Pomoxis Larvae	0.0073	2	747360	10,911
					Sum	**10,911**
May 11, 1994(a).	D	Aplodinotus Eggs	0.0065	2	747360	9,716
	N	Aplodinotus Eggs	0.0172	2	747360	25,709
					Sum	**35,425**
	D	Damaged Eggs	0.0092	2	747360	13,751
	N	Damaged Eggs	0.0200	2	747360	29,894
					Sum	**43,646**
	N	Dorosoma Larvae	0.0176	2	747360	26,307
					Sum	**26,307**
	D	Menidia Eggs	0.0130	2	747360	19,431
					Sum	**19,431**
May 18, 1994(a).	D	Aplodinotus Eggs	0.0401	2	747360	59,938
	N	Aplodinotus Eggs	0.0639	2	747360	95,513
					Sum	**155,451**
	D	Dorosoma Larvae	0.0098	2	747360	14,648
					Sum	**14,648**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 2
Constant = (17.3 m3/sec)(43,200 sec.)
(a)=density of ichthyoplankton infront of Unit 1 used for period of Unit 2 outage.

Table 6-2. Total daily entrainment of ichthyoplank .ll genera) for date of sampling collections at Unit 2.

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
May 25, 1994(a).	D	Empty	0	2	747360	-
	N	No Sample	NA	2	747360	-
Jun. 1, 1994(a)	D	Empty	0	3	747360	-
	N	Empty	0	3	747360	-
Jun. 8, 1994(a)	D	Aplodinotus Larvae	0.0067	3	747360	15,022
					Sum	**15,022**
	N	Empty	0	3	747360	-
Jun. 15, 1994(a)	D	Aplodinotus Larvae	0.0116	3	747360	26,008
					Sum	**26,008**
	N	Aplodinotus Eggs	0.0382	3	747360	85,647
					Sum	**85,647**
	N	Damaged Eggs	0.0926	3	747360	207,617
					Sum	**207,617**
Jun. 22, 1994	N	Aplodinotus Larvae	0.0057	4	747360	17,040
					Sum	**17,040**
	N	Centrarc. Larvae	0.0493	4	747360	147,379
					Sum	**147,379**
	D	Empty	0	4	747360	-
	D	Empty	0	4	747360	-
Jun. 29, 1994	N	Lepomis Larvae	0.0058	4	747360	17,369
					Sum	**17,369**
	D	Lepomis Larvae	0.0062	4	747360	18,505
Jul. 6, 1994					**Sum**	**18,505**
	D	Pomoxis Larvae	0.0125	4	747360	37,368
					Sum	**37,368**
	N	Empty	0	4	747360	-
	D	Lepomis Larvae	0.0056	4	747360	16,741

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 2
Constant = (17.3 m3/sec)(43,200 sec.)
(a)=density of ichthyoplankton infront of Unit 1 used for period of Unit 2 outage.

Table 6-2. Total daily entrainment of ichthyoplank ,all genera) for date of sampling collections at Unit 2.

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
Jul. 13, 1994					**Sum**	**16,741**
	D	Pomoxis Larvae	0.0148	4	747360	44,244
					Sum	**44,244**
	N	Empty	0	4	747360	-
	D	Empty	0	4	747360	-
Jul. 20, 1994	N	Empty	0	4	747360	-
	D	Empty	0	4	747360	-
Jul. 27, 1994	N	Empty	0	4	747360	-
	D	Aplodinotus Larvae	0.0257	4	747360	76,829
Aug. 3, 1994	N	Aplodinotus Larvae	0.0212	4	747360	63,376
					Sum	**140,205**
	N	Pomoxis Larvae	0.0259	4	747360	77,426
					Sum	**77,426**
	N	Centrarc. Larave	0.0128	4	747360	38,265
					Sum	**38,265**
	D	Lepomis Larvae	0.0870	4	747360	260,081
Aug. 10, 1994					**Sum**	**260,081**
	D	Morone Larvae	0.0411	4	747360	122,866
	N	Morone Larvae	0.0061	4	747360	18,116
					Sum	**140,982**
	D	Pomoxis Larvae	0.0269	4	747360	80,416
	N	Pomoxis Larvae	0.0068	4	747360	20,179
					Sum	**100,595**
	D	Lepomis Larvae	0.0177	4	747360	52,913
Aug. 17, 1994	N	Lepomis Larvae	0.0304	4	747360	90,879
					Sum	**143,792**
	N	Pomoxis Juveniles	0.0084	4	747360	25,081
					Sum	**25,081**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 2
Constant = (17.3 m3/sec)(43,200 sec.)
(a)=density of ichthyoplankton infront of Unit 1 used for period of Unit 2 outage.

Table 6-2. Total daily entrainment of ichthyoplank .ll genera) for date of sampling collections at Unit 2.

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
	D	Lepomis Larvae	0.0143	4	747360	42,749
Aug. 24, 1994					**Sum**	**42,749**
	D	Pomoxis Larvae	0.0143	4	747360	42,749
	N	Pomoxis Larvae	0.0071	4	747360	21,285
					Sum	**64,034**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 2
Constant = (17.3 m3/sec)(43,200 sec.)
(a)=density of ichthyoplankton infront of Unit 1 used for period of Unit 2 outage.

Table 6-3. Total weekly entrainme. :hthyoplankton (all genera) by Unit 1.

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
1	Apr. 6-12,1994	Dorosoma Larvae	424,500	7	2,971,500
		Menidia Larvae	31,389	7	219,723
		Damaged Eggs	27,503	7	192,521
				Sub Total	**3,383,744**
2	Apr. 13-19,1994	Aplodinotus Eggs	35,873	7	251,111
		Dorosoma Larvae	175,181	7	1,226,267
		Menidia Eggs	20,926	7	146,482
		Damaged Eggs	17,040	7	119,280
				Sub Total	**1,743,140**
3	Apr.20-26,1994	Dorosoma Larvae	60,686	7	424,802
				Sub Total	**424,802**
4	Apr. 27-May 3, 1994	Menidia Eggs	19,132	7	133,924
		Damaged Eggs	710,590	7	4,974,130
		Dorosoma Larvae	19,192	7	134,344
		Dorosoma Juveniles	19,192	7	134,344
				Sub Total	**5,376,742**
5	May 4-10, 1994	Aplodinotus Eggs	169,292	7	1,185,044
		Damaged Eggs	40,567	7	283,969
		Dorosoma Juveniles	21,913	7	153,391
		Dorosoma Larvae	65,768	7	460,376
		Menidia Larvae	21,913	7	153,391
		Pomoxis Larvae	21,823	7	152,761
				Sub Total	**2,388,932**
6	May 11-17, 1994	Aplodinotus Eggs	70,909	7	496,363
		Dorosoma Larvae	52,614	**7**	368,298
		Menidia Eggs	38,863	7	272,041
		Damaged Eggs	87,411	7	611,877
				Sub Total	**1,748,579**

Table 6-3. Total weekly entrainmer ·hthyoplankton (all genera) by Unit 1.

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
7	May 18-24, 1994	Aplodinotus Eggs	310,902	**7**	2,176,314
		Dorosoma Larvae	29,326	7	205,282
				Sub Total	**2,381,596**
8	May 25-31, 1994	Empty		7	0
				Sub Total	**0**
9	Jun. 1-7	Empty		7	0
				Sub Total	**0**
10	Jun. 8-14, 1994	Aplodinotus Larvae	19,880	**7**	139,160
				Sub Total	**139,160**
11	Jun.15-21, 1994	Aplodinotus Larvae	34,677	7	242,739
		Aplodinotus Eggs	114,197	7	799,379
		Damaged Eggs	276,822	7	1,937,754
				Sub Total	**2,979,872**
12	Jun. 22-28, 1994	Aplodinotus Larvae	237,122	7	1,659,854
		Centrachidae Larvae	391,617	7	2,741,319
		Menidia Larvae	24,304	7	170,128
		Menidia Eggs	24,214	7	169,498
		Damaged Eggs	17,100	7	119,700
		Morone Larvae	24,304	7	170,128
				Sub Total	**5,030,627**
13	Jun. 29-Jul. 5, 1994	Lepomis Larvae	40,656	7	284,592
				Sub Total	**284,592**
14	Jul. 6-12, 1994	Lepomis Larvae	144,988	7	1,014,916
				Sub Total	**1,014,916**
15	Jul. 13-19, 1994	Centrachidae Larvae	40,955	7	286,685
		Lepomis Larvae	41,553	7	290,871

Table 6-3. Total weekly entrainme. .chthyoplankton (all genera) by Unit 1.

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
		Pomoxis Larvae	176,975	7	1,238,825
				Sub Total	**1,816,381**
16	Jul. 20-26, 1994			**Sub Total**	0
17	Jul. 27-Aug. 2, 1994			**Sub Total**	0
18	Aug. 3-9, 1994	Aplodinotus Larvae	206,570	7	1,445,990
		Centrarchidae Larvae	15,665	7	109,655
		Lepomis Larvae	17,996	7	125,972
		Pomoxis Larvae	32,286	7	226,002
				Sub Total	**1,907,619**
19	Aug. 10-16, 1994	Lepomis Larvae	252,010	7	1,764,070
		Morone Larvae	217,631	7	1,523,417
		Pomoxis Larvae	135,870	7	951,090
				Sub Total	**4,238,577**
20	Aug.17-23, 1994	Lepomis Juveniles	62,778	7	439,446
		Lepomis Larvae	295,656	7	2,069,592
		Morone Larvae	232,279	7	1,625,953
		Pomoxis Juveniles	23,318	7	163,226
		Pomoxis Larvae	384,741	7	2,693,187
				Sub Total	**6,991,404**
21	Aug. 24-30, 1994	Lepomis Larvae	159,337	7	1,115,359
		Morone Larvae	151,265	7	1,058,855
		Pomoxis Larvae	68,458	7	479,206
				Sub Total	**2,653,420**

Table 6-4. Total weekly entrainmer. chthyoplankton (all genera) for Unit 2.

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
1	Apr. 6-12,1994	Aplodinotus Eggs	109,346	7	765,422
		Dorsoma Larvae	100,220	7	701,540
		Menidia Eggs	19,214	7	134,498
		Damaged Eggs	78,024	7	546,168
				Sub Total	**2,147,628**
2	Apr. 13-19,1994	Dorsoma Larvae	100,512	7	703,584
		Damaged Eggs	26,457	7	185,199
				Sub Total	**888,783**
3	Apr.20-28,1994	Dorsoma Larvae	14,685	7	102,795
		Menidia Eggs	14,685	7	102,795
		Damaged Eggs	16,008	7	112,056
				Sub Total	**317,646**
4(a)	Apr. 29-May 3,1994	Menidia Eggs	9,566	7	66,962
		Damaged Eggs	355,295	7	2,487,065
		Dorosoma Larvae	9,566	7	66,962
		Dorosoma Juveniles	9,566	7	66,962
				Sub Total	**2,687,951**
5(a)	May 4-10,1994	Aplodinotus Eggs	84,601	7	592,207
		Damaged Eggs	20,328	7	142,296
		Dorosoma Larvae	32,884	7	230,188
		Dorosoma Juveniles	10,911	7	76,377
		Menidia Larvae	10,911	7	76,377
		Pomoxis Larvae	10,911	7	76,377
				Sub Total	**1,193,822**
6(a)	May 11-17,1994	Aplodinotus Eggs	35,425	7	247,975
		Menidia Eggs	19,431	7	136,017
		Damaged Eggs	43,646	7	305,522
		Dorosoma Larvae	26,307	7	184,149
				Sub Total	**873,663**

(a) Unit 2 weekly extrapolations based on mean densities in front of Unit 1 during outage period.

Table 6-4. Total weekly entrainmer. .chthyoplankton (all genera) for Unit 2.

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
7(a)	May 18-24,1994	Aplodinotus Eggs	155,451	7	1,088,157
		Dorosoma Larvae	14,648	7	102,536
				Sub Total	**1,190,693**
8(a)	May 25-31,1994	Empty	0	7	0
				Sub Total	0
9(a)	Jun. 1-7, 1994	Empty	0	7	0
				Sub Total	0
10(a)	Jun. 8-14	Aplodinotus Larvae	15,022	7	105,154
				Sub Total	**105,154**
11(a)	Jun. 15-21,1994	Aplodinotus Larvae	26,008	7	182,056
		Aplodinotus Eggs	85,647	7	599,529
		Damaged Eggs	207,617	7	1,453,319
				Sub Total	**2,234,904**
12	Jun.22-28,1994	Aplodinotus Larvae	17,040	7	119,280
		Centrarchidae Larvae	147,380	7	1,031,660
				Sub Total	**1,150,940**
13	Jun. 29-Jul. 5, 1994	Lepomis Larvae	17,370	7	121,590
				Sub Total	**121,590**
14	Jul. 6-Jul. 12, 1994	Lepomis Larvae	18,504	7	129,528
		Pomoxis Larvae	37,368	7	261,576
				Sub Total	**391,104**
15	Jul. 13-19, 1994	Lepomis Larvae	16,740	7	117,180
		Pomoxis Larvae	44,243	7	309,701
				Sub Total	**426,881**

(a) Unit 2 weekly extrapolations based on mean densities in front of Unit 1 during outage period.

Table 6-4. Total weekly entrainme ,hthyoplankton (all genera) for Unit 2.

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
16	Jul. 20-26, 1994	Empty			0
				Sub Total	0
17	Jul. 27-Aug. 2,1994	Empty			0
				Sub Total	0
18	Aug. 3-9, 1994	Aplodinotus Larvae	140,205	7	981,435
		Pomoxis Larvae	77,426	7	541,982
		Centrarchidae Larvae	38,265	7	267,855
				Sub Total	**1,791,272**
19	Aug.10-16, 1994	Lepomis Larvae	260,081	7	1,820,567
		Morone Larvae	140,982	7	986,874
		Pomoxis Larvae	100,595	7	704,165
				Sub Total	**3,511,606**
20	Aug. 17-23, 1994	Lepomis Larvae	143,792	7	1,006,544
		Pomoxis Larvae	25,081	7	175,567
				Sub Total	**1,182,111**
21	Aug. 24-30, 1994	Pomoxis Larvae	64,034	7	448,238
		Lepomis Larvae	42,749	7	299,243
				Sub Total	**747,481**

(a) Unit 2 weekly extrapolations based on mean densities in front of Unit 1 during outage period.

Table 6-5 . Monthly entrainment (all genera identified) for the sa , period of April 6-August 24, 1994 for CPSES Unit 1 CWS intake.

Month Number	Monthly Interval	Genus/Stage	Monthly Period (Days)	Total Entrained	% Composition
1	Apr. 6-May 6	Aplodinotus Eggs	31	696,211	11.0
		Menidia Eggs		243,789	3.8
		Damaged Eggs		5,407,632	85.2
			Subtotal Eggs	**6,347,632**	
		Dorsoma Larvae	31	4,541,441	89.2
		Dorsoma Juveniles		200,083	3.93
		Menidia Larvae		285,462	5.6
		Pomoxis Larvae		65,469	1.3
			Subtotal Larvae/Juv.	**5,092,455**	
2	May 7-Jun. 7	Aplodinotus Eggs	31	3,349,845	76.2
		Menidia Eggs		272,041	6.19
		Damaged Eggs		774,145	17.61
			Subtotal Eggs	**4,396,031**	
		Dorsoma Larvae	31	836,652	76.1
		Dorsoma Juveniles		87,652	7.97
		Menidia Larvae		87,652	7.97
		Pomoxis Larvae		87,292	7.94
			Subtotal Larvae/Juv.	**1,099,248**	
3	Jun. 8-July 8	Aplodinotus Eggs	31	799,379	21.0
		Menidia Eggs		169,498	4.5
		Damaged Eggs		2,831,599	74.5
			Subtotal Eggs	**3,800,476**	
		Aplodinotus Larvae	31	2,041,753	38.5
		Centrarchidae Larvae		2,741,319	51.7
		Lepomis Larvae		475,620	9.0
		Menidia Larvae		24,304	0.46
		Morone Larvae		24,304	0.46
			Subtotal Larvae	**5,307,300**	
4	July 9-Aug. 9	Aplodinotus Larvae	31	1,445,990	33.6
		Centrarchidae Larvae		396,340	9.21
		Lepomis Larvae		996,795	23.2
		Poxomis Larvae		1,464,827	34.0
			Subtotal Larvae	**4,303,952**	
5	Aug. 10-Aug. 30	Lepomis Larvae	15	4,949,021	35.6
		Lepomis Juveniles		439,446	3.17
		Morone Larvae		4,208,225	30.3
		Poxomis Larvae		4,123,483	29.7
		Poxomis Juveniles		163,226	1.18
			Subtotal Larvae	**13,883,401**	

Note: The period of August 10 - August 30, 1994 represents 0.67 months or 21 days.

Table 6-6 . Monthly entrainment (all genera identified) for the s J period of April 6-August 30, 1994 for CPSES Unit 2 CWS intake.

Month Number	Monthly Interval	Genus/Stage	Monthly Period (Days)	Total Entrained	% Composition
1	Apr. 6- May 6	Aplodinotus Eggs	31	1,019,225	21.6
		Menidia Eggs		304,255	6.5
		Damaged Eggs		3,391,472	71.9
			SubTotal Eggs	**4,714,952**	
		Dorosoma Larvae	31	1,673,533	91.02
		Menidia Larvae		32,733	1.78
		Pomoxis Larvae		32,733	1.78
		Dorosoma Juveniles		99,695	5.42
			SubTotal Larvae/Juv.	**1,838,694**	
2	May 7- Jun. 7	Aplodinotus Eggs	31	1,674,536	76.2
		Damaged Eggs		386,834	17.6
		Menidia Eggs		136,017	6.19
			SubTotal Eggs	**2,197,387**	
		Dorosoma Larvae	31	418,221	76.2
		Menidia Larvae		43,644	7.95
		Pomoxis Larvae		43,644	7.95
		Dorosoma Juveniles		43,644	7.95
			SubTotal Larvae/Juv.	**549,153**	
3	Jun. 8-Jul. 8	Aplodinotus Eggs	31	599,529	29.2
		Damaged Eggs		1,453,319	70.8
			SubTotal Eggs	**2,052,848**	
		Aplodinotus Larvae	31	406,490	23.5
		Lepomis Larvae		177,102	10.3
		Pomoxis Larvae		112,104	6.49
		Centrarchidae Larvae		1,031,660	59.7
			SubTotal Larvae	**1,727,356**	
4	Jul. 9-Aug. 9	Aplodinotus Larvae	31	981,435	37.3
		Lepomis Larvae		191,196	7.26
		Pomoxis Larvae		1,192,351	45.3
		Centrarchidae Larvae		267,855	10.2
			SubTotal Larvae	**2,632,837**	
5	Aug. 10-Aug. 30	Lepomis Larvae	31	3,126,354	66.0
		Pomoxis Larvae		623,805	13.2
		Morone Larvae		986,874	20.8
			SubTotal Larvae	**4,737,033**	

Note: For the Unit 2 outage period, Unit 1 densities were used to determine entrainment of ichthyoplankton.

Table 7-1. Fish species collected from SCR during electroshocking and gill net surveys for the Comanche Peak 316(b) Demonstration.

Common Name	Scientific Name
Channel Catfish	*Ictalurus puntatus*
Gizzard Shad	*Dorosoma cepedianum*
White Bass	*Morone chrysops*
Black Crappie	*Pomoxis nigromaculatus*
White Crappie	*Pomoxis annularis*
Largemouth Bass	*Micropterus salmoides*
Smallmouth Bass	*Micropterus dolomieui*
Freshwater Drum	*Aplodinotus grunniens*
Common Carp	*Cyprinus carpio*
Threadfin Shad	*Dorosoma petenese*
Bluegill Sunfish	*Lepomis macrochirus*
Blacktail Shiner	*Cyprinella venusta*
Green Sunfish	*Lepomis cyanellus*
Longear Sunfish	*Lepomis megalotis*
Inland Silverside	*Menidia beryllina*
Golden Shiner	*Notemigonus crysoleucas*
Yellow Bullhead	*Ameiurus natalis*
Redbreast Sunfish	*Lepomis auritus*
Blue Catfish	*Ictalurus furcatus*
Flathead Catfish	*Pylodictis olivaris*

Table 7-2. Overall species abundance from SCR based upon electroshocking and gill net surveys for the Comanche Peak 316(b) Demonstration.

Common Name	Scientific Name	N	Percent Abundance
Channel Catfish	*Ictalurus puntatus*	445	21.8
Gizzard Shad	*Dorosoma cepedianum*	279	13.7
White Bass	*Morone chrysops*	68	3.33
Black Crappie	*Pomoxis nigromaculatus*	6	0.294
White Crappie	*Pomoxis annularis*	27	1.32
Largemouth Bass	*Micropterus salmoides*	71	3.48
Smallmouth Bass	*Micropterus dolomieui*	32	1.57
Freshwater Drum	*Aplodinotus grunniens*	43	2.11
Common Carp	*Cyprinus carpio*	69	3.38
Threadfin Shad	*Dorosoma petenese*	627	30.8
Bluegill Sunfish	*Lepomis macrochirus*	200	9.81
Blacktail Shiner	*Cyprinella venusta*	5	0.245
Green Sunfish	*Lepomis cyanellus*	38	1.86
Longear Sunfish	*Lepomis megalotis*	11	0.539
Inland Silverside	*Menidia beryllina*	107	5.25
Golden Shiner	*Notemigonus crysoleucas*	1	0.049
Yellow Bullhead	*Ameiurus natalis*	3	0.147
Redbreast Sunfish	*Lepomis auritus*	4	0.196
Blue Catfish	*Ictalurus furcatus*	2	0.098
Flathead Catfish	*Pylodictis olivaris*	1	0.049

Table 7-3. Estimated daily entrainment of ichthyoplankt. .l genera) by Unit 1 under full operation (4 CWS pumps).

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
Apr. 6, 1994	D	Damaged Eggs	0.0092	4	747360	27,503
					Sum	**27,503**
	N	Dorosoma Larvae	0.1420	4	747360	424,500
					Sum	**424,500**
	N	Menidia Larvae	0.0105	4	747360	31,389
					Sum	**31,389**
Apr. 13, 1994	D	Aplodinotus Eggs	0.0120	4	747360	35,873
					Sum	**35,873**
	N	Dorosoma Larvae	0.0586	4	747360	175,181
					Sum	**175,181**
	N	Menidia Eggs	0.0070	4	747360	20,926
					Sum	**20,926**
	N	Damaged Eggs	0.0076	4	747360	22,720
					Sum	**22,720**
Apr. 20, 1994	D	Dorosoma Larvae	0.0203	4	747360	60,686
					Sum	**60,686**
	N	Empty	0	4	747360	-
Apr. 27, 1994	D	Damaged Eggs	0.0167	4	747360	49,924
	N	Damaged Eggs	0.2210	4	747360	660,666
					Sum	**710,590**
	N	Menidia Eggs	0.0064	4	747360	19,132
					Sum	**19,132**
	N	Dorosoma Larvae	0.0064	4	747360	19,192
					Sum	**19,192**
	N	Dorosoma Juveniles	0.0064	4	747360	19,192
					Sum	**19,192**
May 4, 1994.	D	Aplodinotus Eggs	0.0053	4	747360	15,934
	N	Aplodinotus Eggs	0.0513	4	747360	153,358
					Sum	**169,292**
	D	Damaged Eggs	0.0063	4	747360	18,744

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 1
Constant = (17.3 m3/sec)(43,200 sec.)

Table 7-3. Estimated daily entrainment of ichthyoplank .l genera) by Unit 1 under full operation (4 CWS pumps).

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
	N	Damaged Eggs	0.0073	4	747360	21,823
					Sum	**40,567**
	N	Damaged Larvae	0.0360	4	747360	107,620
					Sum	**107,620**
	N	Dorosoma Juveniles	0.0073	4	747360	21,913
					Sum	**21,913**
	N	Dorosoma Larvae	0.0220	4	747360	65,768
					Sum	**65,768**
	N	Menidia Larvae	0.0073	4	747360	21,913
					Sum	**21,913**
	N	Pomoxis Larvae	0.0073	4	747360	21,823
					Sum	**21,823**
May 11, 1994.	D	Aplodinotus Eggs	0.0065	4	747360	19,491
	N	Aplodinotus Eggs	0.0172	4	747360	51,418
					Sum	**70,910**
	D	Damaged Eggs	0.0092	4	747360	27,622
	N	Damaged Eggs	0.0200	4	747360	59,789
					Sum	**87,411**
	N	Dorosoma Larvae	0.0176	4	747360	52,614
					Sum	**52,614**
	D	Menidia Eggs	0.0130	4	747360	38,863
					Sum	**38,863**
May 18, 1994.	D	Aplodinotus Eggs	0.0401	4	747360	119,877
	N	Aplodinotus Eggs	0.0639	4	747360	191,025
					Sum	**310,902**
	D	Dorosoma Larvae	0.0098	4	747360	29,326
					Sum	**29,326**
May 25, 1994.	D	Empty	0	4	747360	-
	N	No Sample	NA	NA	NA	-
Jun. 1, 1994	D	Empty	0	4	747360	-

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 1
Constant = (17.3 m3/sec)(43,200 sec.)

Table 7-3. Estimated daily entrainment of ichthyoplankt genera) by Unit 1 under full operation (4 CWS pumps).

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
	N	Empty	0	4	747360	-
Jun. 8, 1994	D	Aplodinotus Larvae	0.0067	4	747360	19,880
					Sum	**19,880**
	N	Empty	0	4	747360	-
Jun. 15, 1994	D	Aplodinotus Larvae	0.0116	4	747360	34,678
					Sum	**34,678**
	N	Aplodinotus Eggs	0.0382	4	747360	114,197
					Sum	**114,197**
	N	Damaged Eggs	0.0926	4	747360	276,822
					Sum	**276,822**
Jun. 22, 1994	D	Aplodinotus Larvae	0.0057	4	747360	17,100
	N	Aplodinotus Larvae	0.0736	4	747360	220,023
					Sum	**237,122**
	N	Centract. Larvae	0.1310	4	747360	391,617
					Sum	**391,617**
	D	Damaged Eggs	0.0057	4	747360	17,100
					Sum	**17,100**
	N	Mendia Larvae	0.0081	4	747360	24,304
					Sum	**24,304**
	N	Menidia Eggs	0.0081	4	747360	24,214
					Sum	**24,214**
	N	Morone Larvae	0.0081	4	747360	24,304
					Sum	**24,304**
Jun. 29, 1994	D	Empty	0	4	747360	-
	N	Lepomis Larvae	0.0136	4	747360	40,656
					Sum	**40,656**
Jul. 6, 1994	D	Lepomis Larvae	0.0485	4	747360	144,988
					Sum	**144,988**
	N	Empty	0	4	747360	-

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 1
Constant = (17.3 m3/sec)(43,200 sec.)

Table 7-3. Estimated daily entrainment of ichthyoplankt .l genera) by Unit 1 under full operation (4 CWS pumps).

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
Jul. 13, 1994	N	Centrarc. Larvae	0.0137	4	747360	40,955
					Sum	**40,955**
	D	Lepomis Larvae	0.0139	4	747360	41,553
					Sum	**41,553**
	D	Pomoxis Larvae	0.0313	4	747360	93,569
	N	Pomoxis Larvae	0.0279	4	747360	83,405
					Sum	**176,975**
Jul. 20, 1994	D	Empty	0	4	747360	-
	N	Empty	0	4	747360	-
Jul. 27, 1994	D	Empty	0	4	747360	-
	N	Empty	0	4	747360	-
Aug. 3, 1994	D	Aplodinotus Larvae	0.0422	4	747360	126,154
	N	Aplodinotus Larvae	0.0269	4	747360	80,416
					Sum	**206,570**
	N	Centrarc. Larave	0.0052	4	747360	15,665
					Sum	**15,665**
	D	Lepomis Larvae	0.0060	4	747360	17,996
					Sum	**17,996**
	N	Pomoxis Larvae	0.0108	4	747360	32,286
					Sum	**32,286**
Aug. 10, 1994	D	Lepomis Larvae	0.0590	4	747360	176,377
	N	Lepomis Larvae	0.0253	4	747360	75,633
					Sum	**252,010**
	D	Morone Larvae	0.0473	4	747360	141,401
	N	Morone Larvae	0.0255	4	747360	76,231
					Sum	**217,631**
	D	Pomoxis Larvae	0.0392	4	747360	117,186
	N	Pomoxis Larvae	0.0063	4	747360	18,684
					Sum	**135,870**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 1
Constant = (17.3 m3/sec)(43,200 sec.)

Table 7-3. Estimated daily entrainment of ichthyoplankt genera) by Unit 1 under full operation (4 CWS pumps).

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
Aug. 17, 1994	N	Damaged Larvae	0.0081	4	747360	24,304
					Sum	**24,304**
	D	Lepomis Juveniles	0.0210	4	747360	62,778
					Sum	**62,778**
	D	Lepomis Larvae	0.0748	4	747360	223,610
	N	Lepomis Larvae	0.0241	4	747360	72,046
					Sum	**295,656**
	D	Morone Larvae	0.0777	4	747360	232,279
					Sum	**232,279**
	N	Pomoxis Juveniles	0.0078	4	747360	23,318
					Sum	**23,318**
	D	Pomoxis Larvae	0.1130	4	747360	337,807
	N	Pomoxis Larvae	0.0157	4	747360	46,934
					Sum	**384,741**
Aug. 24, 1994	D	Damaged Eggs	0.0180	4	747360	53,810
					Sum	**53,810**
	D	Damaged Larvae	0.0106	4	747360	31,688
					Sum	**31,688**
	D	Lepomis Larvae	0.0296	4	747360	88,487
	N	Lepomis Larvae	0.0237	4	747360	70,850
					Sum	**159,337**
	D	Morone Larvae	0.0211	4	747360	63,077
	N	Morone Larvae	0.0295	4	747360	88,188
					Sum	**151,266**
	D	Pomoxis Larvae	0.0229	4	747360	68,458
					Sum	**68,458**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 1
Constant = (17.3 m3/sec)(43,200 sec.)

Table 7-4. Estimated daily entrainment of ichthyoplank il genera) by Unit 2 under full operation (4 CWS pumps).

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
Apr. 6, 1994	D	Aplodinotus Eggs	0.0402	4	747360	120,175
	N	Aplodinotus Eggs	0.0086	4	747360	25,620
					Sum	**145,795**
	D	Damaged Eggs	0.0253	4	747360	75,633
	N	Damaged Eggs	0.0095	4	747360	28,400
					Sum	**104,033**
	N	Dorsoma Larvae	0.0447	4	747360	133,628
					Sum	**133,628**
	N	Menidia Eggs	0.0086	4	747360	25,620
					Sum	**25,620**
Apr. 13, 1994	D	Damaged Eggs	0.0118	4	747360	35,275
					Sum	**35,275**
	D	Dorsoma Larvae	0.0068	4	747360	20,418
	N	Dorsoma Larvae	0.0380	4	747360	113,599
					Sum	**134,017**
Apr. 20, 1994	D	Damaged Eggs	0.0071	4	747360	21,345
					Sum	**21,345**
	D	Dorsoma Larvae	0.0066	4	747360	19,581
					Sum	**19,581**
	N	Menidia Eggs	0.0066	4	747360	19,581
					Sum	**19,581**
Apr. 29, 1994(a)	D	Damaged Eggs	0.0167	4	747360	49,924
	N	Damaged Eggs	0.221	4	747360	660,666
					Sum	**710,590**
	N	Menidia Eggs	0.0064	4	747360	19,132
					Sum	**19,132**
	N	Dorosoma Larvae	0.0064	4	747360	19,132
					Sum	**19,132**
	N	Dorosoma Juveniles	0.0064	4	747360	19,132
					Sum	**19,132**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 2
Constant = (17.3 m3/sec)(43,200 sec.)
(a)=density of ichthyoplankton infront of Unit 1 used for period of Unit 2 outage.

Table 7-4. Estimated daily entrainment of ichthyoplank .l genera) by Unit 2 under full operation (4 CWS pumps).

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
May 4, 1994(a)	D	Aplodinotus Eggs	0.0053	4	747360	15,844
	N	Aplodinotus Eggs	0.0513	4	747360	153,358
					Sum	**169,202**
	D	Damaged Eggs	0.0063	4	747360	18,833
	N	Damaged Eggs	0.0073	4	747360	21,823
					Sum	**40,656**
	N	Damaged Larvae	0.0360	4	747360	107,620
					Sum	**107,620**
	N	Dorosoma Juveniles	0.0073	4	747360	21,823
					Sum	**21,823**
	N	Dorosoma Larvae	0.0220	4	747360	65,768
					Sum	**65,768**
	N	Menidia Larvae	0.0073	4	747360	21,823
					Sum	**21,823**
	N	Pomoxis Larvae	0.0073	4	747360	21,823
					Sum	**21,823**
May 11, 1994(a).	D	Aplodinotus Eggs	0.0065	4	747360	19,431
	N	Aplodinotus Eggs	0.0172	4	747360	51,418
					Sum	**70,850**
	D	Damaged Eggs	0.0092	4	747360	27,503
	N	Damaged Eggs	0.0200	4	747360	59,789
					Sum	**87,292**
	N	Dorosoma Larvae	0.0176	4	747360	52,614
					Sum	**52,614**
	D	Menidia Eggs	0.0130	4	747360	38,863
					Sum	**38,863**
May 18, 1994(a).	D	Aplodinotus Eggs	0.0401	4	747360	119,877
	N	Aplodinotus Eggs	0.0639	4	747360	191,025
					Sum	**310,902**
	D	Dorosoma Larvae	0.0098	4	747360	29,297
					Sum	**29,297**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 2
Constant = (17.3 m3/sec)(43,200 sec.)
(a)=density of ichthyoplankton infront of Unit 1 used for period of Unit 2 outage.

Table 7-4. Estimated daily entrainment of ichthyoplank. .ll genera) by Unit 2 under full operation (4 CWS pumps).

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
May 25, 1994(a).	D	Empty	0	4	747360	-
	N	No Sample	NA	4	747360	-
Jun. 1, 1994(a)	D	Empty	0	4	747360	-
	N	Empty	0	4	747360	-
Jun. 8, 1994(a)	D	Aplodinotus Larvae	0.0067	4	747360	20,029
					Sum	**20,029**
	N	Empty	0	4	747360	-
Jun. 15, 1994(a)	D	Aplodinotus Larvae	0.0116	4	747360	34,678
					Sum	**34,678**
	N	Aplodinotus Eggs	0.0382	4	747360	114,197
					Sum	**114,197**
	N	Damaged Eggs	0.0926	4	747360	276,822
					Sum	**276,822**
Jun. 22, 1994	N	Aplodinotus Larvae	0.0057	4	747360	17,040
					Sum	**17,040**
	N	Centrarc. Larvae	0.0493	4	747360	147,379
					Sum	**147,379**
	D	Empty	0	4	747360	-
Jun. 29, 1994	D	Empty	0	4	747360	-
	N	Lepomis Larvae	0.0058	4	747360	17,369
					Sum	**17,369**
Jul. 6, 1994	D	Lepomis Larvae	0.0062	4	747360	18,505
					Sum	**18,505**
	D	Pomoxis Larvae	0.0125	4	747360	37,368
					Sum	**37,368**
	N	Empty	0	4	747360	-
Jul. 13, 1994	D	Lepomis Larvae	0.0056	4	747360	16,741

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 2
Constant = (17.3 m3/sec)(43,200 sec.)
(a)=density of ichthyoplankton infront of Unit 1 used for period of Unit 2 outage.

Table 7-4. Estimated daily entrainment of ichthyoplank[illegible] [illegible]all genera) by Unit 2 under full operation (4 CWS pumps).

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
					Sum	**16,741**
	D	Pomoxis Larvae	0.0148	4	747360	44,244
					Sum	**44,244**
	N	Empty	0	4	747360	-
Jul. 20, 1994	D	Empty	0	4	747360	-
	N	Empty	0	4	747360	-
Jul. 27, 1994	D	Empty	0	4	747360	-
	N	Empty	0	4	747360	-
Aug. 3, 1994	D	Aplodinotus Larvae	0.0257	4	747360	76,829
	N	Aplodinotus Larvae	0.0212	4	747360	63,376
					Sum	**140,205**
	N	Pomoxis Larvae	0.0259	4	747360	77,426
					Sum	**77,426**
	N	Centrarc. Larave	0.0128	4	747360	38,265
					Sum	**38,265**
Aug. 10, 1994	D	Lepomis Larvae	0.0870	4	747360	260,081
					Sum	**260,081**
	D	Morone Larvae	0.0411	4	747360	122,866
	N	Morone Larvae	0.0061	4	747360	18,116
					Sum	**140,982**
	D	Pomoxis Larvae	0.0269	4	747360	80,416
	N	Pomoxis Larvae	0.0068	4	747360	20,179
					Sum	**100,595**
Aug. 17, 1994	D	Lepomis Larvae	0.0177	4	747360	52,913
	N	Lepomis Larvae	0.0304	4	747360	90,879
					Sum	**143,792**
	N	Pomoxis Juveniles	0.0084	4	747360	25,081
					Sum	**25,081**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 2
Constant = (17.3 m3/sec)(43,200 sec.)
(a)=density of ichthyoplankton infront of Unit 1 used for period of Unit 2 outage.

Table 7-4. Estimated daily entrainment of ichthyoplank .l genera) by Unit 2 under full operation (4 CWS pumps).

Date	D/N	Genus/Stage	Density(No./m3)	No. CWS Pumps	Constant	Entrained Daily
Aug. 24, 1994	D	Lepomis Larvae	0.0143	4	747360	42,749
					Sum	**42,749**
	D	Pomoxis Larvae	0.0143	4	747360	42,749
	N	Pomoxis Larvae	0.0071	4	747360	21,285
					Sum	**64,034**

D/N = Day/Nite Collection
Density = Mean Density (N=3) in Front of Unit 2
Constant = (17.3 m3/sec)(43,200 sec.)
(a)=density of ichthyoplankton infront of Unit 1 used for period of Unit 2 outage.

Table 7-5. Estimated weekly entrainment of ichthyopla (all genera) by Unit 1 under full operation (4 CWS pumps).

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
1	Apr. 6-12,1994	Dorosoma Larvae	424,500	7	2,971,500
		Menidia Larvae	31,389	7	219,723
		Damaged Eggs	27,503	7	192,521
				Sub Total	**3,383,744**
2	Apr. 13-19,1994	Aplodinotus Eggs	35,873	7	251,111
		Dorosoma Larvae	175,181	7	1,226,267
		Menidia Eggs	20,926	7	146,482
		Damaged Eggs	22,720	7	159,040
				Sub Total	**1,782,900**
3	Apr.20-26,1994	Dorosoma Larvae	60,686	7	424,802
				Sub Total	**318,598**
4	Apr. 27-May 3, 1994	Menidia Eggs	19,132	7	133,924
		Damaged Eggs	710,590	7	4,974,130
		Dorosoma Larvae	19,192	7	134,344
		Dorosoma Juveniles	19,192	7	134,344
				Sub Total	**5,376,742**
5	May 4-10, 1994	Aplodinotus Eggs	169,292	7	1,185,044
		Damaged Eggs	40,567	7	283,969
		Dorosoma Juveniles	21,913	7	153,391
		Dorosoma Larvae	65,768	7	460,376
		Menidia Larvae	21,913	7	153,391
		Pomoxis Larvae	21,823	7	152,761
				Sub Total	**2,388,932**
6	May 11-17, 1994	Aplodinotus Eggs	70,909	7	496,363
		Damaged Eggs	87,411	7	611,877
		Dorosoma Larvae	52,614	7	368,298
		Menidia Eggs	38,863	7	272,041
				Sub Total	**1,748,579**

Table 7-5. Estimated weekly entrainment of ichthyoplar ,all genera) by Unit 1 under full operation (4 CWS pumps).

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
7	May 18-24, 1994	Aplodinotus Eggs	310,902	7	2,176,314
		Dorosoma Larvae	29,326	7	205,282
				Sub Total	**2,381,596**
8	May 25-31, 1994	Empty		7	0
				Sub Total	**0**
9	Jun. 1-7	Empty		7	0
				Sub Total	**0**
10	Jun. 8-14, 1994	Aplodinotus Larvae	19,880	**7**	139,160
				Sub Total	**139,160**
11	Jun.15-21, 1994	Aplodinotus Larvae	34,677	7	242,739
		Damaged Eggs	276,822	7	1,937,754
		Aplodinotus Eggs	114,197	7	799,379
				Sub Total	**2,979,872**
12	Jun. 22-28, 1994	Aplodinotus Larvae	237,122	7	1,659,854
		Centrachidae Larvae	391,617	7	2,741,319
		Menidia Larvae	24,304	7	170,128
		Menidia Eggs	24,214	7	169,498
		Damaged Eggs	17,100	7	119,700
		Morone Larvae	24,304	7	170,128
				Sub Total	**5,030,627**
13	Jun. 29-Jul. 5, 1994	Lepomis Larvae	40,656	7	284,592
				Sub Total	**284,592**
14	Jul. 6-12, 1994	Lepomis Larvae	144,988	7	1,014,916
				Sub Total	**1,014,916**
15	Jul. 13-19, 1994	Centrachidae Larvae	40,955	7	286,685
		Lepomis Larvae	41,553	7	290,871

Table 7-5. Estimated weekly entrainment of ichthyopla (all genera) by Unit 1 under full operation (4 CWS pumps).

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
		Pomoxis Larvae	176,975	7	1,238,825
				Sub Total	**1,816,381**
16	Jul. 20-26, 1994	Empty		**Sub Total**	0
17	Jul. 27-Aug. 2, 1994	Empty		**Sub Total**	0
18	Aug. 3-9, 1994	Aplodinotus Larvae	206,570	7	1,445,990
		Centrarchidae Larvae	15,665	7	109,655
		Lepomis Larvae	17,996	7	125,972
		Pomoxis Larvae	32,286	7	226,002
				Sub Total	**1,907,619**
19	Aug. 10-16, 1994	Lepomis Larvae	252,010	7	1,764,070
		Morone Larvae	217,631	7	1,523,417
		Pomoxis Larvae	135,870	7	951,090
				Sub Total	**4,238,577**
20	Aug.17-23, 1994	Lepomis Juveniles	62,778	7	439,446
		Lepomis Larvae	295,656	7	2,069,592
		Morone Larvae	232,279	7	1,625,953
		Pomoxis Juveniles	23,318	7	163,226
		Pomoxis Larvae	384,741	7	2,693,187
				Sub Total	**6,991,404**
21	Aug. 24-30, 1994	Lepomis Larvae	159,337	7	1,115,359
		Morone Larvae	151,265	7	1,058,855
		Pomoxis Larvae	68,458	7	479,206
		Damaged Eggs	53,810	7	376,670
				Sub Total	**3,030,090**

Table 7-6. Estimated weekly entrainment of ichthyoplan .all genera) by Unit 2 under full operation (4 CWS pumps).

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
1	Apr. 6-12,1994	Aplodinotus Eggs	145,795	7	1,020,565
		Dorsoma Larvae	133,628	7	935,396
		Menidia Eggs	25,620	7	179,340
		Damaged Eggs	104,033	7	728,231
				Sub Total	**2,863,532**
2	Apr. 13-19,1994	Dorsoma Larvae	134,017	7	938,119
		Damaged Eggs	35,275	7	246,925
				Sub Total	**1,185,044**
3	Apr.20-26,1994	Dorsoma Larvae	19,581	7	137,067
		Menidia Eggs	19,581	7	137,067
		Damaged Eggs	21,345	7	149,415
				Sub Total	**423,549**
4(a)	Apr. 27-May 3,1994	Menidia Eggs	19,132	7	133,924
		Damaged Eggs	710,590	7	4,974,130
		Dorosoma Larvae	19,132	7	133,924
		Dorosoma Juveniles	19,132	7	133,924
				Sub Total	**5,375,902**
5(a)	May 4-10,1994	Aplodinotus Eggs	169,202	7	1,184,414
		Damaged Eggs	40,656	7	284,592
		Dorosoma Larvae	65,768	7	460,376
		Dorosoma Juveniles	21,823	7	152,761
		Menidia Larvae	21,823	7	152,761
		Pomoxis Larvae	21,823	7	152,761
				Sub Total	**2,387,665**
6(a)	May 11-17,1994	Aplodinotus Eggs	70,850	7	495,950
		Menidia Eggs	38,863	7	272,041
		Damaged Eggs	87,292	7	611,044
		Dorosoma Larvae	52,614	7	368,298
				Sub Total	**1,747,333**

(a) Unit 2 weekly extrapolations based on mean daily entrainment by Unit 1 during the Unit 2 outage period.

Table 7-6. Estimated weekly entrainment of ichthyoplan, ,all genera) by Unit 2 under full operation (4 CWS pumps).

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
7(a)	May 18-24,1994	Aplodinotus Eggs	310,902	7	2,176,314
		Dorosoma Larvae	29,297	7	205,079
				Sub Total	**2,381,393**
8(a)	May 25-31,1994	Empty	0	7	0
				Sub Total	0
9(a)	Jun. 1-7, 1994	Empty	0	7	0
				Sub Total	0
10(a)	Jun. 8-14	Aplodinotus Larvae	20,029	7	140,203
				Sub Total	**140,203**
11(a)	Jun. 15-21,1994	Aplodinotus Larvae	34,678	7	242,746
		Aplodinotus Eggs	114,197	7	799,379
		Damaged Eggs	276,822	7	1,937,754
				Sub Total	**2,979,879**
12	Jun.22-28,1994	Aplodinotus Larvae	17,040	7	119,280
		Centrarchidae Larvae	147,379	7	1,031,653
				Sub Total	**1,150,933**
13	Jun. 29-Jul. 5, 1994	Lepomis Larvae	17,369	7	121,583
				Sub Total	**121,590**
14	Jul. 6-Jul. 12, 1994	Lepomis Larvae	18,505	7	129,535
		Pomoxis Larvae	37,368	7	261,576
				Sub Total	**391,111**
15	Jul. 13-19, 1994	Lepomis Larvae	16,741	7	117,187
		Pomoxis Larvae	44,244	7	309,708
				Sub Total	**426,895**

(a) Unit 2 weekly extrapolations based on mean daily entrainment by Unit 1 during the Unit 2 outage period.

Table 7-6. Estimated weekly entrainment of ichthyoplan all genera) by Unit 2 under full operation (4 CWS pumps).

Week Number	Daily Interval	Genus/Stage	Daily Entrained	Weekly Period(Days)	Total Weekly Entrained
16	Jul. 20-26, 1994	Empty			0
				Sub Total	0
17	Jul. 27-Aug. 2,1994	Empty			0
				Sub Total	0
18	Aug. 3-9, 1994	Aplodinotus Larvae	140,205	7	981,435
		Pomoxis Larvae	77,426	7	541,982
		Centrarchidae Larvae	38,265	7	267,855
				Sub Total	**1,791,272**
19	Aug.10-16, 1994	Lepomis Larvae	260,081	7	1,820,567
		Morone Larvae	140,982	7	986,874
		Pomoxis Larvae	100,595	7	704,165
				Sub Total	**3,511,606**
20	Aug. 17-23, 1994	Lepomis Larvae	143,792	7	1,006,544
		Pomoxis Juveniles	25,081	7	175,567
				Sub Total	**1,182,111**
21	Aug. 24-30, 1994	Pomoxis Larvae	64,034	7	448,238
		Lepomis Larvae	42,749	7	299,243
				Sub Total	**747,481**

(a) Unit 2 weekly extrapolations based on mean daily entrainment by Unit 1 during the Unit 2 outage period.

Table 7-7. Estimated yearly entrainment of fish eggs, larvae, and juveniles by Unit 1 and Unit 2.

Unit 1				
Species	Eggs	Larvae	Juveniles	Total
Aplodinotus	4,908,211	3,487,743	0	8,395,954
Dorosoma	0*	5,790,969	287,835	6,078,804
Menidia	721,945	543,242	0	1,265,187
Centrarchidae	0	3,137,659	0	3,137,659
Lepomis	0	6,665,372	439,446	7,104,818
Pomoxis	0	5,741,071	163,226	5,904,297
Morone	0	4,378,353	0	4,378,353
Unit 2				
Species	Eggs	Larvae	Juveniles	Total
Aplodinotus	5,676,622	1,483,664	0	7,160,286
Dorosoma	0*	3,178,259	286,685	3,464,944
Menidia	722,372	152,761	0	875,133
Centrarchidae	0	1,299,508	0	1,299,508
Lepomis	0	3,494,659	0	3,494,659
Pomoxis	0	2,418,430	175,567	2,593,997
Morone	0	986,874	0	986,874

* Likely represented among those "damaged".

Table 7-8. Minimum, maximum and average fecundities for representative important species.

Common Name	Scientific Name	Fecundity Min.	Max.	Ave.	Reference
Freshwater Drum	*Aplodinotus grunniens*	43,000	508,000	275,000	Daiber (1953)
Largemouth Bass	*Micropterus salmoides*	2,000	109,314	55,657	Scott and Crossman (1973)
Inland Silverside	*Menidia beryllina*	20,000	170,000	95,000	Hubbs (1982)
Threadfin Shad	*Dorosoma petenense*	6,700	12,400	9,550	Burns (1966)
Gizzard Shad	*Dorosoma cepedianum*	22,405	543,912	283,159	Mansueti and Hardy, Jr. (1967)
White Bass	*Morone chrysops*	242,000	933,000	587,500	Riggs(1955)
Channel Catfish	*Ictalurus punctatus*	6,000	12,000	9,000	Clemens and Sneed (1957)
Bluegill Sunfish	*Lepomis macrochirus*	2,540	49,400	25,970	Morgan (1951)

Notes:
1. Fecundity estimate for channel catfish is for individuals in the 2-4 pound weight range.
2. Fecundity estimate for bluegill sunfish for individuals in the 10.1-23.5 cm range class.

Table 7-9. Estimated yearly entrainment of fish eggs, larvae, and juveniles by Unit 1 and Unit 2, and fecundity ratios.*

Unit 1							
					Fecundity Ratio Using:		
Species	Eggs	Larvae	Juveniles	Total	Max.F	Min.F	Ave.F
Aplodinotus	4,908,211	3,487,743	0	8,395,954	195	17	31
Dorosoma**	0	5,790,969	287,835	6,078,804	907	490	637
Menidia	721,945	543,242	0	1,265,187	63	7	13
Centrarchidae	0	3,137,659	0	3,137,659	-	-	-
Lepomis	0	6,665,372	439,446	7,104,818	2,797	144	274
Morone	0	4,378,353	0	4,378,353	18	5	7
Unit 2							
					Fecundity Ratio Using:		
Species	Eggs	Larvae	Juveniles	Total	Max.F	Min.F	Ave.F
Aplodinotus	5,676,622	1,483,664	0	7,160,286	167	14	26
Dorosoma**	0	3,178,259	286,685	3,464,944	517	279	363
Menidia	722,372	152,761	0	875,133	44	5	9
Centrarchidae	0	1,299,508	0	1,299,508	-	-	-
Lepomis	0	3,494,659	0	3,494,659	1,376	71	135
Morone	0	986,874	0	986,874	4	1	2

* Fecundity ratio = total est. entrainment/min., max., and average fecundity.
** Fecundity ratios for *Dorosoma* were determined utilizing those of threadfin shad.

Table 7-10. Estimated yearly (Oct. 1993-Oct. 1994) impingement of fish by CP CWS for both Unit 1 and 2.

Yearly Interval	Species	Yearly Species Specific	Percent Composition(%)	Rank
Oct.18,1993-Oct.31,1994	Threadfin Shad	251,269	96.0	1
	Bluegill Sunfish	4,626	2	2
	Inland Silverside	3,100	1.2	3
	Green Sunfish	1,144	0.44	4
	Largemouth Bass	908	0.35	5
	Gizzard Shad	829	0.32	6
	Channel Catfish	177	0.07	7
	Warmouth Sunfish	142	0.05	8
	Freshwater Drum	85	0.03	9
	Redear Sunfish	78	0.03	10
	White Bass	70	0.03	11
	White Crappie	42	0.02	12
	Longear Sunfish	28	0.01	13
	Total =	**262,498**	**100**	**13**

Note: Yearly estimate based upon plant operation during the period of Oct. 1993-Oct. 1994.

Table 7-11. Characteristics of other steam electric stations of similar capacity on southern lacustrine water bodies.

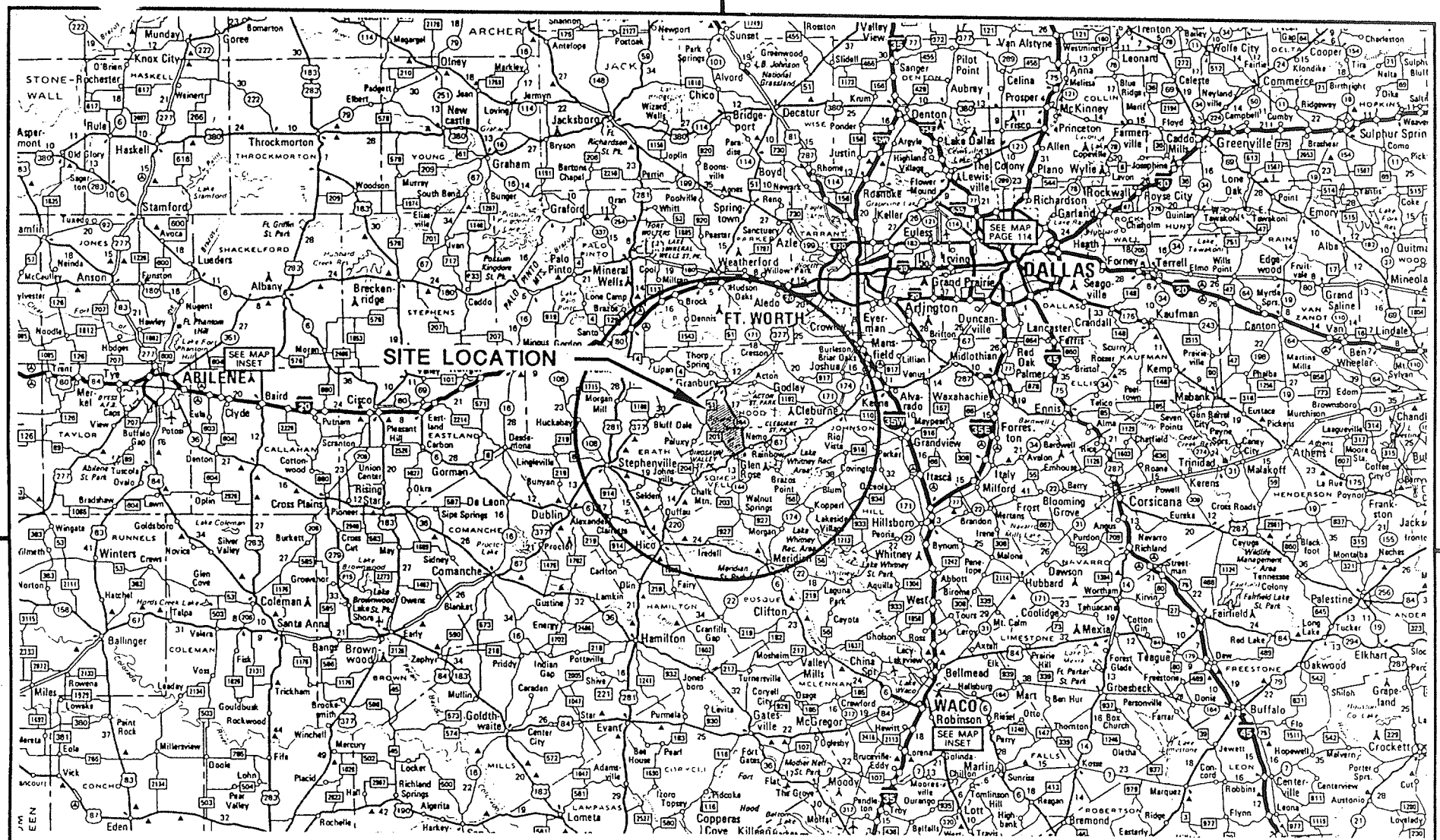
Facility/Location/Owner	No. of Units	Rating per Unit (MWe)	Cooling System Design	No. of CWS Pumps (total)	Capacity per Pump (gpm)	Approach Velocity (fps)	Cooling Water Source	Intake Design
Brown's Ferry Nuclear Plant/ Limestone, Co., Alabama/ TVA	3*	1,098	Once-through	6	220,000	1.6	Wheeler Reservoir	Shoreline
Arkansas Nuclear One/ Pope Co., Arkansas/ Arkansas Power and Light Co.	2**	820 (Unit 1) 902 (Unit 2)	Once-through Closed cycle	Unknown***	766,000 (all pumps combined) 14,000 (all pumps combined)	1.5	Lake Dardanelle	Shoreline
Comanche Peak Nuclear SES/ Somervell Co., Texas/ TUEC	2	1,150	Once-through	8	274,260	0.43	Squaw Creek Reservoir	Shoreline

* Only two units were in operation during impingement monitoring.
** Unit 1 only in operation during impingement monitoring.
*** Not given in description summary.

Table 7-12. Impingement estimates for steam electric stations of similar capacity on southern lacustrine water bodies.

Facility	Study Year (Monitoring Period)	Shad/ Herring	Freshwater Drum	Catfish	Other Species	Annual Total
Brown's Ferry	1975 (12 months)	645,259	27,291	3,739	15,489	691,778
Arkansas Unit One	1975 (7 months)	16,102,485	59,022	---*	294,979	16,456,486
Comanche Peak	1994 (12 months)	252,098**	85	177	10,138	262,498

* Catfish were included in Other Species for this facility
** Inclusive of threadfin shad and gizzard shad



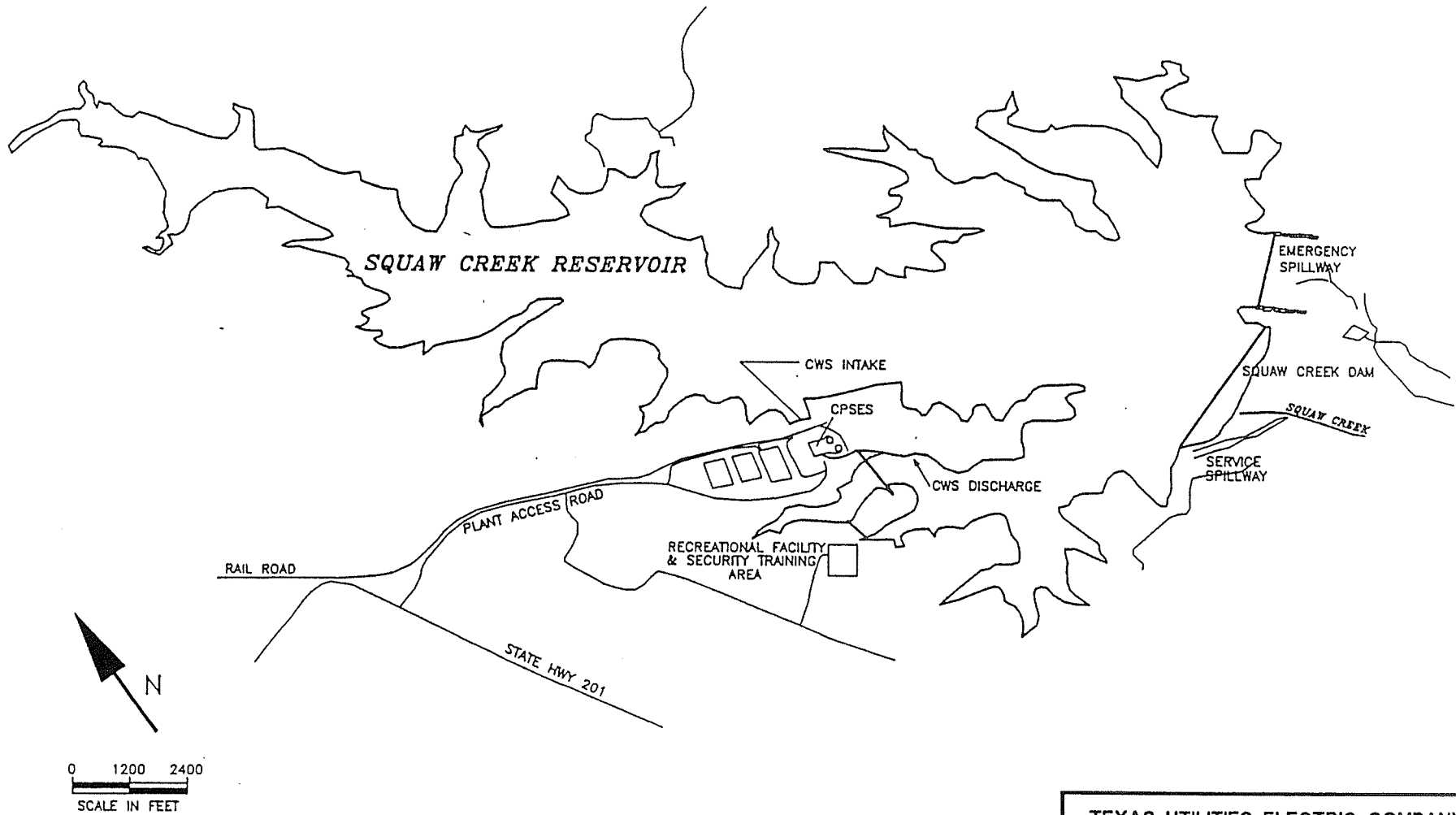
TEXAS UTILITIES ELECTRIC COMPANY

COMANCHE PEAK 316 (b)

FIGURE 2-1

LOCATION AND 30 MILE RADIUS SURROUNDING CPSES

FOSTER WHEELER ENVIRONMENTAL CORPORATION



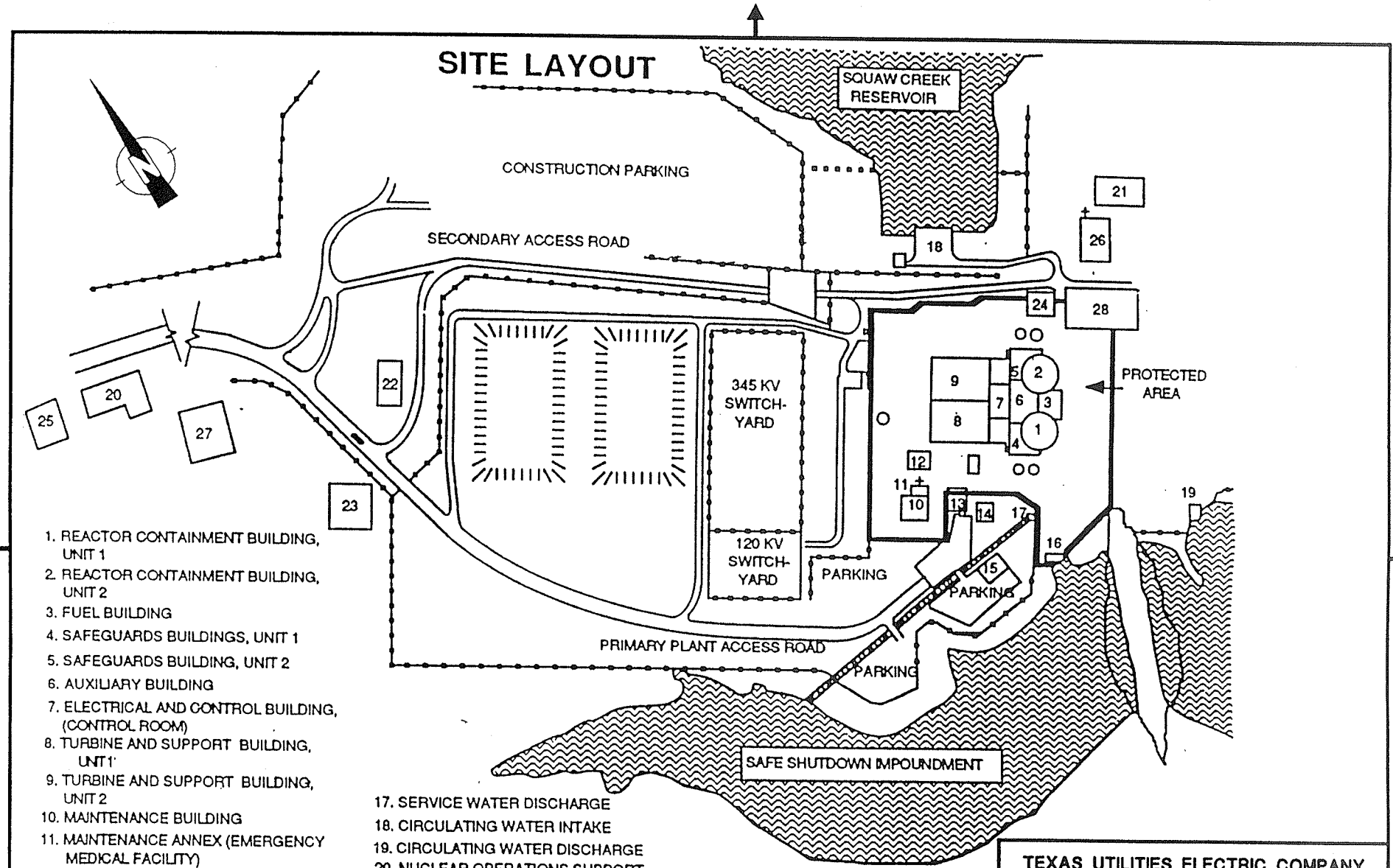
TEXAS UTILITIES ELECTRIC COMPANY

COMANCHE PEAK 316 (b)

FIGURE 2-2

CPSES/SCR MAP

FOSTER WHEELER ENVIRONMENTAL CORPORATION



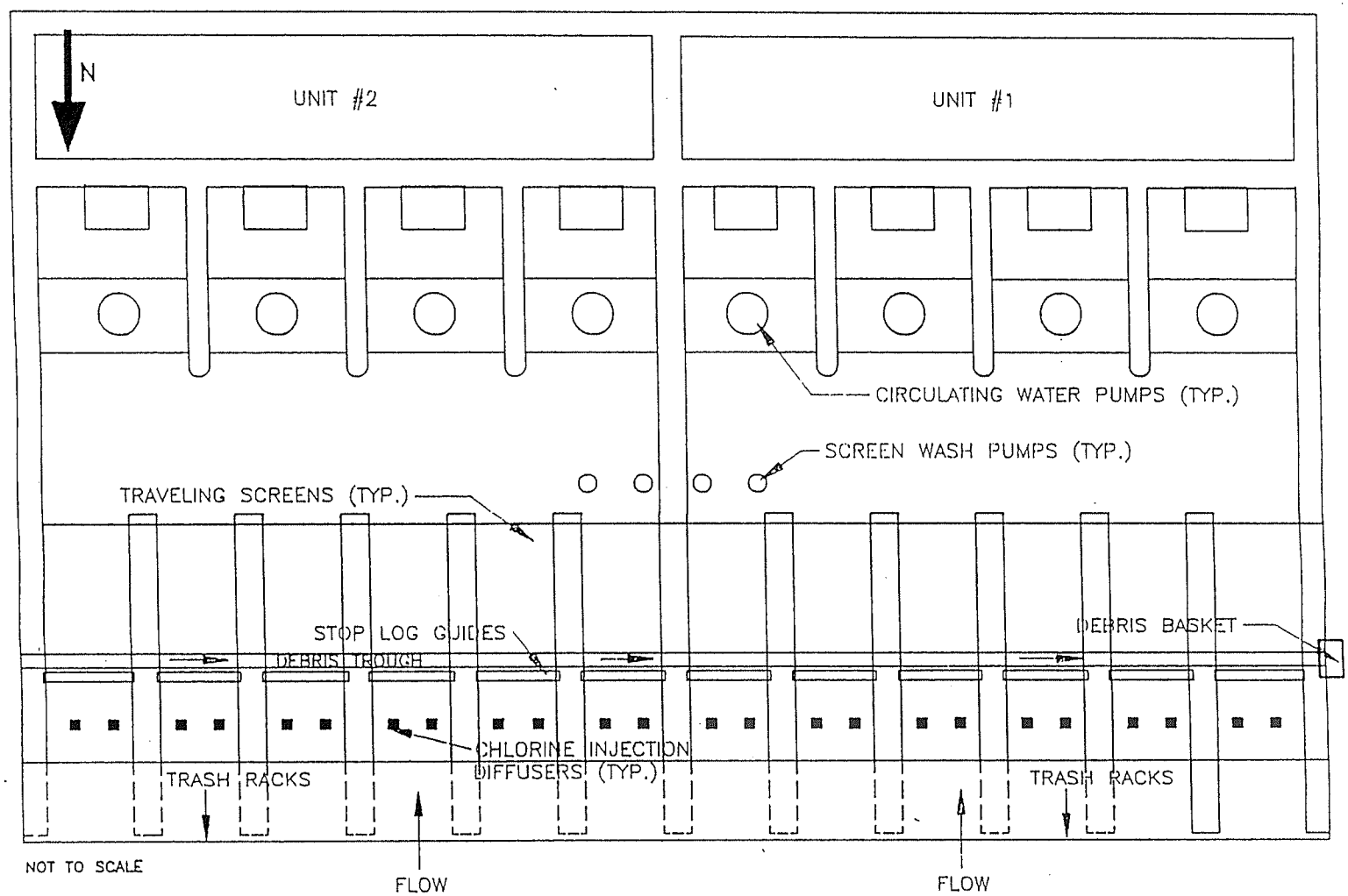
TEXAS UTILITIES ELECTRIC COMPANY

COMANCHE PEAK 316 (b)

FIGURE 2–3

CPSES FACILITY MAP

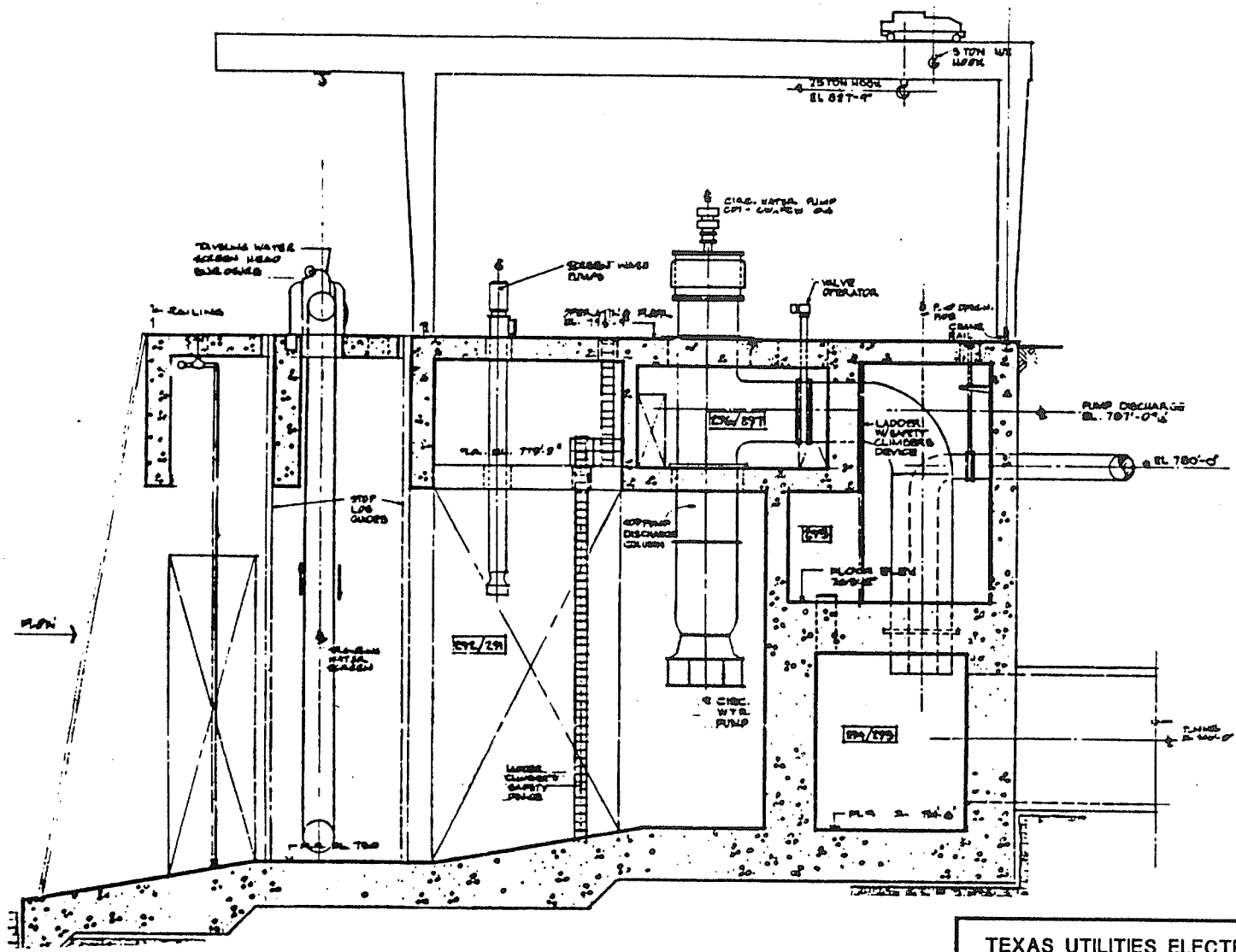
FOSTER WHEELER ENVIRONMENTAL CORPORATION



NOT TO SCALE

SQUAW CREEK RESERVOIR

TEXAS UTILITIES ELECTRIC COMPANY
COMANCHE PEAK 316 (b)
FIGURE 2-4 PLAN VIEW OF CPSES INTAKE STRUCTURE
FOSTER WHEELER ENVIRONMENTAL CORPORATION



TEXAS UTILITIES ELECTRIC COMPANY

COMANCHE PEAK 316 (b)

FIGURE 2–5

CROSS SECTION OF
CP INTAKE STRUCTURE

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Figure 2-6 . Total number of operating CWS pumps (Unit 1 and 2 combined) for the CPSES recorded during impingement sampling.

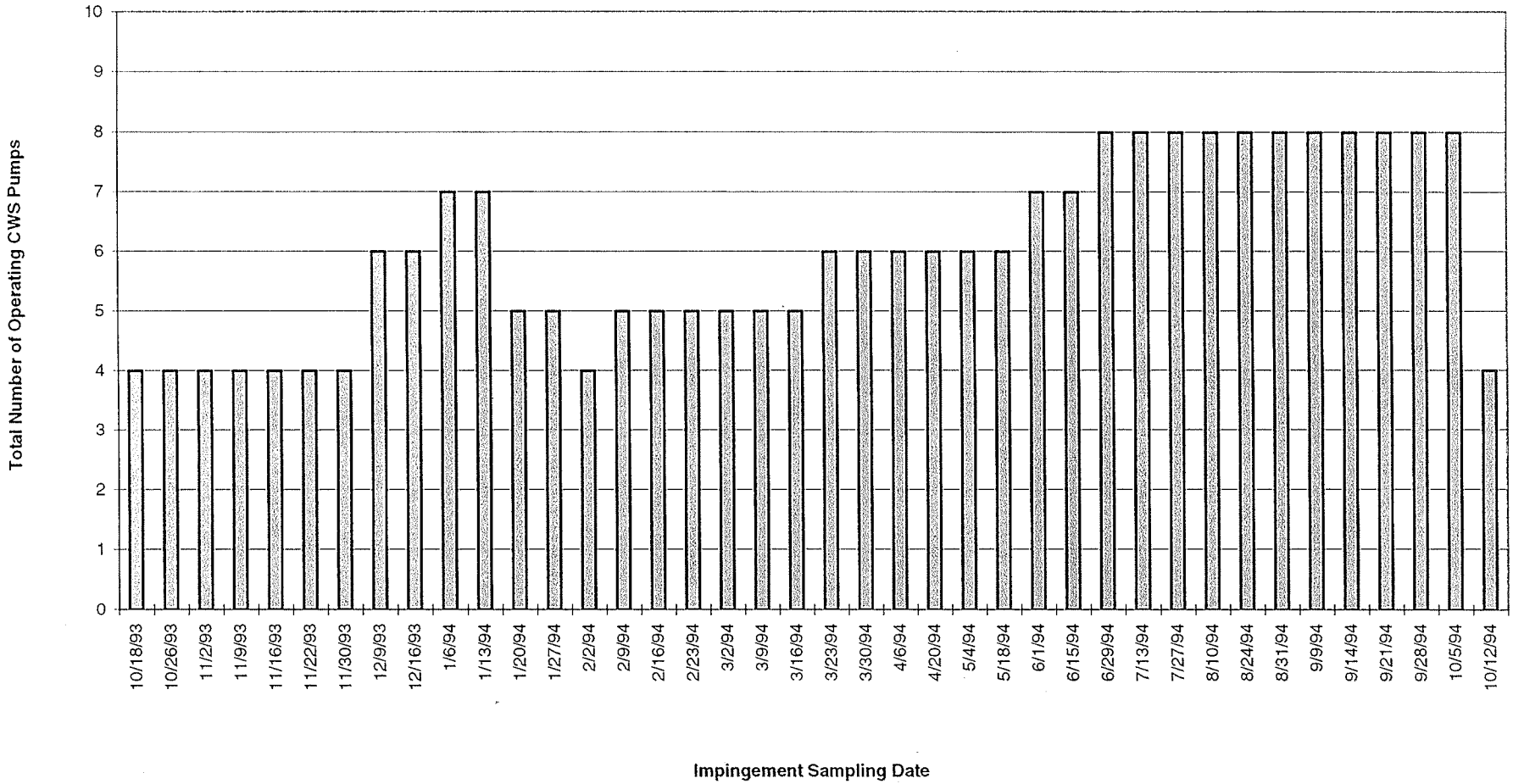


Figure 2-7. Comparison of CPSES CWS pump operation and daily discharge for outfall 001.

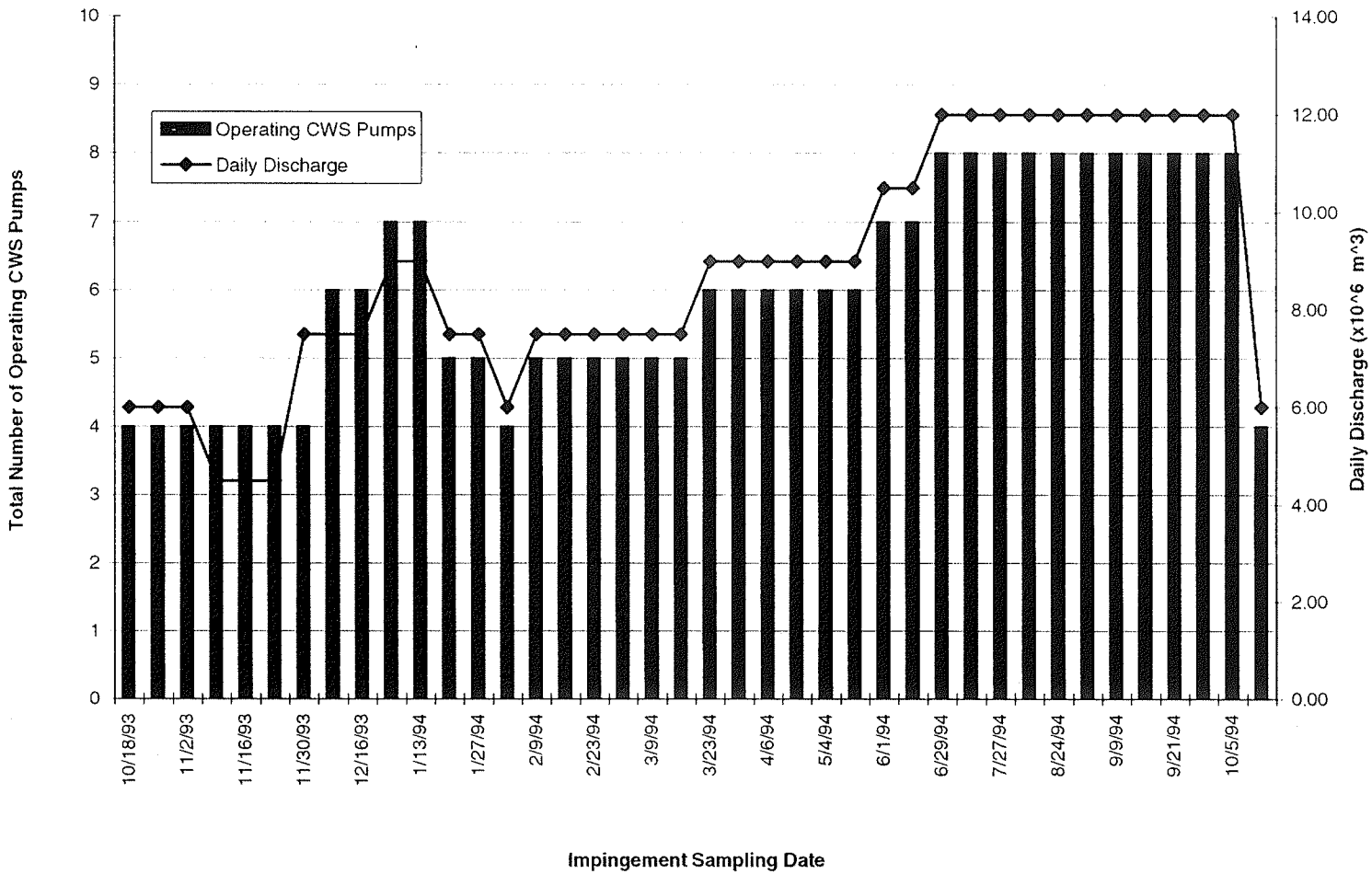


Figure 2-8 . Unit 1 CWS pump operating history during impingement sampling.

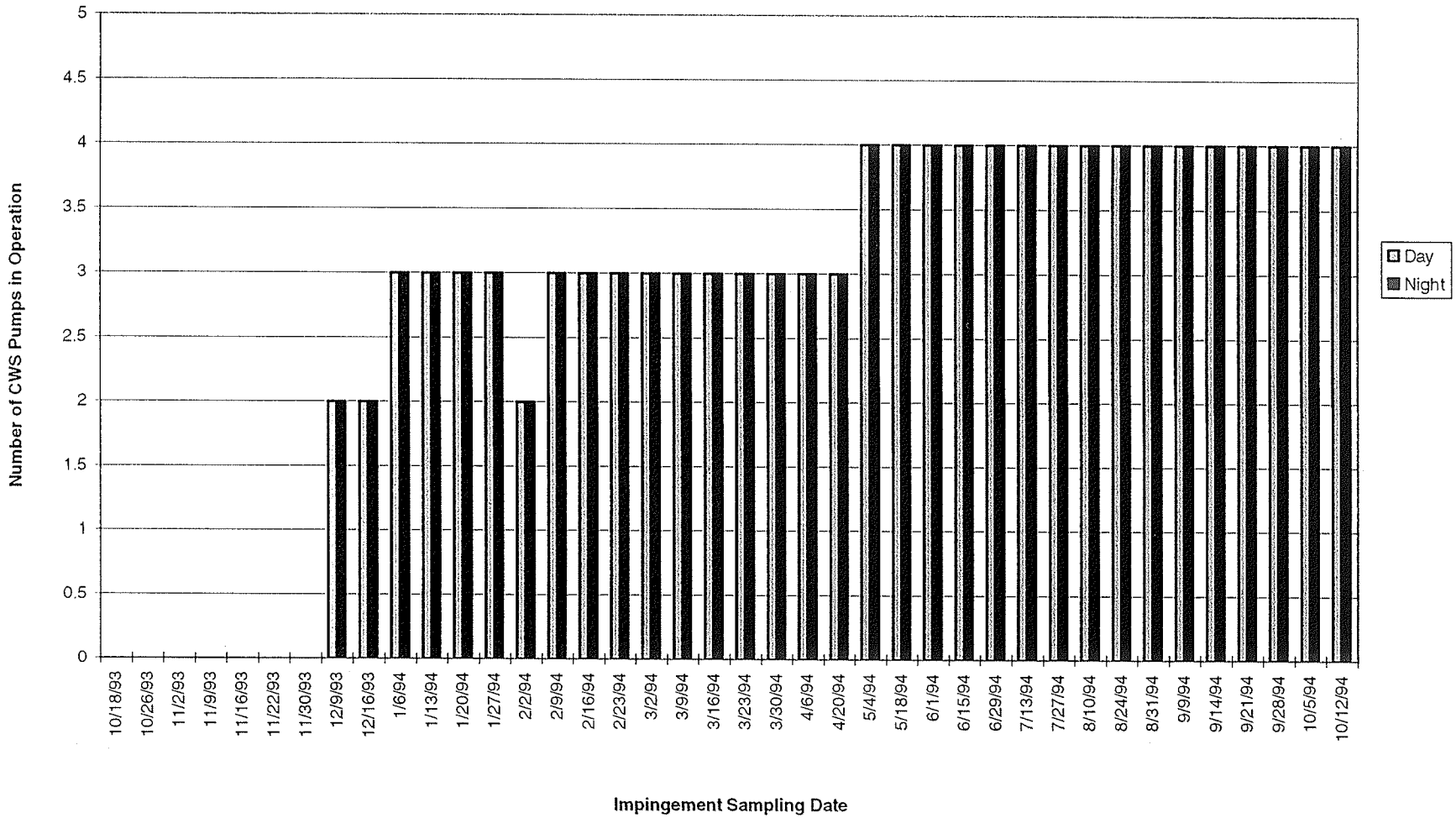


Figure 2-9. Unit 2 CWS pump operating history during impingement sampling.

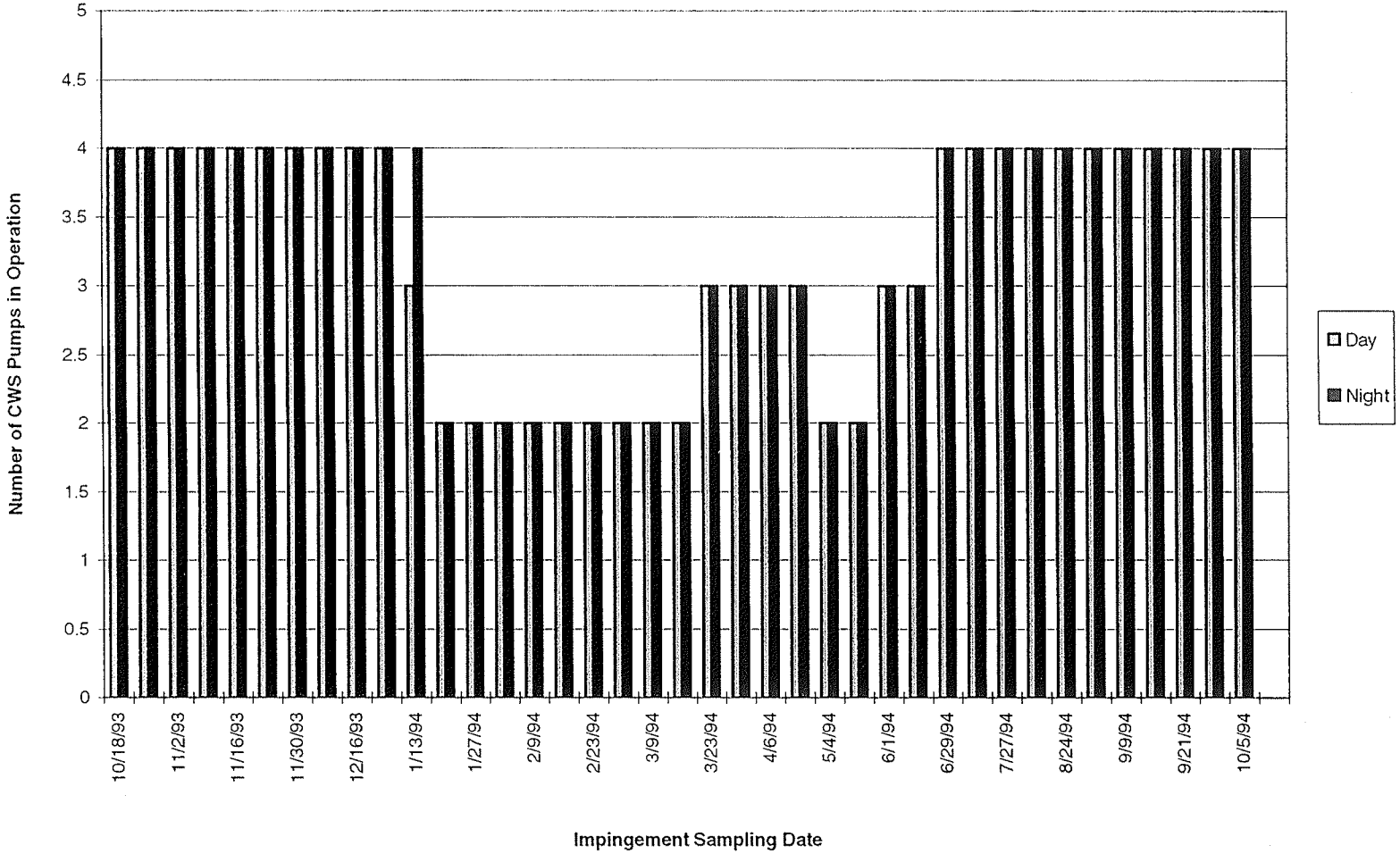
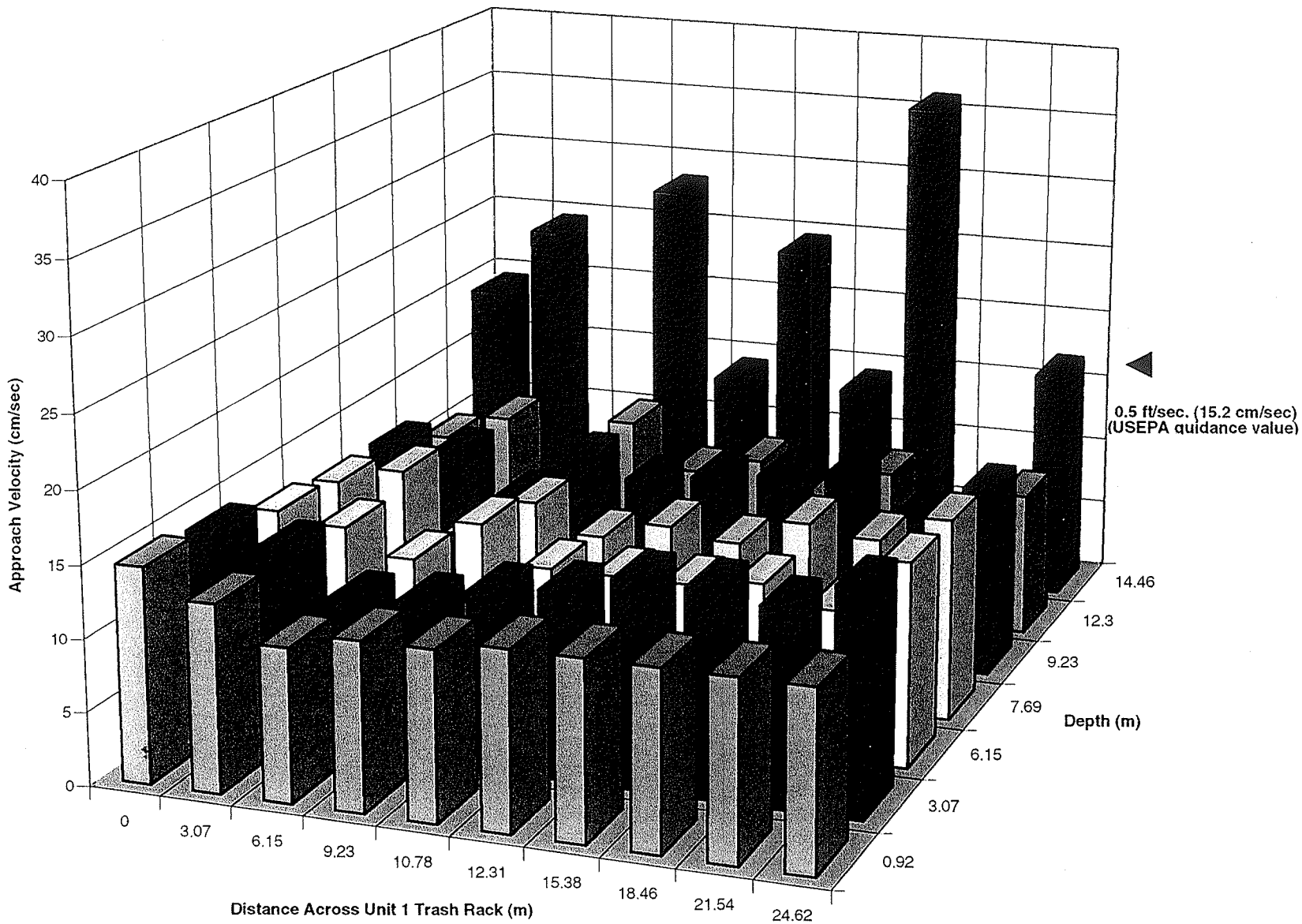
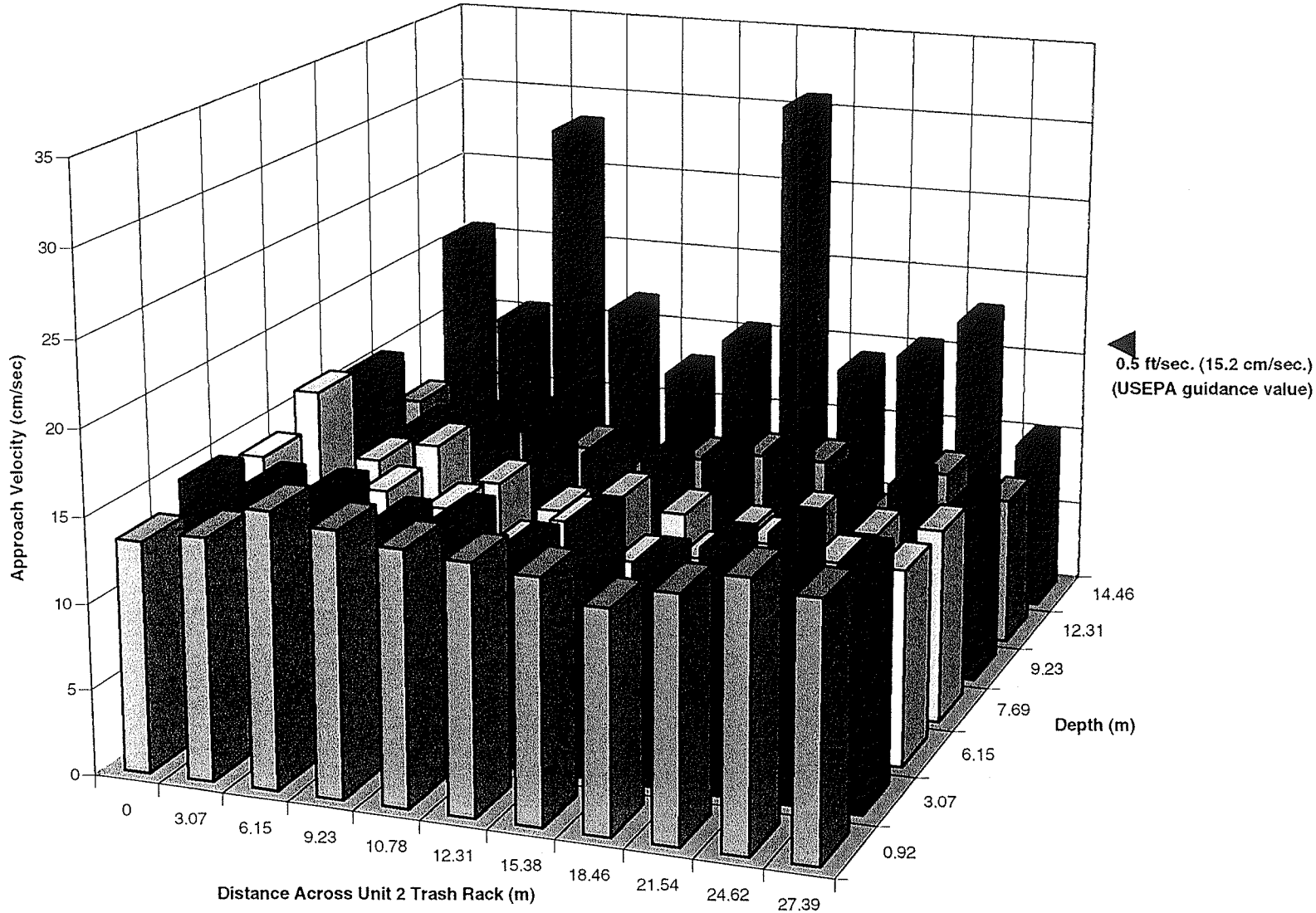


Figure 2-10. Velocity profile (cm/sec) across the Unit 1 trash rack



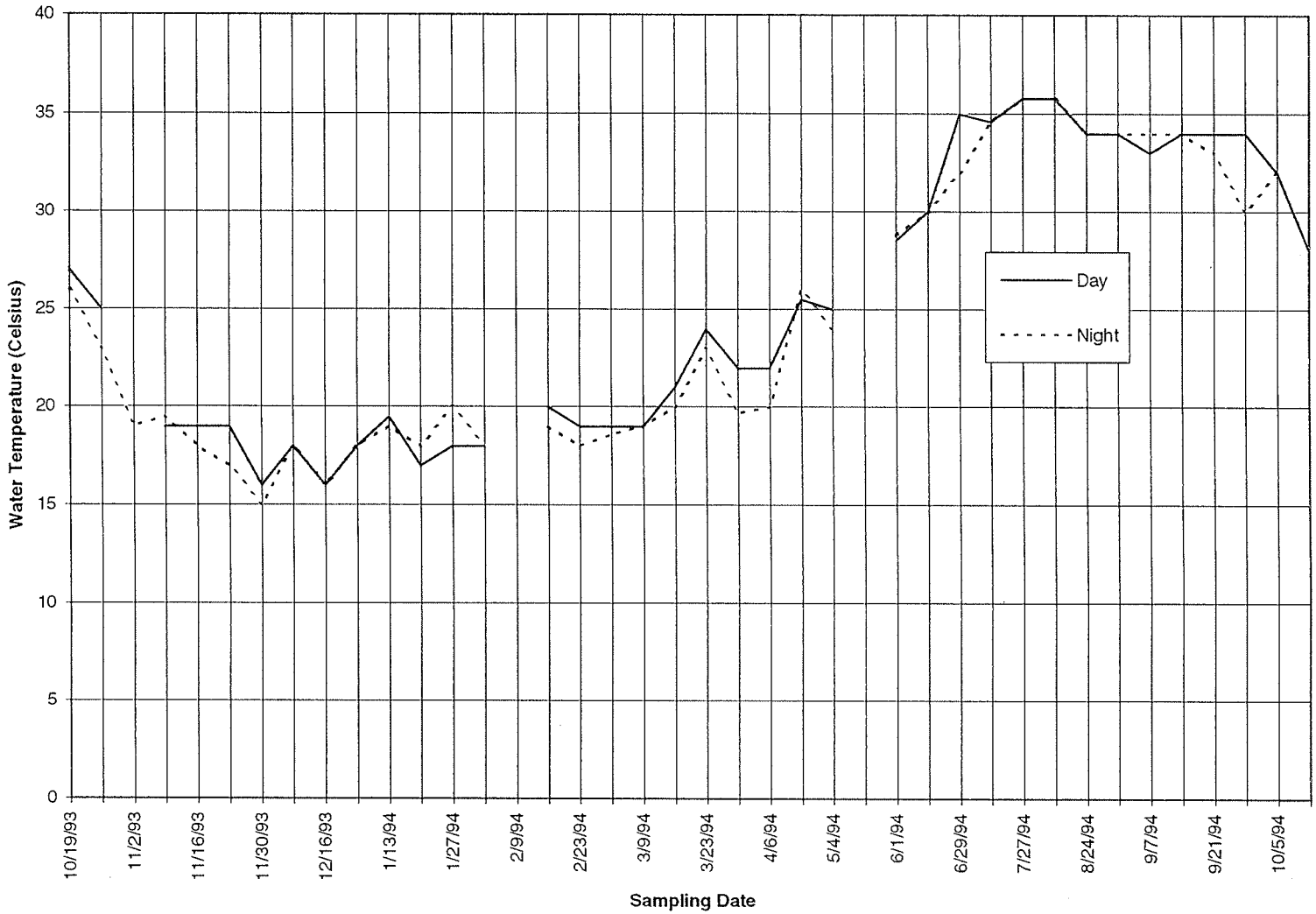
Note: The distance across the Unit 1 trash rack is measured in an eastward direction.

Figure 2-11. Velocity profiles (cm/sec) across the Unit 2 trash rack.



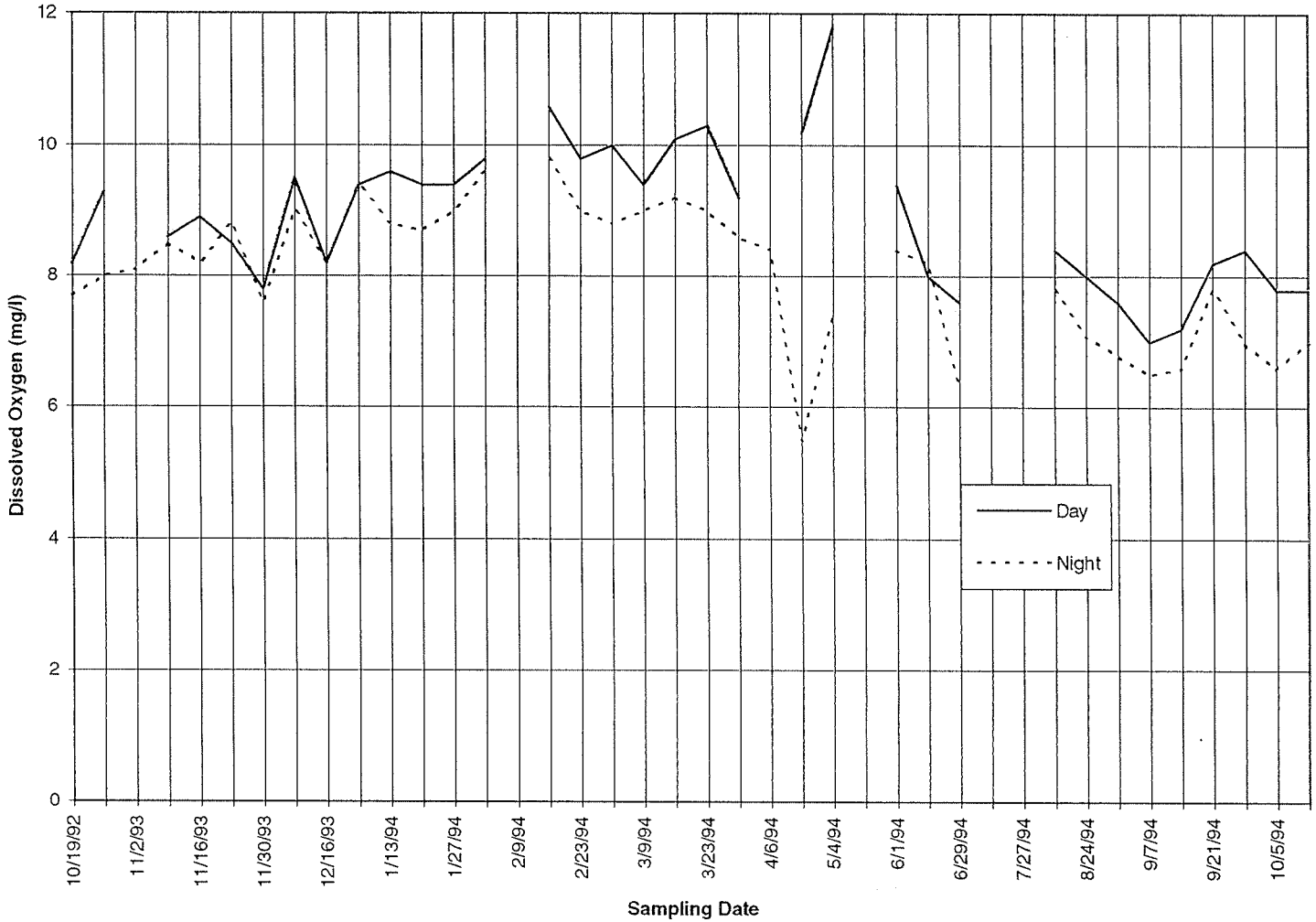
Note : The distance across the Unit 2 trash rack is measured in an eastward direction.

Figure 3-1. Annual fluctuation in surface water temperature for SCR as measured during impingement monitoring



Note:
1. Data gaps occurred as a result of mechanical and weather related difficulties.

Figure 3-2. Dissolved oxygen concentrations measured in SCR intake waters (surface) over the impingement monitoring period



Note:
1. Data gaps occurred as a result of mechanical and weather related difficulties.

Figure 4-1. Relative abundance of species collected by all methods from Squaw Creek Reservoir during preoperational monitoring (Hellier et al, 1987).

N = 20,399

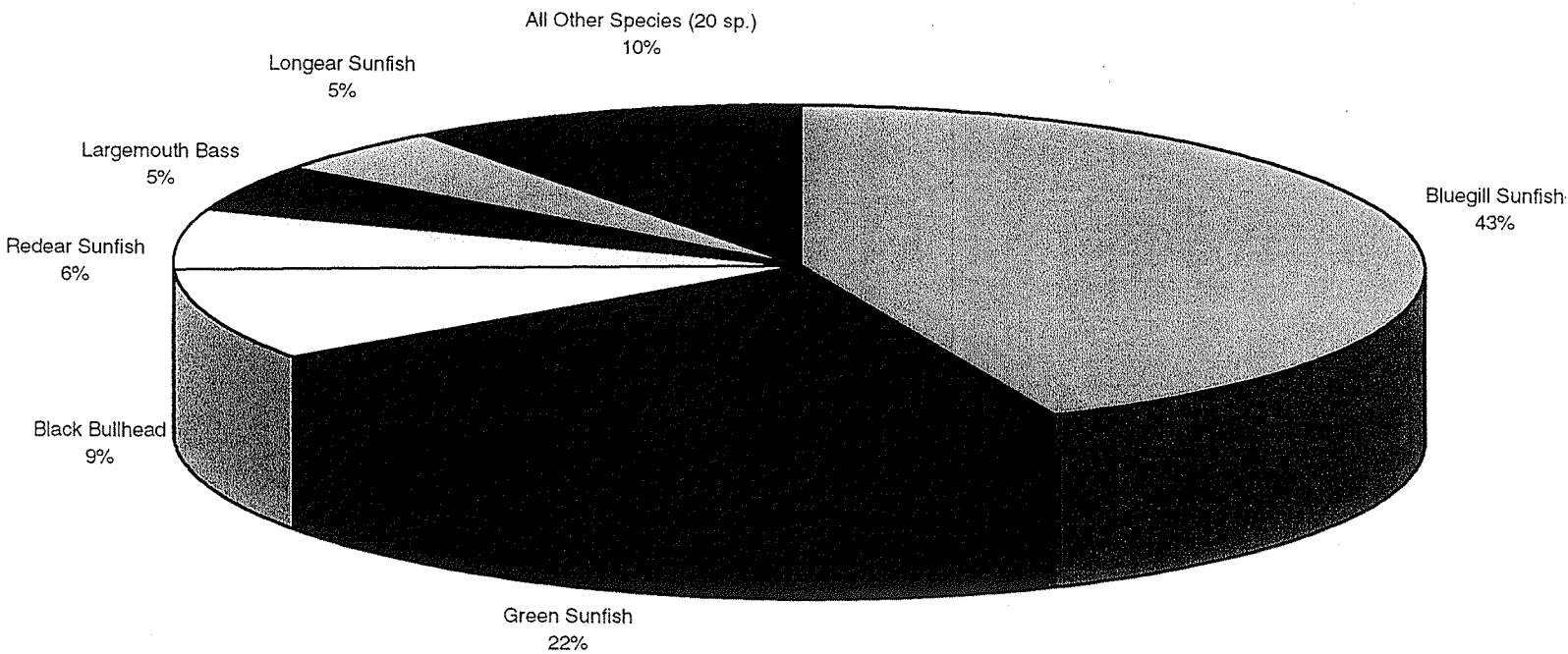


Figure 4-2. Creel census form distributed to SCR fisherpersons.

SQUAW CREEK RESERVOIR
FISHERMAN CREEL CENSUS

INTERVIEW FORM

DATE: _____ / _____ / _____

NUMBER IN PARTY: _____

ESTIMATED TOTAL FISHING TIME ___ ___ : ___ ___ hrs.

VISITOR CHECK-IN TIME

___ ___ : ___ ___ AM ___ ___ : ___ ___ PM

VISITOR CHECK-OUT TIME

___ ___ : ___ ___ AM ___ ___ : ___ ___ PM

BAIT: _____ ARTIFICIAL _____ NATURAL

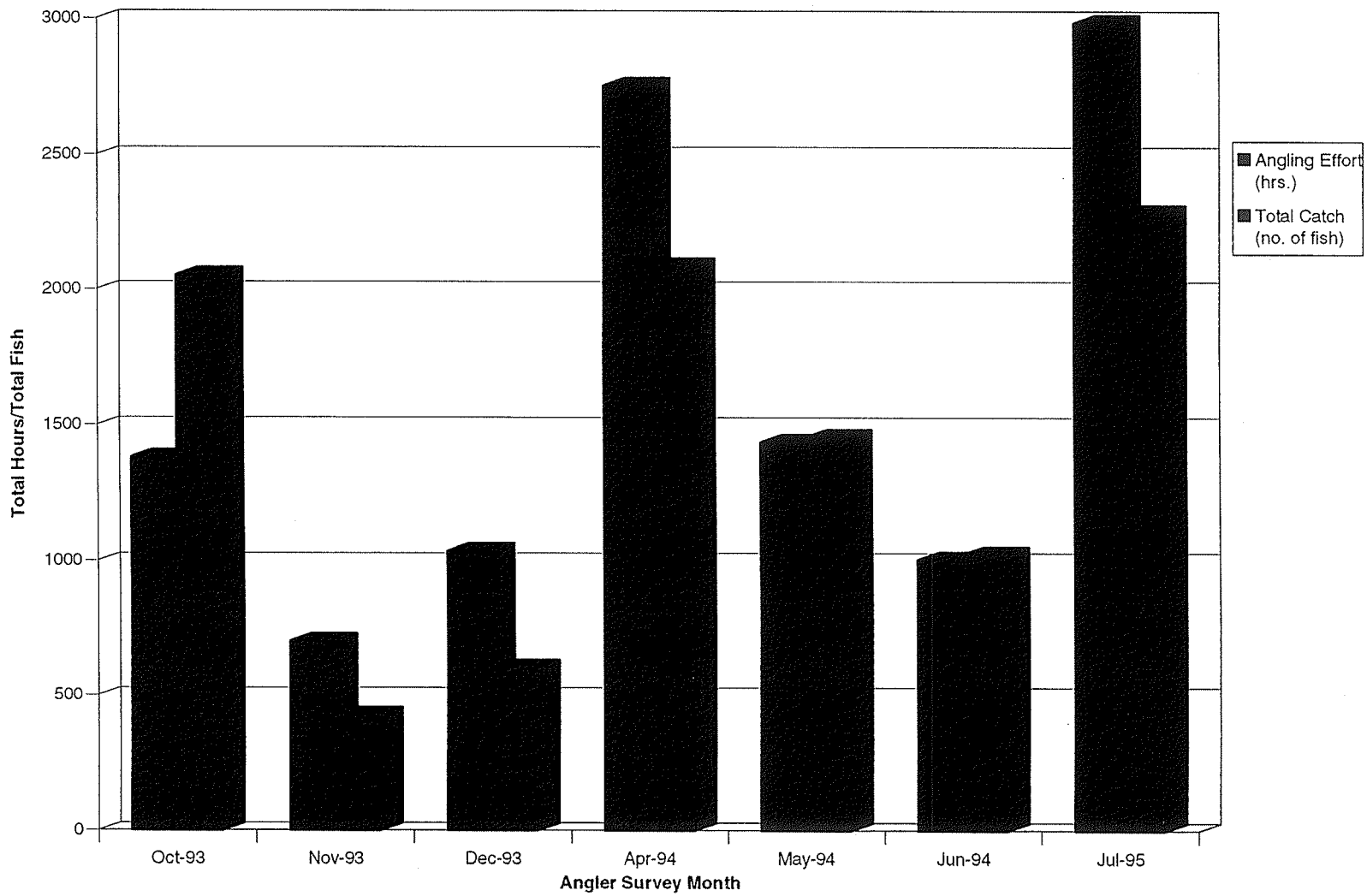
HABITAT: _____ DEEP _____ NEARSHORE

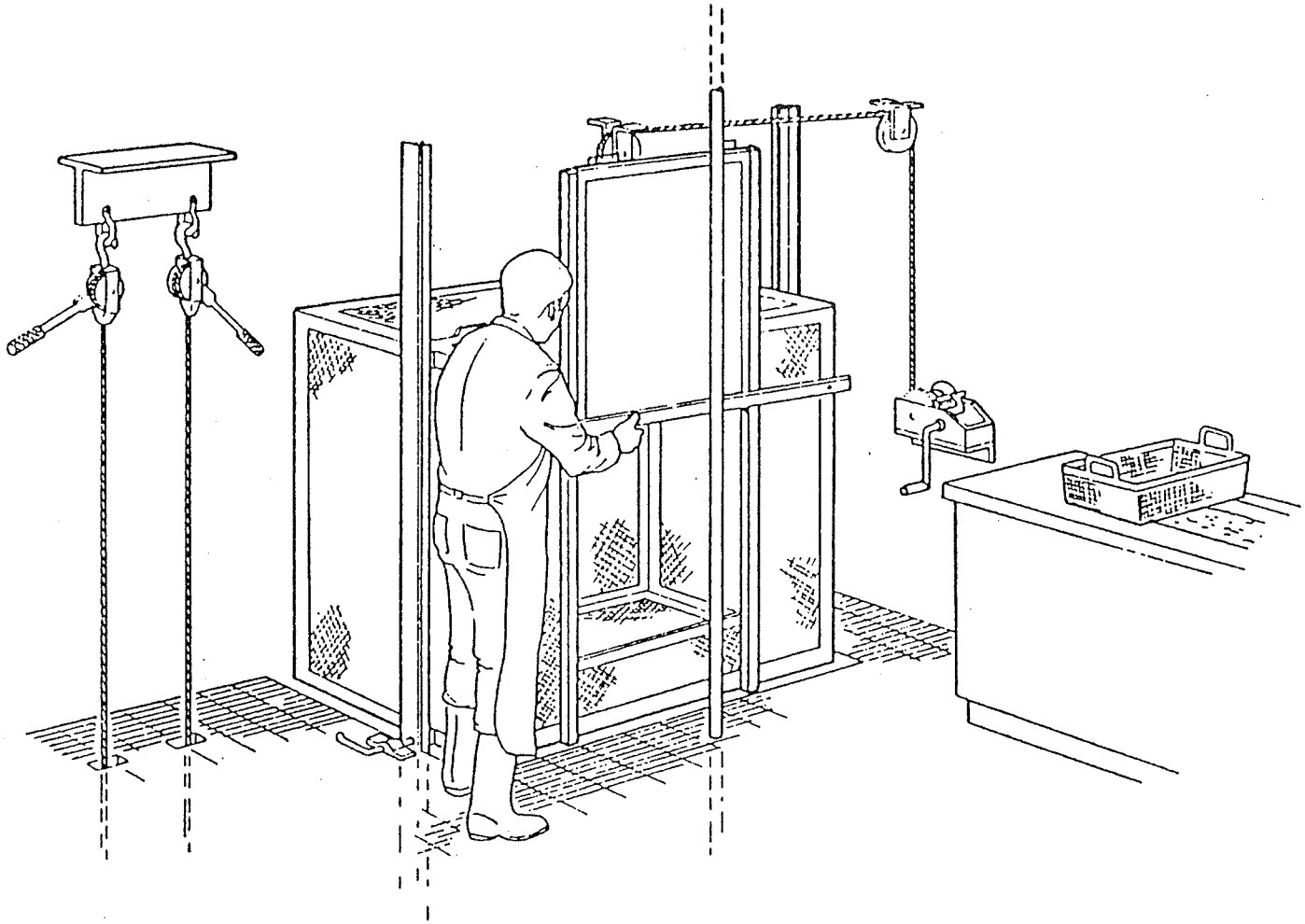
CATCH INFORMATION

SPECIES	ID #	# CAUGHT	SIZE (Inches) SMALLEST	LARGEST	AVERAGE
Striped Bass	2				
Largemouth Bass	1				
Smallmouth Bass	4				
White Bass	3				
Walleye	14				
White Crappie	24				
Sunfish	all				
Channel Catfish	7				
Bullhead	5/6				
Drum	17				
Carp	10				

CENSUS.XLS

Figure 4-3. Total angling effort (hours) and total catch (number of fish) for the months sampled during the SCR angler survey.





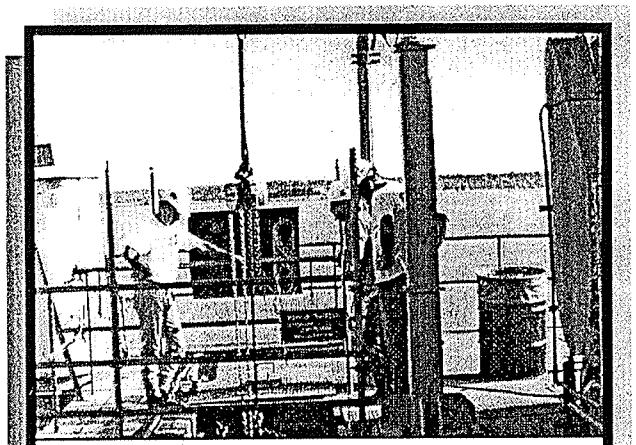
TEXAS UTILITIES ELECTRIC COMPANY

COMANCHE PEAK 316 (b)

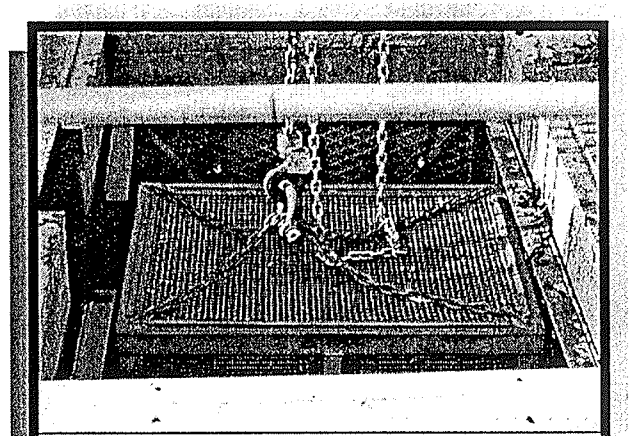
FIGURE 5-1A

GENERAL DESIGN OF
IMPINGEMENT BASKET SAMPLER

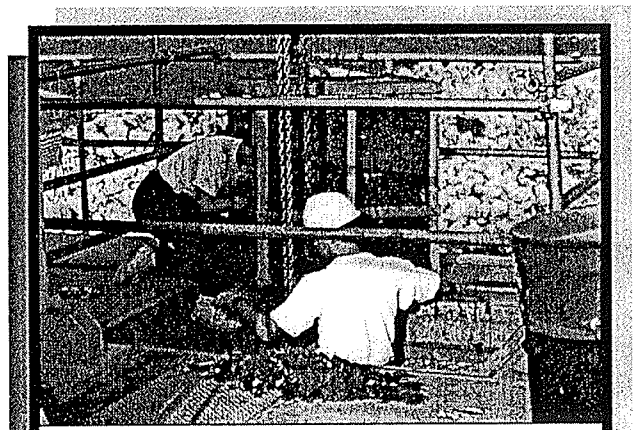
FOSTER WHEELER ENVIRONMENTAL CORPORATION



1. Preparing to remove impingement sample basket.



2. Hoisting impingement sample basket from collection trough.



3. Removal of basket and collection of sample.

TEXAS UTILITIES ELECTRIC COMPANY

COMANCHE PEAK 316 (B)

FIGURE 5-1B
CPSES IMPINGEMENT SAMPLING OPERATIONS

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Figure 5-2. Impingement field data sheet (Form 1 of 2).

COMANCHE PEAK 316(b) DEMONSTRATION
IMPINGEMENT SAMPLING/PROCESSING

Form 1 of 2

THIS SAMPLING EVENT

Represents (check one): D. ____ N. ____

Date (m/d/yr): ____ / ____ / ____

Time Basket Lifted/Emptied: ____ : ____ AM (if "N" sample) ____ : ____ PM (if "D" sample)

BASKET LAST EMPTIED (should be approx. 12 hours earlier)*

Date (m/d/yr): ____ / ____ / ____

Time: ____ : ____ Last PM (if "N" sample) ____ : ____ This AM (if "D" sample)

OPERATIONAL PROFILE (check all that apply)*

	Unit 1										Unit 2									
	Pumps				Screens						Pumps				Screens					
	1	2	3	4	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	6
At Time Basket Lifted/Emptied (n)																				
Last 4 hours (n -4)																				
Prev. 4 hours n - (4-8)																				
First 4 hours n - (8-12)																				

ENVIRONMENTAL CONDITIONS

Weather	Air Temp.	WaterTemp.	Conductivity	D.O.
_____	_____ F/C	_____ F/C	_____ mmhos	_____ mg/l

*COMMENTS.EXCEPTIONS/CORRECTIONS _____

PERSONNEL (initial) _____, _____, _____.

SOP-EX3.XLS

Figure 5-3. Impingement field data sheet (Form 2 of 2).

COMANCHE PEAK 316(b) DEMONSTRATION
IMPINGEMENT SAMPLING/PROCESSING

Form 2 of 2; Page ___ of ___

THIS SAMPLING EVENT (should match Form 1 of 2)

Represents (check one)

D. ____ N. ____

Date (m/d/yr) ____ / ____ / ____

Time Basket Lifted/Emptied

____ : ____ AM (if "N" sample) ____ : ____ PM (if "D" sample)

FISH PROCESSING DATA

1	2	3*	4	5*	6	7	8	Specimen Detail				
Species/ "Group" (Genus)	Code	Total < 26? (Y/N)	Size Group**	Size Group <26? (Y/N)	Total Group Weight (Kg)	Subsample Weight (Kg)	Fish No.	Length (mm)	Weight (gms)	Sex ***	Scale? (Y/N)	Voucher? (Y/N)

* If yes, proceed to column 8.
** Size Groups: 0 = N/A, 1 = small, 2 = large (if split by size)
*** Sex: 1= immature, 2 = female, 3 = male

PERSONNEL (initial) : _____ , _____ , _____

SOP-EX5.XLS

Figure 5-4. Daytime and nightime fish impingement by the CPSES CWS

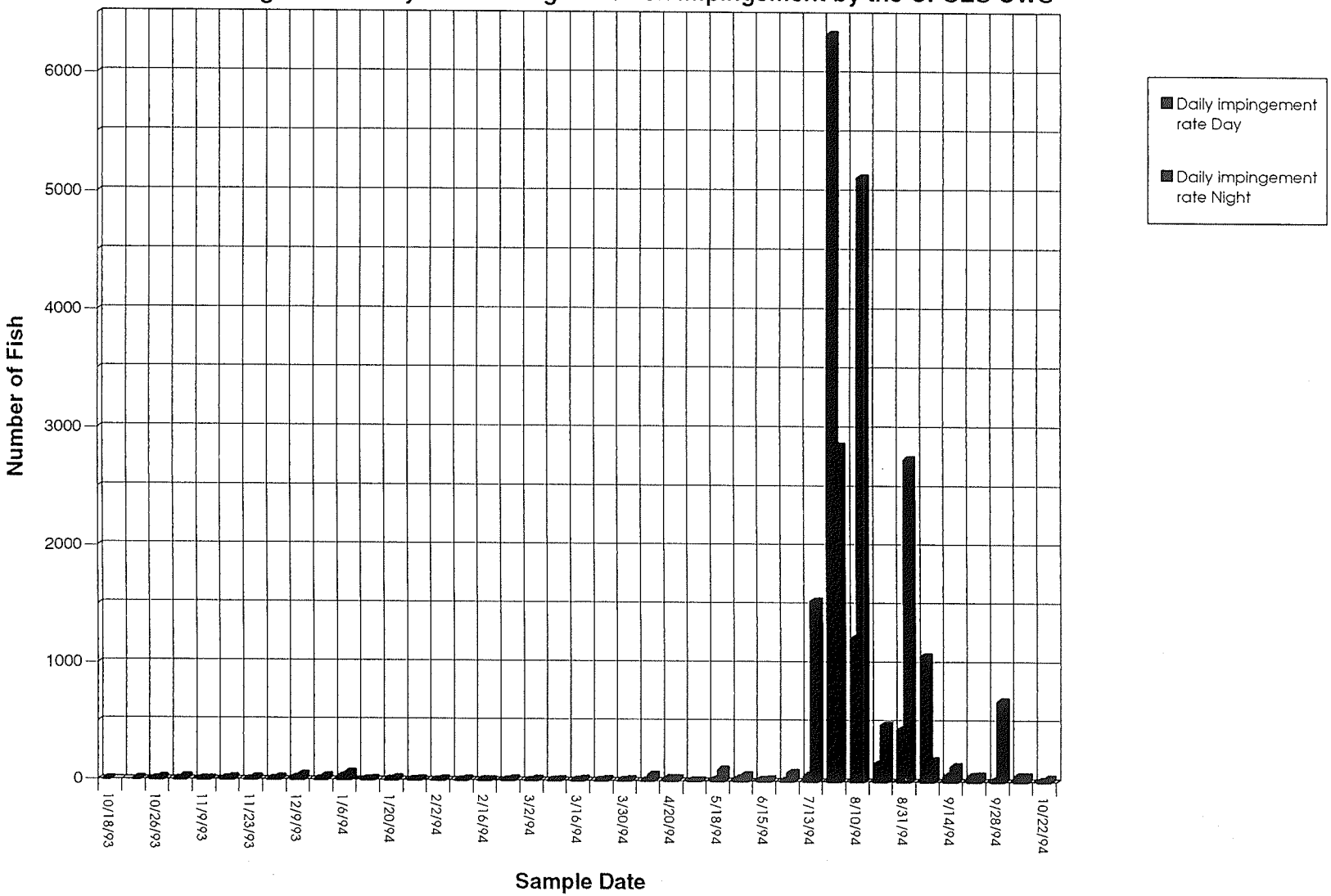
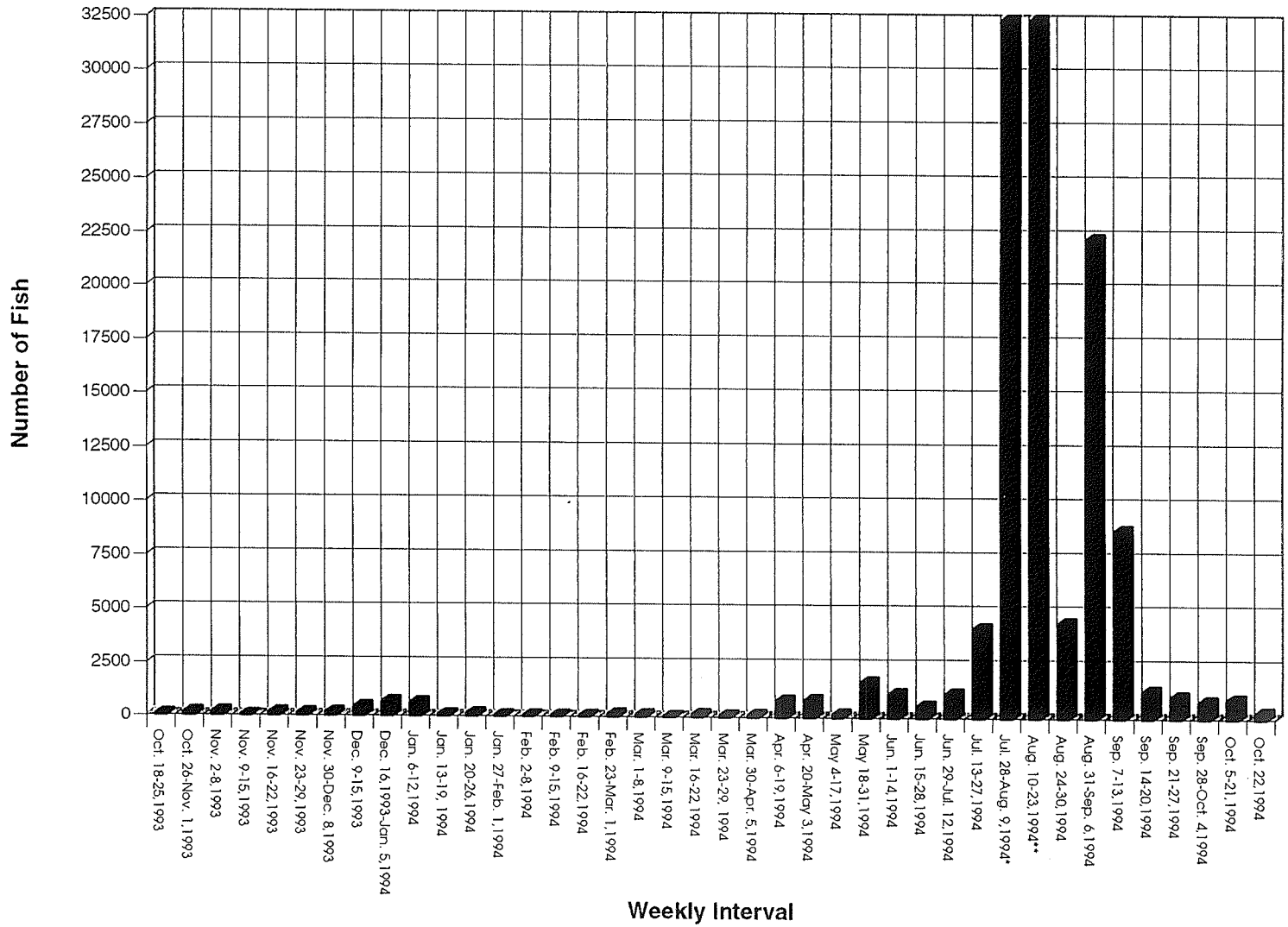


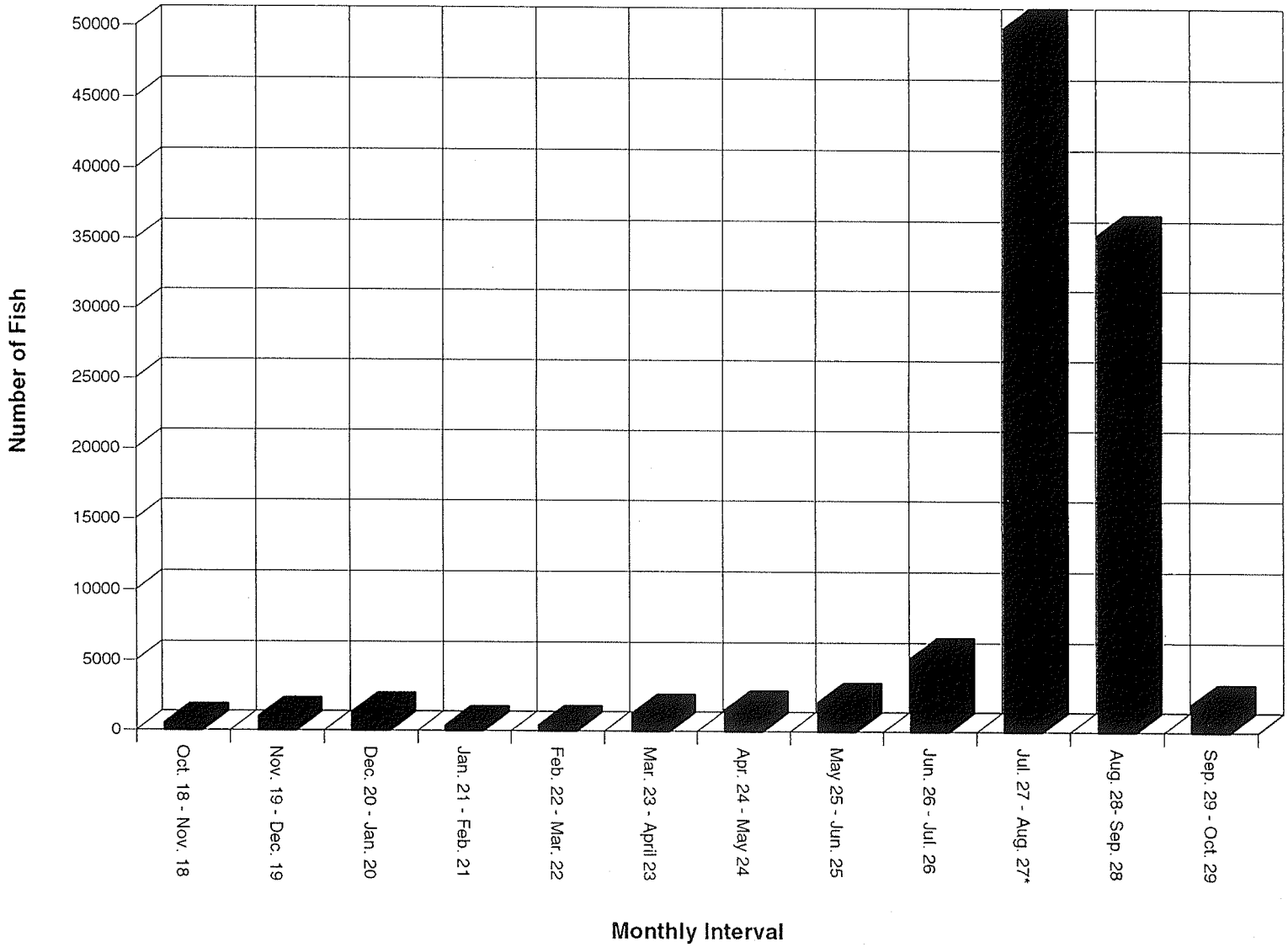
Figure 5-5. Estimated weekly impingement of fish by the CPSES CWS.



* The actual number of fish experiencing impingement during the period Jul. 28-Aug. 9, 1994 was 119,522

** The actual number of fish experiencing impingement during the period Aug. 10-23, 1994 was 88,928

Figure 5-6. Total monthly impingement during operation of CPSES CWS



* The actual number of fish experiencing impingement from July 27 to August 27 was 210,757

Figure 5-7. Seasonal impingement of fish by the CPSES CWS

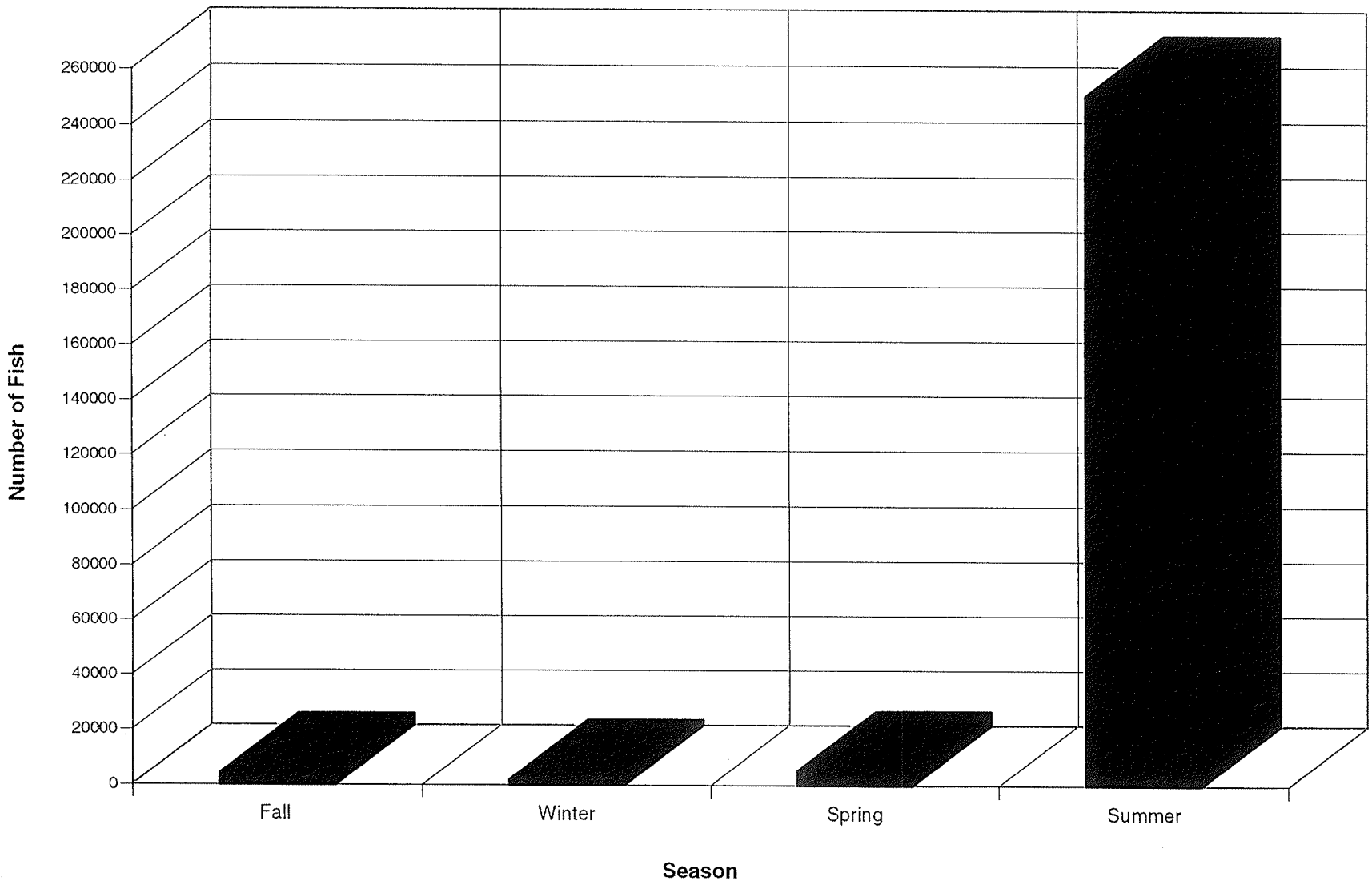
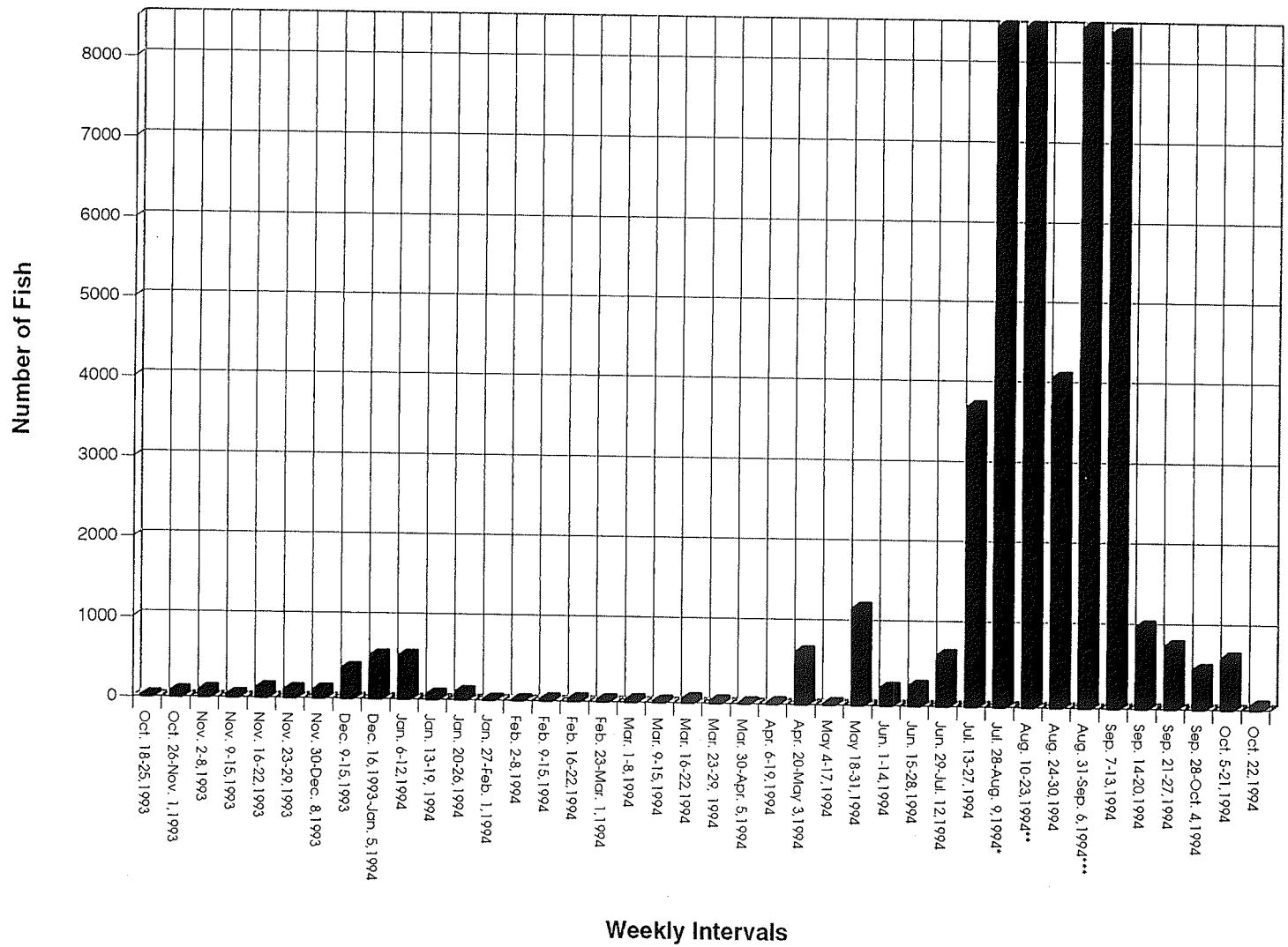
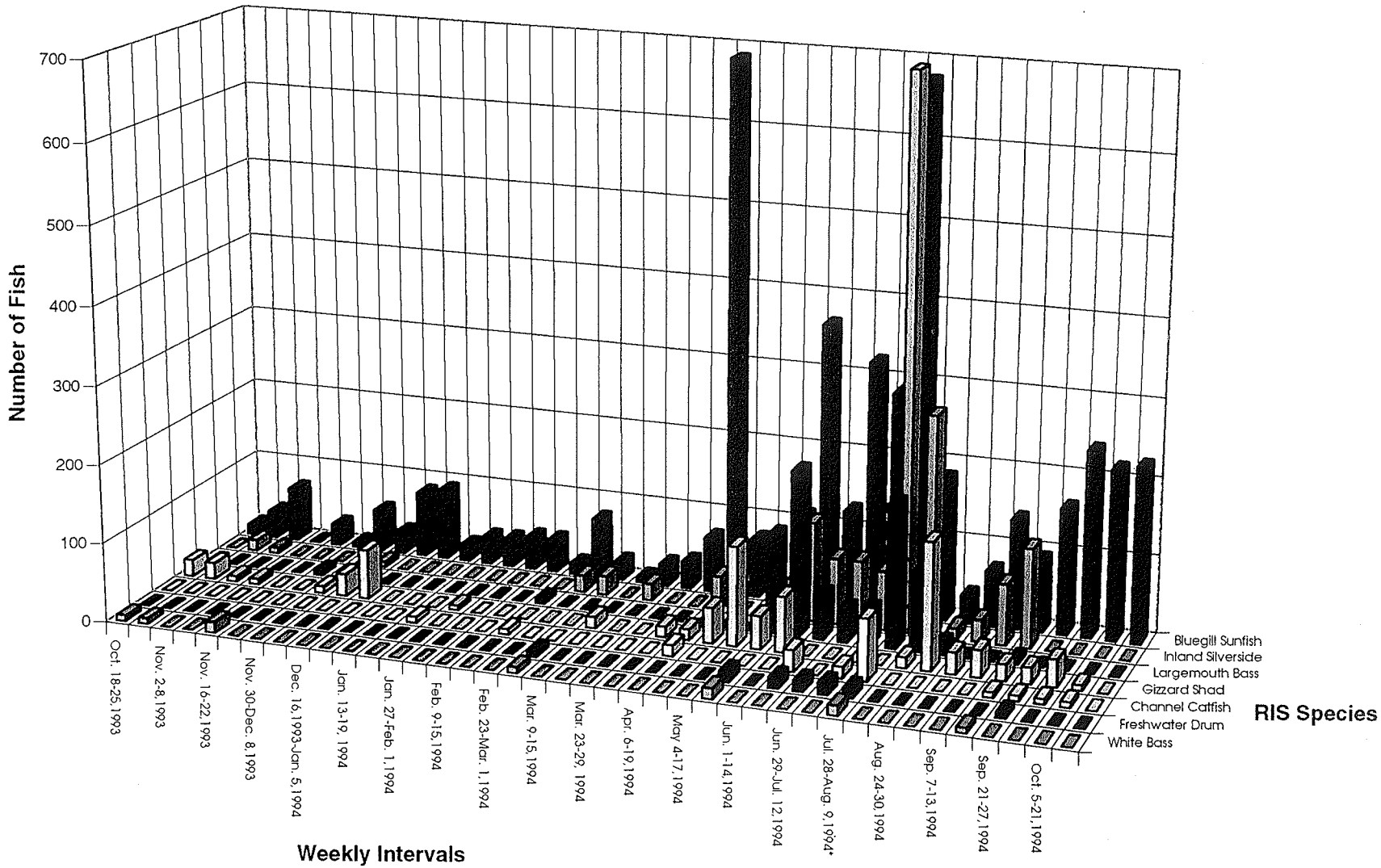


Figure 5-8. Weekly estimates of threadfin shad impingment by the CPSES CWS



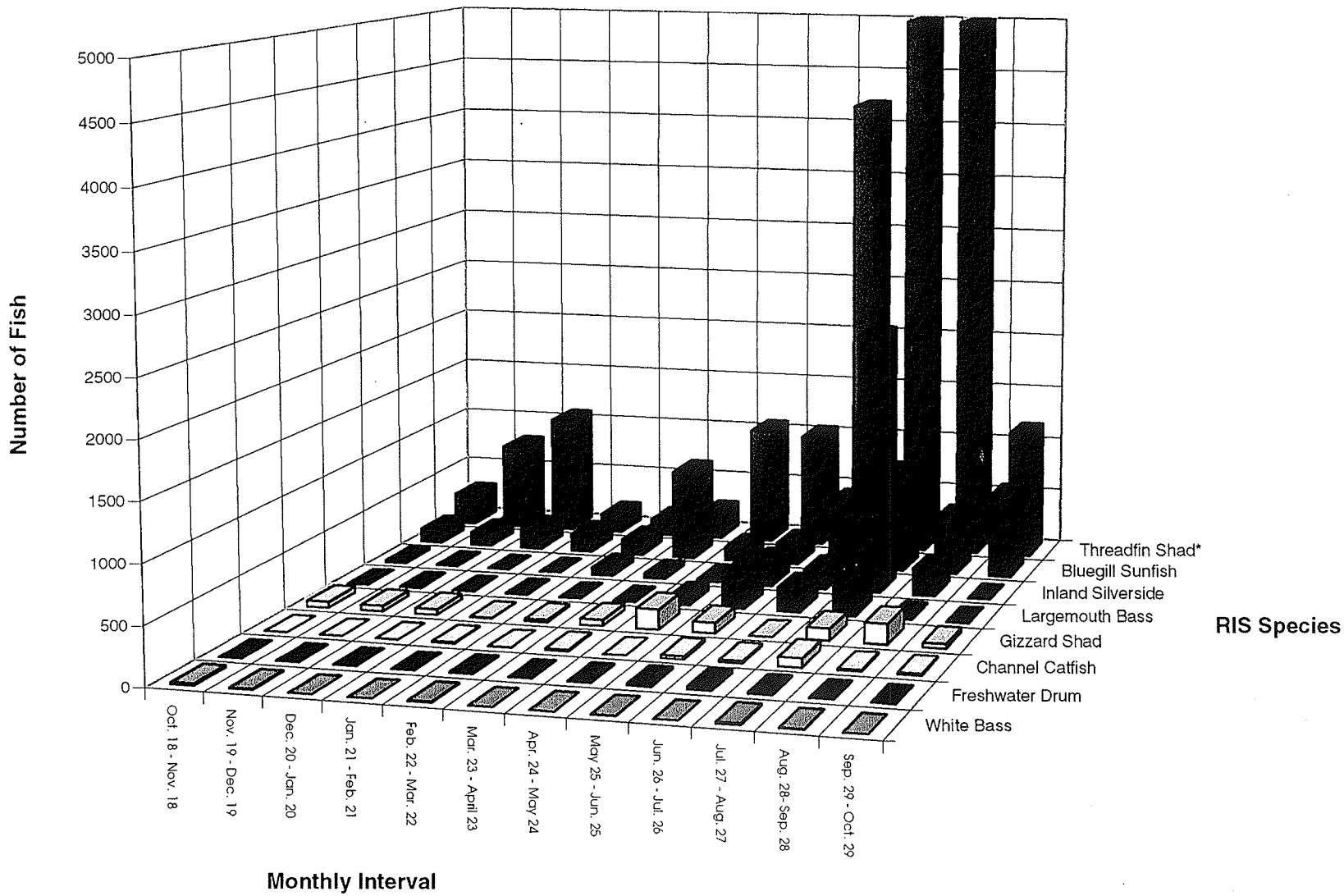
*The actual no. of threadfin shad impinged from Jul.28-Aug.9, 1994 was 116,051.
**The actual no. of threadfin shad impinged from Aug.10-Aug.23, 1994 was 88,200.
***The actual no. of threadfin shad impinged from Aug.31-Sep.6, 1994 was 22,169.

Figure 5-9. Weekly estimates of impingement of seven RIS by the CPSES CWS



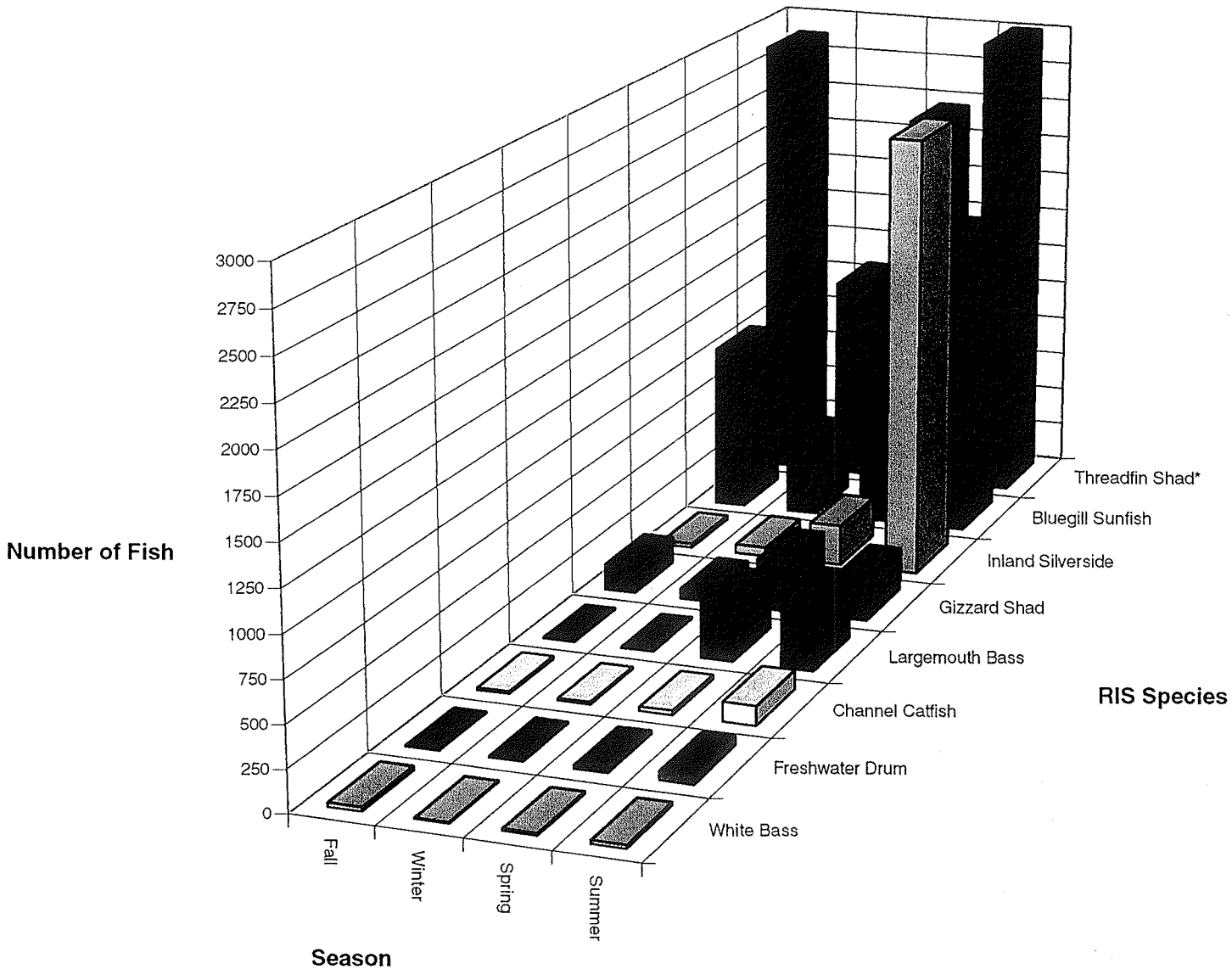
* The actual number of inland silversides impinged from July 28 to August 9 was 2,028.

Figure 5-10. Monthly impingement estimates of RIS species



* The estimated monthly impingements of threadfin shad for Jul. 27-Aug. 27 and Aug. 28-Sep. 28, are 206,857 and 34,277, respectively.

Figure 5-11. Seasonal estimates of RIS species impingement



* Actual total summer impingement of threadfin shad was 244,780 fish.

Figure 5-12. Length-frequency distribution of largemouth bass impinged by the CPSES CWS (N=46)

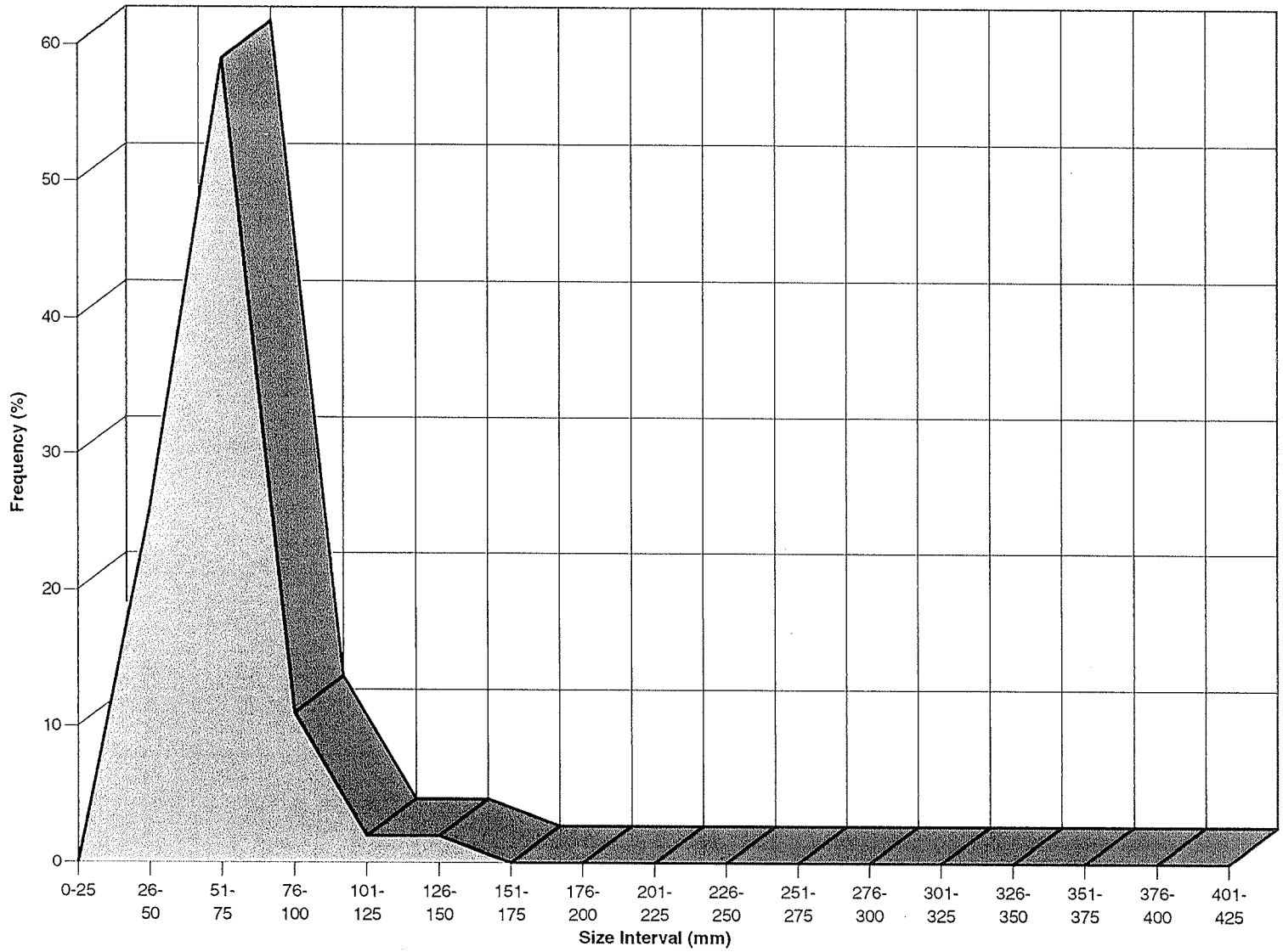


Figure 5-13. Length-frequency distribution of freshwater drum impinged by the CPSES CWS (N=7).

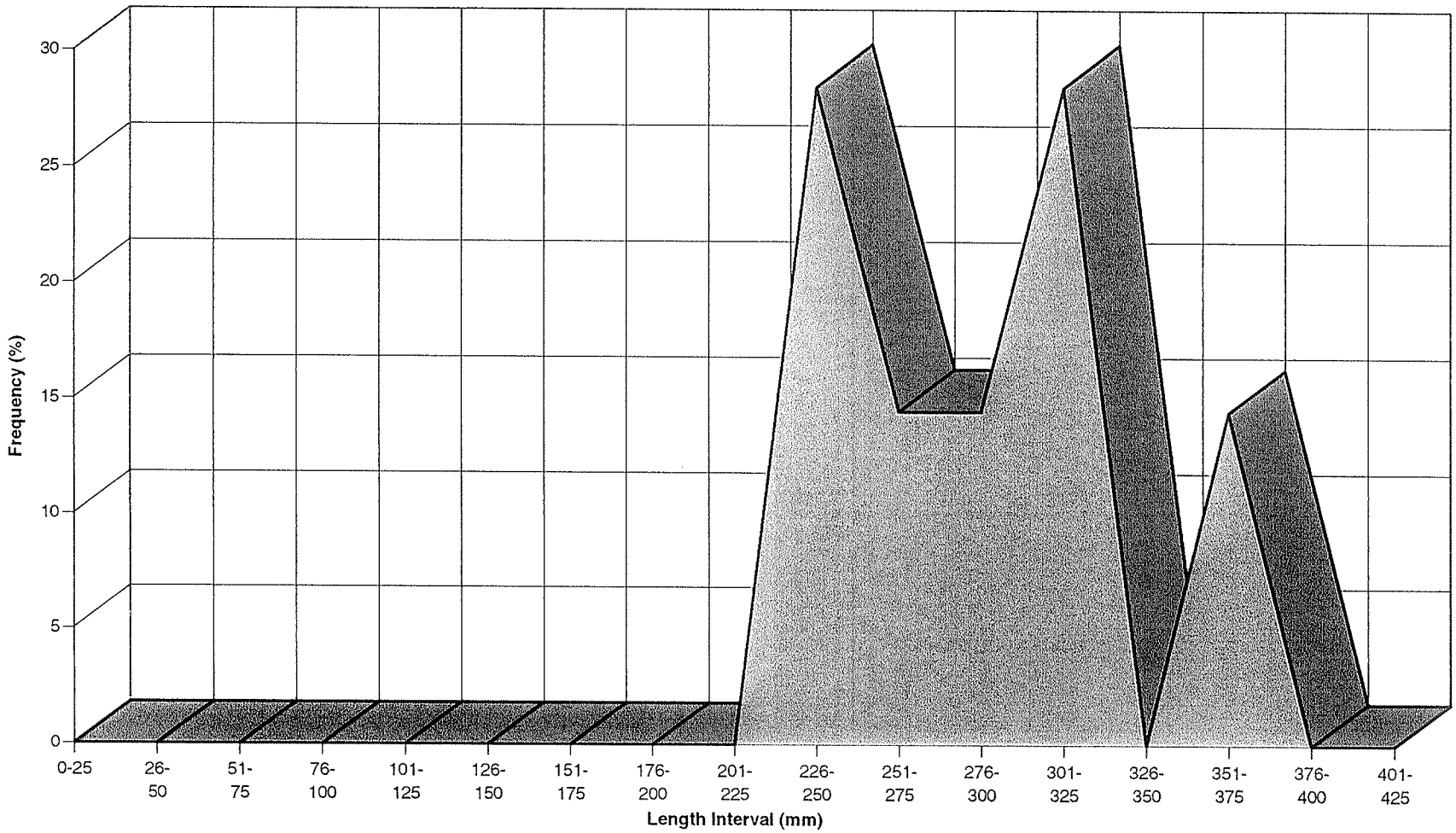


Figure 5-14. Length frequency distribution of inland silversides impinged by the CPSES CWS (N=115).

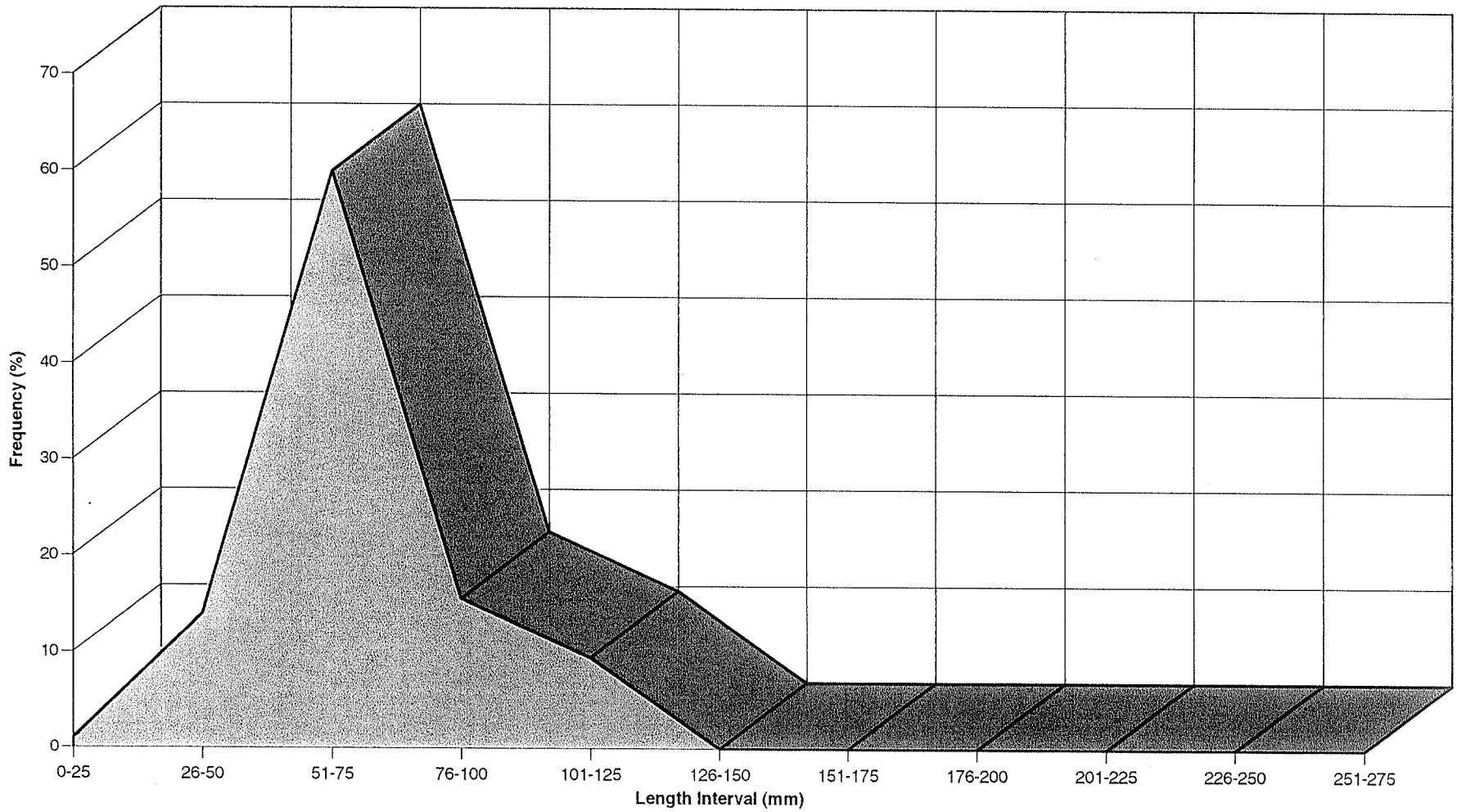


Figure 5-15. Length frequency distribution of threadfin shad impinged by the CPSES CWS (N=1,070).

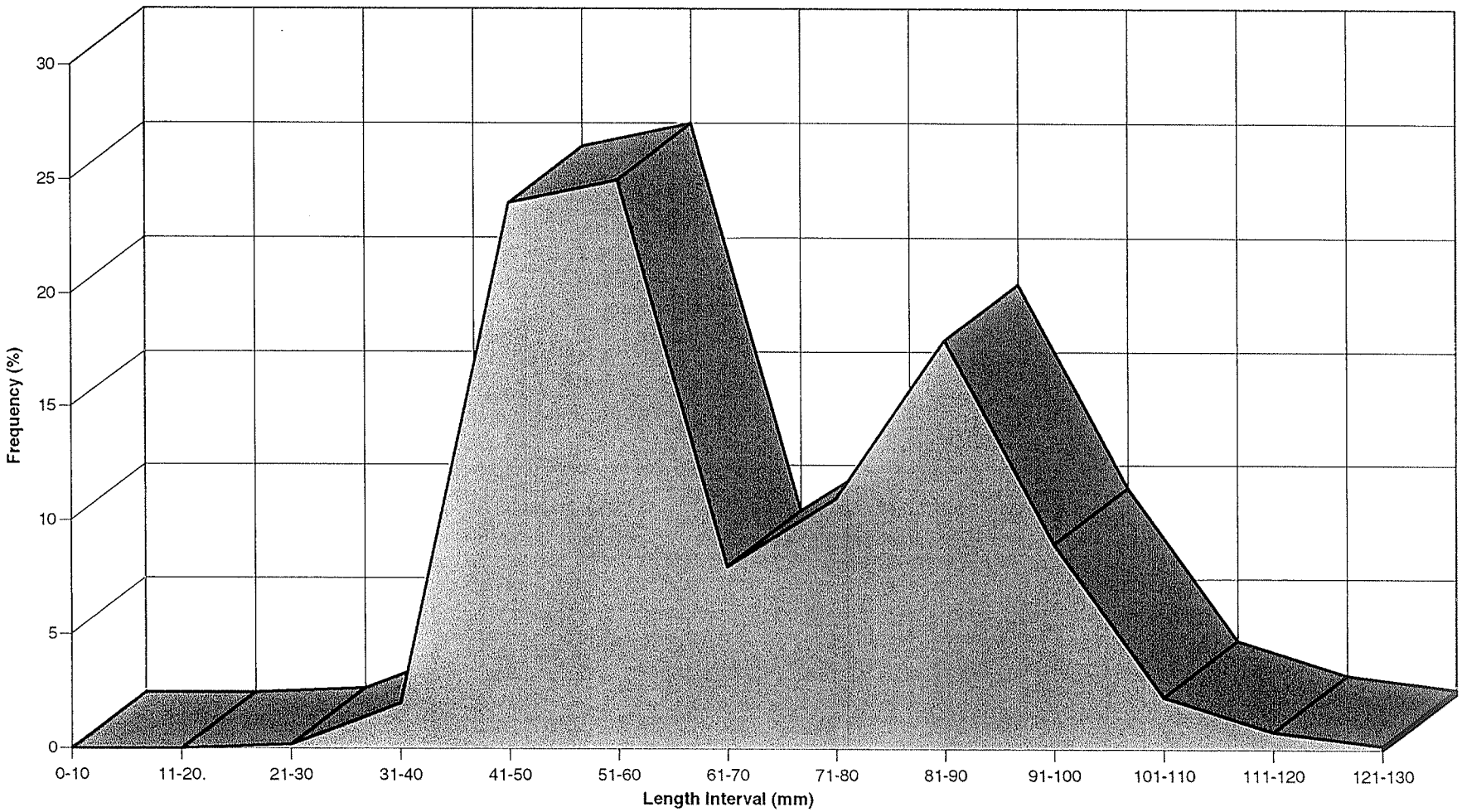


Figure 5-16. Length-frequency distribution of gizzard shad impinged by the CPSES CWS (N=84).

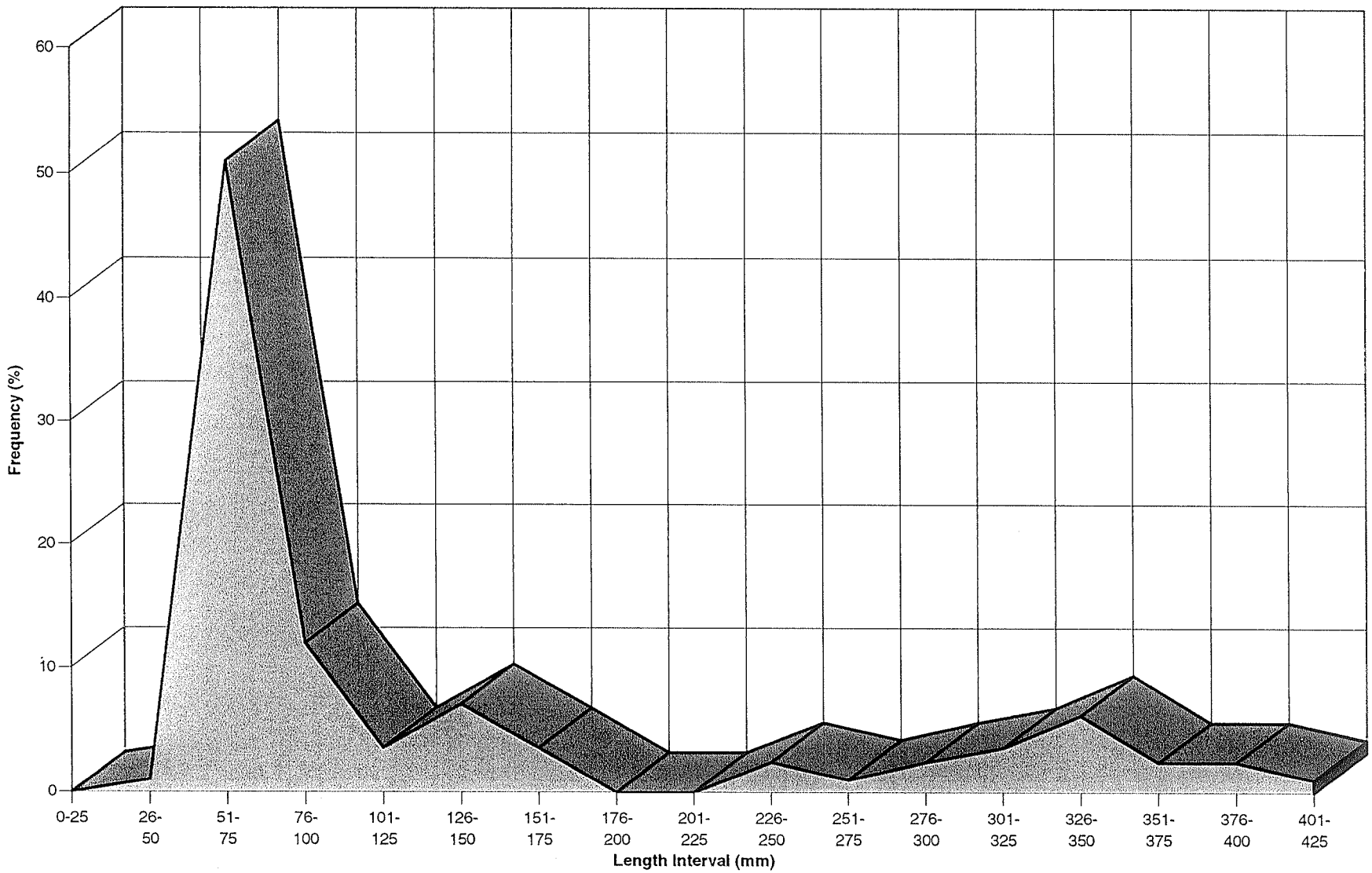


Figure 5-17. Length-frequency distribution of white bass impinged by the CPSES (N=8).

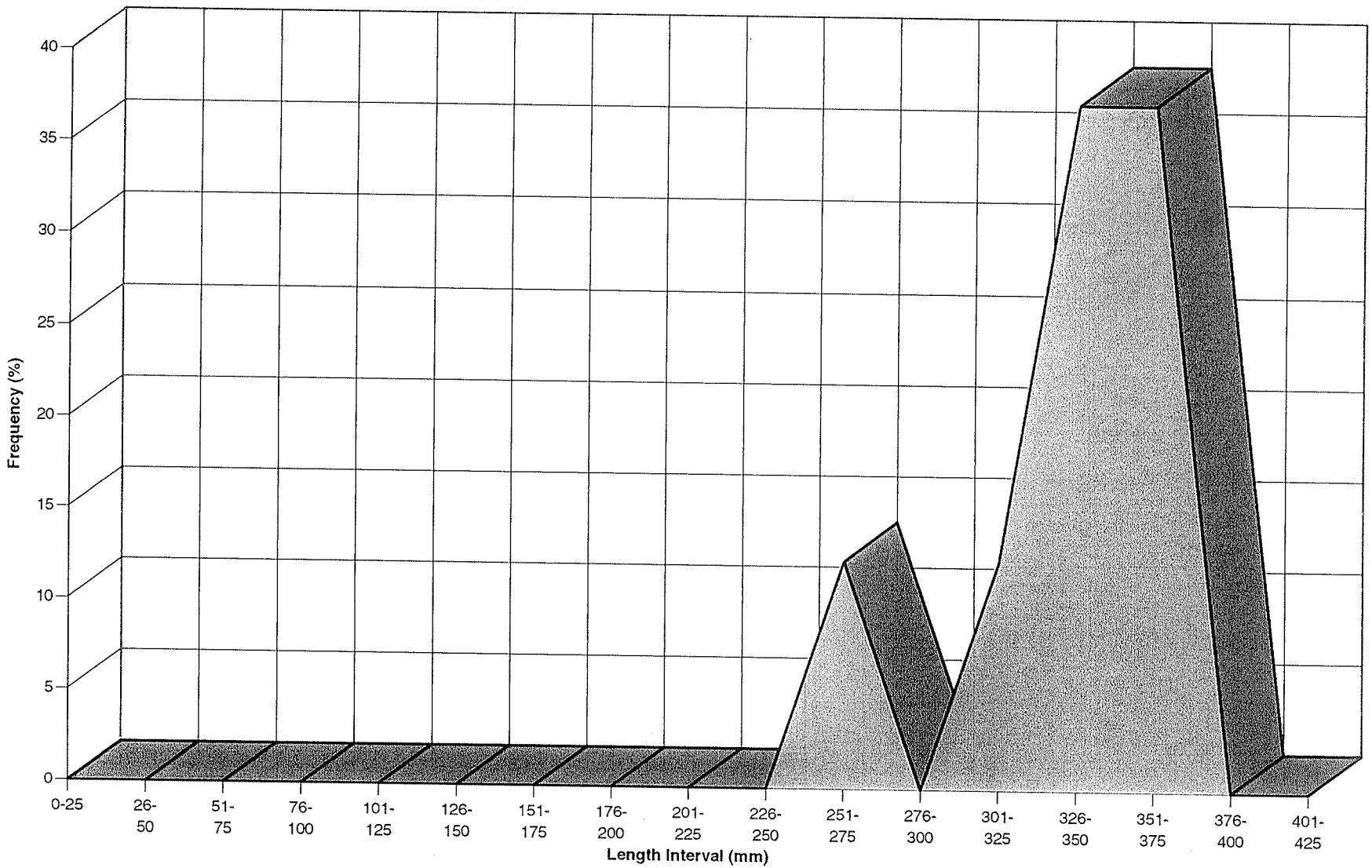


Figure 5-18. Length-frequency distribution of channel catfish impinged by the CPSES CWS (N=11).

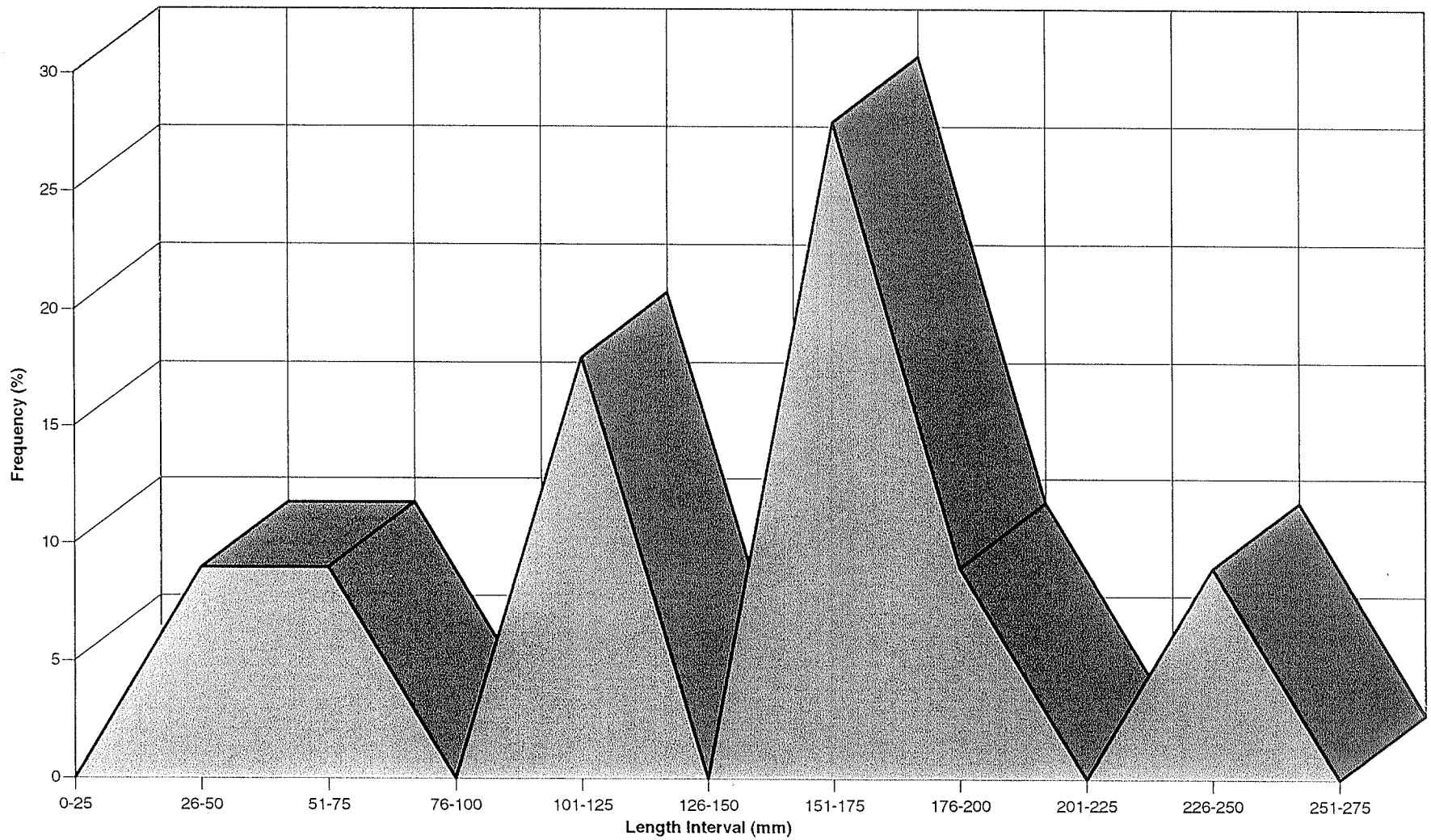
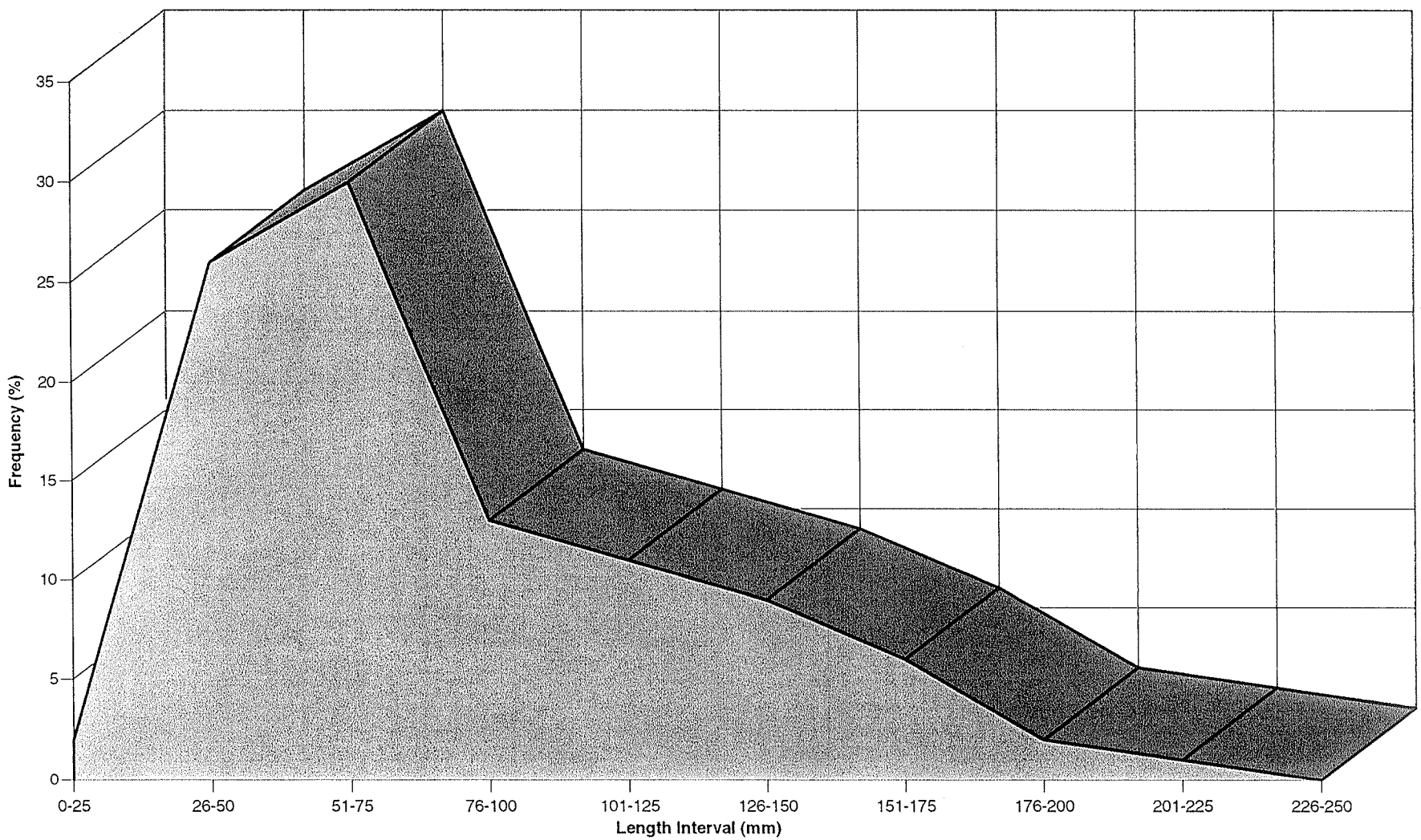
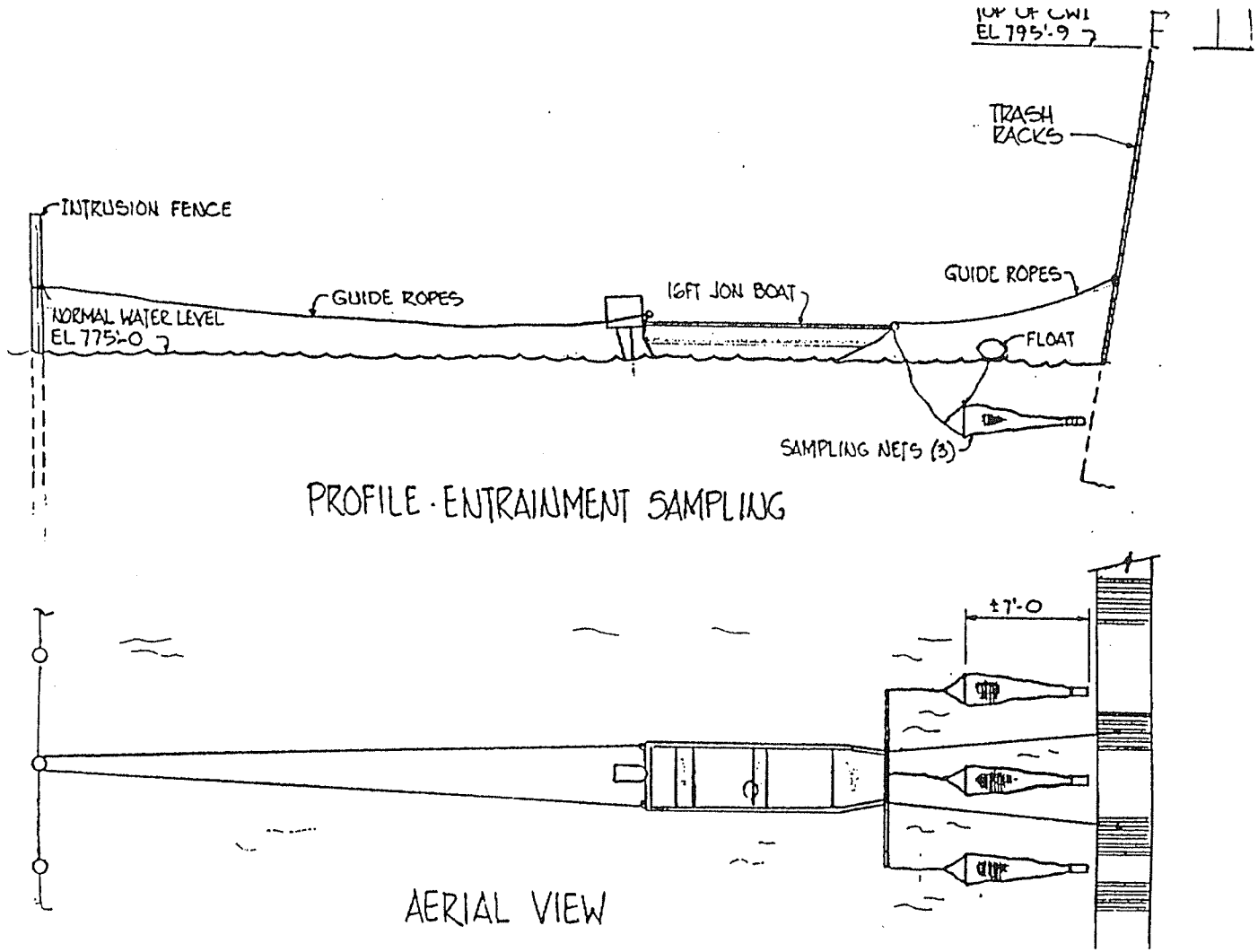


Figure 5-19. Length-frequency distribution of bluegill sunfish impinged by the CPSES CWS (N=440).





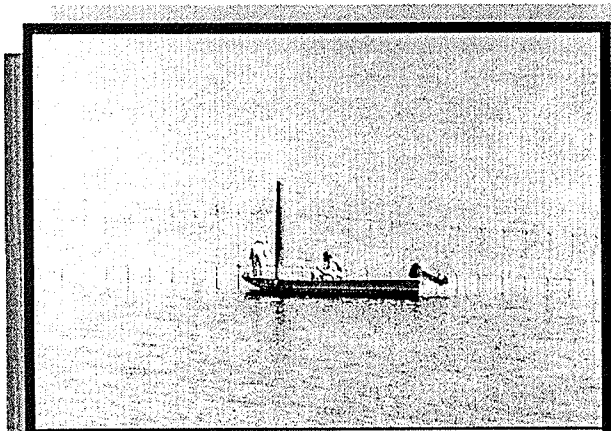
TEXAS UTILITIES ELECTRIC COMPANY

COMANCHE PEAK 316 (b)

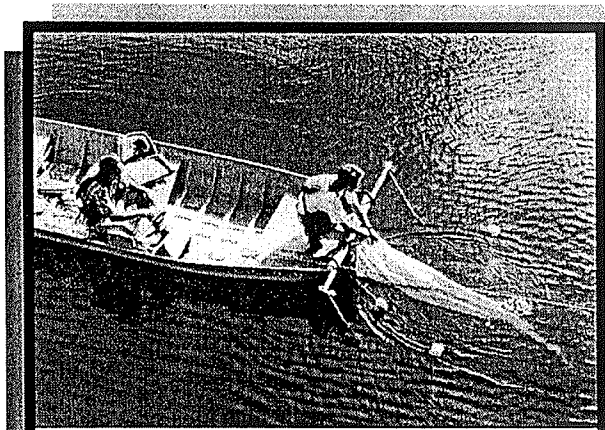
FIGURE 6–1A

FIELD DEPLOYMENT OF ENTRAINMENT NETS IN FRONT OF CPSES INTAKE STRUCTURE

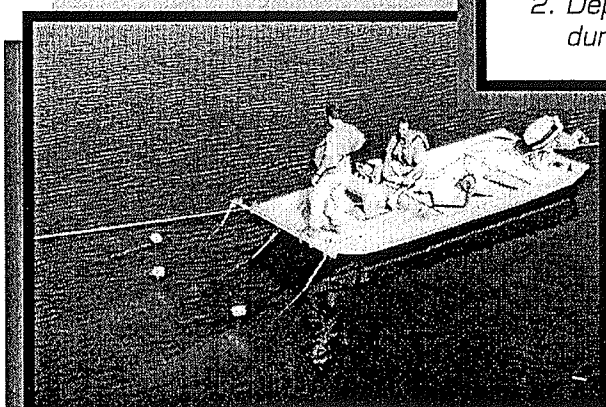
FOSTER WHEELER ENVIRONMENTAL CORPORATION



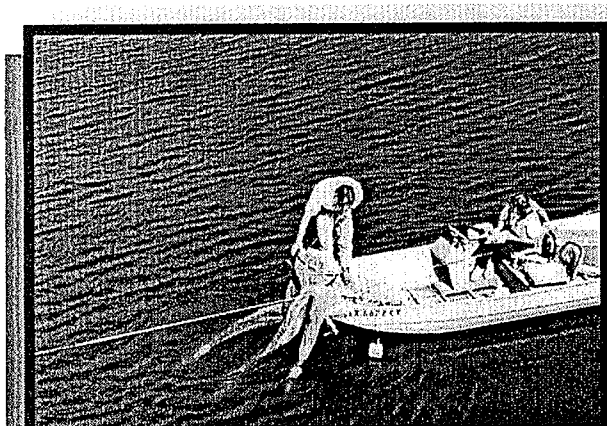
1. Securing boat to intrusion barrier prior to sampling.



2. Deployment of ichthyoplankton nets during entrainment sampling.



3. Triplicate ichthyoplankton nets fishing in front of CPSES intake.



4. Retrieval of ichthyoplankton nets for entrainment sample processing.

TEXAS UTILITIES ELECTRIC COMPANY

COMANCHE PEAK 316 (B)

FIGURE 6-1B
CPSES ENTRAINMENT SAMPLING OPERATIONS

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Figure 6-2 Entrainment data collection sheet.

EXHIBIT 7
COMANCHE PEAK 316(B) DEMONSTRATION
ENTRAINMENT SAMPLING/PROCESSING
Form 1 of 4

THIS SAMPLING EVENT

Date (m/d/yr)	**Day - Night (circle)**	**Sample #**
___ / ___ / ___		_____

Check Units Operating:	Unit 1___	Unit 2___
Check Pumps Operating:	1___ , 2___ , 3___ , 4___	1___ , 2___ , 3___ , 4___
Check Screens Operating:	1___ , 2___ , 3___ , 4___ , 5___ , 6___	1___ , 2___ , 3___ , 4___ , 5___ , 6___
Enter #s of Area Sampled:	Pump_____ Screen/Bar_____ (1-4) (1-6)	Pump_____ Screen/Bar_____ (1-4) (1-6)
SW Velocity/Sample:	_____ mps/(fps)	_____ mps/(fps)

ICHTHYOPLANKTON TOWS

Replicate 1

Flowmeter Count (start):_____ Time of Net Deployment:_____
Flowmeter Count (end):_____ Time of Net Retrieval:_____
Calculated Volume (m3):_____ Depth (feet):_____

Replicate 2

Flowmeter Count (start):_____ Time of Net Deployment:_____
Flowmeter Count (end):_____ Time of Net Retrieval:_____
Calculated Volume (m3):_____ Depth (feet):_____

Replicate 3

Flowmeter Count (start):_____ Time of Net Deployment:_____
Flowmeter Count (end):_____ Time of Net Retrieval:_____
Calculated Volume (m3):_____ Depth (feet):_____

Weather	**Air Temp.**	**Water Temp.**	**D.O.**
_____	_____F/C	_____F/C	_____ mg/l

Sunrise	**Sunset**	**Moon Stage**
_____ AM	_____ PM	_____

COMMENTS/CORRECTIONS:

PERSONNEL (initials):_____ , _____ , _____

Figure 6- 3. Weekly entrainment of fish eggs (all genera) by CPSES Unit 1 and 2 for the period of April - July 1994

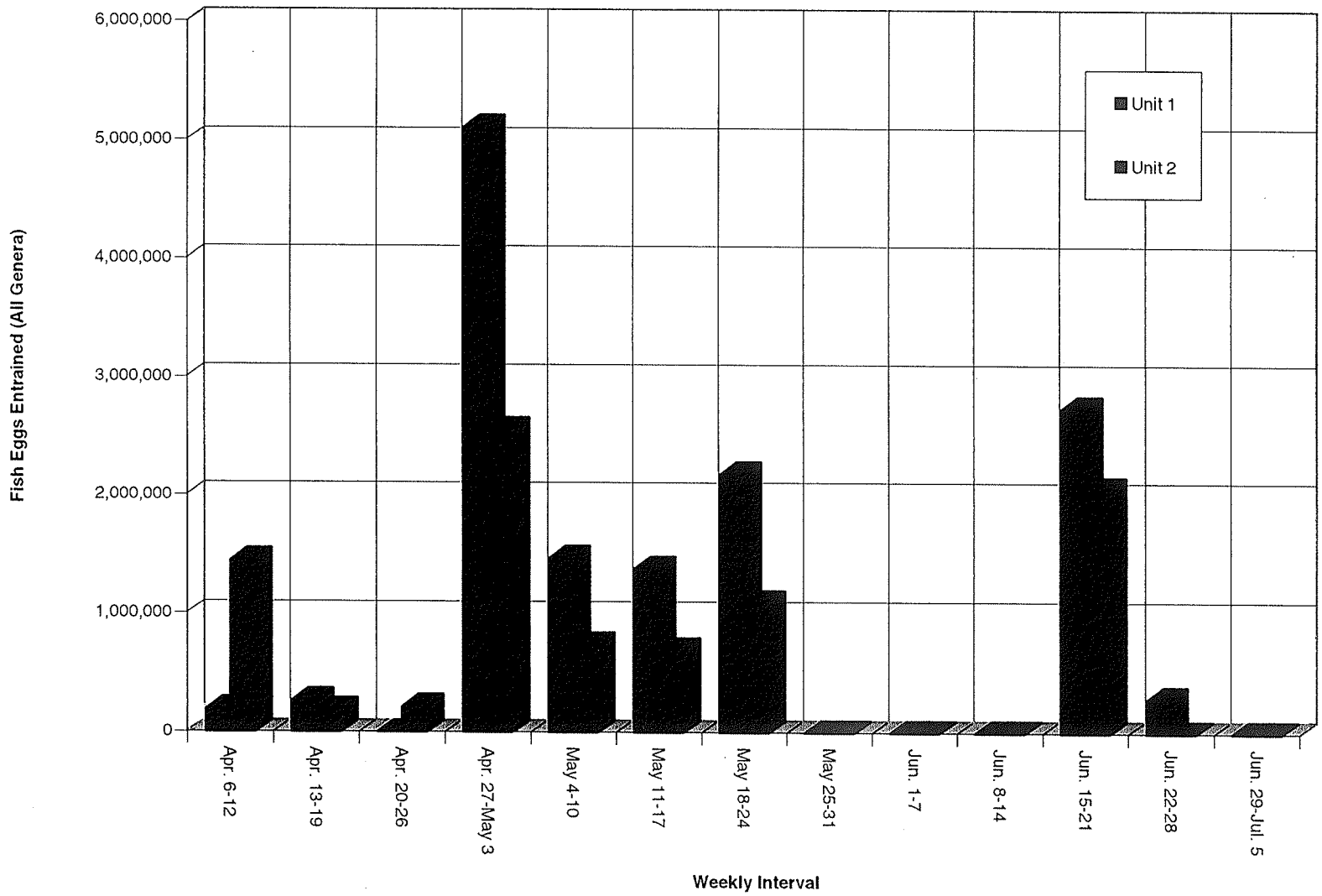


Figure 6- 4 . Weekly entrainment of fish larvae/juveniles (all genera) by CPSES Unit 1 and Unit 2 for the period of April-August 1994

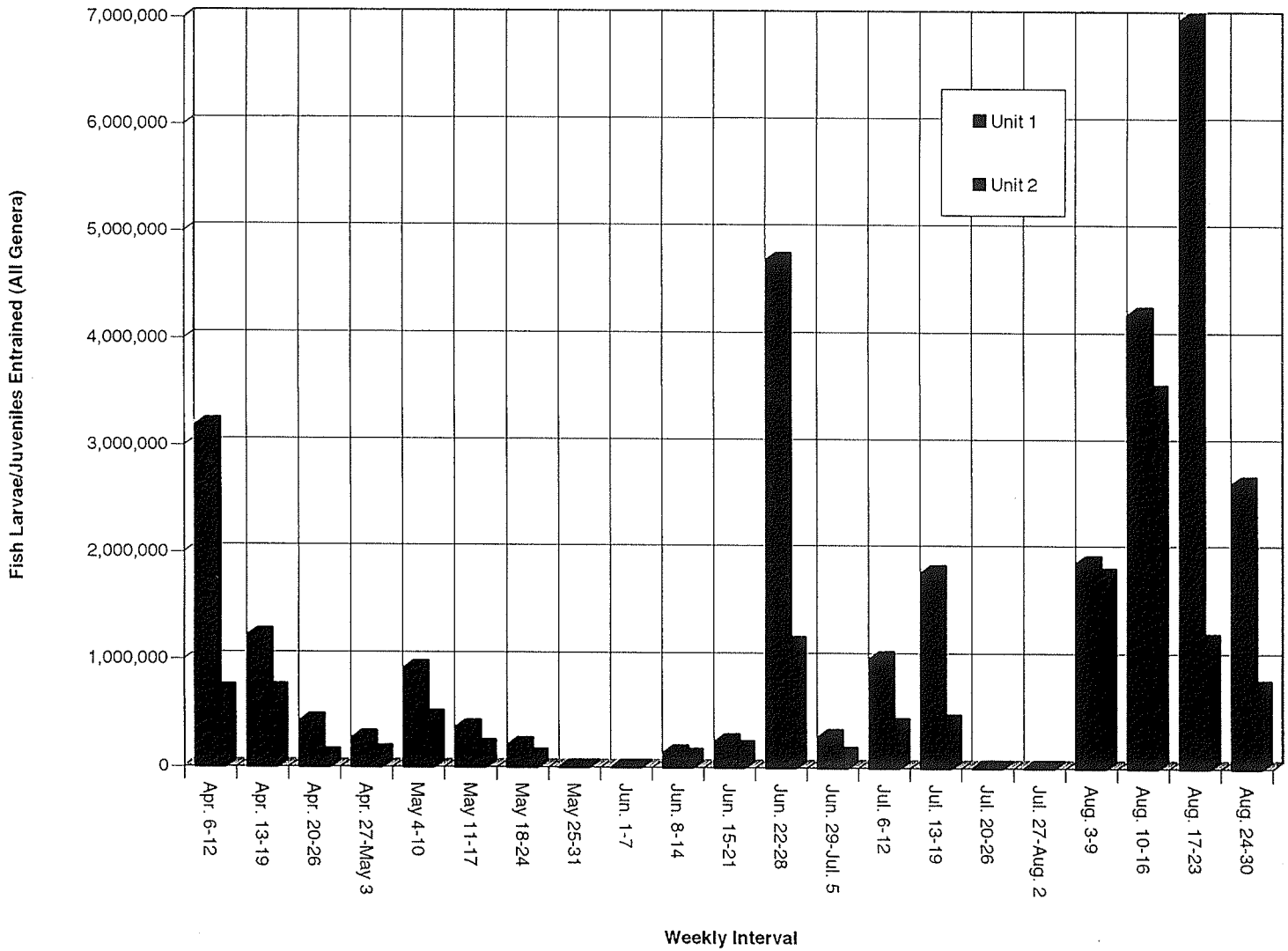


Figure 6-5. Monthly entrainment of fish eggs (total for all species) by CPSES Units 1 and 2 for the period of April - August 1994

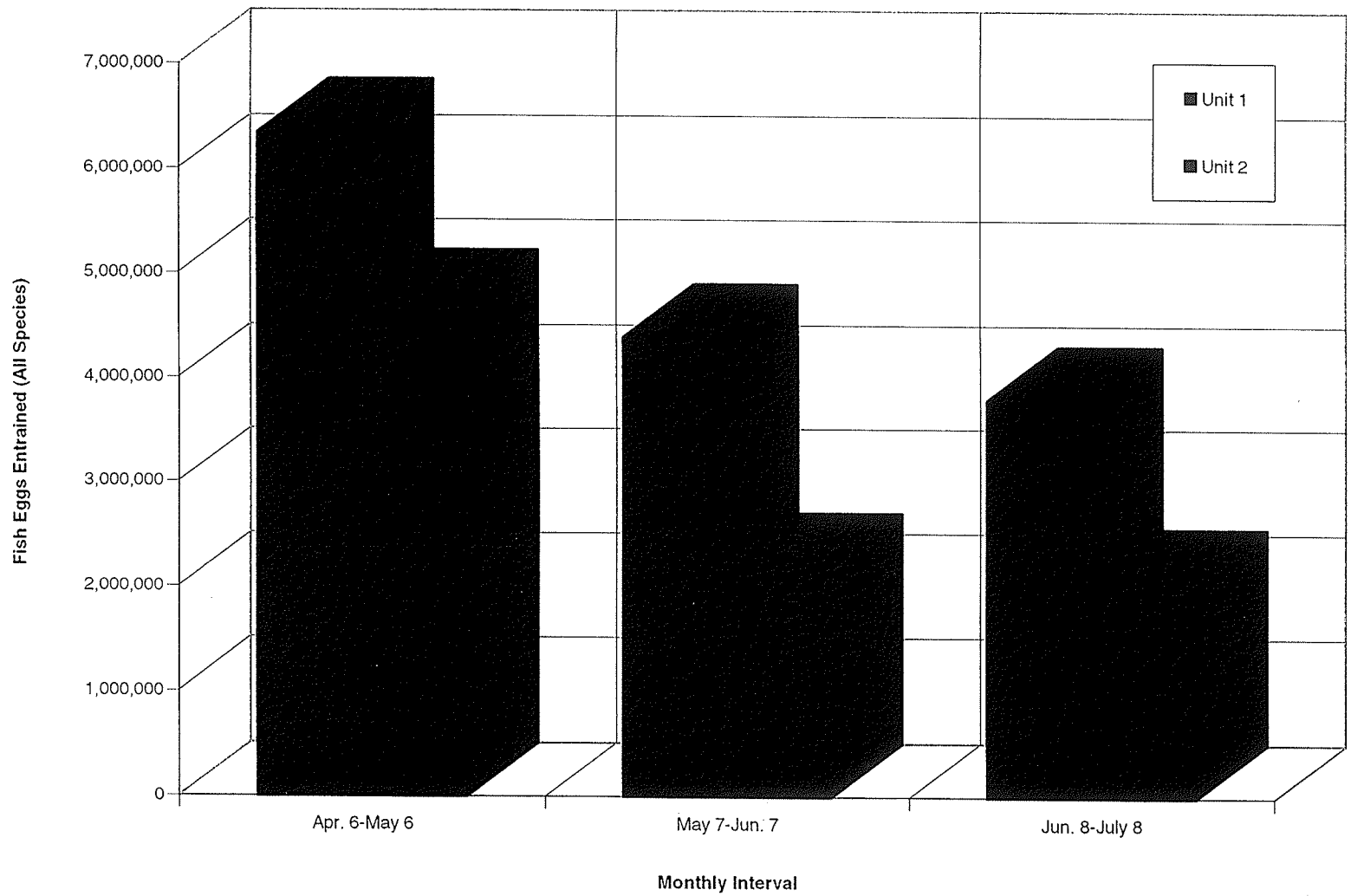


Figure 6-6. Monthly entrainment of fish larvae/ juveniles (total for all species) by CPSES Units 1 and 2 for the period of April-August 1994.

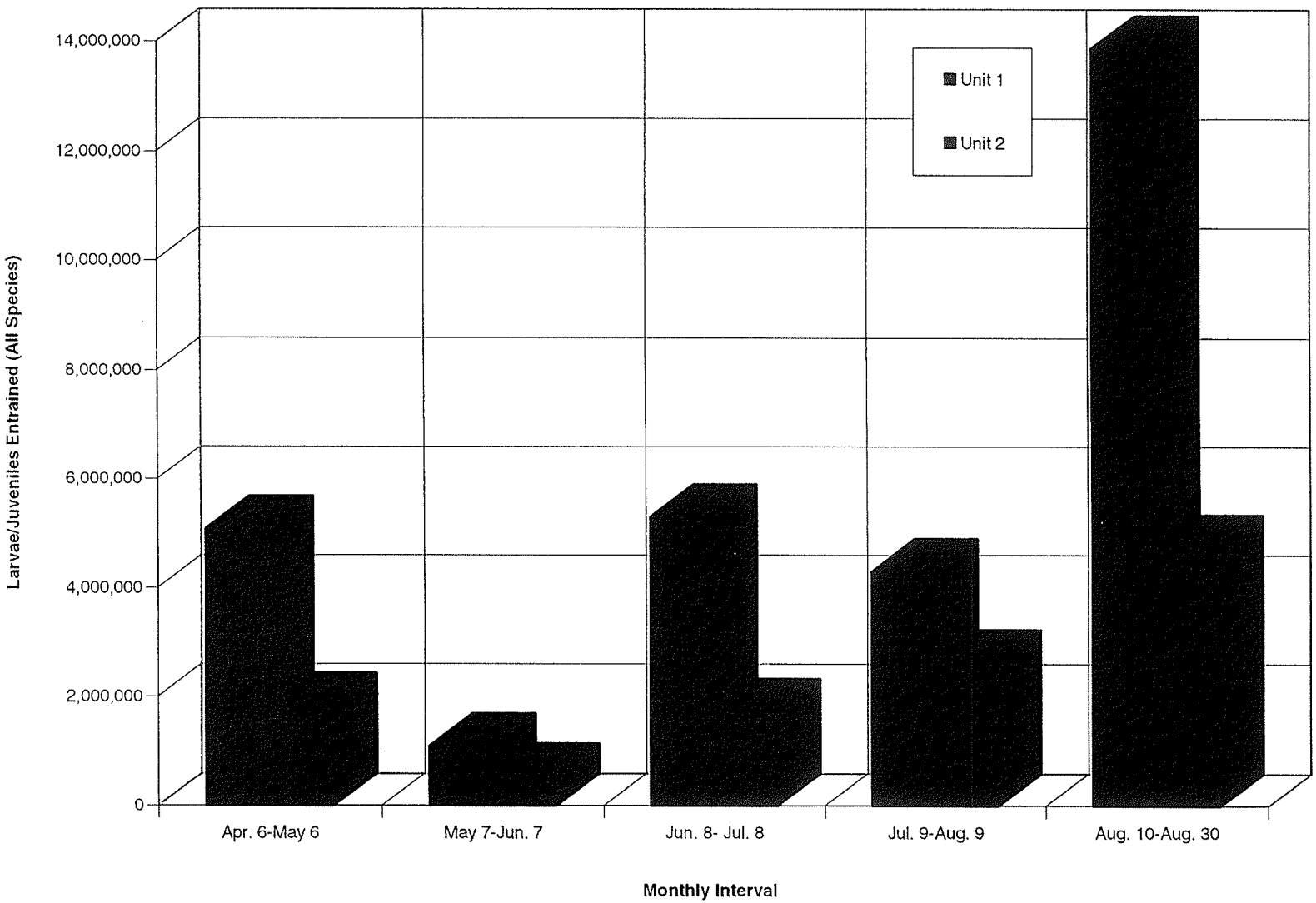


Figure 6-7. Seasonal entrainment of fish eggs (all genera) by CPSES Units 1 and 2

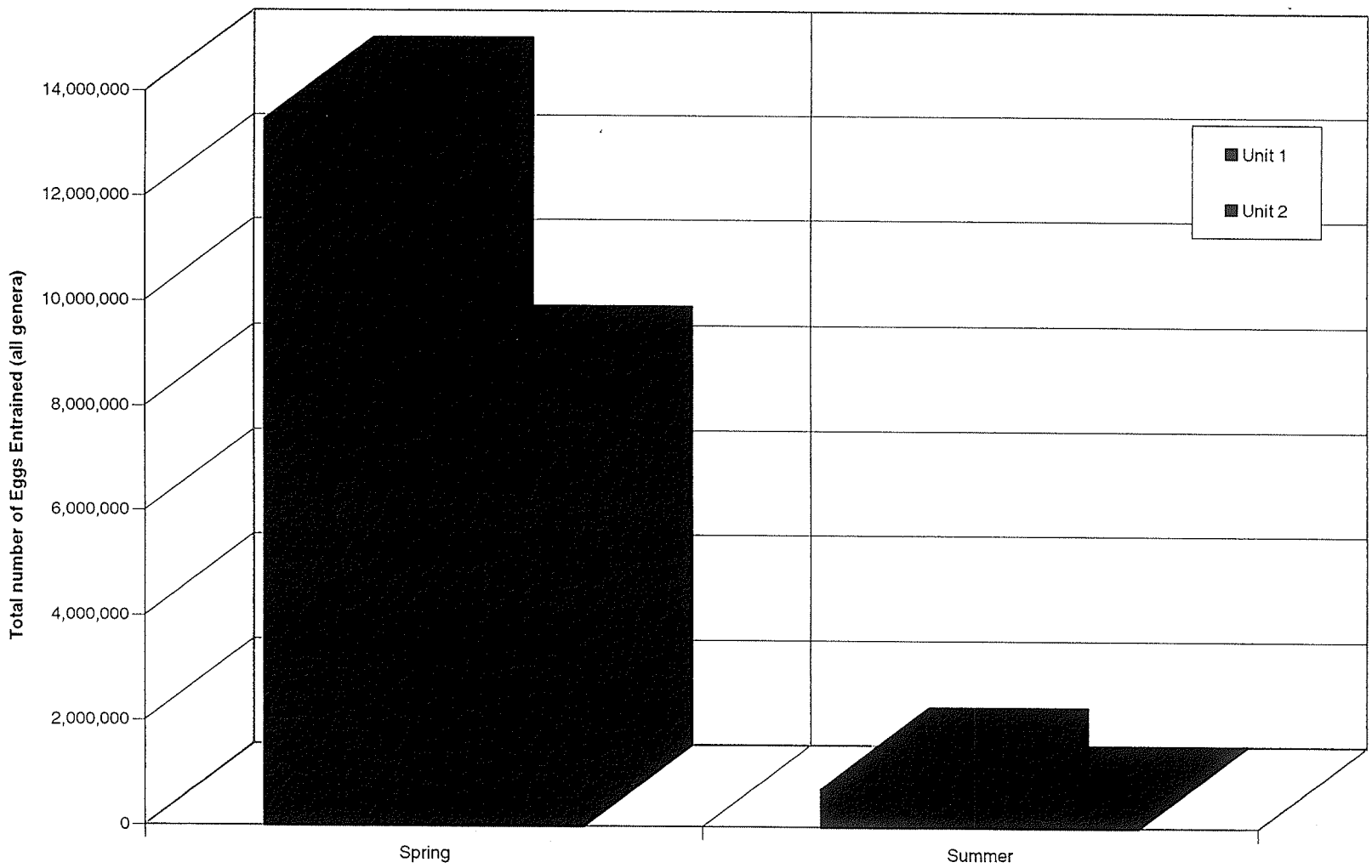


Figure 6-8. Seasonal entrainment of fish larvae/juveniles (all genera) by CPSES Units 1 and 2

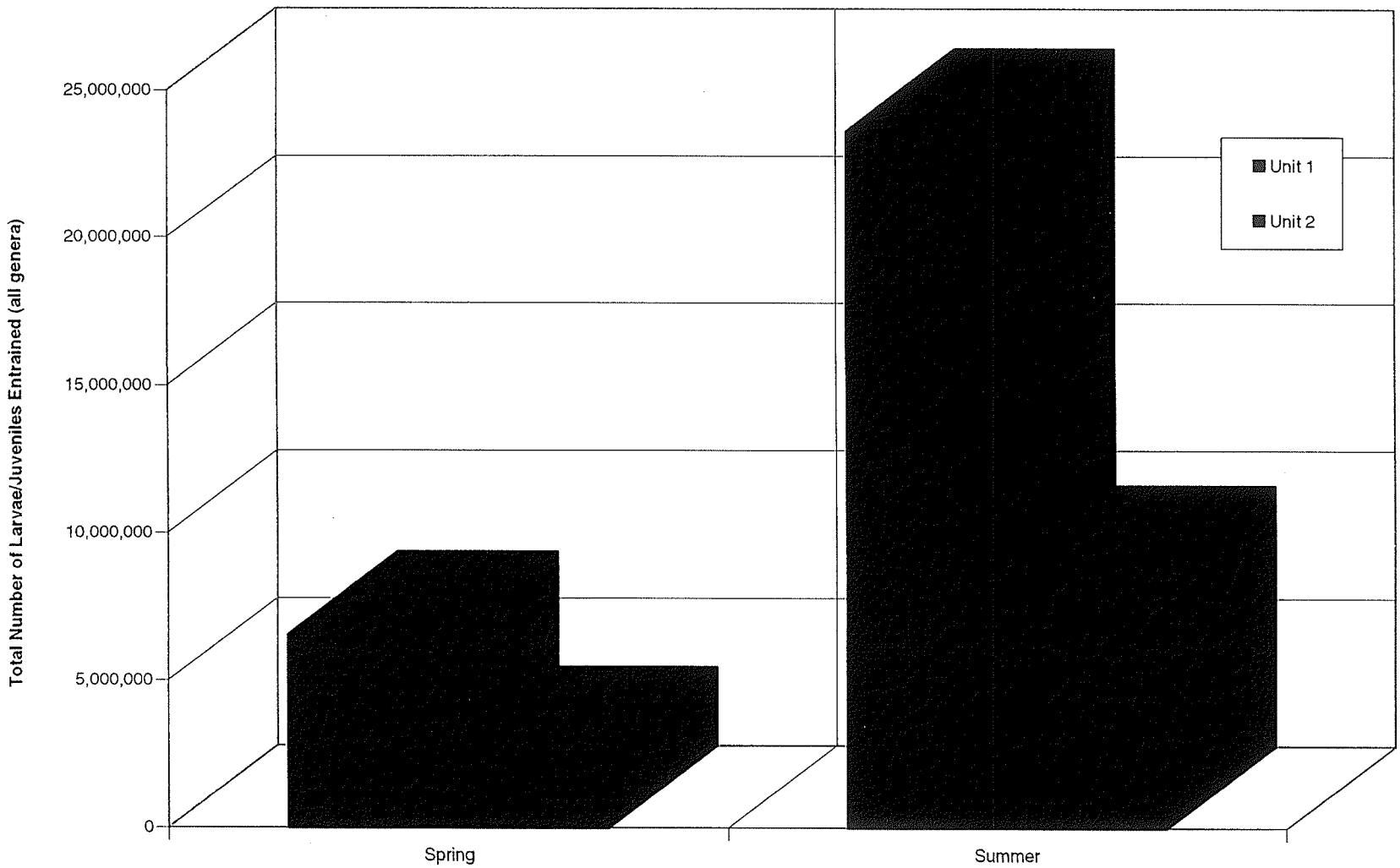


Figure 6-9. Weekly entrainment estimate for fish eggs (by genera) by CPSES Unit 1.

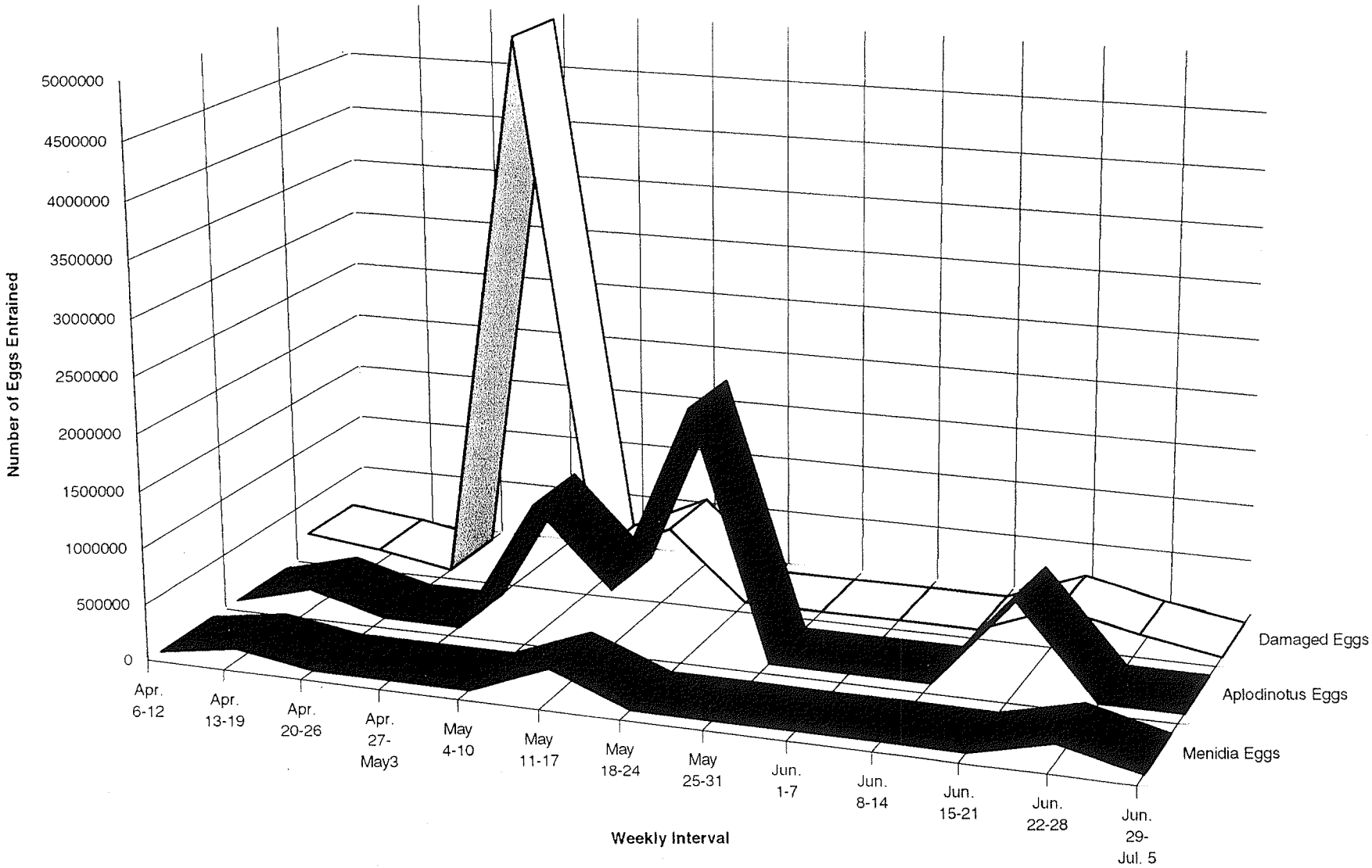


Figure 6-10. Weekly entrainment estimate of fish eggs (by genera) by CPSES Unit 2

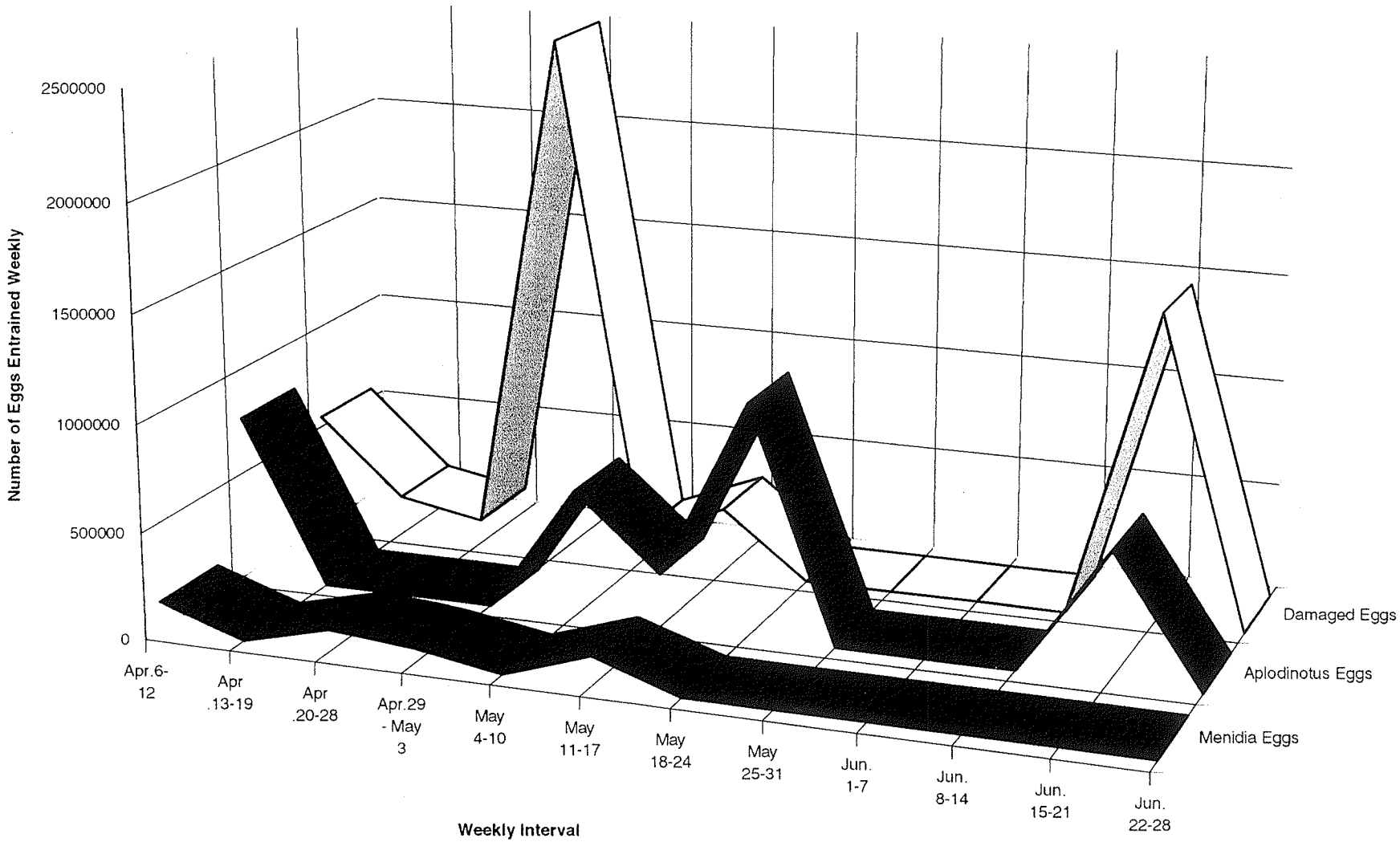


Figure 6-11. Weekly entrainment of fish larvae (by genus) by CPSES Unit 1

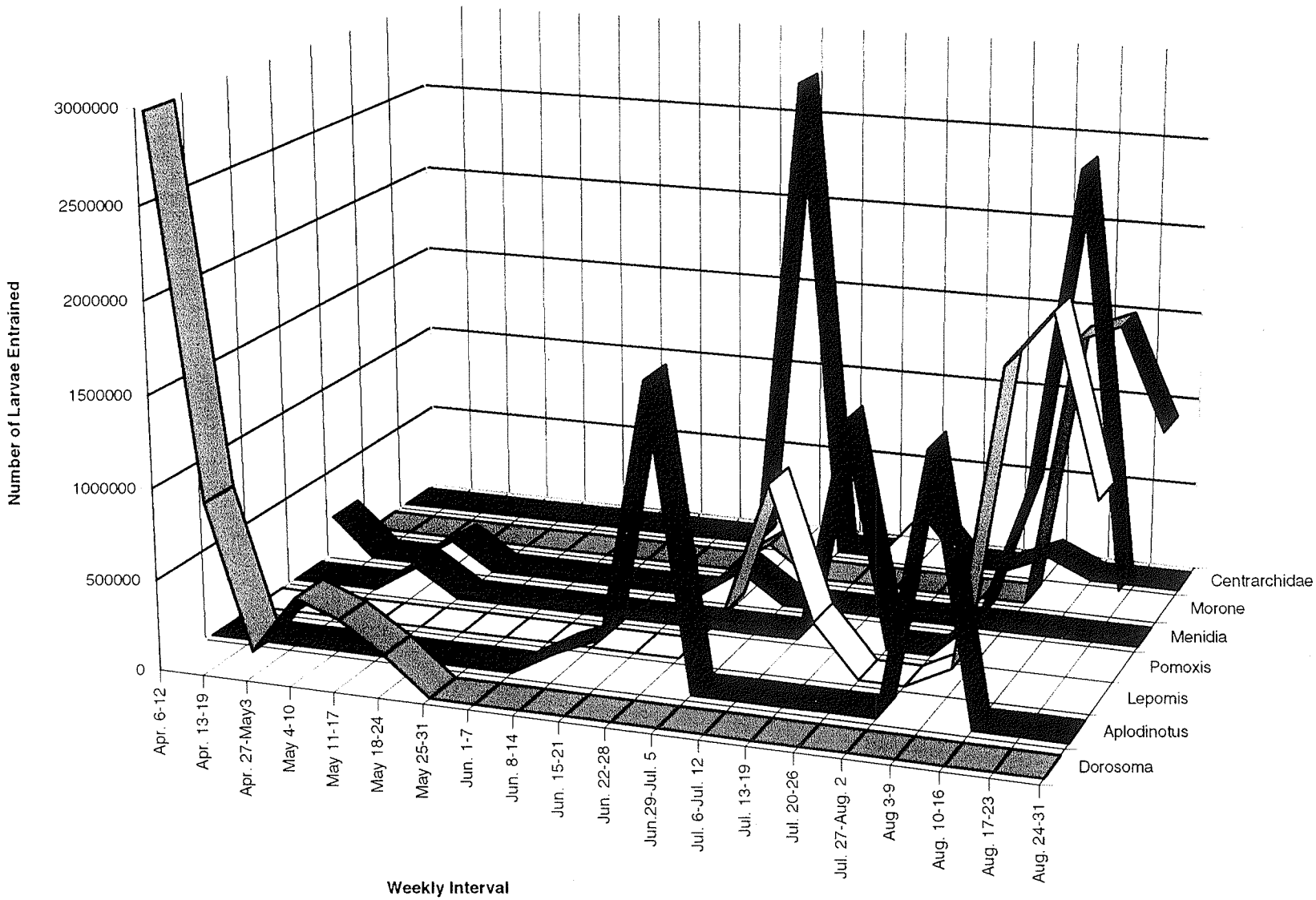
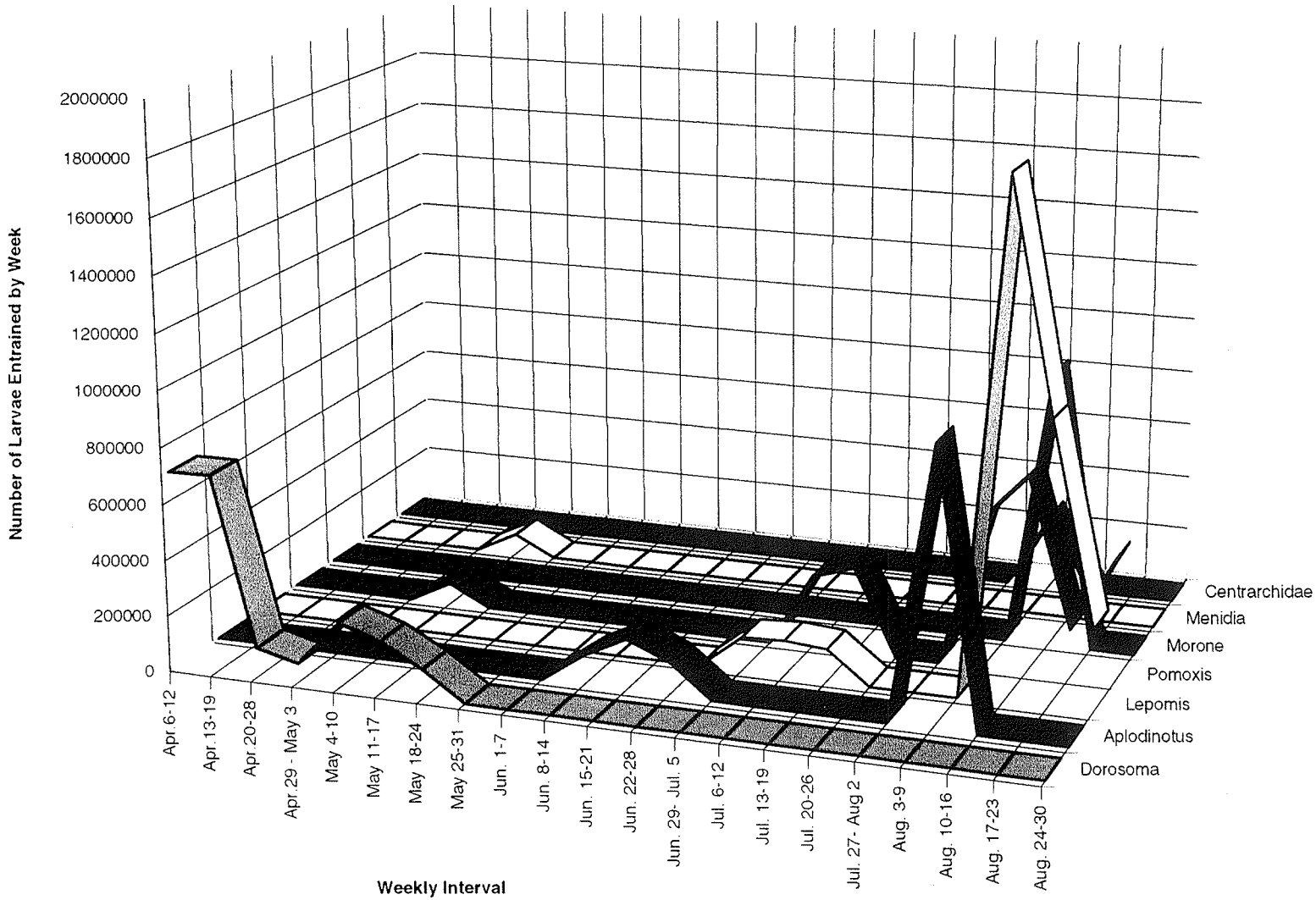


Figure 6-12. Weekly entrainment of fish larvae (by genera) by CPSES Unit 2



Note: Weekly extrapolations for the period of April 29-June 15 based upon densities in-front of Unit 1.

Figure 6-13. Monthly entrainment of RIS eggs by CPSES Unit 1.

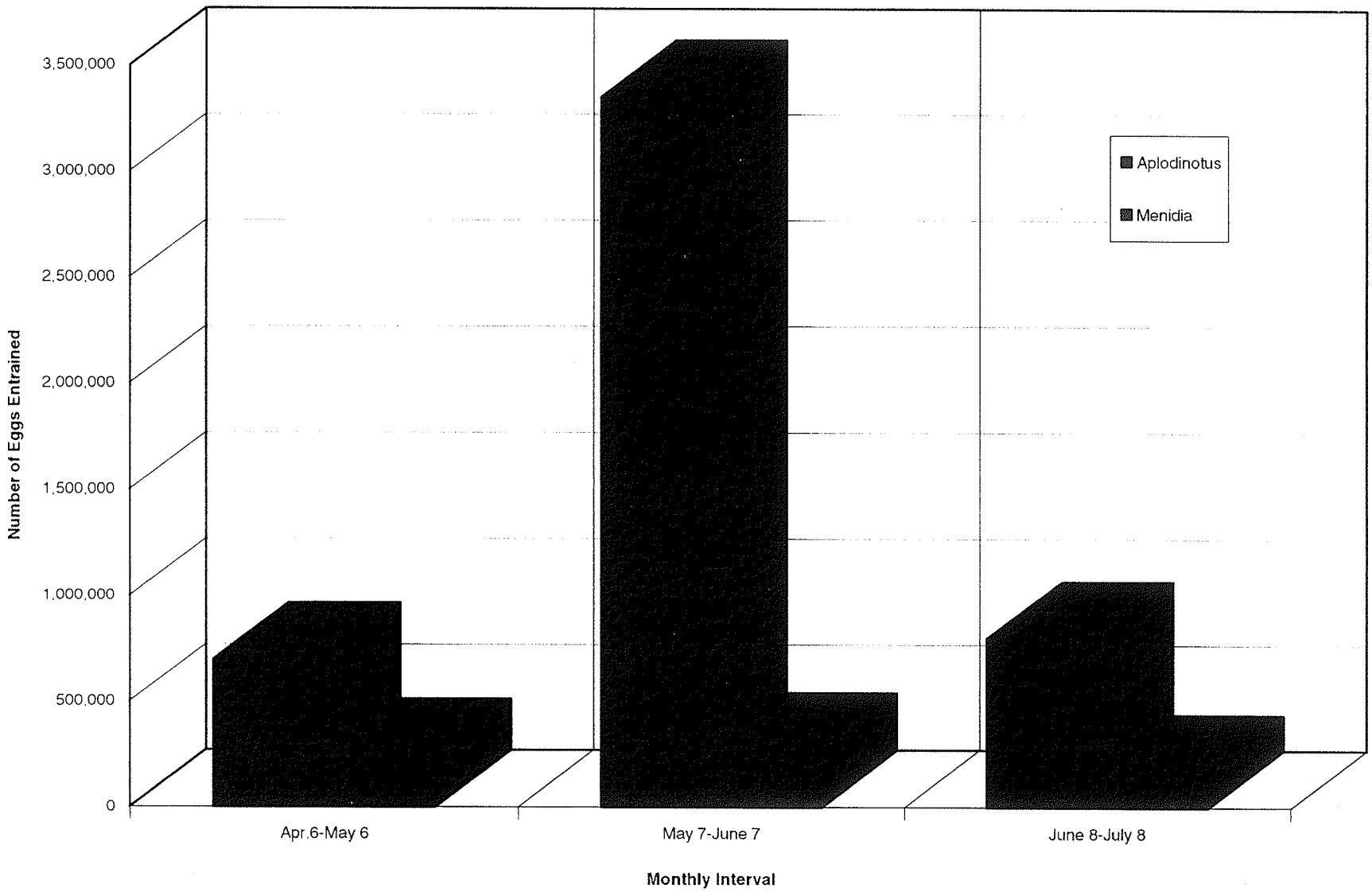


Figure 6-14. Monthly entrainment of RIS eggs by CPSES Unit 2.

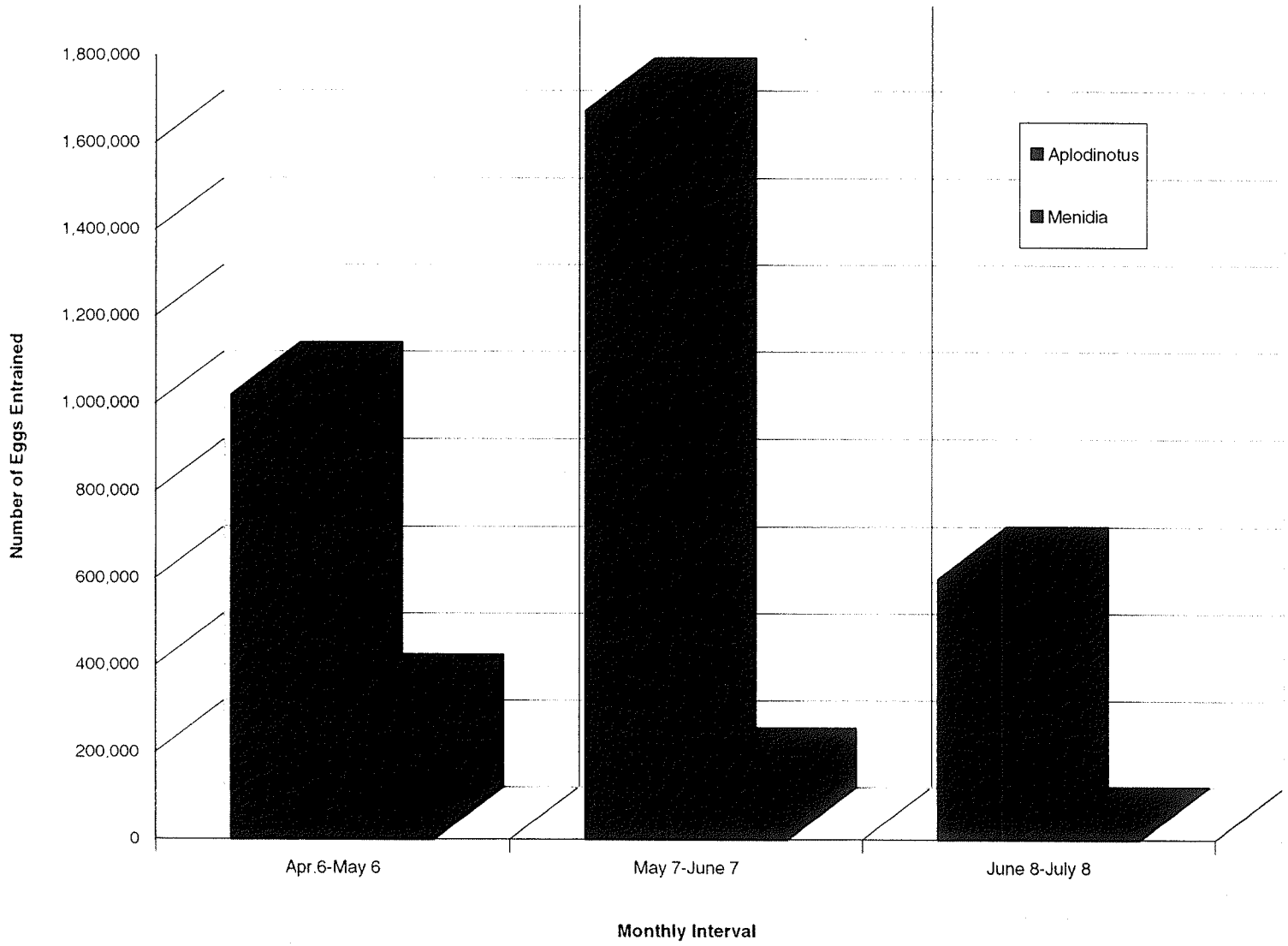
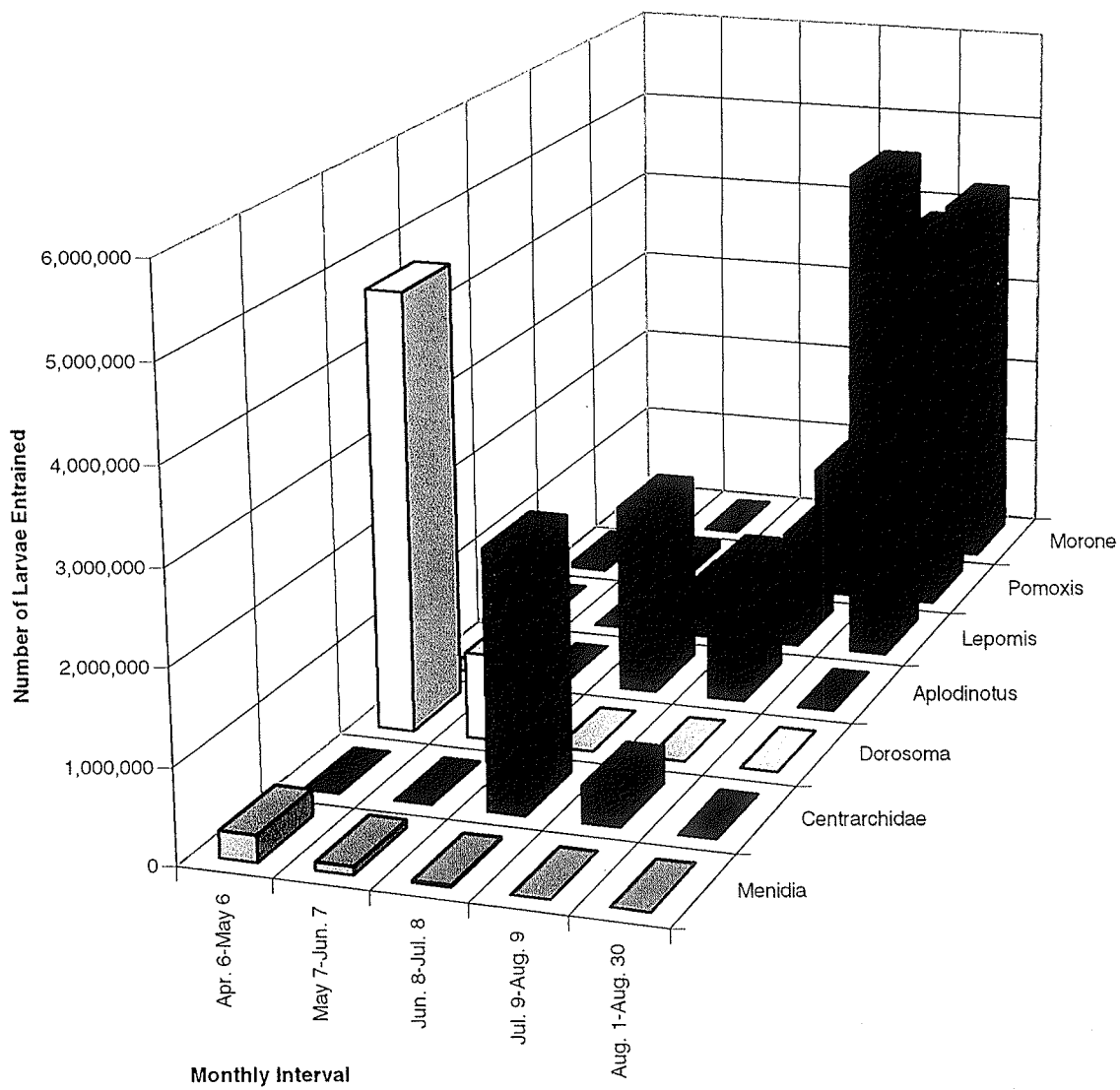
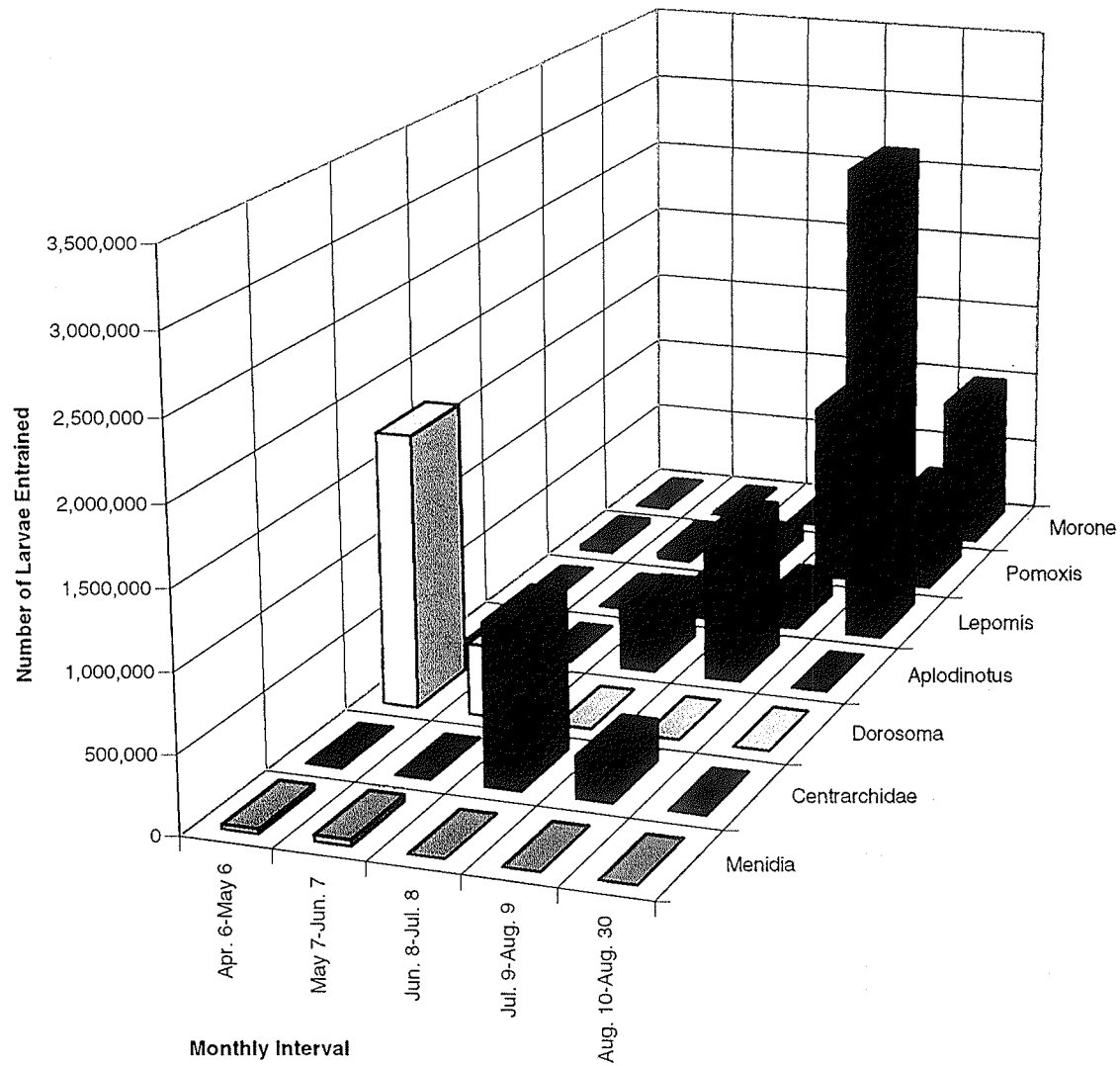


Figure 6-15. Monthly entrainment of RIS larvae/juveniles by CPSES Unit 1.



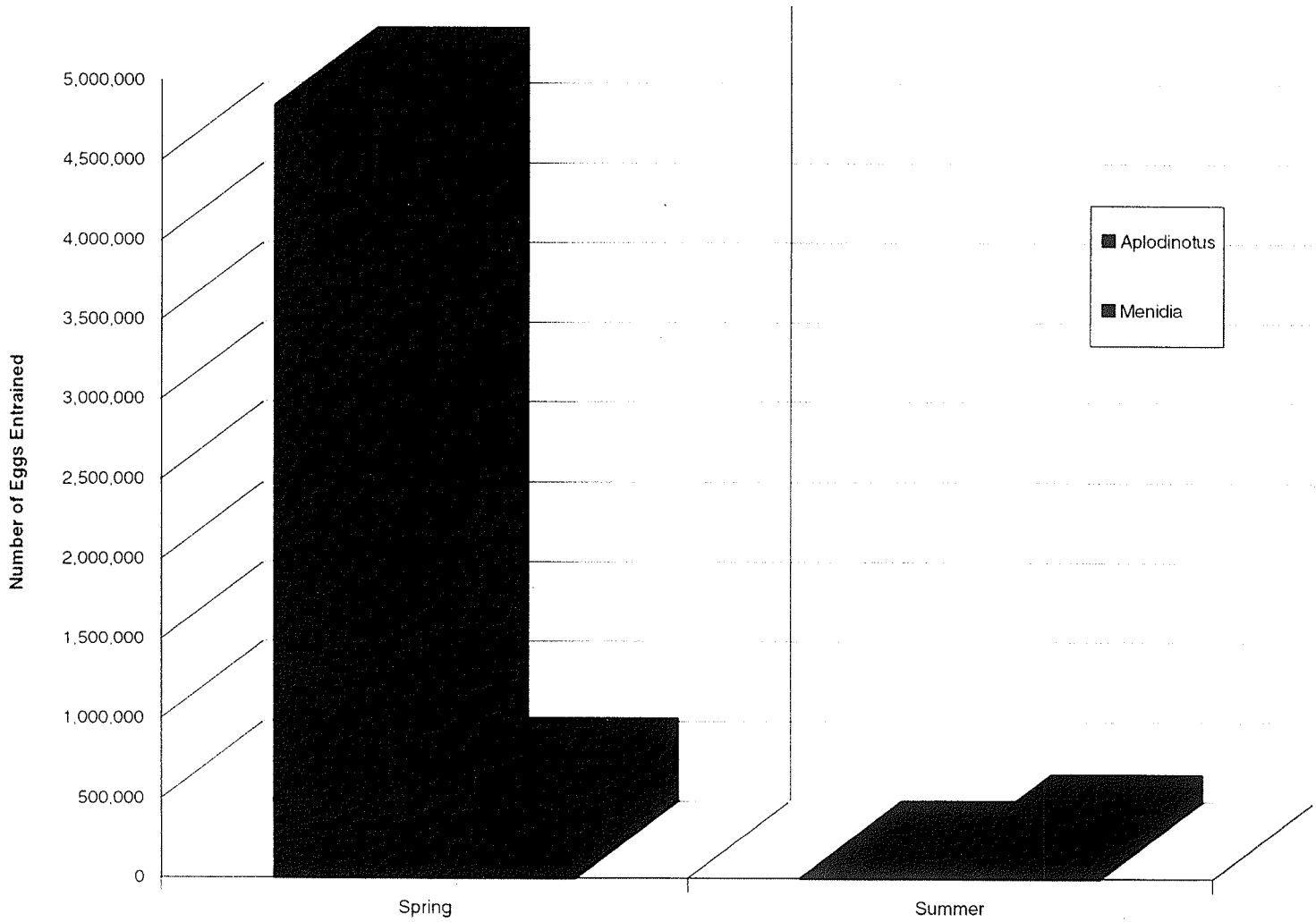
Note:
1. The period of Aug. 10-Aug. 30 represents 0.67 months or 21 days.

Figure 6-16. Monthly entrainment of RIS larvae/juveniles by CPSES Unit 2.



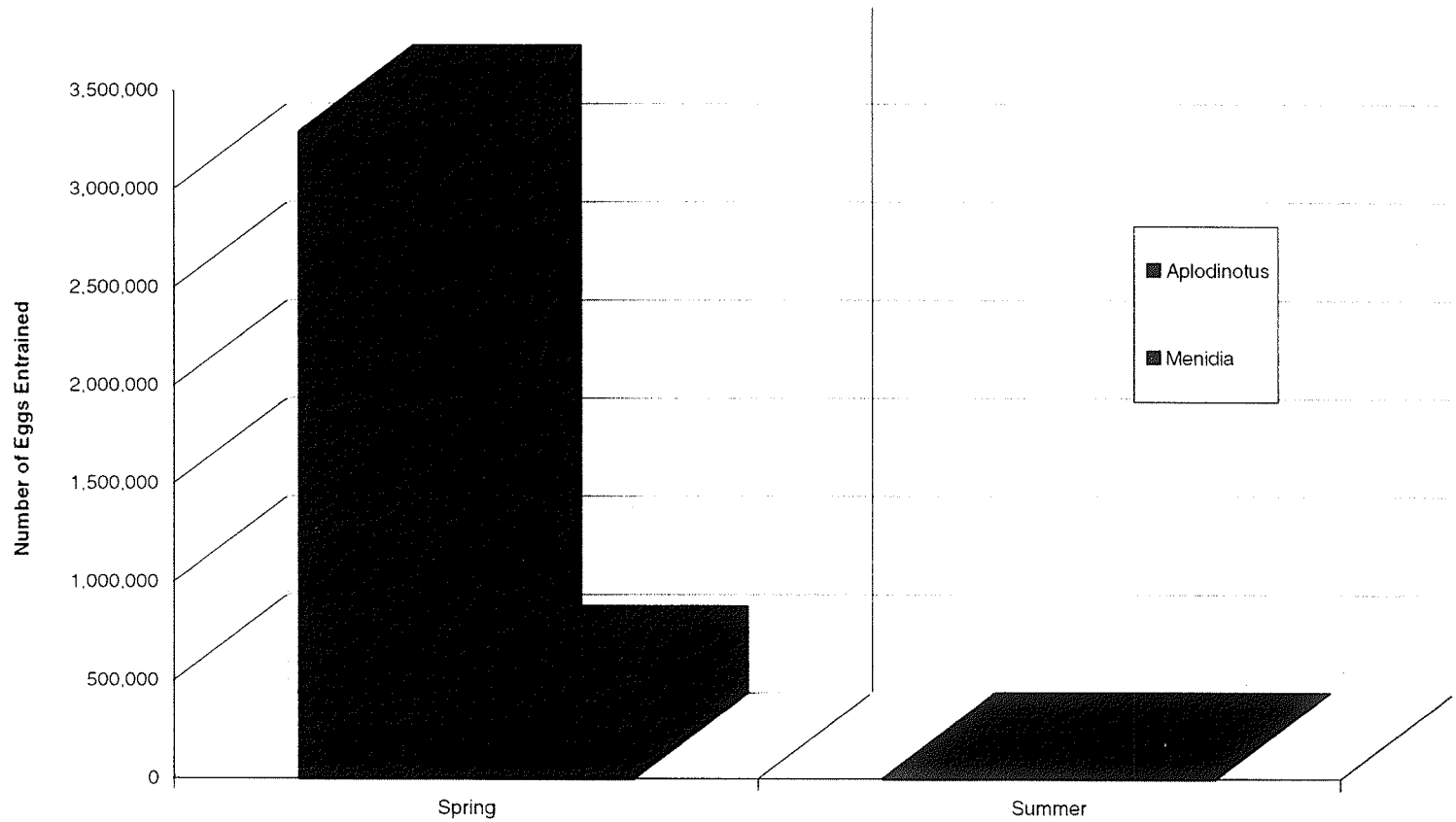
Note:
1. The period of Aug. 10 - Aug. 30 represents 0.67 months or 21 days.

Figure 6-17. Seasonal entrainment of RIS eggs by CPSES Unit 1.



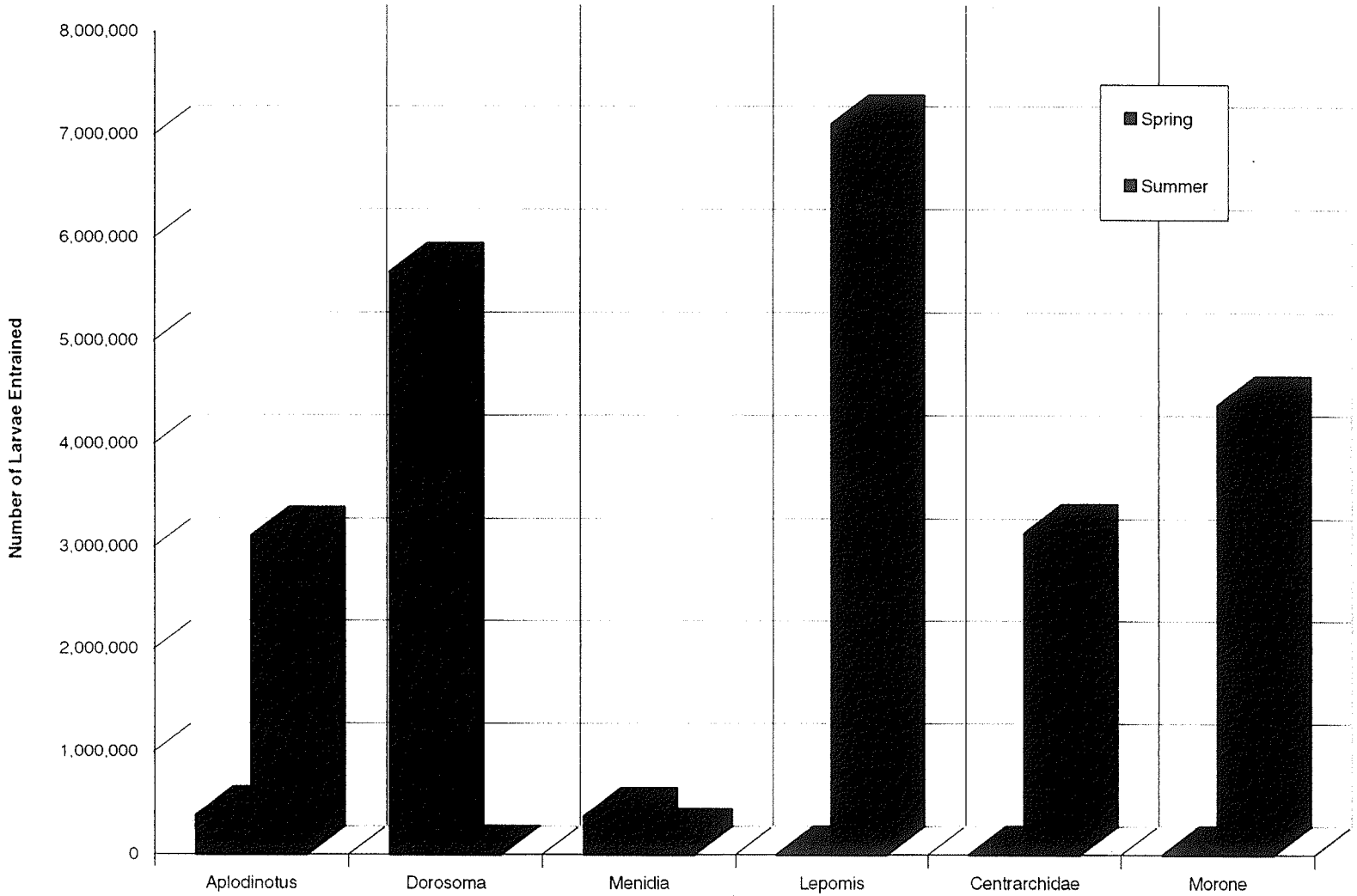
Note:
1. Spring period for April 6 through June 20.
2. Summer period for June 21 through August 30.

Figure 6-18. Seasonal entrainment of RIS eggs by CPSES Unit 2.



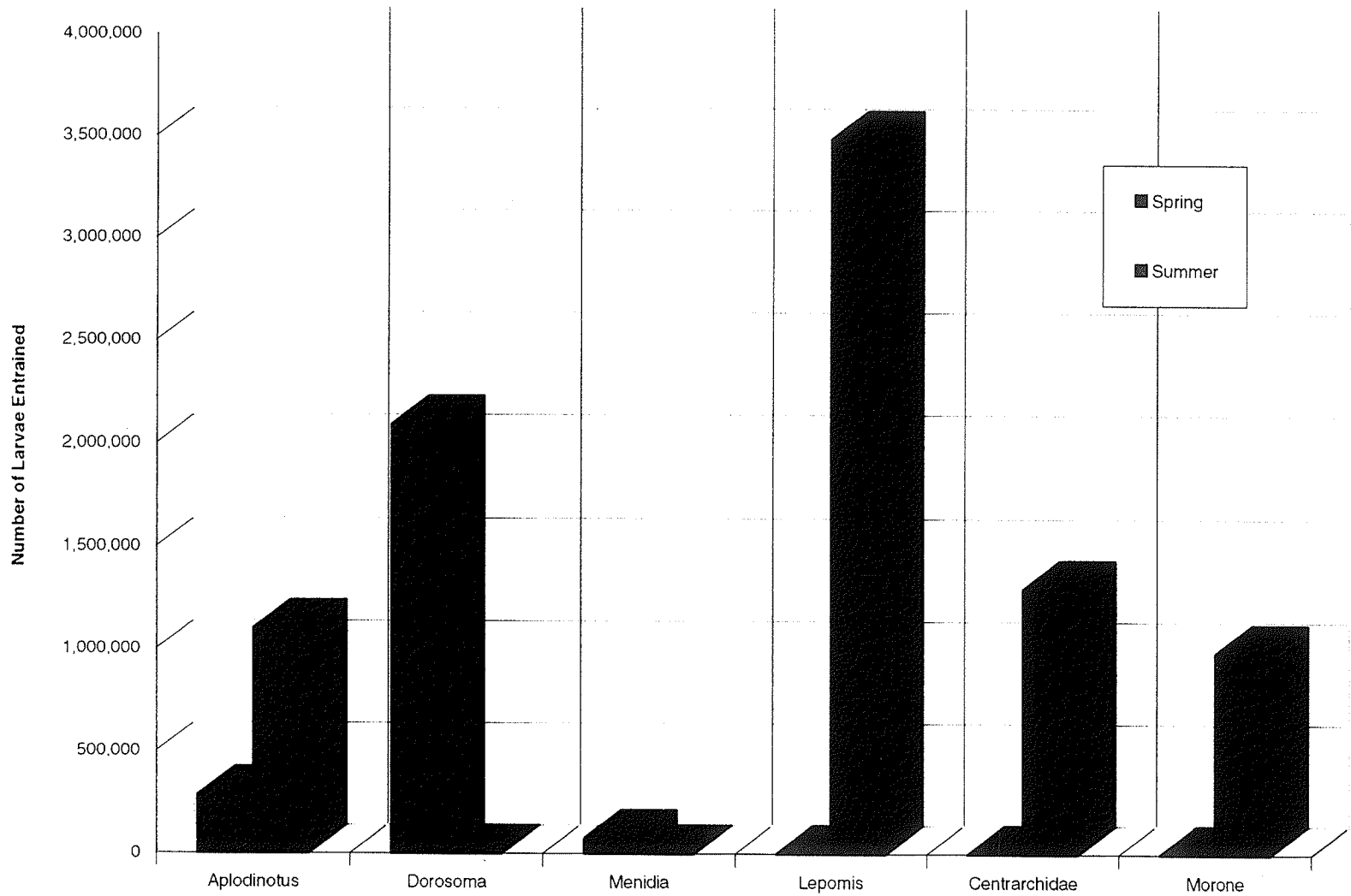
Note:
1. Speing period for April 6 through June 20.
2. Summer period for June 21 through August 30.

Figure 6-19. Seasonal entrainment of RIS larvae by CPSES Unit 1.

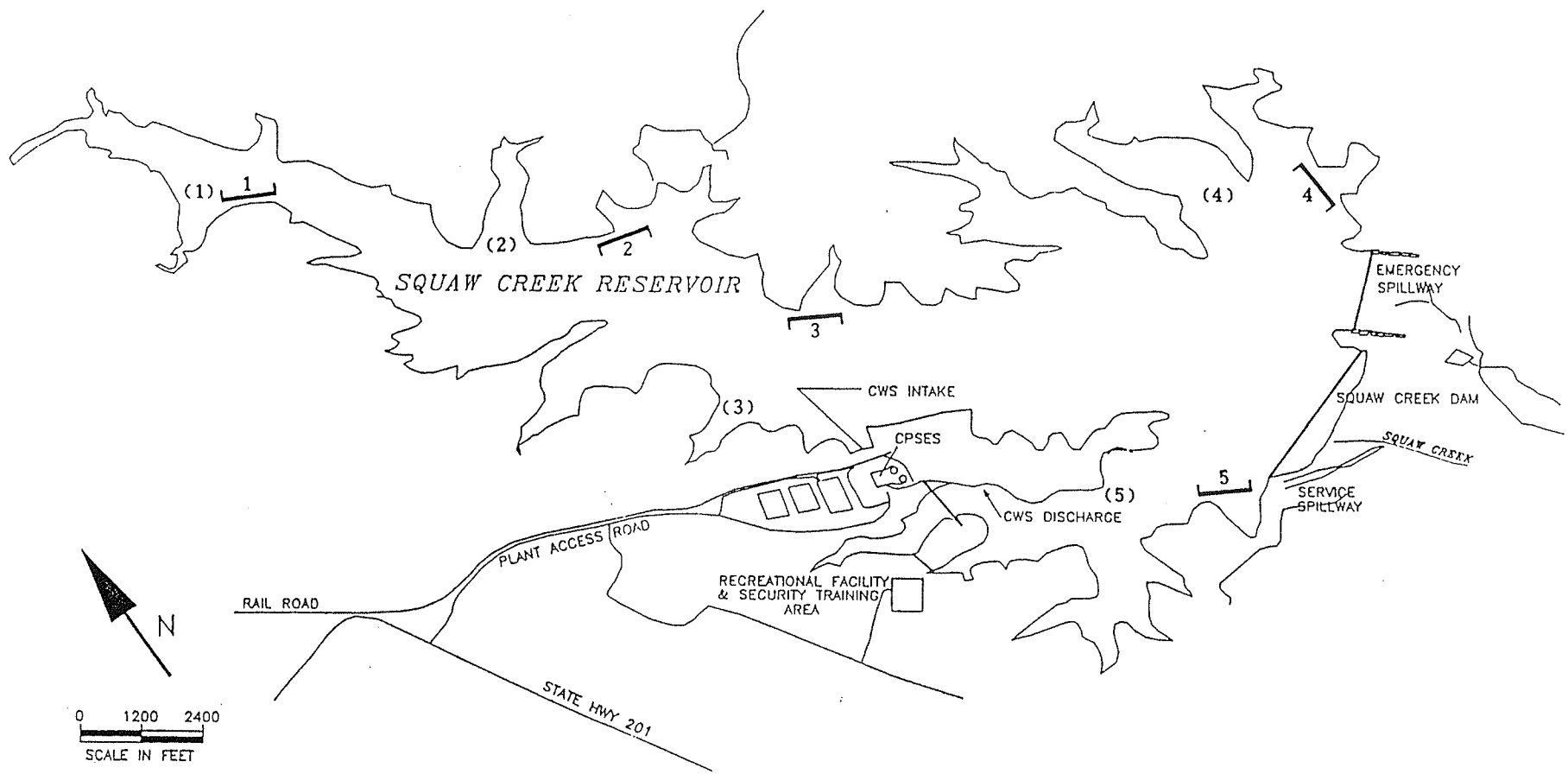


Note:
1. Spring period for April 6 through June 20.
2. Summer period for June 21 through August 30

Figure 6-20. Seasonal entrainment of RIS larvae by CPSES Unit 2.



Note:
1. Spring period for April 6 through June 20.
2. Summer period for June 21 through August 30.



(1) Gill nets

1 Electrofishing

TEXAS UTILITIES ELECTRIC COMPANY

COMANCHE PEAK 316 (b)

FIGURE 7-1

STUDIES FOR THE CPSES
316(b) DEMONSTRATION

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Figure 7-2. Relative abundance of fish collected by gill net from the SCR - November 1993

N = 198

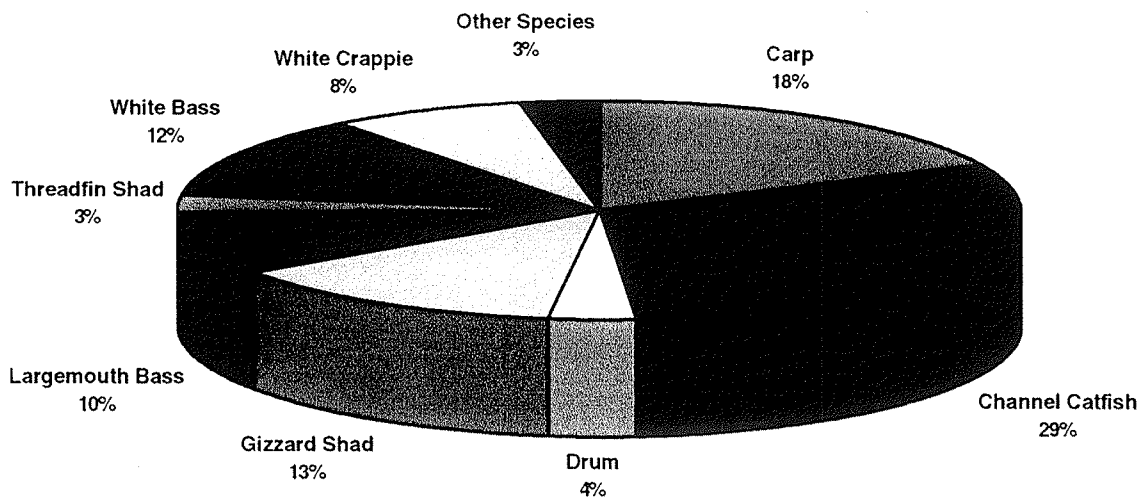
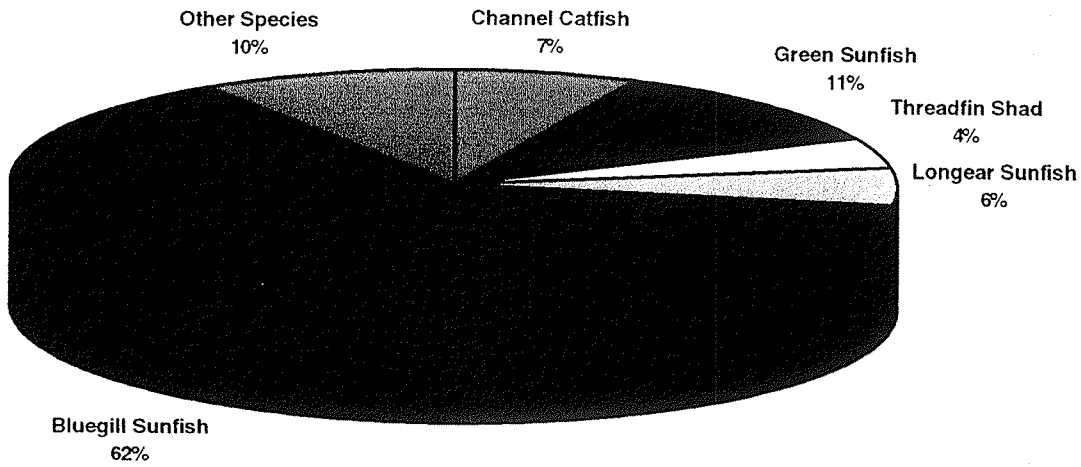


Figure 7-3. Relative abundance of fish collected by electroshocking from the SCR - November 1993

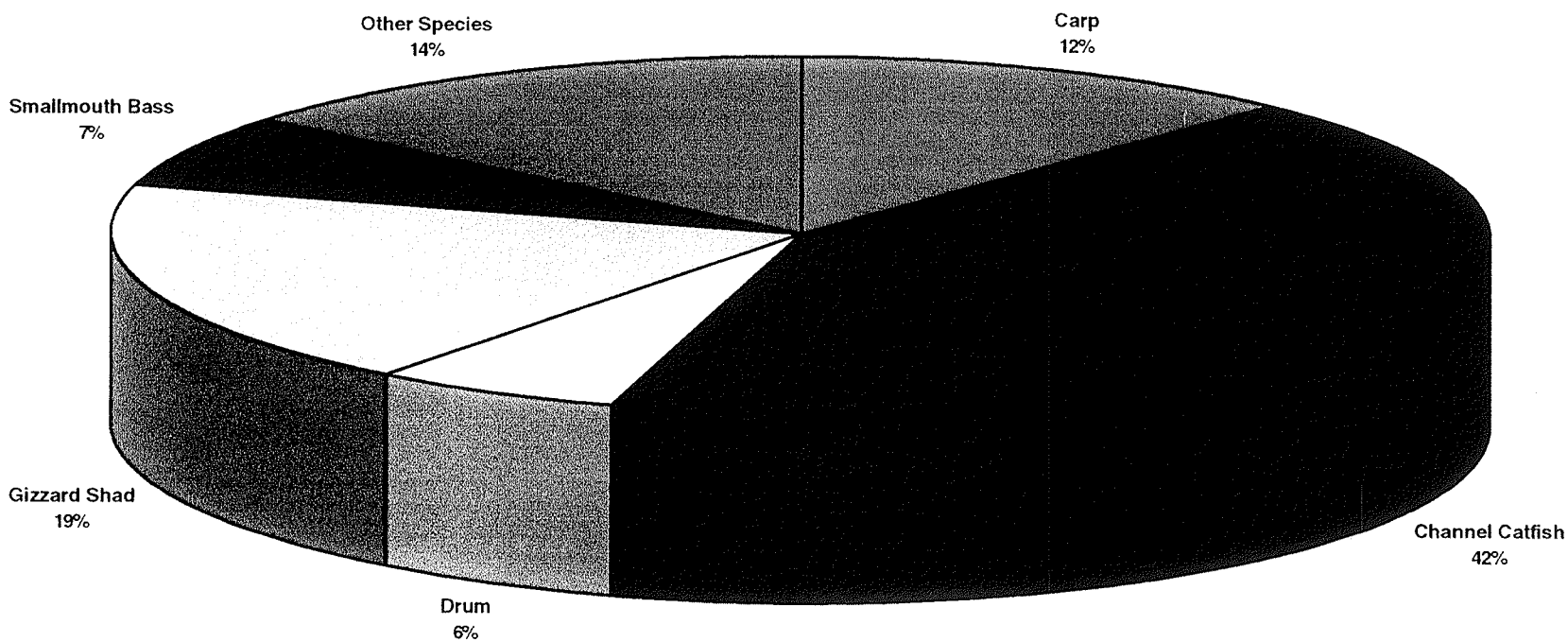
N = 199



Note : Other species is inclusive of carp, gizzard shad, largemouth bass, inland silverside, and b. shiner.

Figure 7-4. Relative abundance of fish collected by gill net from the SCR - June 1994

N = 149



Note: Other species is inclusive of largemouth bass, threadfin shad, white bass, white crappie, blacktail shiner, and bluegill sunfish.

Figure 7-5. Relative abundance of fish collected by electroshocking from the SCR - June 1994

N = 468

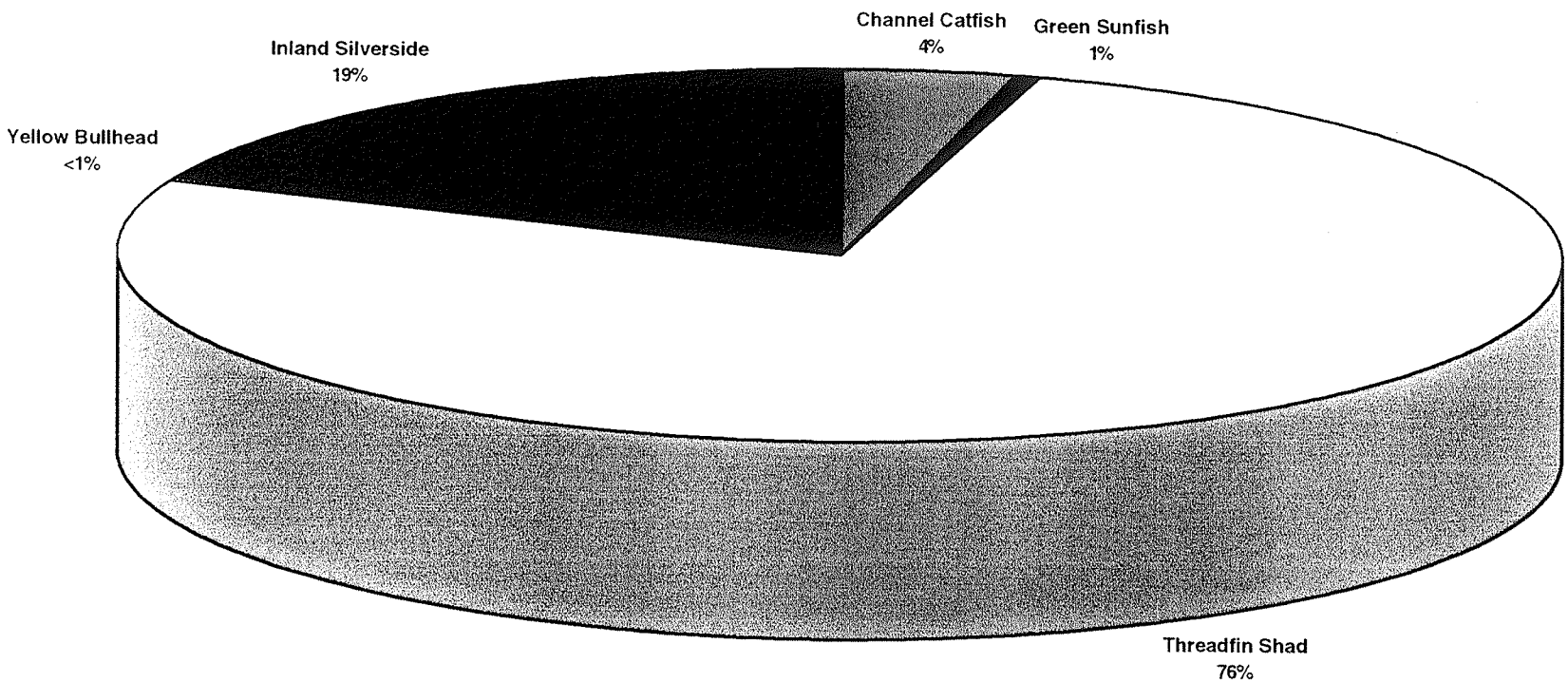
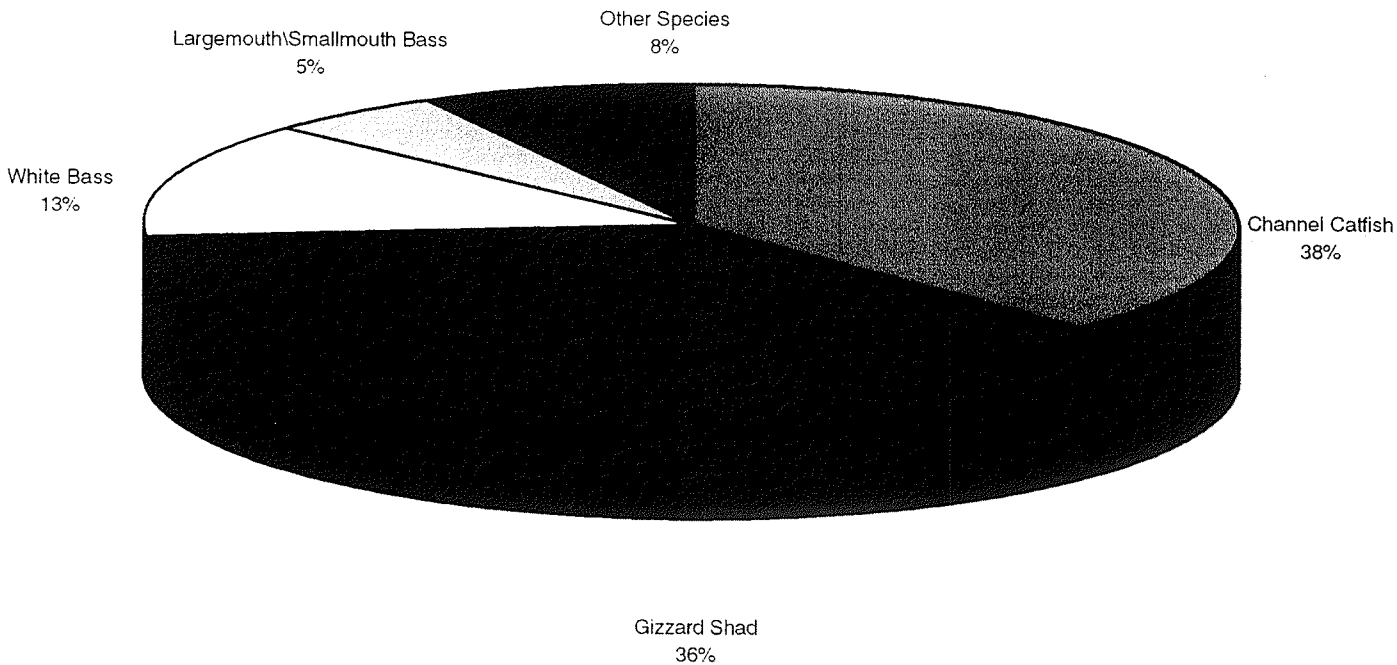


Figure 7-6. Relative abundance of fish collected by gill net from the SCR - Feb. 1995.

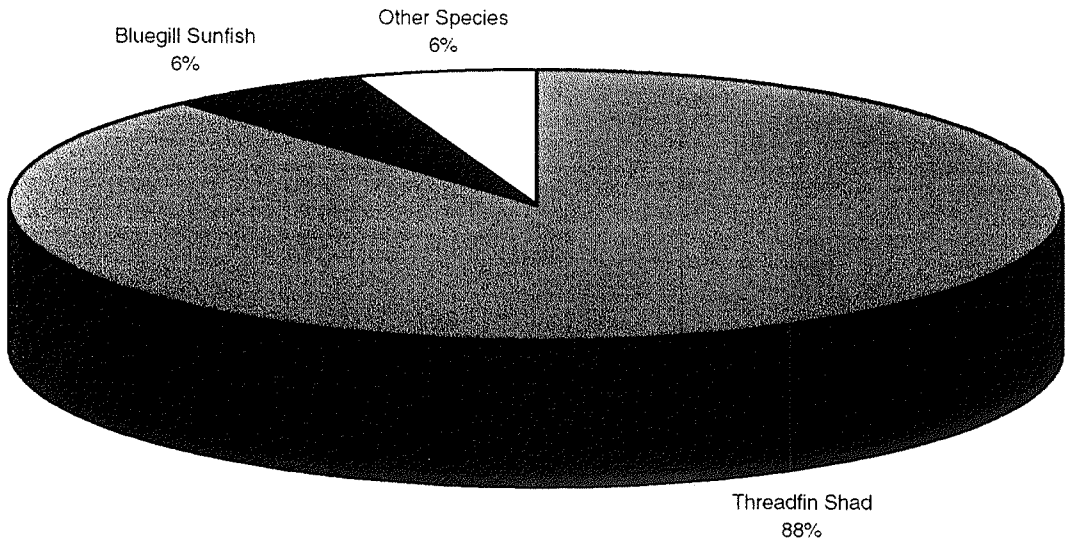
N = 187



Note: The other species category includes bluegill sunfish, carp, f.w. drum, threadfin shad, black and white crappie.

Figure 7-7. Relative abundance of fish collected by electrofishing from the SCR - Feb. 1995.

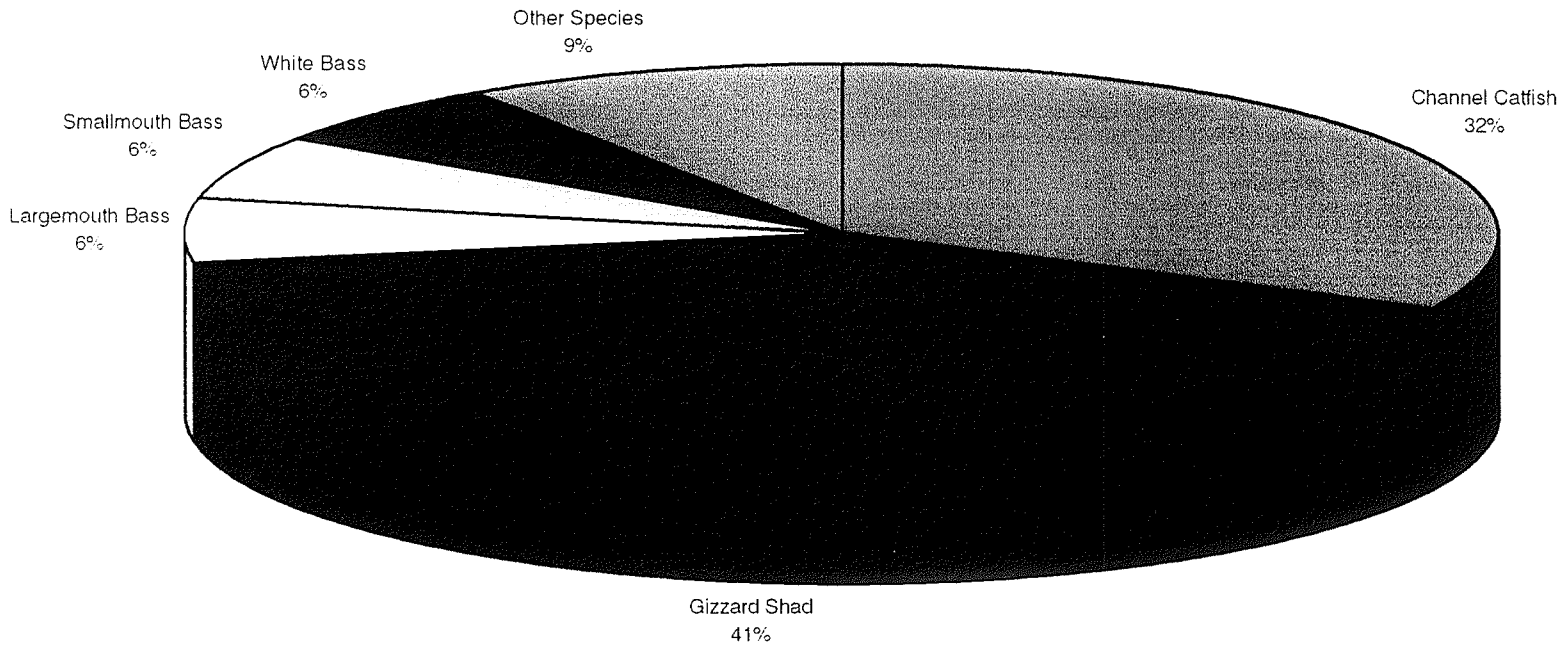
N = 264



Note: The other species category includes gizzard shad, carp, green sunfish, channel catfish, inland silverside and golden shiner.

Figure 7-8. Relative abundance of fish collected by gill net from the SCR - June 1995.

N = 180



Note: The other species category includes f.w. drum, threadfin shad, carp, bluegill sunfish, redbreast sunfish, green sunfish, blacktail shiner and blue catfish.

Figure 7-9. Relative abundance of fish collected by electroshocking from the SCR - June 1995.

N = 35

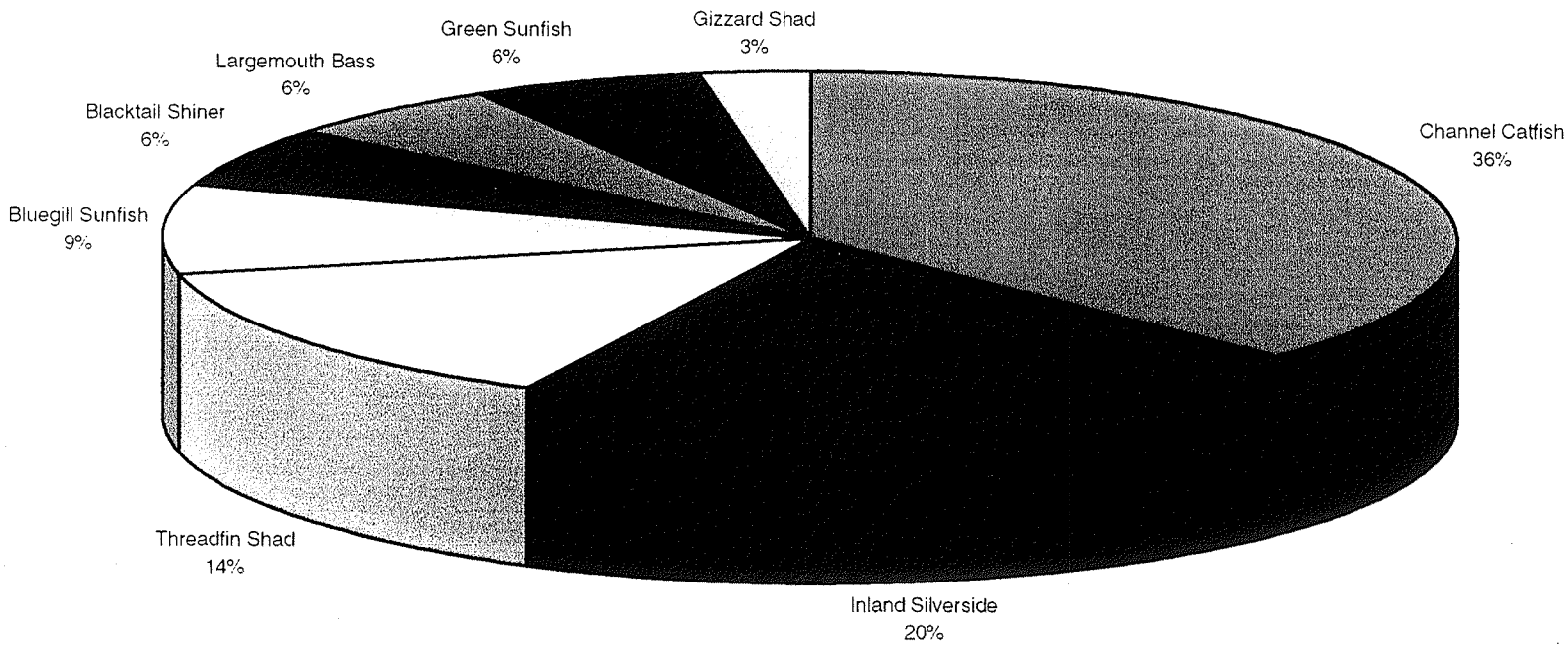
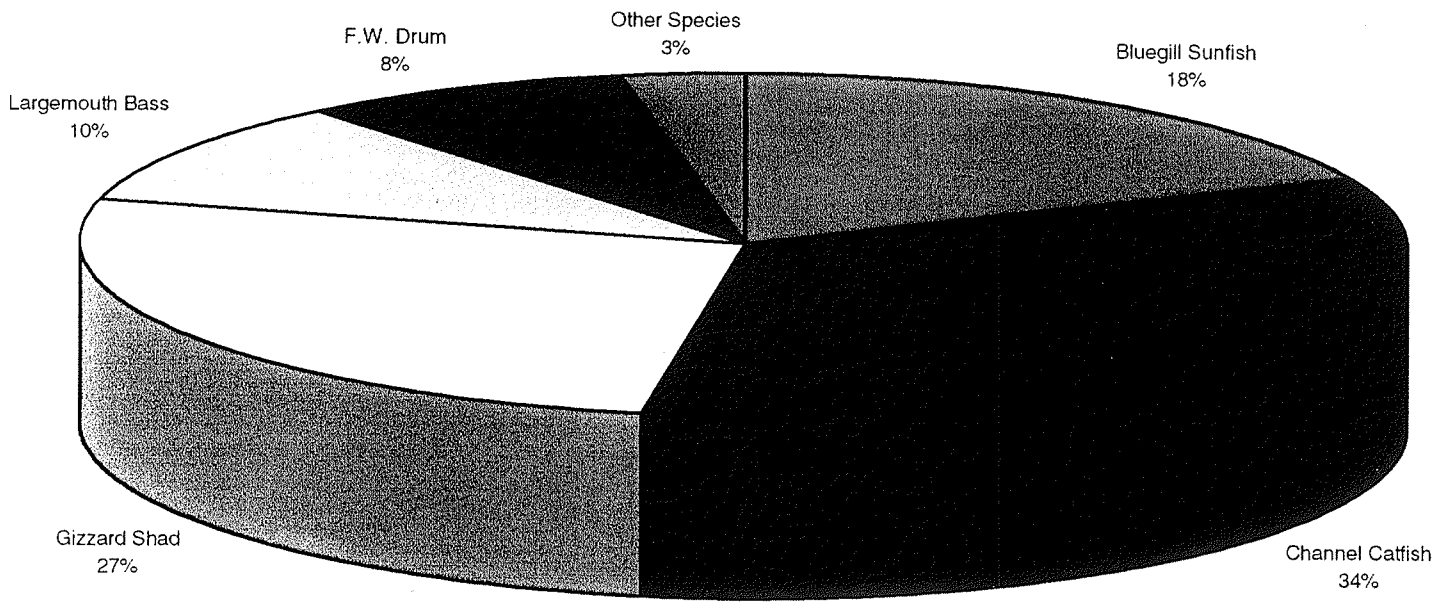


Figure 7-10. Relative abundance of fish collected by gill net from SCR - August 1995.

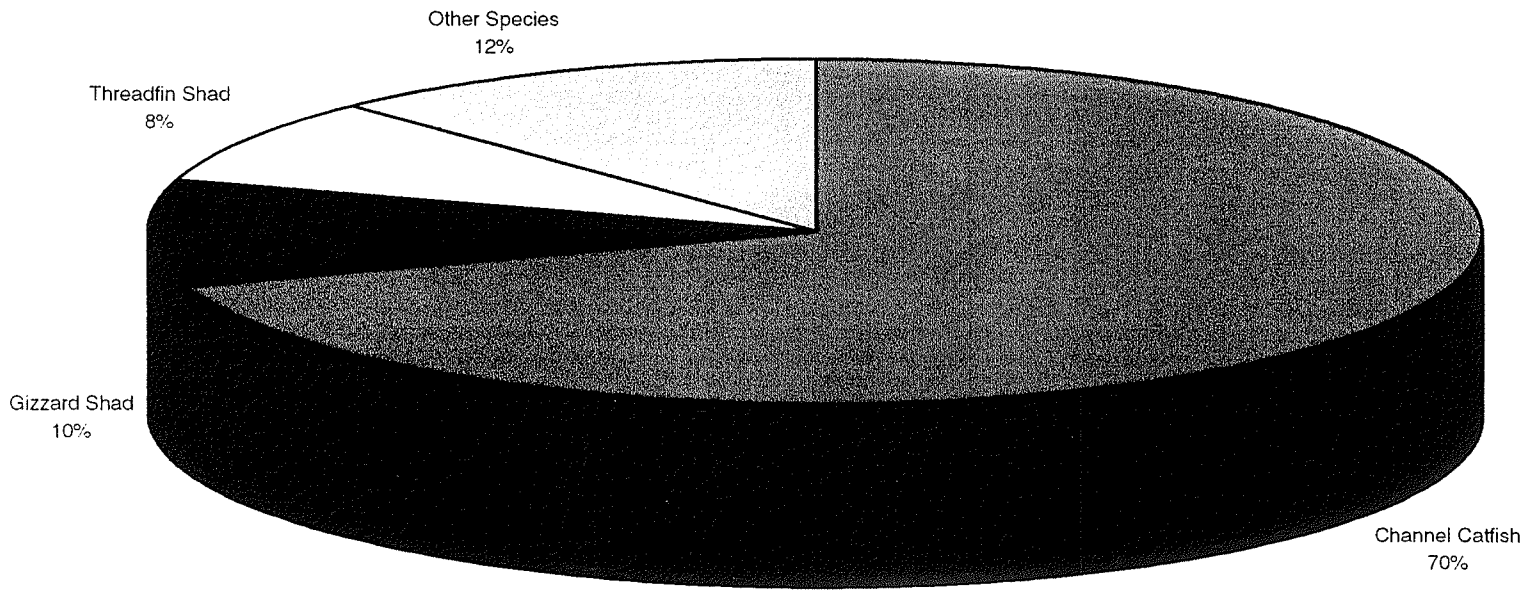
N = 252



Note: The other species category includes white bass, smallmouth bass, flathead catfish, blue catfish and carp.

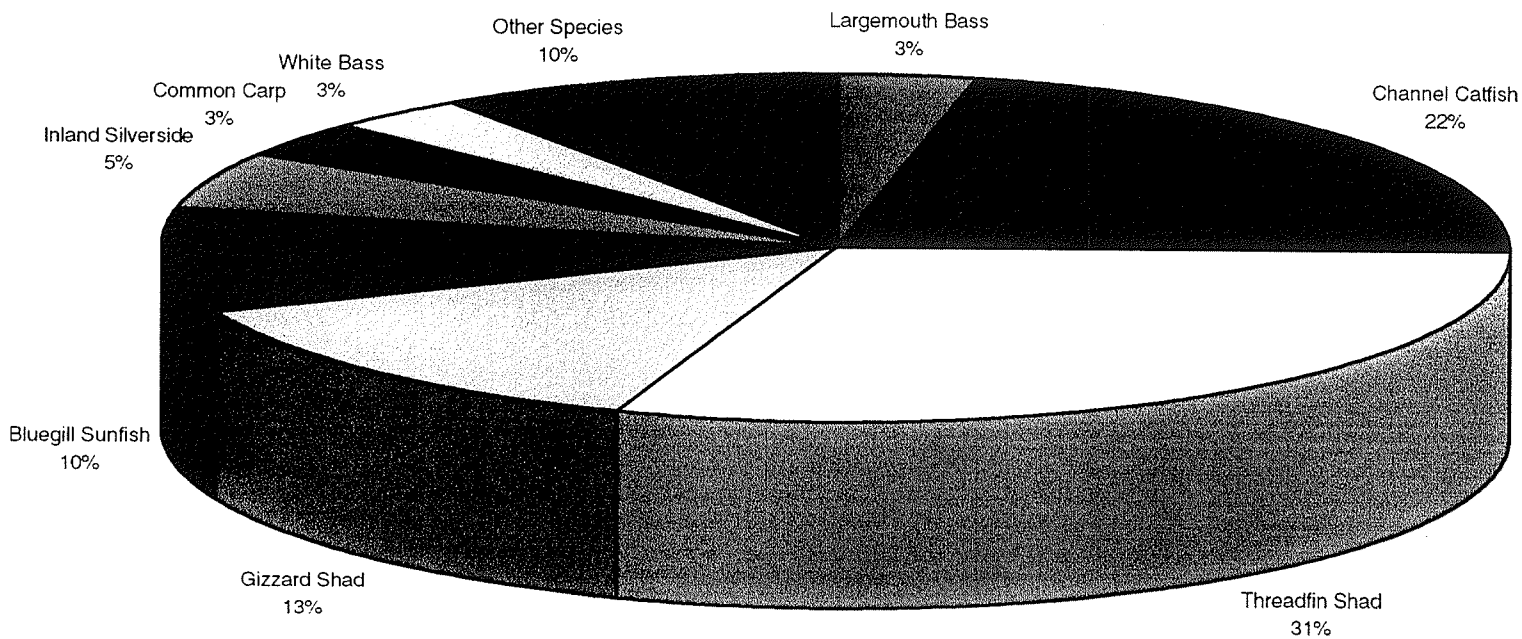
Figure 7-11. Relative abundance of fish collected by electroshocking from SCR - August 1995.

N = 89



Note: The other species category includes yellow bullhead, bluegill sunfish, inland silverside, green sunfish and redbreast sunfish.

Figure 7-12. Overall percent abundance of dominant fish species as collected by both sampling methods (gill net and electroshocking) in SCR.
N = 2,039



Note: The "other species" category includes eleven other species as identified from Table 7-1.

Figure 7-13. Length frequency distribution of largemouth bass collected from SCR (N= 73).

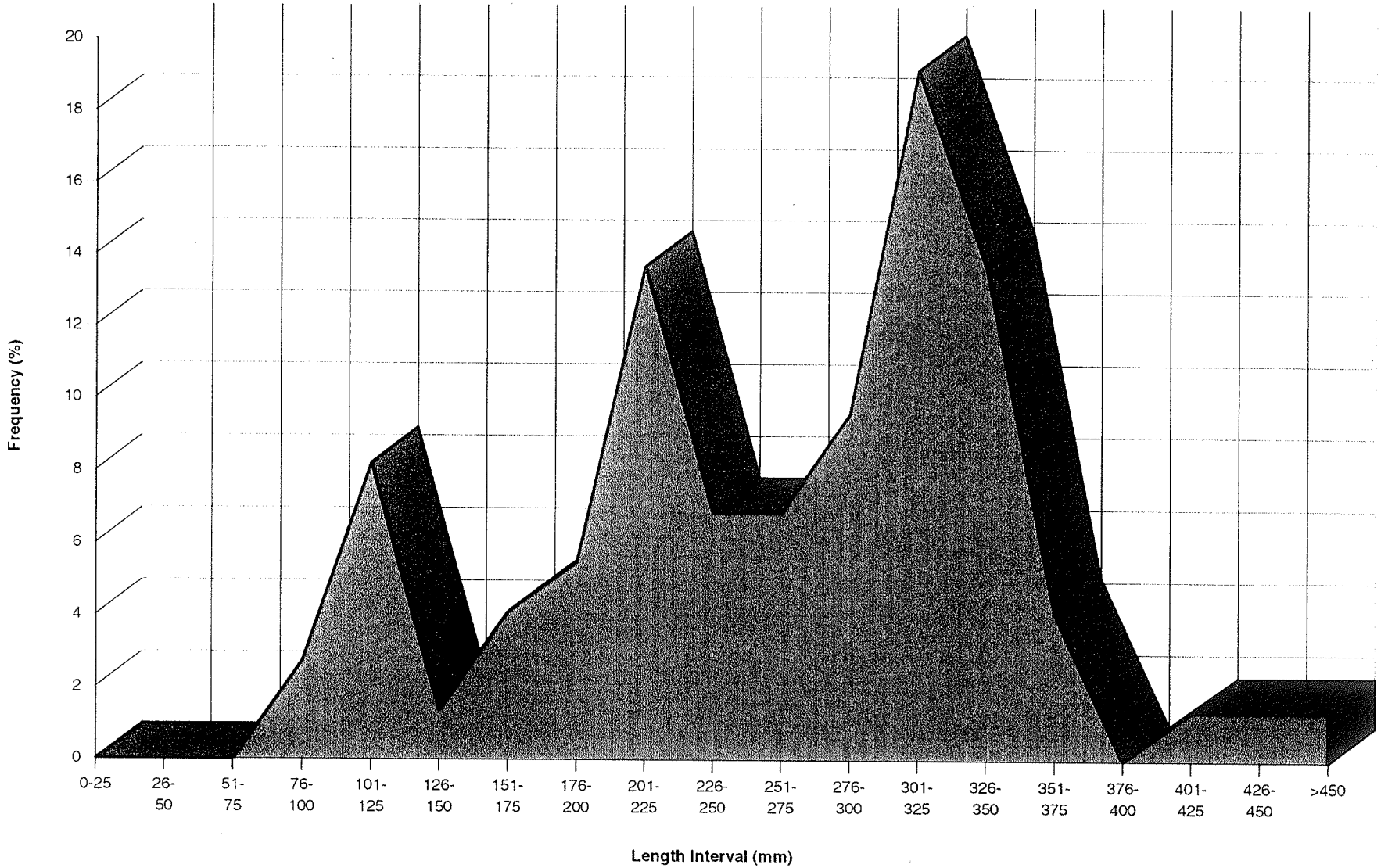


Figure 7-14. Length frequency distribution of freshwater drum collected from SCR (N=42).

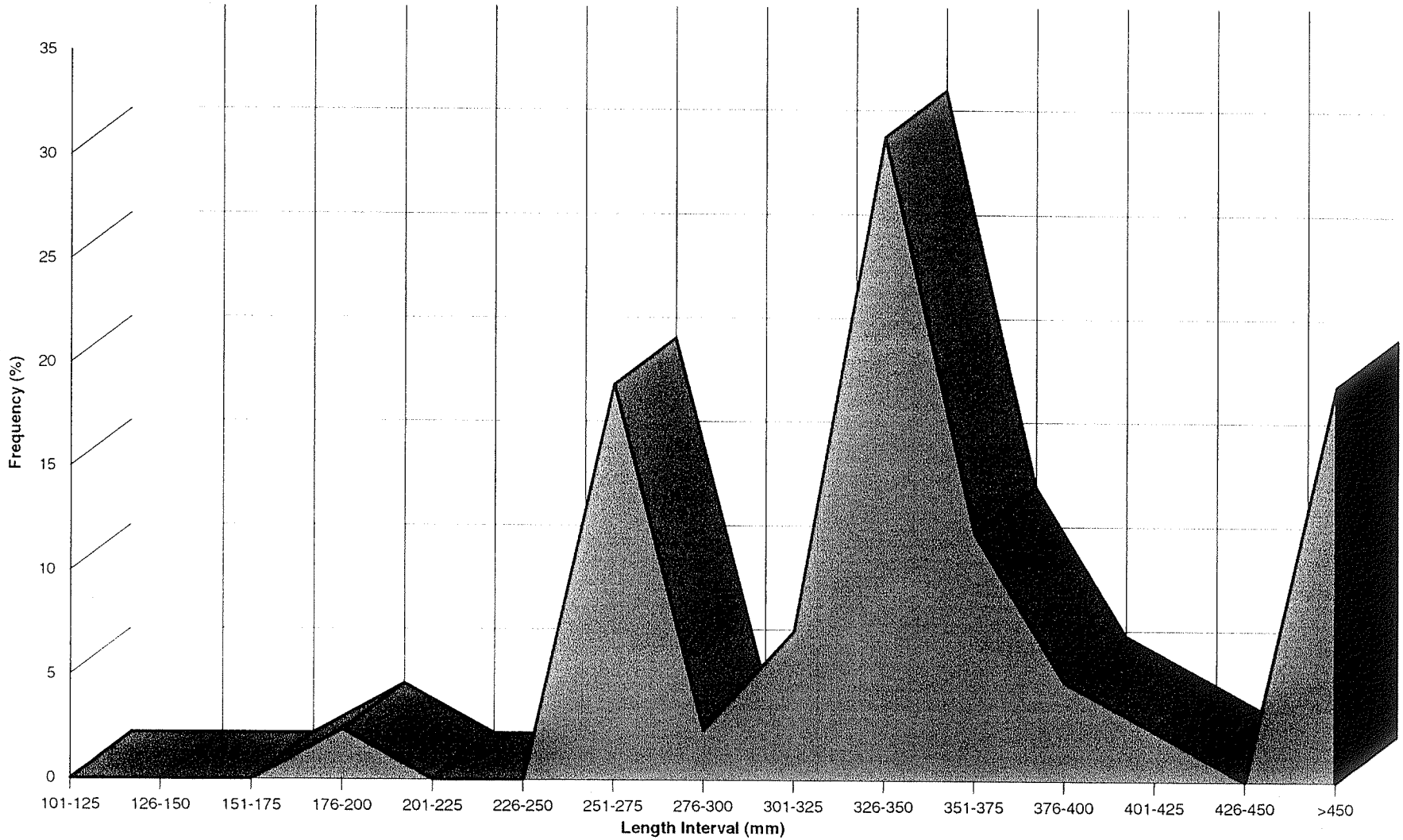
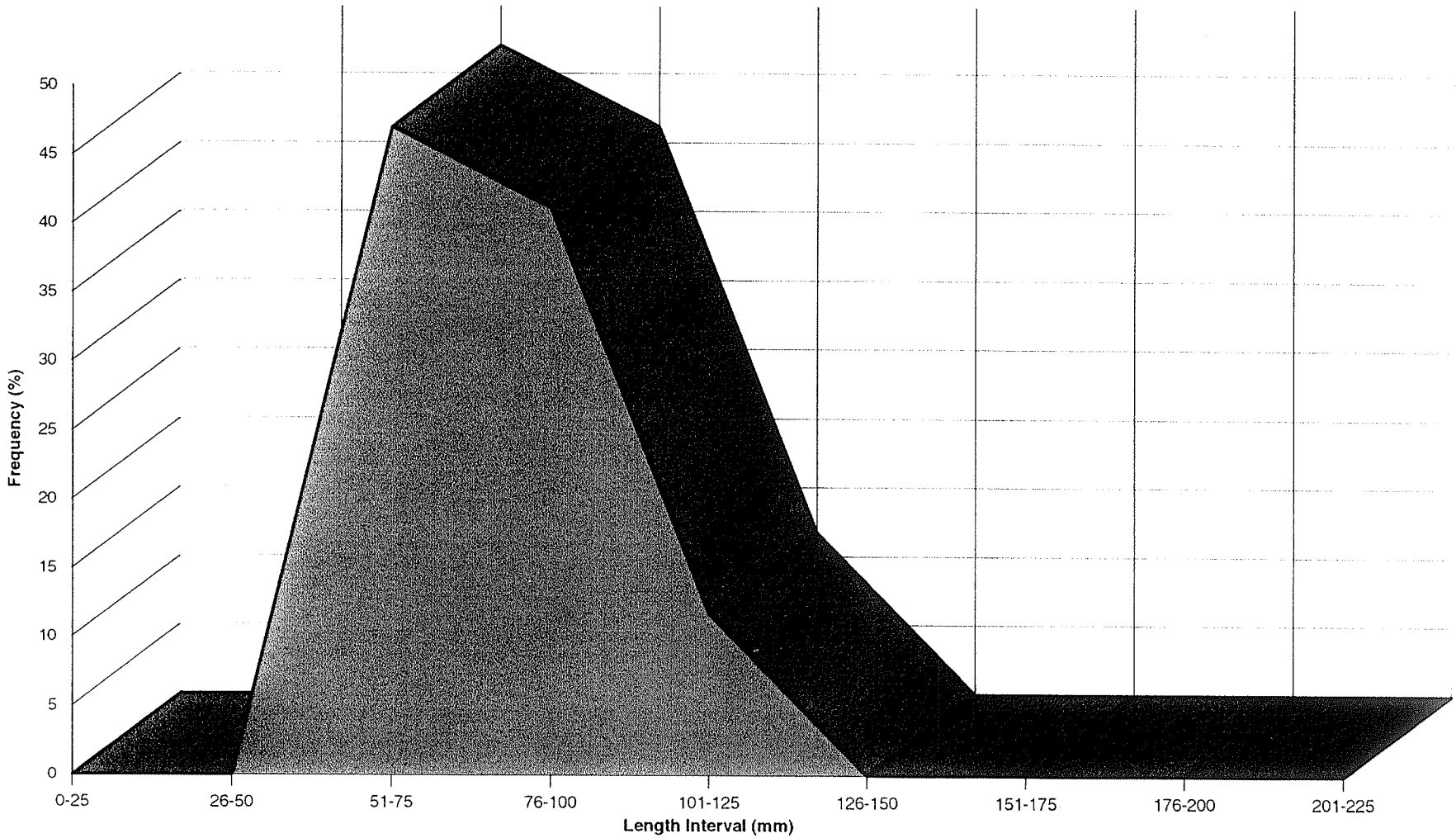
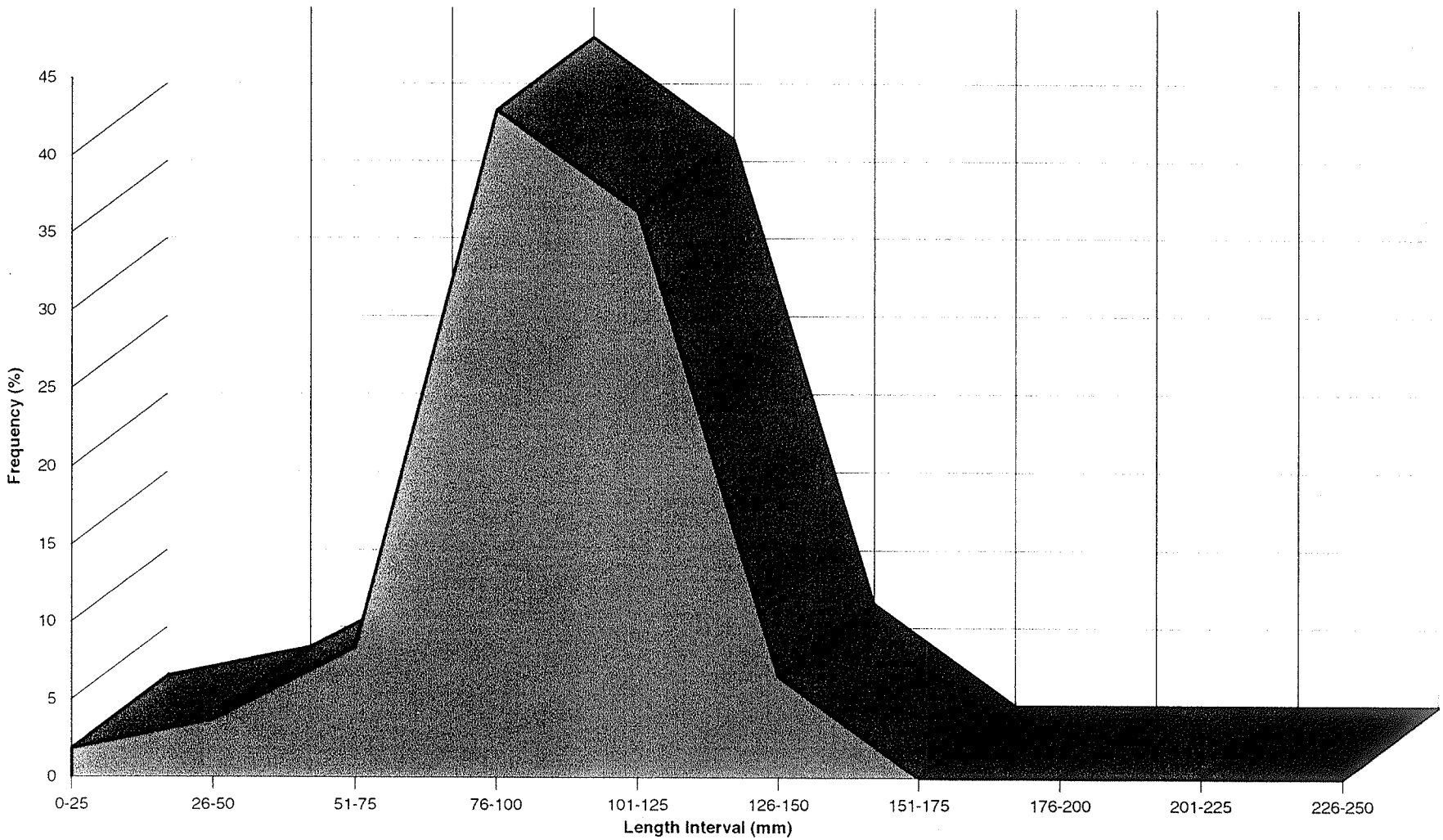


Figure 7-15. Length frequency* distribution of inland silverside collected from SCR (N=17).



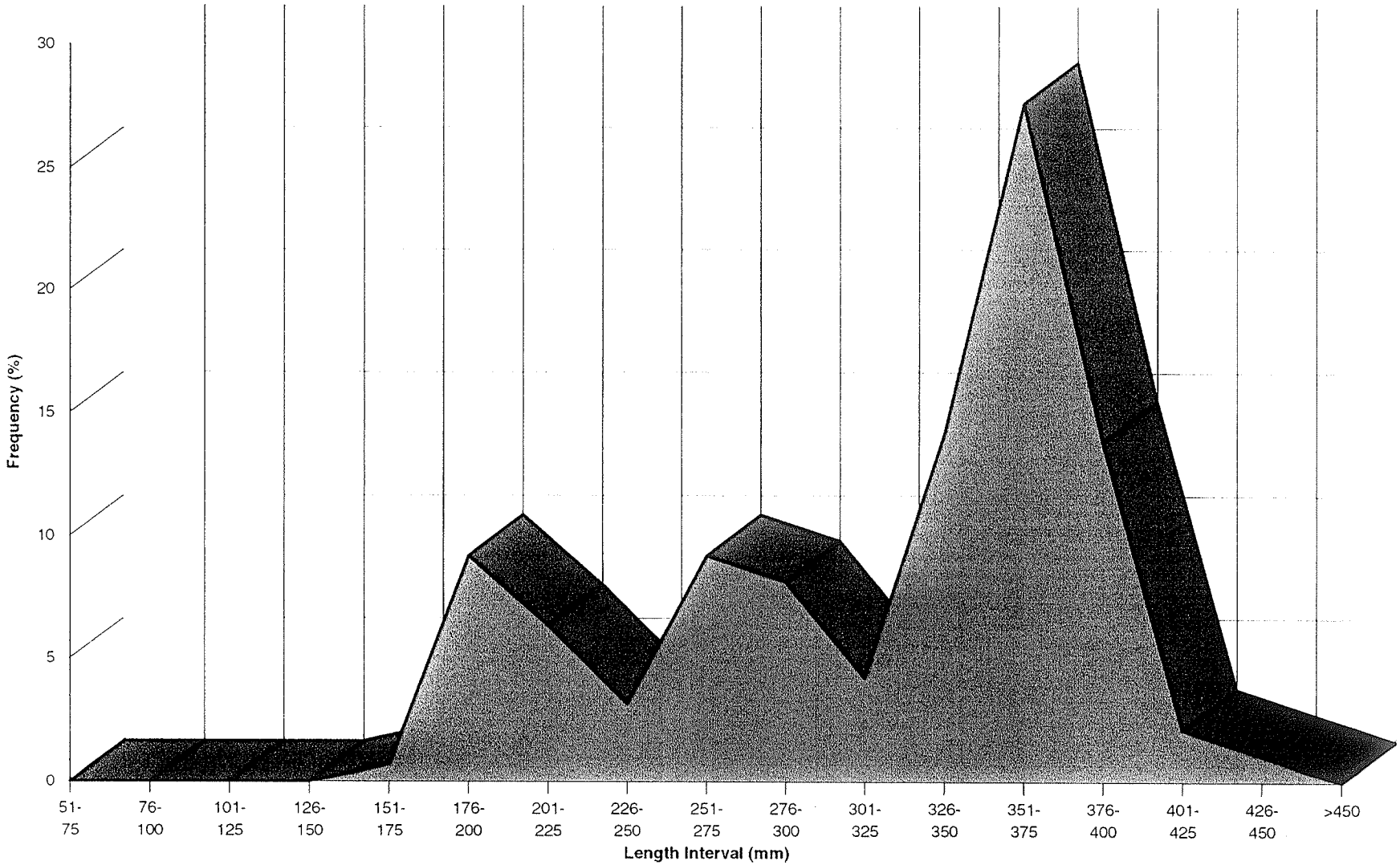
* Data does not include mean lengths from subsampled individuals.

Figure 7-16. Length frequency* distribution of threadfin shad collected from SCR (N=107).



* Data does not include mean lengths from subsampled individuals.

Figure 7-17. Length frequency* distribution of gizzard shad collected from SCR (N=282).



* Data does not include mean lengths from subsampled individuals.

Figure 7-18. Length frequency distribution of white bass collected from SCR (N=69).

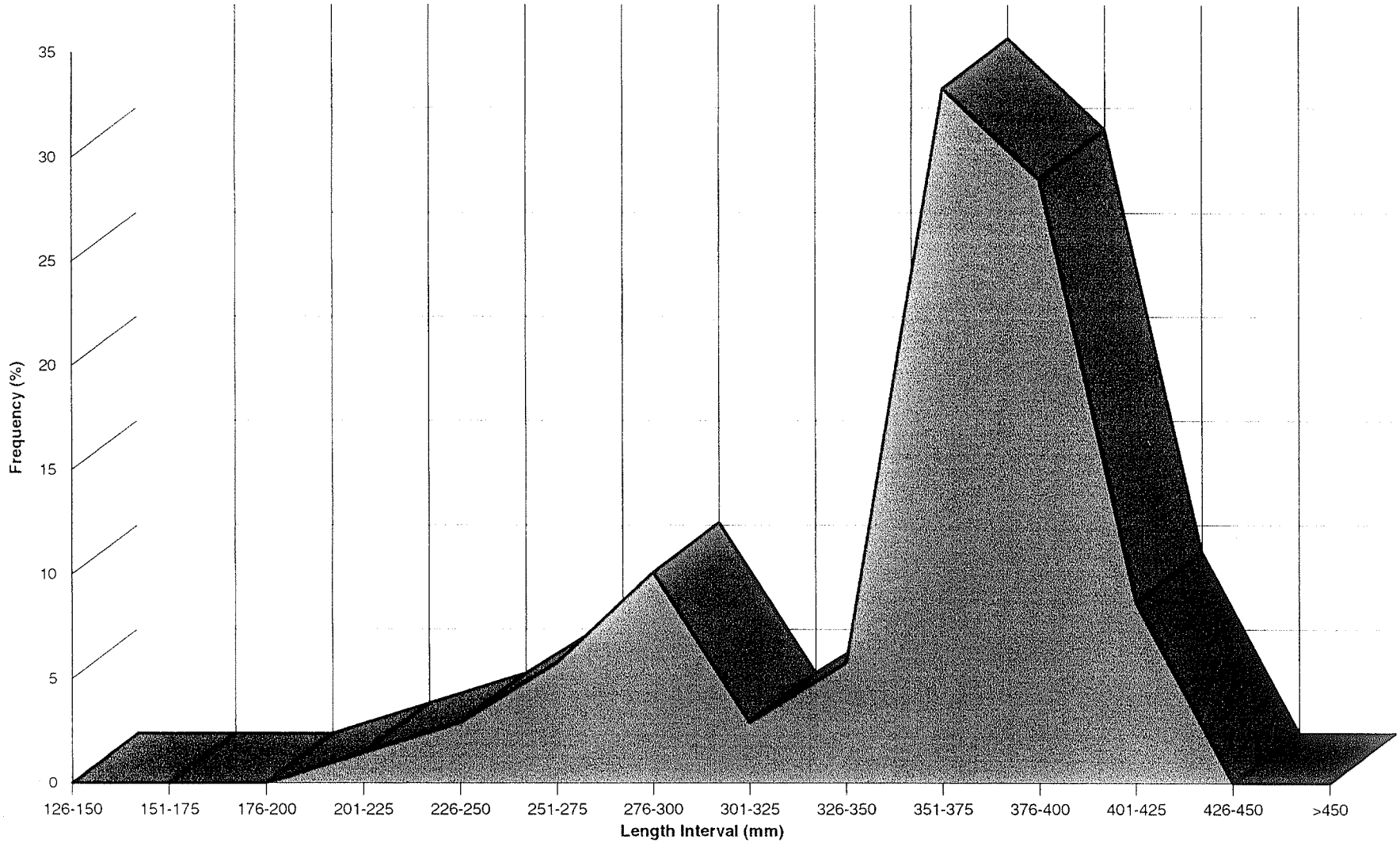


Figure 7-19. Length frequency distribution of channel catfish collected from SCR (N = 424).

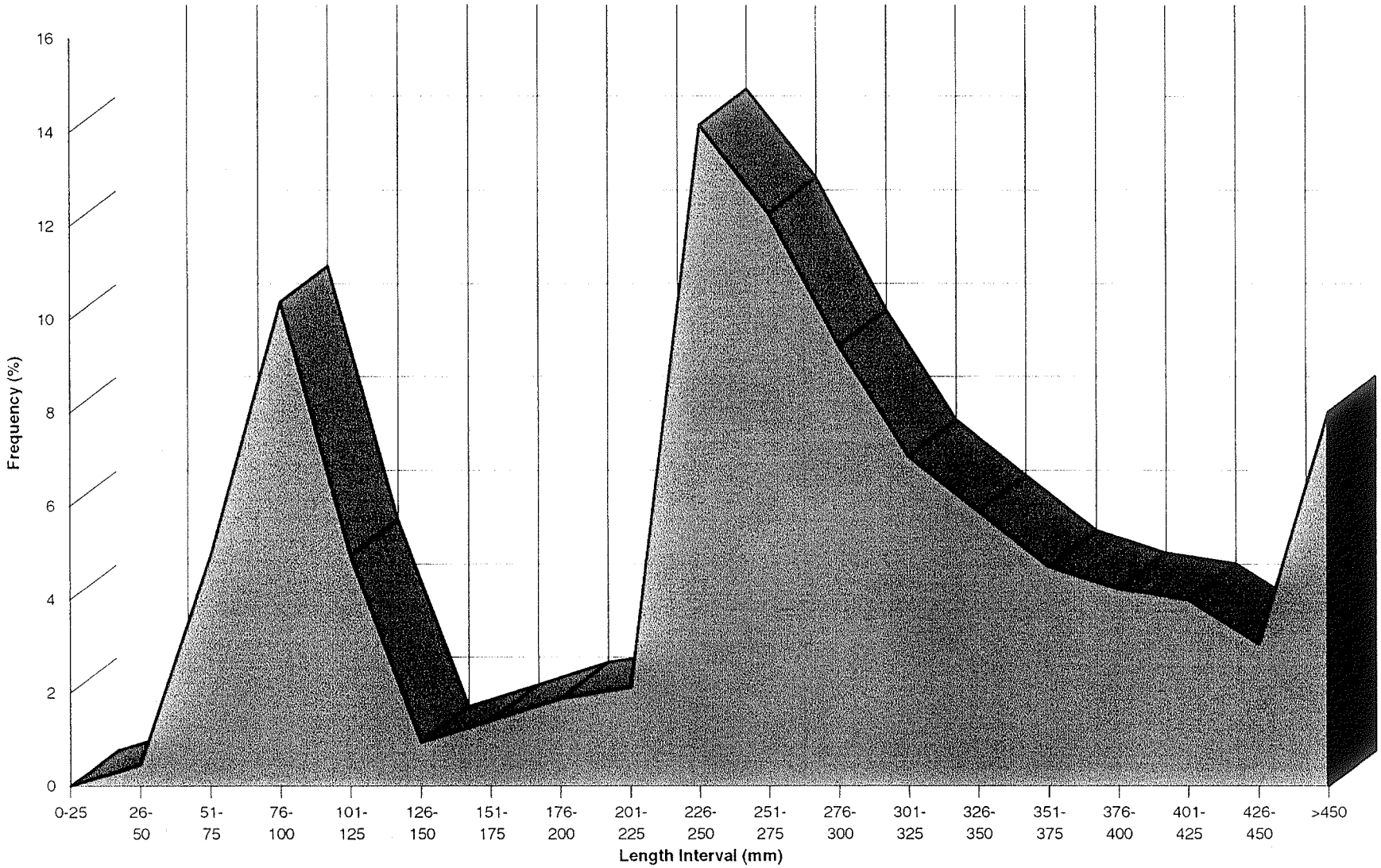
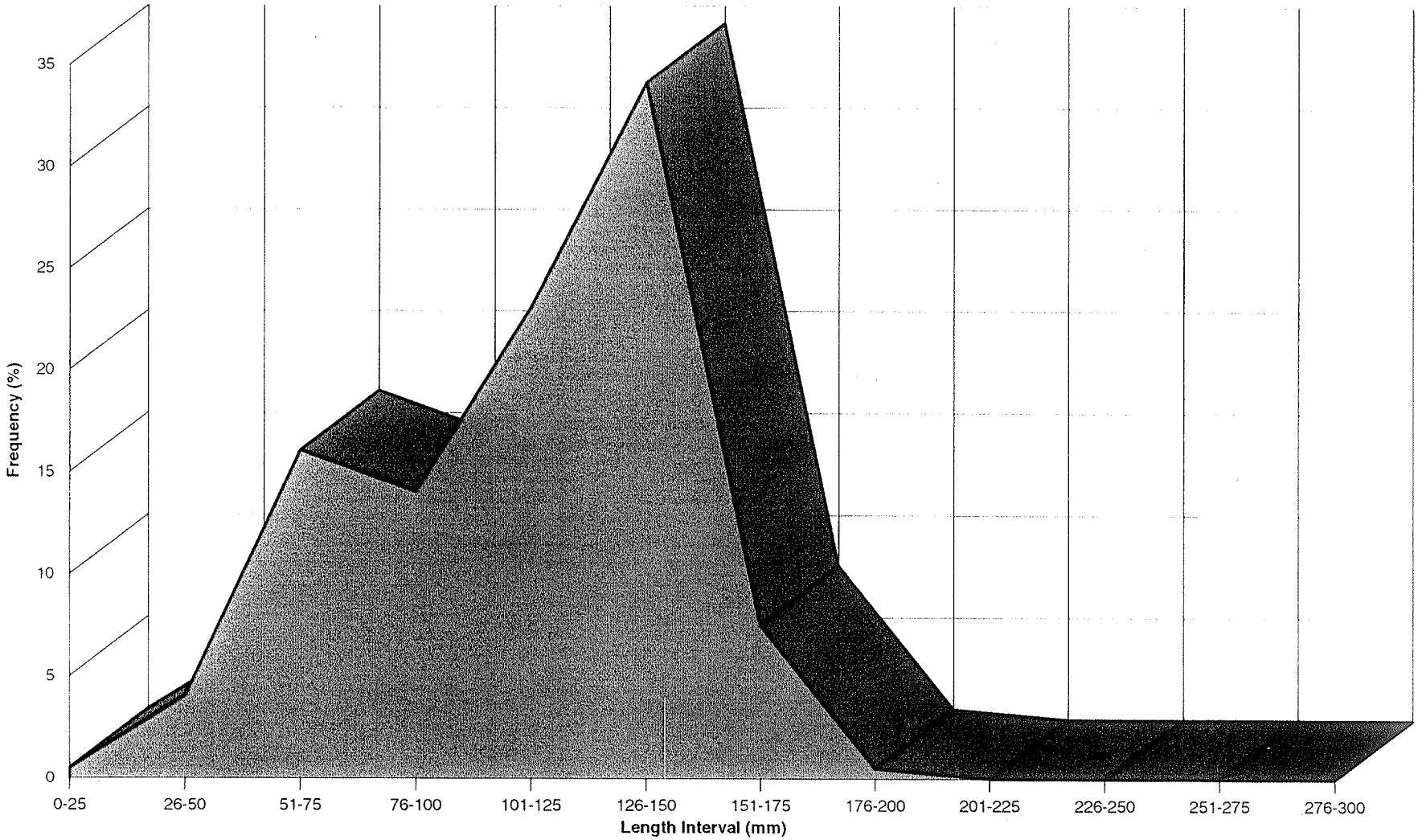


Figure 7-20. Length frequency distribution of bluegill sunfish collected from SCR (N=199).



APPENDIX A

Comanche Peak Steam Electric Station NPDES Permit

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

September 30, 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED (P 239 546 240)

REPLY TO: 6W-PS

Mr. William J. Cahill, Jr.
Group Vice President, Nuclear
Texas Utilities Electric Company
400 N. Olive Street, LB 81
Dallas, TX 75201

RECEIVED
OCT 03 1994
C. L. TERRY

Re: NPDES Permit No. TX0065854
Public Notice of Final Permit Decision

Dear Mr. Cahill:

Enclosed is the public notice of the Agency's final permit decision, a copy of our response to comments, and the final permit. For administrative purposes, the permit is to become effective on November 1, 1994, following regulations at 40 CFR Part 124.15(b)(1). This public notice describes any substantial changes from the draft permit.

Should you have any questions regarding the final permit, please feel free to contact Fred Humke of the Permits Branch at (214) 655-7503, FAX (214) 655-6490. Should you have any questions regarding compliance with the conditions of this permit, please contact the Enforcement Branch at (214) 655-6450.

Sincerely yours,

Myron O. Knudson, P.E.
Director
Water Management Division (6W)

Enclosures

cc (w/enclosures): Texas Natural Resource Conservation Commission

U.S. Environmental Protection Agency - Region 6
Public Notice of Final Permit Decision

SEPTEMBER 30, 1994

This is to give notice that the U.S. Environmental Protection Agency, Region 6, has made a final permit decision and will issue the following Proposed Permit(s) under the National Pollutant Discharge Elimination System. The permit(s) will become effective 30 days from the date of this Public Notice. Any substantial changes from the Draft Permit are cited.

This issuance is based on a final staff review of the administrative record and comments received. A Response to Comments is available by writing to:

Ms. Ellen Caldwell
Permits Branch (6W-PS)
U.S. Environmental Protection Agency, Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 655-7513

Any person may request an Evidentiary Hearing on this final permit decision. However, the request must be submitted within 30 days from the date of this Notice. The request should be in accordance with the requirements of 40 CFR 124.74 (Federal Register Vol. 45, No. 98, Monday, May 19, 1980). The original public notice contains the stay provisions of a granted evidentiary hearing request.

Within 30 days after service of an initial decision, or a denial in whole or in part of a request for an evidentiary hearing, any person may file an appeal in accordance with the requirements of 40 CFR 124.91. Submissions may be mailed to: U.S. Environmental Protection Agency, Environmental Appeals Board (MC-1103B), 401 M Street, SW, Washington, D.C. 20460. Hand-delivered submissions may be made at: U.S. Environmental Protection Agency, Environmental Appeals Board, Westory Building, 607 14th Street, NW, Suite 500, Washington, D.C. 20005.

Further information including the administrative record may be viewed at the above address between 8 a.m. and 4:30 p.m., Monday through Friday.

AUTHORIZATION TO DISCHARGE TO WATERS OF THE UNITED STATES,
NPDES PERMIT NO. TX0065854

The applicant's mailing address is:

Texas Utilities Electric Company
400 N. Olive Street, L.B. 81
Dallas, Texas 75201

The discharge from this existing source is made into Squaw Creek Reservoir, thence to Squaw Creek, thence to the Paluxy River in Segment No. 1229 of the Brazos River Basin, a water of the United States classified for contact recreation, high quality aquatic habitat, and public water supply. The discharger is located on Squaw Creek Reservoir along Hwy 56 approximately four and one half miles (4.5) northwest of the City of Glen Rose, Somerville County, Texas. Under the Standard Industrial Classification (SIC) Code(s) 4911, the applicant currently operates a steam electric generating facility consisting of two (2) nuclear-fueled steam electric generating units.

There are substantial changes from the draft reissued permit publicly noticed on July 16, 1994.

1. Section II.J.3.d. is changed to specify a minimum of three (3) flow weighted composite samples be collected as opposed to two (2) in the draft permit.

2. Paragraph II.J.3.d.i. is changed to specify that a 24-hour composite sample consist of a minimum of 12 effluent portions, not four (4) which appears in the draft permit.

3. Outfall 003 sample types are corrected for Flow to Estimate and for BOD as Record.

4. Outfall 104 description is changed to metal cleaning waste/low volume wastewater.

RESPONSE TO COMMENTS
FINAL PERMIT DECISION

This is our response to comments received on the subject draft permit in accordance with regulations promulgated at 40 CFR Part 124.17.

Permit No.	TX0065854
Applicant:	Texas Utilities Electric Company 400 N. Olive Street, L.B. 81 Dallas, Texas 75201
Issuing Office:	U.S. Environmental Protection Agency Region 6 1445 Ross Avenue Dallas, Texas 75202-2733
Prepared By:	Fred Humke Industrial Permits Section (6W-PI) Permits Branch Water Management Division (214) 655-7180
Permit Action:	Final permit decision and response to comments received on the draft reissued permit publicly noticed on July 16, 1994.
Date Prepared:	August 23, 1994.

Unless otherwise stated, citations to 40 CFR refer to promulgated regulations listed at Title 40, Code of Federal Regulations, revised as of 7/1/94.

STATE CERTIFICATION

Texas Natural Resource Conservation Commission, dated August 17, 1994.

The following effluent limitations and/or conditions are included in the final permit in conformance with regulations listed at 40 CFR Part 122.44(d)(3):

1. Item 3.d., Samples and Composites, Page 7 of Part II, changed to specify a minimum of three (3) flow-weighted 24-hour composite samples be collected as opposed to two (2) as specified in the draft permit. Two flow-weighted samples would cause the permittee to exceed the 72 hour holding time limit for samples.

2. Recommendation included that Item 3.d.i., Page 7 of Part II, be modified to specify that a 24-hour composite sample consist of a minimum of 12 effluent portions, not four (4) which appears in the draft permit, to correspond with the requirements of the TNRCC permit.

COMMENTS RECEIVED ON DRAFT PERMIT

From Texas Utilities Electric Company, dated August 15, 1994.

RESPONSE TO COMMENTS

ISSUE NUMBER 1

Cover Page The discharge route mentions only one of the facility's two possible options. While discharge will normally go to Squaw Creek, the option exists to discharge to Lake Granbury in Segment No. 1205 of the Brazos River Basin. In order to more accurately describe the facility's discharge route the Agency may wish to include Segment 1205.

RESPONSE

This matter was discussed with the TNRCC. The alternate discharge location can not be allowed for this permit as applied for and drafted under the application dated 9/27/93. The water quality calculations are based on Squaw Creek Reservoir and Waterbody Segment Code No. 1229 of the Brazos River. Therefore, TNRCC could not certify this change without a revised WQ analysis.

ISSUE NUMBER 2

For Outfall 001, once-through and auxiliary cooling, just below the effluent characterization table a reference is made to Part II, Paragraph O. Since there is no Paragraph O in Part II, the Agency may wish to either delete this line or reference an existing paragraph.

RESPONSE

The draft permit being issued shows Footnote *1 as Part II, Paragraph D., which is FLOW-WEIGHTED AVERAGE TEMPERATURE. This is the correct reference for temperature. Therefore, no change is needed.

ISSUE NO. 3

Outfall 003, sanitary sewage effluents The Permit lists the sample type for both Flow and BOD as Record. The Company believes these sample types were inadvertently changed from Estimate and Grab, respectively, as listed in the current Permit. Consequently, the Company requests that the Agency change the Sample Type for Flow to Estimate and the Sample Type for BOD to Grab.

RESPONSE

These changes have been made.

ISSUE NO. 4

Outfall 104, metal cleaning wastes The Agency dropped the term "low-volume wastewater" from the outfall's description. On rare occasion, the facility may wish to discharge some low-volume wastewater from this outfall; therefore, the Company requests that this outfall retain its current description of metal cleaning waste/low volume wastewater.

RESONSE

This change has been made.

ISSUE NO. 5

The Company requests additions to Part II.J. Whole Effluent Toxicity Testing (7-Day Chronic NOEC Freshwater) and Part II.K. Whole Effluent Toxicity Testing (TX 24_Hour Acute LC50 Freshwater) relative to test initiation and dates.

RESPONSE

These are standard paragraphs which are not revised on a permit-by-permit basis.

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, as amended, (33 U.S.C. 1251 et. seq; the "Act"),

Texas Utilities Electric Company
400 N. Olive Street L.B. 81
Dallas, Texas 75201

is authorized to discharge from a facility located on Squaw Creek Reservoir along Hwy 56 approximately four and one half miles (4.5) northwest of the City of Glen Rose, Somervell County, Texas

to receiving waters named Squaw Creek Reservoir, thence to Squaw Creek, Thence to Paluxy River, Waterbody Segment Code No. 1229 of the Brazos River, from

Final Outfall 001: Latitude - 32°17'46"N; Longitude - 97°46'56W"
Final Outfall 002: Latitude - 32°17'29"N; Longitude - 97°47'10W"
Final Outfall 003: Latitude - 32°17'46"N; Longitude - 97°46'56W"
Final Outfall 004: Latitude - 32°17'54"N; Longitude - 97°47'06W"
Latitude - 32°18'08"N; Longitude - 97°47'21W"
Internal Outfall 104: Latitude - 32°18'05"N; Longitude - 97°47'23W"

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I [6 pages], II [17 pages], and III [7 pages] hereof.

This permit supersedes and replaces NPDES Permit No. TX0065854 issued March 31, 1989.

This permit shall become effective on November 1, 1994.

This permit and the authorization to discharge shall expire at midnight, October 30, 1999.

Signed and issued on September 30, 1994

for Myron O. Knudson, P.E.
Director
Water Management Division (6W)

PART I
REQUIREMENTS FOR NPDES PERMITS

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

OUTFALL 001 (FINAL) (Previously Outfall 201)

During the period beginning the effective date of the permit and lasting through the expiration date of the permit,

the permittee is authorized to discharge from Final Outfall 001: the continuous discharge of once-through and auxiliary cooling water and previously monitored effluents (*5) to Squaw Creek Reservoir.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY UNLESS STATED)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
Flow (MGD)	N/A	N/A	(Report)	(Report)
Temperature, °F (*1)	N/A	N/A	113°F	116°F
Free Available Chlorine	440	1101	0.2	0.5
Total Residual Chlorine	Report	880	Report	0.2

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Flow (MGD)	Continuous (*2)	Record
Temperature, °F (*1)	Continuous	Record
Free Available Chlorine (*3)	1/week (*4)	Grab
Total Residual Chlorine (*3)	1/week (*4)	Grab

See Part II, Paragraph O.

The pH shall not be less than N/A standard units nor greater than N/A standard units.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 001, where condenser cooling water and previously monitored effluents (*5) are discharged from the discharge canal to Squaw Creek Reservoir.

FOOTNOTES

*1 See Part II, Paragraph D.
*2 Flow rates shall be obtained from pump curve data.
*3 See Part II, Paragraph E.
*4 Samples shall be representative of periods of chlorination.
*5 Effluent previously monitored at Outfall 004 may be discharged through Outfall 001.

PART I
REQUIREMENTS FOR NPDES PERMITS

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

OUTFALL 002 (FINAL) (Previously Outfall 501)

During the period beginning the effective date of the permit and lasting through the expiration date of the permit,

the permittee is authorized to discharge from Final Outfall 002: the intermittent discharge of Safe Shutdown Impoundment (SSI) containing cooling water, low-volume wastes (*4) (service water) and stormwater runoff to Squaw Creek Reservoir.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY UNLESS STATED)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
Flow (MGD)	N/A	N/A	Report	Report
Total Suspended Solids	N/A	N/A	30	100
Oil and Grease	N/A	N/A	15	20
pH Minimum/Maximum Values (standard Units)	----	----	(Min) 6.0 (*2)	(Max) 9.0 (*2)

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Flow (MGD)	1/day (*1)	Estimate (*3)
Total Suspended Solids	1/week (*1)	Grab
Oil and Grease	1/week (*1)	Grab
pH Minimum/Maximum Values (standard Units)	1/week (*1)	Grab

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 002, where (SSI) effluents are discharged to Squaw Creek Reservoir.

FOOTNOTES

*1 When discharge occurs.
*2 The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units. The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous (rather than the daily average and daily maximum) pH values measured during the sampling month.
*3 See Part II, Paragraph G.
*4 See Part II, Paragraph C.

PART I
REQUIREMENTS FOR NPDES PERMITS

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

OUTFALL 003 (FINAL) (Previously Outfall 301)

During the period beginning the effective date of the permit and lasting through the expiration date of the permit,

the permittee is authorized to discharge from Final Outfall 003: the continuous discharge of sanitary sewage effluents to Squaw Creek Reservoir.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY UNLESS STATED)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
Flow (MGD)	N/A	N/A	(Report)	(Report)
Biochemical Oxygen Demand (5-day)	N/A	N/A	20	45
Total Suspended Solids	N/A	N/A	20	45
pH Minimum/Maximum Values (standard Units)	----	----	(Min) 6.0 (*1)	(Max) 9.0 (*1)

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Flow (MGD)	1/day	Estimate
Biochemical Oxygen Demand (5-day)	2/month	Grab
Total Suspended Solids	2/month	Grab
pH Minimum/Maximum Values (standard Units)	2/month	Grab

There shall be no discharge of floating solids or visible foam in other than trace amounts.

The effluent shall contain chlorine residual of at least 1.0 mg/l and a maximum chlorine residual of 4.0 mg/l after a detention time of at least 20 minutes (based on peak flow), and shall be monitored five times per week, by grab sample.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 003, where sanitary sewage effluents are discharged from the sewage treatment plant prior to discharge to Squaw Creek Reservoir.

FOOTNOTES

*1 The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units. The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous (rather than the daily average and daily maximum) pH values measured during the sampling month.

PART I
REQUIREMENTS FOR NPDES PERMITS

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

OUTFALL 004 (FINAL) (Previously Outfall 101)

During the period beginning the effective date of the permit and lasting through the expiration date of the permit,

the permittee is authorized to discharge from Final Outfall 004: the intermittent discharge of low-volume wastewater (*1) and previously monitored effluents to the condenser cooling water and/or Squaw Creek Reservoir.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY UNLESS STATED)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
Flow (MGD)	N/A	N/A	Report	Report
Total Suspended Solids	N/A	N/A	30	100
Oil and Grease	N/A	N/A	15	20
pH Minimum/Maximum Values (standard Units)	----	----	(Min) 6.0 (*3)	(Max) 9.0 (*3)

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Flow (MGD)	1/day (*2)	Estimate (*4)
Total Suspended Solids	1/week (*2)	Grab (*5)
Oil and Grease	1/week (*2)	Grab (*5)
pH Minimum/Maximum Values (standard Units)	1/week (*2)	Grab (*5)

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 004, where low-volume wastewater and previously monitored effluents are discharged prior to mixing with the condenser cooling water and/or Squaw Creek Reservoir.

FOOTNOTES

*1 See Part II, Paragraph C.
*2 When discharge occurs.
*3 The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units. The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous (rather than the daily average and daily maximum) pH values measured during the sampling month.
*4 See Part II, Paragraph G.
*5 Since more than one source may be associated with this particular waste category, grab samples from each source may be either physically combined into a single flow weighted sample for analysis and reporting or individually analyzed and the results mathematically combined into a single flow weighted result for reporting.

PART I
REQUIREMENTS FOR NPDES PERMITS

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

OUTFALL 104 (INTERNAL) (Previously Outfall 601)

During the period beginning the effective date of the permit and lasting through the expiration date of the permit,

the permittee is authorized to discharge from Internal Outfall 104: the intermittent discharge of metal cleaning (*1) wastes/low volume wastewater to Outfall 004.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY UNLESS STATED)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
Flow (MGD)	N/A	N/A	(Report)	(Report)
Iron, Total	N/A	N/A	1.0	1.0
Copper, Total	N/A	N/A	0.5	1.0

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Flow (MGD)	1/day (*2)	Estimate (*3)
Iron, Total	1/week (*2)	Grab
Copper, Total	1/week (*2)	Grab

The pH shall not be less than N/A standard units nor greater than N/A standard units.

Oil and Grease, total suspended solids and pH are monitored and reported at Outfall 004.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 104, where metal cleaning wastes are discharged from the retention ponds or temporary treatment facilities prior to mixing with low-volume waste stream prior to discharge through Outfall 004.

FOOTNOTES

*1 See Part II, Paragraph B.
*2 When discharge occurs.
*3 See Part II, Paragraph G.

B. SCHEDULE OF COMPLIANCE

The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

NONE

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

C. REPORTING OF MONITORING RESULTS (MAJOR DISCHARGERS)

Monitoring results shall be reported in accordance with the provisions of Part III.D.4 of the permit. Monitoring results obtained during the previous month shall be summarized and reported on a Discharge Monitoring Report form postmarked no later than the 25th day of the month following the completed monthly reporting period.

The first report is due on December 25, 1994 .

PART II
OTHER CONDITIONS

A. TRANSFORMER FLUID DISCHARGE

There shall be no discharge of transformer fluid containing polychlorinated biphenyl (PCB) compounds.

B. METAL CLEANING WASTE

The term "metal cleaning waste" means any wastewater resulting from cleaning (with or without chemical cleaning compounds) any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning.

C. LOW-VOLUME WASTESOURCES

The term "low-volume wastesources" means, taken collectively as if from one source, wastewater from all sources except those for which specific limitations are otherwise established. Low volume waste sources include, but are not limited to: wastewaters from wet scrubber air pollution control systems, ion exchange water treatment systems, water treatment evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning wastes, and recirculating house service water systems. Sanitary and air conditioning wastes are not included.

D. FLOW-WEIGHTED AVERAGE TEMPERATURE

For the purposes of this permit, daily temperature discharge is defined as the flow-weighted average temperature (FWAT) and, on a daily basis, shall be monitored and recorded in accordance with Part I, of this permit. FWAT shall be calculated at equal time intervals not greater than two hours. The method of calculating FWAT is as follows:

$$\text{FWAT} = \frac{\text{SUMMATION (INSTANTANEOUS FLOW X INSTANTANEOUS TEMPERATURE)}}{\text{SUMMATION (INSTANTANEOUS FLOW)}}$$

"Daily average temperature" (also known as average monthly or maximum 30 day value) shall be the arithmetic average of all FWAT's calculated during the calendar month.

"Daily maximum temperature" (also known as the maximum daily value) shall be the highest FWAT calculated during the calendar month.

E. FREE AVAILABLE CHLORINE ANALYSIS

The term "free available chlorine" shall mean the value obtained using the amperometric titration method for free available chlorine described in the latest edition of "Standard Methods for the Examination of Water and Wastewater."

TOTAL RESIDUAL CHLORINE

The term "total residual chlorine" (or total residual oxidants for intake water with bromides) means the value obtained using the amperometric method for total residual chlorine described in the latest edition of "Standard Methods for the Examination of Water and Wastewater."

DISCHARGE OF FREE AVAILABLE OR TOTAL RESIDUAL CHLORINE

Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time.

F. STORET/CAS CROSS-REFERENCE

For the proper identification of parameters being regulated in this permit, the following table lists the corresponding EPA Storet Number and the Chemical Abstract Service (CAS) Registry Number where applicable. The EPA Storet number is used to identify parameters on the Discharge Monitoring Report described at Part III.D.4.

PARAMETERS	STORET	CAS
CONVENTIONAL		
BOD5	00310	----
TSS	00530	----
Oil & Grease (Gravimetric)	00556	----
pH Range (Grab - Field Test)	00400	----
NONCONVENTIONAL		
Flow (MGD)	50050	----
Chlorine (Total Residual)	50060	----
Free Available Chlorine	50064	----
Temperature (°F)	00011	----
METALS AND CYANIDE		
Copper (Total)	01042	7550-50-8
Iron (Total)	01045	----
WHOLE EFFLUENT TOXICITY (CHRONIC 7-DAY NOEC FRESHWATER)		
NOEC, Pass/Fail, Static Renewal, 7-Day Chronic, Lethality, *Pimephales promelas*	TLP6C	----
NOEC, Value, Static Renewal, 7-Day Chronic, Lethality, *Pimephales promelas*	TOP6C	----
NOEC, Value, Static Renewal, 7-Day Chronic, Growth, *Pimephales promelas*	TPP6C	----
Coe. of Variation, Value, Static Renewal, 7-Day Chronic, Lethality, *Pimephales promelas*	TQP6C	----
NOEC, Pass/Fail, Static Renewal, 7-Day Chronic, Lethality, *Ceriodaphnia dubia*	TLP3B	----
NOEC, Value, Static Renewal, 7-Day Chronic, Lethality, *Ceriodaphnia dubia*	TOP3B	----
NOEC, Value, Static Renewal, 7-Day Chronic, Reproduction, *Ceriodaphnia dubia*	TPP3B	----
Coe. of Variation, Value, Static Renewal, 7-Day Chronic, Lethality, *Ceriodaphnia dubia*	TQP3B	----
WHOLE EFFLUENT TOXICITY (TEXAS 24-HOUR ACUTE LC50 FRESHWATER)		
LC50, Pass/Fail, Static Nonrenewal, 24-Hour Acute, Lethality, *Daphnia pulex*	TIE3D	----

LC50, Pass/Fail, Static Nonrenewal, 24-Hour Acute, Lethality, *Pimephales promelas*	TIE6C	----

G. FLOW MEASUREMENT "ESTIMATE" SAMPLE TYPE

If the flow measurement sample type in Part I is specified as "estimate," flow measurements shall not be subject to the accuracy provisions established at Part III.C.6. The daily flow value may be estimated using best engineering judgment.

H. 40 CFR PART 136 ANALYTICAL REQUIREMENTS

Unless otherwise specified in this permit, monitoring shall be conducted according to analytical, apparatus and materials, sample collection, preservation, handling, etc., procedures listed at 40 CFR Part 136 in effect on the effective date of this permit. Appendices A, B, and C to 40 CFR Part 136 are specifically referenced as part of this requirement. Amendments to 40 CFR Part 136 promulgated after the effective date of this permit shall supersede these requirements as applicable.

I. MINIMUM QUANTIFICATION LEVEL (MQL)

If any individual analytical test result is less than the minimum quantification level listed below, a value of zero (0) may be used for that individual result for the Discharge Monitoring Report (DMR) calculations and reporting requirements.

METALS AND CYANIDE	MQL (µg/L)
Copper (Total)	10

The permittee may develop an effluent specific method detection limit (MDL) in accordance with Appendix B to 40 CFR Part 136. For any pollutant for which the permittee determines an effluent specific MDL, the permittee shall send to EPA Region 6 a report containing QA/QC documentation, analytical results, and calculations necessary to demonstrate that the effluent specific MDL was correctly calculated. An effluent specific minimum quantification level (MQL) shall be determined in accordance with the following calculation:

$$MQL = 3.3 \times MDL$$

Upon written approval by EPA Region 6, the effluent specific MQL may be utilized by the permittee for all future Discharge Monitoring Report (DMR) calculations and reporting requirements.

J. WHOLE EFFLUENT TOXICITY TESTING (7-DAY CHRONIC NOEC FRESHWATER)

1. SCOPE, FREQUENCY, AND METHODOLOGY

a. The provisions of this section are applicable to Outfall(s) 001 for whole effluent toxicity.

b. The permittee shall test the effluent for toxicity in accordance with the provisions in this section. This testing will determine if an appropriately dilute effluent sample adversely affects the survival of the test organism. The permittee shall submit the results of these tests on the appropriate Discharge Monitoring Report (DMR) for the reporting period.

c. The permittee shall implement all toxicity tests utilizing the test organisms, procedures, and quality assurance requirements specified in this section of the permit and in accordance with the EPA manual, "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", EPA/600/4-89/001, or the latest update thereof. The permittee shall repeat a test, including the control and all effluent dilutions, if the procedures and quality assurance requirements defined in the test methods or in this permit are not satisfied. A repeat test shall be conducted within the required reporting period of any test determined to be invalid.

d. The permittee shall utilize the Ceriodaphnia dubia chronic static renewal survival and reproduction test (Method 1002.0 or the most recent publication). This test should be terminated when 60% of the surviving females in the control produce three broods. The permittee shall conduct the Ceriodaphnia dubia toxicity test at a frequency of once per year.

e. The permittee shall utilize the Pimephales promelas (Fathead minnow) chronic static renewal 7-day larval survival and growth test (Method 1000.0 or the most recent publication). A minimum of five (5) replicates with eight (8) organisms per replicate must be used in the control and in each effluent dilution of this test. The permittee shall conduct the Fathead minnow toxicity test at a frequency of once per year.

f. The permittee shall use five effluent dilution concentrations in addition to a control (0% effluent) in each toxicity test. These additional effluent concentrations shall be 100%, 75%, 56%, 42%, and 32%. The low-flow effluent concentration (critical dilution) is defined as the 100% effluent.

g. The NOEC (No Observed Effect Concentration) is defined as the greatest effluent dilution which does not result in lethality that is statistically different from the control (0% effluent) at the 95% confidence level.

h. This permit may be reopened to require whole effluent toxicity limits, chemical specific effluent limits, additional testing, and/or other appropriate actions to address toxicity.

2. PERSISTENT LETHALITY

The requirements of this subsection apply only when a toxicity test demonstrates significant lethal effects at the 100% effluent concentration. Significant lethal effects are herein defined as a statistically significant difference at the 95% confidence level between the survival of the appropriate test organism in a specified effluent dilution and the control (0% effluent).

a. The permittee shall conduct a total of two (2) additional tests for any species that demonstrates significant lethal effects at the 100% effluent concentration. The two additional tests shall be conducted monthly during the next two consecutive months. The permittee shall not substitute either of the two additional tests in lieu of routine

toxicity testing, unless the specified testing frequency for the species demonstrating significant lethal effects is monthly. The full report shall be prepared for each test required by this section in accordance with procedures outlined in Item 4 of this section.

b. If one or both of the two additional tests demonstrates significant lethal effects at the 100% effluent concentration, the permittee shall initiate Toxicity Reduction Evaluation requirements as specified under Item 5 of this section.

c. If one or both of the two additional tests demonstrates significant lethal effects at the 100% effluent concentration, the permittee shall henceforth increase the frequency of testing for this species at a frequency of once per quarter for the life of the permit.

d. The provisions of Item 2.a are suspended upon submittal of the TRE Action Plan.

e. If the testing frequency in Item 1 is monthly for a species, the permittee shall initiate the Toxicity Reduction Evaluation requirements as specified under Item 5 of this section when any two of three consecutive monthly toxicity tests exhibit significant lethal effects at the 100% effluent concentration.

3. REQUIRED TOXICITY TESTING CONDITIONS

a. TEST ACCEPTANCE

The permittee shall repeat any toxicity test, including the control and all effluent dilutions, which fails to meet any of the following criteria:

i. The toxicity test control (0% effluent) must have survival equal to or greater than 80%.

ii. The mean number of *Ceriodaphnia dubia* neonates produced per surviving female in the control (0% effluent) must be 15 or more.

iii. The mean dry weight of surviving Fathead minnow larvae at the end of the 7 days in the control (0% effluent) must be 0.25 mg per larva or greater.

iv. The percent coefficient of variation between replicates shall be 40% or less in the control (0% effluent) for: the young of surviving females in the *Ceriodaphnia dubia* reproduction test; the growth and survival endpoints of the Fathead minnow test.

v. The percent coefficient of variation between replicates shall be 40% or less in the {DLL}% effluent concentration, *unless* significant lethal or nonlethal effects are exhibited for: the young of surviving females in the *Ceriodaphnia dubia* reproduction test; the growth and survival endpoints of the Fathead minnow test.

b. STATISTICAL INTERPRETATION

i. For the Ceriodaphnia dubia survival test, the statistical analyses used to determine if there is a significant difference between the control and the low flow (critical dilution) shall be Fisher's Exact Test as described in the "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", EPA/600/4-89/001, or the most recent update thereof.

ii. For the Ceriodaphnia dubia reproduction test and the Fathead minnow larval survival and growth test, the statistical analyses used to determine if there is a significant difference between the control and the low flow effluent concentration (critical dilution) shall be in accordance with the methods for determining the No Observed Effect Concentration (NOEC) as described in the "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", EPA/600/4-89/001, or the most recent update thereof.

c. DILUTION WATER

i. Dilution water used in the toxicity tests will be receiving water collected as close to the point of discharge as possible but unaffected by the discharge. The permittee shall substitute synthetic dilution water of similar pH, hardness, and alkalinity to the closest downstream perennial water for;

(A) toxicity tests conducted on effluent discharges to receiving water classified as intermittent streams; and

(B) toxicity tests conducted on effluent discharges where no receiving water is available due to zero flow conditions.

ii. If the receiving water is unsatisfactory as a result of instream toxicity (fails to fulfill the test acceptance criteria of Item 3.a), the permittee may substitute synthetic dilution water for the receiving water in all subsequent tests provided the unacceptable receiving water test met the following stipulations:

(A) a synthetic dilution water control which fulfills the test acceptance requirements of Item 3.a was run concurrently with the receiving water control;

(B) the test indicating receiving water toxicity has been carried out to completion (i.e., 7 days);

(C) the permittee includes all test results indicating receiving water toxicity with the full report and information required by Item 4 below; and

(D) the synthetic dilution water shall have a pH, hardness, and alkalinity similar to that of the receiving water or closest downstream perennial water not adversely affected by the discharge, provided the magnitude of these parameters will not cause toxicity in the synthetic dilution water.

d. SAMPLES AND COMPOSITES

i. The permittee shall collect a minimum of three flow-weighted 24-hour composite samples from Outfall(s) 001. A 24-hour composite sample consists of a minimum of twelve (12) effluent portions collected at equal time intervals representative of a 24-hour operating day and combined proportional to flow or a sample continuously collected proportional to flow over a 24-hour operating day.

ii. The permittee shall collect a second and third 24-hour composite sample for use during the 24-hour renewal of each dilution concentration the for both tests. The permittee must collect the 24-hour composite samples so that the maximum holding time for any effluent sample shall not exceed 72 hours. The permittee must have initiated the toxicity test within 36 hours after the collection of the last portion of the first 24-hour composite sample. Samples shall be chilled to 4 degrees Centigrade during collection, shipping, and/or storage.

iii. The permittee must collect the 24-hour composite samples such that the effluent samples are representative of any periodic episode of chlorination, biocide usage, or other potentially toxic substance discharged on an intermittent basis.

iv. If the flow from the outfall(s) being tested ceases during the collection of effluent samples, the requirements for the minimum number of effluent samples, the minimum number of effluent portions and the sample holding time are waived during that sampling period. However, the permittee must collect an effluent composite sample volume during the period of discharge that is sufficient to complete the required toxicity tests with daily renewal of effluent. When possible, the effluent samples used for the toxicity tests shall be collected on separate days. The effluent composite sample collection duration and the static renewal protocol associated with the abbreviated sample collection must be documented in the full report required in Item 4 of this section.

4. REPORTING

a. The permittee shall prepare a full report of the results of all tests conducted pursuant to this Part in accordance with the Report Preparation Section of "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", EPA/600/4-89/001, for every valid or invalid toxicity test initiated, whether carried to completion or not. The permittee shall retain each full report pursuant to the provisions of Part III.C.3 of this permit. The permittee shall submit full reports only upon the specific request of the Agency.

b. The permittee shall report the following results of each toxicity test on the subsequent monthly DMR for that reporting period in accordance with Part III.D.4 of this permit:

i. PIMEPHALES PROMELAS (FATHEAD MINNOW)

(A) If the Fathead minnow No Observed Effect Concentration (NOEC) for survival is less than the 100% effluent dilution, enter one ("1"); otherwise, enter zero ("0"). Parameter No. TLP6C.

(B) Report the Fathead minnow NOEC value for survival, Parameter No. TOP6C.

(C) Report the Fathead minnow NOEC value for growth, Parameter No. TPP6C.

(D) Report the % coefficient of variation (larger of low flow and control dilutions), Parameter No. TQP6C.

ii. CERIODAPHNIA DUBIA

(A) If the Ceriodaphnia dubia NOEC for survival is less than the 100% effluent dilution, enter one ("1"); otherwise, enter zero ("0"). Parameter No. TLP3B.

(B) Report the Ceriodaphnia dubia NOEC value for survival, Parameter No. TOP3B.

(C) Report the Ceriodaphnia dubia NOEC value for reproduction, Parameter No. TPP3B.

(D) Report the % coefficient of variation (larger of low flow and control dilutions), Parameter No. TQP3B.

5. TOXICITY REDUCTION EVALUATION (TRE)

a. Within ninety (90) days of confirming lethality in the retests, the permittee shall submit a Toxicity Reduction Evaluation (TRE) Action Plan and Schedule for conducting a TRE. The TRE Action Plan shall specify the approach and methodology to be used in performing the TRE. A Toxicity Reduction Evaluation is an investigation intended to determine those actions necessary to achieve compliance with water quality-based effluent limits by reducing an effluent's toxicity to an acceptable level. A TRE is defined as a step-wise process which combines toxicity testing and analyses of the physical and chemical characteristics of a toxic effluent to identify the constituents causing effluent toxicity and/or treatment methods which will reduce the effluent toxicity. The TRE Action Plan shall lead to the successful elimination of effluent toxicity at the low flow dilution and include the following:

i. SPECIFIC ACTIVITIES

The plan shall detail the specific approach the permittee intends to utilize in conducting the TRE.

The approach may include toxicity characterizations, identifications and confirmation activities, source evaluation, treatability studies, or alternative approaches. When the permittee conducts Toxicity Characterization Procedures the permittee shall perform multiple characterizations and follow the procedures specified in the documents "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA-600/6-91/003), or alternate procedures. When the permittee conducts Toxicity Identification Evaluations and Confirmations, the permittee shall perform multiple identifications and follow the methods specified in the documents "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures" (EPA/600/3-88/035) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures" (EPA/600/3-88/036), as appropriate.

The documents referenced above may be obtained through the National Technical Information Service (NTIS) by phone at (703) 487-4650, or by writing:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

ii. Sampling Plan (e.g., locations, methods, holding times, chain of custody, preservation, etc.);

The effluent sample volume collected for all tests shall be adequate to perform the toxicity test, toxicity characterization, identification and confirmation procedures, and conduct chemical specific analyses when a probable toxicant has been identified.

Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity. Where lethality was demonstrated within 24 hours of test initiation, each 24 hour composite sample shall be analyzed independently. Otherwise the permittee may substitute a composite sample, comprised of equal portions of the individual 24 hour composite samples, for the chemical specific analysis.

iii. Quality Assurance Plan (e.g., QA/QC implementation, corrective actions, etc.); and

iv. Project Organization (e.g., project staff, project manager, consulting services, etc.).

b. The permittee shall initiate the TRE Action Plan within thirty (30) days of plan and schedule submittal. The permittee shall assume all risks for failure to achieve the required toxicity reduction.

c. The permittee shall submit a quarterly TRE Activities Report with the Discharge Monitoring Report in the months of January, April, July, and October containing information on toxicity reduction evaluation activities including:

i. any data and/or substantiating documentation which identifies the pollutant(s) and/or source(s) of effluent toxicity;

ii. any studies/evaluations and results on the treatability of the facility's effluent toxicity; and

iii. any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to meet no lethality at the low flow effluent concentration (critical dilution).

A copy of the TRE Activities Report shall be also be submitted to the Texas Natural Resource Conservation Commission.

d. The permittee shall submit a Final Report on Toxicity Reduction Evaluation Activities no later than twenty-eight (28) months from confirming lethality in the retests, which provides information pertaining to the specific control mechanism selected that will, when implemented, result in reduction of effluent toxicity to no lethality at the low flow effluent concentration (critical dilution). The report will also provide a specific corrective action schedule for implementing the selected control mechanism.

A copy of the Final Report on Toxicity Reduction Evaluation Activities shall also be submitted to the Texas Natural Resource Conservation Commission.

K. WHOLE EFFLUENT TOXICITY TESTING (TX 24-HOUR ACUTE LC50 FRESHWATER)

1. SCOPE, FREQUENCY, AND METHODOLOGY

a. The provisions of this section shall apply individually and separately to Outfall 001. No samples or portions of samples from one outfall may be composited with samples or portions of samples from another outfall. The provisions of this section are in addition to other biomonitoring requirements in this permit.

24-HOUR ACUTE TEST SUBSTITUTIONS - If any other tests conducted under biomonitoring requirements elsewhere in Part II of this permit include the 100% effluent concentration in the dilution series, the mean survival results at 24 hours from those tests for each species may be submitted to fulfill the requirements of this section. See Item 4.b of this section for acceptable test substitutions. The 50% survival in 100% effluent for a 24-hour period standard applies to all tests utilizing a 100% effluent dilution, regardless of whether the results are submitted for compliance with the minimum testing frequency described in Item 1.c, below.

b. The permittee shall test the effluent for lethality in accordance with the provisions of this section. Such testing will determine if an effluent sample meets the Texas Surface Water Quality Standard listed at 30 TAC §307.6(e)(2)(B) of greater than 50% survival of the appropriate test organisms in 100% effluent for a 24-hour period.

c. The permittee shall submit the results of these tests on the Discharge Monitoring Report (DMR) due in the month following the test. The toxicity tests shall be conducted two (2) times per year at six month intervals for the life of the permit.

d. The permittee shall implement all toxicity tests utilizing the test organisms, procedures, and quality assurance requirements specified in this section of the permit and in accordance with the EPA manual, "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms", EPA/600/4-90/027, or the latest update thereof. The permittee shall repeat a test including the control and all effluent dilutions if the procedures and quality assurance requirements defined in the test methods or in this permit are not satisfied. A repeat test shall be conducted within the required reporting period of any test determined to be invalid in accordance with Item 3.b, below, of this section.

e. The permittee shall use the *Daphnia pulex* acute static 24-hour definitive toxicity test. A minimum of five (5) replicates with eight (8) organisms per replicate must be used in the control and in each effluent dilution of this test.

f. The permittee shall use the *Pimephales promelas* (Fathead minnow) acute static 24-hour definitive toxicity test. A minimum of five (5) replicates with eight (8) organisms per replicate must be used in the control and in each effluent dilution of this test.

g. In addition to an appropriate control (0% effluent), a 100% effluent concentration shall be used in the toxicity tests.

h. This permit may be reopened to require whole effluent toxicity limits, chemical specific effluent limits, additional testing, and/or other appropriate actions to address toxicity.

2. PERSISTENT LETHALITY

a. If any toxicity test at the 100% effluent concentration demonstrates 50% or greater mortality, the permittee shall conduct two (2) additional tests (retests) for each species that demonstrates mortality and report these results as required in Item 4 of this section. The two additional retests shall be conducted monthly during the next two consecutive months. Five (5) dilutions in addition to an appropriate control (0% effluent) shall be used in the two (2) retests. These effluent concentrations shall be 100%, 50%, 25%, 13%, and 6%. If one of the retests indicates 50% or greater mortality at the 100% effluent concentration, the permittee may suspend additional retesting for this period and shall notify the EPA in writing within five (5) days. If none of the retests indicates 50% or greater mortality at the 100% effluent concentration, the permittee shall continue testing at the original frequency (two times per year, per species, following the original schedule).

b. Within thirty (30) days after submitting the original and retest results which demonstrate 50% or greater mortality at the 100% effluent concentration, the permittee shall

initiate a Toxicity Reduction Evaluation (TRE) in accordance with the procedures stated in Item 5 of this section. The permittee shall continue biomonitoring quarterly (as a minimum) during the TRE using the affected species unless otherwise authorized by the permitting authority.

c. Within three (3) years from the date of completion of the test confirming 50% or greater mortality at the 100% effluent concentration, the permittee shall demonstrate greater than 50% mean survival of the appropriate test organism in 100% effluent for a 24-hour test period for all subsequent testing.

3. REQUIRED TOXICITY TESTING CONDITIONS

a. CONTROL/DILUTION WATER

Control and/or dilution water used in the test shall normally consist of a standard, synthetic, moderately hard, reconstituted water of similar pH and alkalinity to the closest downstream perennial water. If the permittee is utilizing the results of a 48-hour acute test or 7-day chronic test to satisfy these 24-hour acute biomonitoring requirements in accordance with Item 1.a, the permittee may use receiving water as the control and dilution water if the control meets the requirements of Item 3.b.

b. CONTROL SURVIVAL

If more than 10% of the test organisms in any control die within 24 hours, that test including the control and all effluent dilution(s) shall be repeated with all results from both tests reported as per Item 4 of this section.

c. SAMPLES AND COMPOSITES

The samples shall be collected at a point following the last treatment unit.

One flow-weighted 24-hour composite sample representative of normal operating flows will be collected from each outfall, and a discrete test will be run on each composite sample. A 24-hour composite sample consists of a minimum of twelve (12) effluent portions collected at equal time intervals and combined proportional to flow or a sample continuously collected proportional to flow over a 24-hour operating day.

Samples shall be chilled to 4 degrees Centigrade during collection, shipping, and/or storage. The toxicity tests must be initiated within 36 hours after collection of the 24-hour composite sample. The 24-hour composite sample must be collected such that the sample is representative of any periodic episode of chlorination, biocide usage, or other potentially toxic substance discharged on an intermittent basis.

4. REPORTING

a. The permittee shall prepare a full report of the results of all tests conducted pursuant to this Part in accordance with the Report Preparation Section of "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms", for every valid or invalid

toxicity test initiated, whether carried to completion or not. The permittee shall retain each full report pursuant to the provisions of Part III.C.3 of this permit. The permittee shall submit full reports only upon the specific request of the Agency.

b. The permittee shall report the following results of each toxicity test on the subsequent monthly DMR for that reporting period in accordance with Part III.D.4 of this permit:

i. PIMEPHALES PROMELAS (FATHEAD MINNOW)

Enter the following codes on the DMR for Parameter No. TIE6C:

"0" if mean survival at 24 hours is greater than 50% in 100% effluent;

"1" if the mean survival at 24 hours is less than or equal to 50% in 100% effluent.

In cases of test substitution (See 24-HOUR ACUTE TEST SUBSTITUTIONS, Item 1.a, above), mean survival results in 100% effluent from the 48-hour acute or 7-day chronic Pimephales promelas tests determined at 24 hours shall be reported on the DMR under Parameter No. TIE6C.

ii. DAPHNIA PULEX

Enter the following codes on the DMR for Parameter No. TIE3D:

"0" if mean survival at 24 hours is greater than 50% in 100% effluent;

"1" if the mean survival at 24 hours is less than or equal to 50% in 100% effluent.

In cases of test substitution (See 24-HOUR ACUTE TEST SUBSTITUTIONS, Item 1.a, above), mean survival results in 100% effluent from the 48-hour Daphnia pulex acute test or the 7-day chronic Ceriodaphnia dubia test determined at 24 hours shall be reported on the DMR under Parameter No. TIE3D.

5. TOXICITY REDUCTION EVALUATION (TRE)

a. Within ninety (90) days of confirming lethality in the retests, the permittee shall submit a Toxicity Reduction Evaluation (TRE) Action Plan and Schedule for conducting a TRE. The TRE Action Plan shall specify the approach and methodology to be used in performing the TRE. A Toxicity Reduction Evaluation is an investigation intended to determine those actions necessary to achieve compliance with water quality-based effluent limits by reducing an effluent's toxicity to an acceptable level. A TRE is defined as a step-wise process which combines toxicity testing and analyses of the physical and chemical characteristics of a toxic effluent to identify the constituents causing effluent toxicity and/or treatment methods which will reduce the effluent toxicity. The TRE Action Plan shall lead to the successful elimination of effluent toxicity at the low flow dilution and include the following:

i. SPECIFIC ACTIVITIES

The plan shall detail the specific approach the permittee intends to utilize in conducting the TRE. The approach may include toxicity characterizations, identifications and confirmation activities, source evaluation, treatability studies, or alternative approaches. When the permittee conducts Toxicity Characterization Procedures the permittee shall perform multiple characterizations and follow the procedures specified in the documents "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA-600/6-91/003), or alternate procedures. When the permittee conducts Toxicity Identification Evaluations and Confirmations, the permittee shall perform multiple identifications and follow the methods specified in the documents "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures" (EPA/600/3-88/035) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures" (EPA/600/3-88/036), as appropriate.

The documents referenced above may be obtained through the National Technical Information Service (NTIS) by phone at (703) 487-4650, or by writing:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

ii. Sampling Plan (e.g., locations, methods, holding times, chain of custody, preservation, etc.);

The effluent sample volume collected for all tests shall be adequate to perform the toxicity test, toxicity characterization, identification and confirmation procedures, and conduct chemical specific analyses when a probable toxicant has been identified.

Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity. Where lethality was demonstrated within 24 hours of test initiation, each 24 hour composite sample shall be analyzed independently. Otherwise the permittee may substitute a composite sample, comprised of equal portions of the individual 24 hour composite samples, for the chemical specific analysis.

iii. Quality Assurance Plan (e.g., QA/QC implementation, corrective actions, etc.); and

iv. Project Organization (e.g., project staff, project manager, consulting services, etc.).

b. The permittee shall initiate the TRE Action Plan within thirty (30) days of plan and schedule submittal. The permittee shall assume all risks for failure to achieve the required toxicity reduction.

c. The permittee shall submit a quarterly TRE Activities Report with the Discharge Monitoring Report in the months of January, April, July, and October containing information on toxicity reduction evaluation activities including:

i. any data and/or substantiating documentation which identifies the pollutant(s) and/or source(s) of effluent toxicity;

ii. any studies/evaluations and results on the treatability of the facility's effluent toxicity; and

iii. any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to meet no lethality at the low flow effluent concentration (critical dilution).

A copy of the TRE Activities Report shall be also be submitted to the Texas Natural Resource Conservation Commission.

d. The permittee shall submit a Final Report on Toxicity Reduction Evaluation Activities no later than twenty-eight (28) months from confirming lethality in the retests, which provides information pertaining to the specific control mechanism selected that will, when implemented, result in reduction of effluent toxicity to no lethality at the low flow effluent concentration (critical dilution). The report will also provide a specific corrective action schedule for implementing the selected control mechanism.

A copy of the Final Report on Toxicity Reduction Evaluation Activities shall also be submitted to the Texas Natural Resource Conservation Commission.

L. MIXING ZONE DEFINITION (TEXAS)

Chronic toxic criteria apply at the edge of the mixing zone. The mixing zone is defined as a volume within a radius of 100 feet from the point of discharge.

M. RAW WATER INTAKE

The makeup water intake, located on Lake Granbury, is approved pursuant to Section 316(b) of the Clean Water Act. The applicant shall conduct a program to monitor the impingement and entrainment of organisms at the circulating water intake structure in Squaw Creek Reservoir.

PART III
STANDARD CONDITIONS FOR NPDES PERMITS

SECTION A. GENERAL CONDITIONS

1. Introduction
In accordance with the provisions of 40 CFR Part 122.41, et. seq., this permit incorporates by reference ALL conditions and requirements applicable to NPDES Permits set forth in the Clean Water Act, as amended, (hereinafter known as the "Act") as well as ALL applicable regulations.

2. Duty to Comply
The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

3. Toxic Pollutants

a. Notwithstanding Part III.A.5, if any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition.

b. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Act for toxic pollutants within the time provided in the regulations that established those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

4. Duty to Reapply
If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application shall be submitted at least 180 days before the expiration date of this permit. The Director may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date. Continuation of expiring permits shall be governed by regulations promulgated at 40 CFR Part 122.6 and any subsequent amendments.

5. Permit Flexibility
This permit may be modified, revoked and reissued, or terminated for cause in accordance with 40 CFR 122.62-64. The filing of a request for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

6. Property Rights
This permit does not convey any property rights of any sort, or any exclusive privilege.

7. Duty to Provide Information
The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

8. Criminal and Civil Liability
Except as provided in permit conditions on "Bypassing" and "Upsets", nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Any false or materially misleading representation or concealment of information required to be reported by the provisions of the permit, the Act, or applicable regulations, which avoids or effectively defeats the regulatory purpose of the Permit may subject the Permittee to criminal enforcement pursuant to 18 U.S.C. Section 1001.

9. Oil and Hazardous Substance Liability
Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

10. State Laws
Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

11. Severability
The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

SECTION B. PROPER OPERATION AND MAINTENANCE

1. Need to Halt or Reduce not a Defense
It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. The permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failure either by means of alternate power sources, standby generators or retention of inadequately treated effluent.

2. Duty to Mitigate
The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

3. Proper Operation and Maintenance

a. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by permittee as efficiently as possible and in a manner which will minimize upsets and discharges of excessive pollutants and will achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems which are installed by a permittee only

when the operation is necessary to achieve compliance with the conditions of this permit.

b. The permittee shall provide an adequate operating staff which is duly qualified to carry out operation, maintenance and testing functions required to insure compliance with the conditions of this permit.

4. Bypass of Treatment Facilities

a. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Parts III.B.4.b. and 4.c.

b. Notice

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall, within 24 hours, submit notice of an unanticipated bypass as required in Part III.D.7.

c. Prohibition of bypass

(1) Bypass is prohibited, and the Director may take enforcement action against a permittee for bypass, unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and,

(c) The permittee submitted notices as required by Part III.B.4.b.

(2) The Director may allow an anticipated bypass after considering its adverse effects, if the Director determines that it will meet the three conditions listed at Part III.B.4.c(1).

5. Upset Conditions

a. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of Part III.B.5.b. are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

b. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the cause(s) of the upset;

(2) The permitted facility was at the time being properly operated;

(3) The permittee submitted notice of the upset as required by Part III.D.7; and,

(4) The permittee complied with any remedial measures required by Part III.B.2.

c. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

6. Removed Substances
Solids, sewage sludges, filter backwash, or other pollutants removed in the course of treatment or wastewater control shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

7. Percent Removal
For publicly owned treatment works, the 30-day average percent removal for Biochemical Oxygen Demand and Total Suspended Solids shall not be less than 85 percent unless otherwise authorized by the permitting authority in accordance with 40 CFR 133.103.

SECTION C. MONITORING AND RECORDS

1. Inspection and Entry
The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by the law to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

2. Representative Sampling
Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

3. Retention of Records
The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data

used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of the Director at any time.

4. Record Contents
Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) and time(s) analyses were performed;
d. The individual(s) who performed the analyses;
e. The analytical techniques or methods used; and
f. The results of such analyses.

5. Monitoring Procedures

a. Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit or approved by the Regional Administrator.

b. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instruments at intervals frequent enough to insure accuracy of measurements and shall maintain appropriate records of such activities.

c. An adequate analytical quality control program, including the analyses of sufficient standards, spikes, and duplicate samples to insure the accuracy of all required analytical results shall be maintained by the permittee or designated commercial laboratory.

6. Flow Measurements
Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to insure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than 10% from true discharge rates throughout the range of expected discharge volumes.

SECTION D. REPORTING REQUIREMENTS

1. Planned Changes

a. Industrial Permits
The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

(1) The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR Part 122.29(b); or,

(2) The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements listed at Part III.D.10.a.

b. Municipal Permits
Any change in the facility discharge (including the introduction of any new source or significant discharge or significant changes in the quantity or quality of existing discharges of pollutants) must be reported to the permitting authority. In no case are any new connections, increased flows, or significant changes in influent quality permitted that will cause violation of the effluent limitations specified herein.

2. Anticipated Noncompliance
The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements

3. Transfers
This permit is not transferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Act.

4. Discharge Monitoring Reports and Other Reports
Monitoring results must be reported on Discharge Monitoring Report (DMR) Form EPA No. 3320-1 in accordance with the "General Instructions" provided on the form. The permittee shall submit the original DMR signed and certified as required by Part III.D.11 and all other reports required by Part III.D. to the EPA at the address below. Duplicate copies of DMR's and all other reports shall be submitted to the appropriate State agency(ies) at the following address(es):

EPA:
Water Management Division
Enforcement Branch (6W-E)
U.S. Environmental Protection
Agency, Region 6
1445 Ross Avenue
Dallas, TX 75202-2733

New Mexico:
Program Manager
Surface Water Quality Bureau
New Mexico Environment Department
1190 Saint Francis Drive
Santa Fe, NM 87501-4182

Oklahoma (Industrial Permits Only):
Director
Oklahoma Department of
Environmental Quality
1000 NE 10th Street
Oklahoma City, OK 73117-1212

Louisiana:
Assistant Secretary for Water
Water Pollution Control Division
Louisiana Department of
Environmental Quality
P.O. Box 82215
Baton Rouge, LA 70884-2215

5. Additional Monitoring by the Permittee
If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR Part 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report (DMR). Such

increased monitoring frequency shall also be indicated on the DMR.

6. Averaging of Measurements
Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

7. Twenty-Four Hour Reporting

a. The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall be provided within 5 days of the time the permittee becomes aware of the circumstances. The report shall contain the following information:

(1) A description of the noncompliance and its cause;

(2) The period of noncompliance including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and,

(3) Steps being taken to reduce, eliminate, and prevent recurrence of the noncomplying discharge.

b. The following shall be included as information which must be reported within 24 hours:

(1) Any unanticipated bypass which exceeds any effluent limitation in the permit;

(2) Any upset which exceeds any effluent limitation in the permit; and,

(3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in Part II (industrial permits only) of the permit to be reported within 24 hours.

c. The Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

8. Other Noncompliance
The permittee shall report all instances of noncompliance not reported under Parts III.D.4 and D.7 and Part I.B (for industrial permits only) at the time monitoring reports are submitted. The reports shall contain the information listed at Part III.D.7.

9. Other Information
Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, it shall promptly submit such facts or information.

10. Changes in Discharges of Toxic Substances
All existing manufacturing, commercial, mining, and silvacultural permittees shall notify the Director as soon as it knows or has reason to believe:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant listed at 40 CFR Part 122, Appendix D, Tables II and III (excluding Total Phenols) which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) One hundred micrograms per liter (100 µg/L);
(2) Two hundred micrograms per liter (200 µg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 µg/L) for 2,4 -dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
(3) Five (5) times the maximum concentration value reported for that pollutant in the permit application; or
(4) The level established by the Director.

b. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) Five hundred micrograms per liter (500 µg/L);
(2) One milligram per liter (1 mg/L) for antimony;
(3) Ten (10) times the maximum concentration value reported for that pollutant in the permit application; or
(4) The level established by the Director.

11. Signatory Requirements
All applications, reports, or information submitted to the Director shall be signed and certified.

a. All permit applications shall be signed as follows:

(1) For a corporation - by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(a) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation; or,

(b) The manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) For a partnership or sole proprietorship - by a general partner or the proprietor, respectively.

(3) For a municipality, State, Federal, or other public agency - by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

(a) The chief executive officer of the agency, or

(b) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency.

b. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described above;

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, or position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. A duly authorized representative may thus be either a named individual or an individual occupying a named position; and,

(3) The written authorization is submitted to the Director.

c. Certification. Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

12. Availability of Reports
Except for applications, effluent data, permits, and other data specified in 40 CFR 122.7, any information submitted pursuant to this permit may be claimed as confidential by the submitter. If no claim is made at the time of submission, information may be made available to the public without further notice.

13. Archeological/Historical Sites (Texas Permits Only)
If during the life of this permit, new construction or land acquisition or any construction related activity where previously undisturbed ground is proposed for disturbance by the permittee which is related to an activity authorized by this permit, the permittee shall send the following items to the Texas State Historic Preservation Officer (SHPO): (1) a description of the new construction and the potential impact that this activity may have upon the ground (including sludge application methods, if applicable), and (2) a copy of a USGS topographic map outlining the location of the project and associated sludge disposal areas or other ancillary impact areas. The address of the Texas SHPO is:

Texas State Historic Preservation Officer
Department of Antiquities Protection
Texas Historical Commission
P.O. Box 12276
Austin, Texas 78711

This information will be used by the Texas SHPO and EPA to consult according to the requirements of 36 CFR Part 800.4-800.6 on methods to minimize harm to historical properties. The applicant will be contacted within 30 days about further actions that may be needed to meet the requirements of 36 CFR Part 800.

SECTION E. PENALTIES FOR VIOLATIONS OF PERMIT CONDITIONS

1. Criminal

a. Negligent Violations
The Act provides that any person who negligently violates permit conditions implementing Section 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both.

b. Knowing Violations
The Act provides that any person who knowingly violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a fine of not less than $5,000 nor more than $50,000 per day of violation, or by imprisonment for not more than 3 years, or both.

c. Knowing Endangerment
The Act provides that any person who knowingly violates permit conditions implementing Sections 301, 302, 303, 306, 307, 308, 318, or 405 of the Act and who knows at that time that he is placing another person in imminent danger of death or serious bodily injury is subject to a fine of not more than $250,000, or by imprisonment for not more than 15 years, or both.

d. False Statements
The Act provides that any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under the Act or who knowingly falsifies, tampers with, or renders inaccurate, any monitoring device or method required to be maintained under the Act, shall upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than 2 years, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or by both. (See Section 309.c.4 of the Clean Water Act)

2. Civil Penalties
The Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a civil penalty not to exceed $25,000 per day for each violation.

3. Administrative Penalties
The Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to an administrative penalty, as follows:

a. Class I Penalty
Not to exceed $10,000 per violation nor shall the maximum amount exceed $25,000.

b. Class II Penalty

Not to exceed $10,000 per day for each day during which the violation continues nor shall the maximum amount exceed $125,000.

SECTION F. DEFINITIONS

All definitions contained in Section 502 of the Act shall apply to this permit and are incorporated herein by reference. Unless otherwise specified in this permit, additional definitions of words or phrases used in this permit are as follows:

1. "Act" means the Clean Water Act (33 U.S.C. 1251 et. seq.), as amended.

2. "Administrator" means the Administrator of the U.S. Environmental Protection Agency.

3. "Applicable effluent standards and limitations" means all state and federal effluent standards and limitations to which a discharge is subject under the Act, including, but not limited to, effluent limitations, standards or performance, toxic effluent standards and prohibitions, and pretreatment standards.

4. "Applicable water quality standards" means all water quality standards to which a discharge is subject under the Act.

5. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

6. "Daily Discharge" means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes sampling. For pollutants with limitations expressed terms of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the sampling day. "Daily discharge" determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the "daily discharge" determination of concentration shall be arithmetic average (weighted by flow value) of all samples collected during that sampling day.

7. "Daily Average" (also known as monthly average) discharge limitations means the highest allowable average of "daily discharge(s)" over a calendar month, calculated as the sum of all "daily discharge(s)" measured during a calendar month divided by the number of "daily discharge(s)" measured during that month. When the permit establishes daily average concentration effluent limitations or conditions, the daily average concentration means the arithmetic average (weighted by flow) of all "daily discharge(s)" of concentration determined during the calendar month where C = daily concentration, F = daily flow and n = number of daily samples; daily average discharge =

$$\frac{C_1F_1 + C_2F_2 + \ldots + C_nF_n}{F_1 + F_2 + \ldots + F_n}$$

8. "Daily Maximum" discharge limitation means the highest allowable "daily discharge" during the calendar month.

ector" means the U.S. Environmental Protection cy Regional Administrator or an authorized epresentative.

10. "Environmental Protection Agency" means the U.S. Environmental Protection Agency.

11. "Grab sample" means an individual sample collected in less than 15 minutes.

12. "Industrial user" means a nondomestic discharger, as identified in 40 CFR 403, introducing pollutants to a publicly owned treatment works.

13. "National Pollutant Discharge Elimination System" means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 318, 402, and 405 of the Act.

14. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

15. "Sewage sludge" means the solids, residues, and precipitates separated from or created in sewage by the unit processes of a publicly owned treatment works. Sewage as used in this definition means any wastes, including wastes from humans, households, commercial establishments, industries, and storm water runoff, that are discharged to or otherwise enter a publicly owned treatment works.

16. "Treatment works" means any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage and industrial wastes of a liquid nature to implement Section 201 of the Act, or necessary to recycle or reuse water at the most economical cost over the estimated life of the works, including intercepting sewers, sewage collection systems, pumping, power and other equipment, and their appurtenances, extension, improvement, remodeling, additions, and alterations thereof.

17. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

18. For fecal coliform bacteria, a sample consists of one effluent grab portion collected during a 24-hour period at peak loads.

19. The term "MGD" shall mean million gallons per day.

20. The term "mg/L" shall mean milligrams per liter or parts per million (ppm).

21. The term "µg/L" shall mean micrograms per liter or parts per billion (ppb).

22. Municipal Terms:

    a. "7-day average", other than for fecal coliform bacteria, is the arithmetic mean of the daily values for all effluent samples collected during a calendar week, calculated as the sum of all daily discharges

measured during a calendar week divided by the number of daily discharges measured during that week. The 7-day average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calendar week.

b. "30-day average", other than for fecal coliform bacteria, is the arithmetic mean of the daily values for all effluent samples collected during a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month. The 30-day average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calendar month.

c. "24-hour composite sample" consists of a minimum of 12 effluent portions collected at equal time intervals over the 24-hour period and combined proportional to flow or a sample collected at frequent intervals proportional to flow over the 24-hour period.

d. "12-hour composite sample" consists of 12 effluent portions collected no closer together than one hour and composited according to flow. The daily sampling intervals shall include the highest flow periods.

e. "6-hour composite sample" consists of six effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) and composited according to flow.

f. "3-hour composite sample" consists of three effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) and composited according to flow.

APPENDIX B

Daily Discharge Records for Outfall 001 for the Period of October 1, 1993 to October 13, 1994

Appendix B. Daily discharge records for Comanche Peak SES Outfall 001.

Outfall	Date	Discharge Volume (MGD)	Discharge Volume (m3)
OO1	10/1/93	2772	10,492,020
OO1	10/2/93	2772	10,492,020
OO1	10/3/93	2904	10,991,640
OO1	10/4/93	3168	11,990,880
OO1	10/5/93	3168	11,990,880
OO1	10/6/93	3168	11,990,880
OO1	10/7/93	2376	8,993,160
OO1	10/8/93	2376	8,993,160
OO1	10/9/93	2376	8,993,160
OO1	10/10/93	2376	8,993,160
OO1	10/11/93	2376	8,993,160
OO1	10/12/93	1766	6,684,310
OO1	10/13/93	1584	5,995,440
OO1	10/14/93	1584	5,995,440
OO1	10/15/93	1584	5,995,440
OO1	10/16/93	1584	5,995,440
OO1	10/17/93	1584	5,995,440
OO1	10/18/93	1584	5,995,440
OO1	10/19/93	1584	5,995,440
OO1	10/20/93	1584	5,995,440
OO1	10/21/93	1584	5,995,440
OO1	10/22/93	1584	5,995,440
OO1	10/23/93	1584	5,995,440
OO1	10/24/93	1584	5,995,440
OO1	10/25/93	1584	5,995,440
OO1	10/26/93	1584	5,995,440
OO1	10/27/93	1584	5,995,440
OO1	10/28/93	1584	5,995,440
OO1	10/29/93	1584	5,995,440
OO1	10/30/93	1584	5,995,440
OO1	10/31/93	1584	5,995,440
OO1	11/1/93	1584	5,995,440
OO1	11/2/93	1584	5,995,440
OO1	11/3/93	1584	5,995,440
OO1	11/4/93	1584	5,995,440
OO1	11/5/93	1584	5,995,440
OO1	11/6/93	1584	5,995,440
OO1	11/7/93	1584	5,995,440
OO1	11/8/93	1353	5,121,105
OO1	11/9/93	1188	4,496,580
OO1	11/10/93	1188	4,496,580
OO1	11/11/93	1188	4,496,580
OO1	11/12/93	1188	4,496,580
OO1	11/13/93	1188	4,496,580
OO1	11/14/93	1188	4,496,580
OO1	11/15/93	1188	4,496,580
OO1	11/16/93	1188	4,496,580
OO1	11/17/93	1188	4,496,580

Appendix B. Daily discharge records for Comanche Peak SES Outfall 001.

Outfall	Date	Discharge Volume (MGD)	Discharge Volume (m3)
OO1	11/18/93	1188	4,496,580
OO1	11/19/93	1188	4,496,580
OO1	11/20/93	1188	4,496,580
OO1	11/21/93	1188	4,496,580
OO1	11/22/93	1188	4,496,580
OO1	11/23/93	1188	4,496,580
OO1	11/24/93	1188	4,496,580
OO1	11/25/93	1188	4,496,580
OO1	11/26/93	1188	4,496,580
OO1	11/27/93	1188	4,496,580
OO1	11/28/93	1188	4,496,580
OO1	11/29/93	1947	7,369,395
OO1	11/30/93	1980	7,494,300
OO1	12/1/93	1980	7,494,300
OO1	12/2/93	1980	7,494,300
OO1	12/3/93	1980	7,494,300
OO1	12/4/93	1980	7,494,300
OO1	12/5/93	1980	7,494,300
OO1	12/6/93	1980	7,494,300
OO1	12/7/93	1980	7,494,300
OO1	12/8/93	1980	7,494,300
OO1	12/9/93	1980	7,494,300
OO1	12/10/93	1980	7,494,300
OO1	12/11/93	1980	7,494,300
OO1	12/12/93	1980	7,494,300
OO1	12/13/93	1980	7,494,300
OO1	12/14/93	1980	7,494,300
OO1	12/15/93	1980	7,494,300
OO1	12/16/93	1980	7,494,300
OO1	12/17/93	1980	7,494,300
OO1	12/18/93	1980	7,494,300
OO1	12/19/93	2319	8,777,415
OO1	12/20/93	2376	8,993,160
OO1	12/21/93	2376	8,993,160
OO1	12/22/93	2376	8,993,160
OO1	12/23/93	2376	8,993,160
OO1	12/24/93	2376	8,993,160
OO1	12/25/93	2376	8,993,160
OO1	12/26/93	2376	8,993,160
OO1	12/27/93	2376	8,993,160
OO1	12/28/93	2376	8,993,160
OO1	12/29/93	2376	8,993,160
OO1	12/30/93	2376	8,993,160
OO1	12/31/93	2376	8,993,160
OO1	1/1/94	2376	8,993,160
OO1	1/2/94	2376	8,993,160
OO1	1/3/94	2376	8,993,160
OO1	1/4/94	2376	8,993,160

Appendix B. Daily discharge records for Comanche Peak SES Outfall 001.

Outfall	Date	Discharge Volume (MGD)	Discharge Volume (m3)
OO1	1/5/94	2376	8,993,160
OO1	1/6/94	2376	8,993,160
OO1	1/7/94	2376	8,993,160
OO1	1/8/94	2376	8,993,160
OO1	1/9/94	2376	8,993,160
OO1	1/10/94	2376	8,993,160
OO1	1/11/94	2376	8,993,160
OO1	1/12/94	2376	8,993,160
OO1	1/13/94	2376	8,993,160
OO1	1/14/94	2376	8,993,160
OO1	1/15/94	2376	8,993,160
OO1	1/16/94	2376	8,993,160
OO1	1/17/94	2376	8,993,160
OO1	1/18/94	2376	8,993,160
OO1	1/19/94	2343	8,868,255
OO1	1/20/94	1980	7,494,300
OO1	1/21/94	1980	7,494,300
OO1	1/22/94	1980	7,494,300
OO1	1/23/94	1980	7,494,300
OO1	1/24/94	1980	7,494,300
OO1	1/25/94	1980	7,494,300
OO1	1/26/94	1980	7,494,300
OO1	1/27/94	1980	7,494,300
OO1	1/28/94	1980	7,494,300
OO1	1/29/94	1980	7,494,300
OO1	1/30/94	1980	7,494,300
OO1	1/31/94	1980	7,494,300
OO1	2/1/94	1980	7,494,300
OO1	2/2/94	1584	5,995,440
OO1	2/3/94	1584	5,995,440
OO1	2/4/94	1584	5,995,440
OO1	2/5/94	1584	5,995,440
OO1	2/6/94	1980	7,494,300
OO1	2/7/94	1980	7,494,300
OO1	2/8/94	1980	7,494,300
OO1	2/9/94	1980	7,494,300
OO1	2/10/94	1980	7,494,300
OO1	2/11/94	1980	7,494,300
OO1	2/12/94	1980	7,494,300
OO1	2/13/94	1980	7,494,300
OO1	2/14/94	1980	7,494,300
OO1	2/15/94	1980	7,494,300
OO1	2/16/94	1980	7,494,300
OO1	2/17/94	1980	7,494,300
OO1	2/18/94	1980	7,494,300
OO1	2/19/94	1980	7,494,300
OO1	2/20/94	1980	7,494,300
OO1	2/21/94	1980	7,494,300

Appendix B. Daily discharge records for Comanche Peak SES Outfall 001.

Outfall	Date	Discharge Volume (MGD)	Discharge Volume (m3)
OO1	2/22/94	1980	7,494,300
OO1	2/23/94	1980	7,494,300
OO1	2/24/94	1980	7,494,300
OO1	2/25/94	1980	7,494,300
OO1	2/26/94	1980	7,494,300
OO1	2/27/94	1980	7,494,300
OO1	2/28/94	1980	7,494,300
OO1	3/1/94	1980	7,494,300
OO1	3/2/94	1980	7,494,300
OO1	3/3/94	1980	7,494,300
OO1	3/4/94	1980	7,494,300
OO1	3/5/94	1980	7,494,300
OO1	3/6/94	1980	7,494,300
OO1	3/7/94	1980	7,494,300
OO1	3/8/94	1980	7,494,300
OO1	3/9/94	1980	7,494,300
OO1	3/10/94	1980	7,494,300
OO1	3/11/94	1980	7,494,300
OO1	3/12/94	1980	7,494,300
OO1	3/13/94	1980	7,494,300
OO1	3/14/94	1980	7,494,300
OO1	3/15/94	1980	7,494,300
OO1	3/16/94	1980	7,494,300
OO1	3/17/94	1980	7,494,300
OO1	3/18/94	2129	8,058,265
OO1	3/19/94	2376	8,993,160
OO1	3/20/94	2376	8,993,160
OO1	3/21/94	2376	8,993,160
OO1	3/22/94	2376	8,993,160
OO1	3/23/94	2376	8,993,160
OO1	3/24/94	2376	8,993,160
OO1	3/25/94	2376	8,993,160
OO1	3/26/94	2376	8,993,160
OO1	3/27/94	2376	8,993,160
OO1	3/28/94	2376	8,993,160
OO1	3/29/94	2376	8,993,160
OO1	3/30/94	2376	8,993,160
OO1	3/31/94	2376	8,993,160
OO1	4/1/94	2376	8,993,160
OO1	4/2/94	2376	8,993,160
OO1	4/3/94	2376	8,993,160
OO1	4/4/94	2376	8,993,160
OO1	4/5/94	2376	8,993,160
OO1	4/6/94	2376	8,993,160
OO1	4/7/94	2376	8,993,160
OO1	4/8/94	2376	8,993,160
OO1	4/9/94	2376	8,993,160
OO1	4/10/94	2376	8,993,160

Appendix B. Daily discharge records for Comanche Peak SES Outfall 001.

Outfall	Date	Discharge Volume (MGD)	Discharge Volume (m3)
OO1	4/11/94	2376	8,993,160
OO1	4/12/94	2376	8,993,160
OO1	4/13/94	2376	8,993,160
OO1	4/14/94	2376	8,993,160
OO1	4/15/94	2376	8,993,160
OO1	4/16/94	2376	8,993,160
OO1	4/17/94	2376	8,993,160
OO1	4/18/94	2376	8,993,160
OO1	4/19/94	2376	8,993,160
OO1	4/20/94	2376	8,993,160
OO1	4/21/94	2376	8,993,160
OO1	4/22/94	2376	8,993,160
OO1	4/23/94	2376	8,993,160
OO1	4/24/94	2376	8,993,160
OO1	4/25/94	2376	8,993,160
OO1	4/26/94	2376	8,993,160
OO1	4/27/94	2376	8,993,160
OO1	4/28/94	2376	8,993,160
OO1	4/29/94	2376	8,993,160
OO1	4/30/94	2376	8,993,160
OO1	5/1/94	2376	8,993,160
OO1	5/2/94	2376	8,993,160
OO1	5/3/94	2376	8,993,160
OO1	5/4/94	2376	8,993,160
OO1	5/5/94	2376	8,993,160
OO1	5/6/94	2376	8,993,160
OO1	5/7/94	2376	8,993,160
OO1	5/8/94	2376	8,993,160
OO1	5/9/94	2376	8,993,160
OO1	5/10/94	2376	8,993,160
OO1	5/11/94	2376	8,993,160
OO1	5/12/94	2376	8,993,160
OO1	5/13/94	2376	8,993,160
OO1	5/14/94	2376	8,993,160
OO1	5/15/94	2376	8,993,160
OO1	5/16/94	2376	8,993,160
OO1	5/17/94	2376	8,993,160
OO1	5/18/94	2376	8,993,160
OO1	5/19/94	2376	8,993,160
OO1	5/20/94	2376	8,993,160
OO1	5/21/94	2376	8,993,160
OO1	5/22/94	2376	8,993,160
OO1	5/23/94	2376	8,993,160
OO1	5/24/94	2376	8,993,160
OO1	5/25/94	2368	8,962,880
OO1	5/26/94	2772	10,492,020
OO1	5/27/94	2772	10,492,020
OO1	5/28/94	2772	10,492,020

Appendix B. Daily discharge records for Comanche Peak SES Outfall 001.

Outfall	Date	Discharge Volume (MGD)	Discharge Volume (m3)
OO1	5/29/94	2772	10,492,020
OO1	5/30/94	2772	10,492,020
OO1	5/31/94	2772	10,492,020
OO1	6/1/94	2772	10,492,020
OO1	6/2/94	2772	10,492,020
OO1	6/3/94	2772	10,492,020
OO1	6/4/94	2772	10,492,020
OO1	6/5/94	2772	10,492,020
OO1	6/6/94	2772	10,492,020
OO1	6/7/94	2772	10,492,020
OO1	6/8/94	2772	10,492,020
OO1	6/9/94	2772	10,492,020
OO1	6/10/94	2772	10,492,020
OO1	6/11/94	2772	10,492,020
OO1	6/12/94	2772	10,492,020
OO1	6/13/94	2772	10,492,020
OO1	6/14/94	2772	10,492,020
OO1	6/15/94	2772	10,492,020
OO1	6/16/94	2772	10,492,020
OO1	6/17/94	2772	10,492,020
OO1	6/18/94	2772	10,492,020
OO1	6/19/94	2772	10,492,020
OO1	6/20/94	2772	10,492,020
OO1	6/21/94	2970	11,241,450
OO1	6/22/94	3168	11,990,880
OO1	6/23/94	3168	11,990,880
OO1	6/24/94	3168	11,990,880
OO1	6/25/94	3168	11,990,880
OO1	6/26/94	3168	11,990,880
OO1	6/27/94	3168	11,990,880
OO1	6/28/94	3119	11,805,415
OO1	6/29/94	3168	11,990,880
OO1	6/30/94	3168	11,990,880
OO1	7/1/94	3168	11,990,880
OO1	7/2/94	3168	11,990,880
OO1	7/3/94	3168	11,990,880
OO1	7/4/94	3168	11,990,880
OO1	7/5/94	3168	11,990,880
OO1	7/6/94	3168	11,990,880
OO1	7/7/94	3168	11,990,880
OO1	7/8/94	3168	11,990,880
OO1	7/9/94	3168	11,990,880
OO1	7/10/94	3168	11,990,880
OO1	7/11/94	3168	11,990,880
OO1	7/12/94	3168	11,990,880
OO1	7/13/94	3168	11,990,880
OO1	7/14/94	3168	11,990,880
OO1	7/15/94	3168	11,990,880

Appendix B. Daily discharge records for Comanche Peak SES Outfall 001.

Outfall	Date	Discharge Volume (MGD)	Discharge Volume (m3)
OO1	7/16/94	3168	11,990,880
OO1	7/17/94	3168	11,990,880
OO1	7/18/94	3168	11,990,880
OO1	7/19/94	3168	11,990,880
OO1	7/20/94	3168	11,990,880
OO1	7/21/94	3168	11,990,880
OO1	7/22/94	3168	11,990,880
OO1	7/23/94	3168	11,990,880
OO1	7/24/94	3168	11,990,880
OO1	7/25/94	3168	11,990,880
OO1	7/26/94	3168	11,990,880
OO1	7/27/94	3168	11,990,880
OO1	7/28/94	3168	11,990,880
OO1	7/29/94	3168	11,990,880
OO1	7/30/94	3168	11,990,880
OO1	7/31/94	3168	11,990,880
OO1	8/1/94	3168	11,990,880
OO1	8/2/94	3168	11,990,880
OO1	8/3/94	3168	11,990,880
OO1	8/4/94	3168	11,990,880
OO1	8/5/94	3168	11,990,880
OO1	8/6/94	3168	11,990,880
OO1	8/7/94	3168	11,990,880
OO1	8/8/94	3168	11,990,880
OO1	8/9/94	3168	11,990,880
OO1	8/10/94	3168	11,990,880
OO1	8/11/94	3168	11,990,880
OO1	8/12/94	3168	11,990,880
OO1	8/13/94	3168	11,990,880
OO1	8/14/94	3168	11,990,880
OO1	8/15/94	3168	11,990,880
OO1	8/16/94	3168	11,990,880
OO1	8/17/94	3168	11,990,880
OO1	8/18/94	3168	11,990,880
OO1	8/19/94	3168	11,990,880
OO1	8/20/94	3168	11,990,880
OO1	8/21/94	3168	11,990,880
OO1	8/22/94	3168	11,990,880
OO1	8/23/94	3168	11,990,880
OO1	8/24/94	3168	11,990,880
OO1	8/25/94	3148	11,915,180
OO1	8/26/94	2772	10,492,020
OO1	8/27/94	2830	10,711,550
OO1	8/28/94	3168	11,990,880
OO1	8/29/94	3168	11,990,880
OO1	8/30/94	3168	11,990,880
OO1	8/31/94	3168	11,990,880
OO1	9/1/94	3168	11,990,880

Appendix B. Daily discharge records for Comanche Peak SES Outfall 001.

Outfall	Date	Discharge Volume (MGD)	Discharge Volume (m3)
OO1	9/2/94	3168	11,990,880
OO1	9/3/94	3168	11,990,880
OO1	9/4/94	3168	11,990,880
OO1	9/5/94	3168	11,990,880
OO1	9/6/94	3168	11,990,880
OO1	9/7/94	3168	11,990,880
OO1	9/8/94	3168	11,990,880
OO1	9/9/94	3168	11,990,880
OO1	9/10/94	3168	11,990,880
OO1	9/11/94	3168	11,990,880
OO1	9/12/94	3168	11,990,880
OO1	9/13/94	3168	11,990,880
OO1	9/14/94	3168	11,990,880
OO1	9/15/94	3168	11,990,880
OO1	9/16/94	3168	11,990,880
OO1	9/17/94	3168	11,990,880
OO1	9/18/94	3168	11,990,880
OO1	9/19/94	3168	11,990,880
OO1	9/20/94	3168	11,990,880
OO1	9/21/94	3168	11,990,880
OO1	9/22/94	3168	11,990,880
OO1	9/23/94	3168	11,990,880
OO1	9/24/94	3168	11,990,880
OO1	9/25/94	3168	11,990,880
OO1	9/26/94	3168	11,990,880
OO1	9/27/94	3168	11,990,880
OO1	9/28/94	3168	11,990,880
OO1	9/29/94	3168	11,990,880
OO1	9/30/94	3168	11,990,880
OO1	10/1/94	3168	11,990,880
OO1	10/2/94	3168	11,990,880
OO1	10/3/94	3168	11,990,880
OO1	10/4/94	3168	11,990,880
OO1	10/5/94	3168	11,990,880
OO1	10/6/94	3168	11,990,880
OO1	10/7/94	3168	11,990,880
OO1	10/8/94	2805	10,616,925
OO1	10/9/94	2376	8,993,160
OO1	10/10/94	2079	7,869,015
OO1	10/11/94	1584	5,995,440
OO1	10/12/94	1584	5,995,440
OO1	10/13/94	1584	5,995,440

APPENDIX C

Raw Data for Impingement Sampling for CPSES 316(b)

Comanche Peak 316(b) Studies Impingement									
Sample	Species Name	Code	#	Length (mm)	Weight (g)	Sex	NorD	Hour	Date
1.2	Bluegill Sunfish	12	1	170	60	1	d	8:00PM	10/18/93
1.2	Threadfin Shad	22	1	46	1	1	d	8:00PM	10/18/93
1.2	White Bass	3	1	254	118	1	d	8:00PM	10/18/93
1.1	Bluegill Sunfish	12	1	104	17	1	n	8:00PM	10/19/93
1.1	Gizzard Shad	8	1	74	4	1	n	8:00PM	10/19/93
1.1	Gizzard Shad	8	2	65	2	1	n	8:00PM	10/19/93
1.1	Gizzard Shad	8	3	76	3	1	n	8:00PM	10/19/93
1.1	Green Sunfish	21	1	64	3	1	n	8:00PM	10/19/93
1.1	Threadfin Shad	22	1	66	2	1	n	8:00PM	10/19/93
1.1	Threadfin Shad	22	2	83	4	1	n	8:00PM	10/19/93
2.2	Bluegill Sunfish	12	1	154	57	2	d	8:00PM	10/26/93
2.2	Bluegill Sunfish	12	2	173	74	3	d	8:00PM	10/26/93
2.2	Inland Silversides	27	1	57	1	1	d	8:00PM	10/26/93
2.2	Inland Silversides	27	2	55	1	1	d	8:00PM	10/26/93
2.2	Threadfin Shad	22	1	58	1	1	d	8:00PM	10/26/93
2.2	White Bass	3	1	352	427	3	d	8:00PM	10/26/93
2.1	Bluegill Sunfish	12	1	55	2	1	n	8:00AM	10/26/93
2.1	Bluegill Sunfish	12	2	57	3	1	n	8:00AM	10/26/93
2.1	Bluegill Sunfish	12	3	60	2	1	n	8:00AM	10/26/93
2.1	Gizzard Shad	8	1	66	2	1	n	8:00AM	10/26/93
2.1	Gizzard Shad	8	2	63	2	1	n	8:00AM	10/26/93
[illegible].1	Gizzard Shad	8	3	70	2	1	n	8:00AM	10/26/93
[illegible].1	Green Sunfish	21	1	69	4	1	n	8:00AM	10/26/93
2.1	Threadfin Shad	22	1	67	2	1	n	8:00AM	10/26/93
2.1	Threadfin Shad	22	2	64	2	1	n	8:00AM	10/26/93
2.1	Threadfin Shad	22	3	60	1	1	n	8:00AM	10/26/93
2.1	Threadfin Shad	22	4	68	2	1	n	8:00AM	10/26/93
2.1	Threadfin Shad	22	5	65	2	1	n	8:00AM	10/26/93
2.1	Threadfin Shad	22	6	75	3	1	n	8:00AM	10/26/93
2.1	Threadfin Shad	22	7	68	2	1	n	8:00AM	10/26/93
2.1	Threadfin Shad	22	8	77	3	1	n	8:00AM	10/26/93
2.1	Threadfin Shad	22	9	65	2	1	n	8:00AM	10/26/93
2.1	Threadfin Shad	22	10	56	1	1	n	8:00AM	10/26/93
3.2	Inland Silverside	27	1	56	1	ND	d	8:00PM	11/2/93
3.2	Threadfin Shad	22	1	82	4	ND	d	8:00PM	11/2/93
3.2	Threadfin Shad	22	2	62	2	ND	d	8:00PM	11/2/93
3.1	Bluegill Sunfish	12	1	55	2	1	n	8:00AM	11/2/93
3.1	Bluegill Sunfish	12	2	57	3	1	n	8:00AM	11/2/93
3.1	Bluegill Sunfish	12	3	54	2	1	n	8:00AM	11/2/93
3.1	Bluegill Sunfish	12	4	53	2	1	n	8:00AM	11/2/93
3.1	Bluegill Sunfish	12	5	58	3	1	n	8:00AM	11/2/93
3.1	Bluegill Sunfish	12	6	47	2	1	n	8:00AM	11/2/93
3.1	Bluegill Sunfish	12	7	76	6	1	n	8:00AM	11/2/93
3.1	Bluegill Sunfish	12	8	68	4	1	n	8:00AM	11/2/93
3.1	Bluegill Sunfish	12	9	98	17	1	n	8:00AM	11/2/93
[illegible]1	Bluegill Sunfish	12	10	150	59	1	n	8:00AM	11/2/93

3.1	Gizzard Shad	8	1	77	3	1	n	8:00AM	11/2/93
.1	Green Sunfish	21	1	76	6	1	n	8:00AM	11/2/93
3.1	Green Sunfish	21	2	81	9	1	n	8:00AM	11/2/93
3.1	Threadfin Shad	22	1	88	5	1	n	8:00AM	11/2/93
3.1	Threadfin Shad	22	2	74	3	1	n	8:00AM	11/2/93
3.1	Threadfin Shad	22	3	73	3	1	n	8:00AM	11/2/93
3.1	Threadfin Shad	22	4	80	4	1	n	8:00AM	11/2/93
3.1	Threadfin Shad	22	5	90	6	1	n	8:00AM	11/2/93
3.1	Threadfin Shad	22	6	69	2	1	n	8:00AM	11/2/93
3.1	Threadfin Shad	22	7	69	3	1	n	8:00AM	11/2/93
3.1	Threadfin Shad	22	8	75	3	1	n	8:00AM	11/2/93
3.1	Threadfin Shad	22	9	70	3	1	n	8:00AM	11/2/93
3.1	Threadfin Shad	22	10	68	3	1	n	8:00AM	11/2/93
3.1	Threadfin Shad	22	11	76	4	1	n	8:00AM	11/2/93
4.2	Gizzard Shad	8	1	396	423	1	d	8:00PM	11/9/93
4.2	Threadfin Shad	22	1	81	4	1	d	8:00PM	11/9/93
4.2	Threadfin Shad	22	2	66	2	1	d	8:00PM	11/9/93
4.2	Threadfin Shad	22	3	75	2	1	d	8:00PM	11/9/93
4.2	Threadfin Shad	22	4	68	2	1	d	8:00PM	11/9/93
4.1	Threadfin Shad	22	1	60	1	ND	n	8:00AM	11/9/93
4.1	Threadfin Shad	22	2	70	3	ND	n	8:00AM	11/9/93
5.2	Bluegill Sunfish	12	1	43	1	ND	d	8:00PM	11/16/93
5.2	Bluegill Sunfish	12	2	34	1	ND	d	8:00PM	11/16/93
5.2	Threadfin Shad	22	1	90	6	ND	d	8:00PM	11/16/93
2	Threadfin Shad	22	2	94	6	ND	d	8:00PM	11/16/93
2	Threadfin Shad	22	3	77	3	ND	d	8:00PM	11/16/93
5.2	Threadfin Shad	22	4	75	3	ND	d	8:00PM	11/16/93
5.2	Threadfin Shad	22	5	74	3	ND	d	8:00PM	11/16/93
5.1	Bluegill Sunfish	12	1	61	3	ND	n	8:00AM	11/16/93
5.1	Bluegill Sunfish	12	2	63	3	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	1	121	18	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	2	97	6	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	3	91	5	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	4	87	5	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	5	82	5	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	6	76	3	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	7	88	5	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	8	85	5	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	9	75	3	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	10	79	4	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	11	73	3	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	12	72	2	ND	n	8:00AM	11/16/93
5.1	Threadfin Shad	22	13	75	3	ND	n	8:00AM	11/16/93
5.1	White Bass	3	1	374	519	3	n	8:00AM	11/16/93
5.1	White Bass	3	2	350	444	2	n	8:00AM	11/16/93
6.2	Threadfin Shad	22	1	86	4	1	d	8:00PM	11/23/93
6.1	Bluegill Sunfish	12	1	44	1	1	n	8:00AM	11/23/93
6.1	Largemouth Bass	1	1	115	5	1	n	8:00AM	11/23/93
1	Threadfin Shad	22	1	84	4	1	n	8:00AM	11/23/93

6.1	Threadfin Shad	22	2	83	4	1	n	8:00AM	11/23/93
.1	Threadfin Shad	22	3	78	4	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	4	97	7	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	5	71	2	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	6	74	3	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	7	83	3	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	8	80	4	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	9	82	4	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	10	84	5	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	11	75	3	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	12	69	2	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	13	85	4	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	14	75	3	1	n	8:00AM	11/23/93
6.1	Threadfin Shad	22	15	81	3	1	n	8:00AM	11/23/93
7.2	Bluegill Sunfish	12	1	66	4	1	d	8:00PM	11/30/93
7.2	Bluegill Sunfish	12	2	48	2	1	d	8:00PM	11/30/93
7.2	Bluegill Sunfish	12	3	62	3	1	d	8:00PM	11/30/93
7.1	Bluegill Sunfish	12	1	55	2	1	n	8:00AM	11/30/93
7.1	Bluegill Sunfish	12	2	72	5	1	n	8:00AM	11/30/93
7.1	Bluegill Sunfish	12	3	51	2	1	n	8:00AM	11/30/93
7.1	Gizzard Shad	8	1	70	2	1	n	8:00AM	11/30/93
7.1	Threadfin Shad	22	1	77	3	1	n	8:00AM	11/30/93
7.1	Threadfin Shad	22	2	81	4	1	n	8:00AM	11/30/93
7.1	Threadfin Shad	22	3	67	2	1	n	8:00AM	11/30/93
7.1	Threadfin Shad	22	4	70	2	1	n	8:00AM	11/30/93
.1	Threadfin Shad	22	5	79	4	1	n	8:00AM	11/30/93
7.1	Threadfin Shad	22	6	80	3	1	n	8:00AM	11/30/93
7.1	Threadfin Shad	22	7	81	4	1	n	8:00AM	11/30/93
7.1	Threadfin Shad	22	8	75	3	1	n	8:00AM	11/30/93
7.1	Threadfin Shad	22	9	83	4	1	n	8:00AM	11/30/93
7.1	Threadfin Shad	22	10	83	3	1	n	8:00AM	11/30/93
7.1	Threadfin Shad	22	11	72	3	1	n	8:00AM	11/30/93
7.1	Threadfin Shad	22	12	79	3	1	n	8:00AM	11/30/93
8.2	Gizzard Shad	8	1	126	15	1	d	6:00PM	12/9/93
8.2	Gizzard Shad	8	2	77	3	1	d	6:00PM	12/9/93
8.2	Inland Silverside	27	1	71	2	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	1	84	4	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	2	77	3	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	3	105	8	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	4	77	4	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	5	71	2	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	6	76	2	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	7	75	2	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	8	79	4	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	9	81	4	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	10	73	2	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	11	80	4	1	d	6:00PM	12/9/93
8.2	Threadfin Shad	22	12	78	3	1	d	6:00PM	12/9/93
2	Threadfin Shad	22	13	79	4	1	d	6:00PM	12/9/93

8.2	Threadfin Shad	22	14	86	5	1	d	6:00PM	12/9/93
.2	Threadfin Shad	22	15	80	4	1	d	6:00PM	12/9/93
3.1	Bluegill Sunfish	12	1	53	2	1	n	8:00AM	12/9/93
8.1	Bluegill Sunfish	12	2	123	21	1	n	8:00AM	12/9/93
8.1	Bluegill Sunfish	12	3	120	25	1	n	8:00AM	12/9/93
8.1	Bluegill Sunfish	12	4	128	26	1	n	8:00AM	12/9/93
8.1	Gizzard Shad	8	1	69	2	1	n	8:00AM	12/9/93
8.1	Gizzard Shad	8	2	79	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	1	90	5	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	2	81	4	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	3	90	5	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	4	83	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	5	93	6	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	6	84	4	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	7	79	4	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	8	80	4	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	9	78	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	10	73	2	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	11	76	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	12	75	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	13	74	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	14	77	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	15	61	2	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	16	80	4	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	17	77	3	1	n	8:00AM	12/9/93
1	Threadfin Shad	22	18	74	3	1	n	8:00AM	12/9/93
.1	Threadfin Shad	22	19	79	4	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	20	78	4	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	21	75	2	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	22	78	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	23	72	2	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	24	80	4	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	25	78	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	26	86	5	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	27	75	2	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	28	90	4	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	29	70	2	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	30	91	5	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	31	86	5	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	32	95	5	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	33	79	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	34	82	4	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	35	78	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	36	78	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	37	75	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	38	72	3	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	39	87	5	1	n	8:00AM	12/9/93
8.1	Threadfin Shad	22	40	74	3	1	n	8:00AM	12/9/93
2	Bluegill Sunfish	12	1	54	2	1	d	5:00PM	12/16/93

9.2	Threadfin Shad	22	1	76	3	1	d	5:00PM	12/16/93
9.1	Bluegill Sunfish	12	1	61	3	1	n	8:00AM	12/16/93
9.1	Bluegill Sunfish	12	2	57	3	1	n	8:00AM	12/16/93
9.1	Bluegill Sunfish	12	3	61	3	1	n	8:00AM	12/16/93
9.1	Gizzard Shad	8	1	89	4	1	n	8:00AM	12/16/93
9.1	Gizzard Shad	8	2	80	3	1	n	8:00AM	12/16/93
9.1	Gizzard Shad	8	3	70	2	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	1	85	5	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	2	86	4	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	3	83	4	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	4	75	2	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	5	87	4	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	6	86	4	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	7	78	3	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	8	69	2	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	9	97	6	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	10	78	4	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	11	84	4	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	12	77	4	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	13	85	3	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	14	87	4	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	15	74	2	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	16	85	5	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	17	84	4	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	18	80	3	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	19	86	4	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	20	84	3	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	21	83	3	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	22	86	4	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	23	68	2	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	24	83	3	1	n	8:00AM	12/16/93
9.1	Threadfin Shad	22	25	75	2	1	n	8:00AM	12/16/93
10.2	Bluegill Sunfish	12	1	48	1	1	d	8:00PM	1/6/94
10.2	Bluegill Sunfish	12	2	51	2	1	d	8:00PM	1/6/94
10.2	Bluegill Sunfish	12	3	52	2	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	1	76	2	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	2	77	3	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	3	75	2	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	4	87	4	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	5	84	4	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	6	85	4	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	7	99	7	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	8	83	3	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	9	77	3	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	10	81	3	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	11	78	3	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	12	82	3	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	13	85	4	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	14	93	4	1	d	8:00PM	1/6/94

10.2	Threadfin Shad	22	15	82	4	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	16	88	4	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	17	81	3	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	18	105	6	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	19	90	4	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	20	91	5	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	21	95	7	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	22	91	4	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	23	80	2	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	24	94	5	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	25	88	4	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	26	78	2	1	d	8:00PM	1/6/94
10.2	Threadfin Shad	22	27	77	2	1	d	8:00PM	1/6/94
10.1	Bluegill Sunfish	12	1	85	8	1	n	9:00AM	1/6/94
10.1	Bluegill Sunfish	12	2	78	7	1	n	9:00AM	1/6/94
10.1	Bluegill Sunfish	12	3	70	6	1	n	9:00AM	1/6/94
10.1	Bluegill Sunfish	12	4	102	16	1	n	9:00AM	1/6/94
10.1	Bluegill Sunfish	12	5	53	2	1	n	9:00AM	1/6/94
10.1	Bluegill Sunfish	12	6	70	4	1	n	9:00AM	1/6/94
10.1	Bluegill Sunfish	12	7	50	2	1	n	9:00AM	1/6/94
10.1	Bluegill Sunfish	12	8	46	2	1	n	9:00AM	1/6/94
10.1	Bluegill Sunfish	12	9	40	1	1	n	9:00AM	1/6/94
10.1	Bluegill Sunfish	12	10	80	8	1	n	9:00AM	1/6/94
10.1	Green Sunfish	21	1	79	1	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	1	103	6	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	2	74	2	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	3	78	2	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	4	96	5	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	5	86	3	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	6	77	2	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	7	85	4	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	8	83	3	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	9	91	5	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	10	90	4	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	11	83	4	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	12	84	4	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	13	71	2	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	14	112	9	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	15	82	4	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	16	76	3	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	17	94	5	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	18	79	3	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	19	85	3	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	20	83	3	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	21	93	7	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	22	86	4	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	23	86	3	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	24	82	3	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	25	95	4	1	n	9:00AM	1/6/94

10.1	Threadfin Shad	22	26	69	2	1	n	9:00AM	1/6/94
0.1	Threadfin Shad	22	27	86	4	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	28	71	2	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	29	98	6	1	n	9:00AM	1/6/94
10.1	Threadfin Shad	22	30	86	3	1	n	9:00AM	1/6/94
11.2	Bluegill Sunfish	12	1	201	180	3	d	4:30PM	1/13/94
11.2	Bluegill Sunfish	12	2	50	1	1	d	4:30PM	1/13/94
11.2	Threadfin Shad	22	1	94	5	1	d	4:30PM	1/13/94
11.2	Threadfin Shad	22	2	88	4	1	d	4:30PM	1/13/94
11.2	Threadfin Shad	22	3	84	3	1	d	4:30PM	1/13/94
11.1	Warmouth Sunfish	16	1	111	20	1	d	8:00 AM	1/13/94
11.1	Bluegill Sunfish	12	1	44	1	1	n	8:00 AM	1/13/94
11.1	Threadfin Shad	22	1	82	4	1	n	8:00 AM	1/13/94
11.1	Threadfin Shad	22	2	93	4	1	n	8:00 AM	1/13/94
11.1	Threadfin Shad	22	3	80	3	1	n	8:00 AM	1/13/94
11.1	Threadfin Shad	22	4	86	3	1	n	8:00 AM	1/13/94
11.1	Threadfin Shad	22	5	82	3	1	n	8:00 AM	1/13/94
11.1	Threadfin Shad	22	6	92	4	1	n	8:00 AM	1/13/94
11.1	Threadfin Shad	22	7	88	3	1	n	8:00 AM	1/13/94
12.2	Bluegill Sunfish	12	1	54	2	1	d	4:30 PM	1/20/94
12.2	Threadfin Dhad	22	1	80	3	1	d	4:30 PM	1/20/94
12.1	Bluegill Sunfish	12	1	78	6	1	n	8:15 AM	1/20/94
12.1	Bluegill Sunfish	12	2	83	9	1	n	8:15 AM	1/20/94
12.1	Bluegill Sunfish	12	3	49	1	1	n	8:15 AM	1/20/94
2.1	Bluegill Sunfish	12	4	47	2	1	n	8:15 AM	1/20/94
2.1	Channel Catfish	7	1	102	9	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	1	78	3	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	2	80	3	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	3	86	5	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	4	69	2	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	5	81	4	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	6	88	4	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	7	79	3	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	8	90	4	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	9	94	5	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	10	85	4	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	11	93	5	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	12	88	4	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	13	86	3	1	n	8:15 AM	1/20/94
12.1	Threadfin Shad	22	14	82	3	1	n	8:30AM	1/20/94
13.1	Bluegill Sunfish	12	1	190	118	2	n	8:30AM	1/27/94
13.1	Bluegill Sunfish	12	2	129	34	1	n	8:30AM	1/27/94
13.1	Bluegill Sunfish	12	3	134	42	1	n	8:30AM	1/27/94
13.1	Bluegill Sunfish	12	4	62	3	1	n	8:30AM	1/27/94
13.1	Bluegill Sunfish	12	5	54	2	1	n	8:30AM	1/27/94
13.2	Bluegill Sunfish	12	1	161	66	1	n	8:30AM	1/27/94
13.1	Gizzard Shad	8	1	261	164	1	n	8:30AM	1/27/94
13.1	Threadfin Shad	22	1	77	4	1	n	8:30AM	1/27/94
3.2	Threadfin Shad	22	1	78	4	1	n	8:30AM	1/27/94

14.2	No fish			N/A	N/A	N/A	d	8:00 PM	2/2/94
4.1	Bluegill Sunfish	12	1	140	38	1	n	8:45AM	2/2/94
14.1	Bluegill Sunfish	12	2	126	27	1	n	8:45AM	2/2/94
14.1	Bluegill Sunfish	12	3	82	9	1	n	8:45AM	2/2/94
14.1	Bluegill Sunfish	12	4	41	1	1	n	8:45AM	2/2/94
14.1	Bluegill Sunfish	12	5	53	1	1	n	8:45AM	2/2/94
14.1	Bluegill Sunfish	12	6	50	1	1	n	8:45AM	2/2/94
14.1	Threadfin Shad	22	1	86	3	1	n	8:45AM	2/2/94
14.1	Warmouth	16	1	87	8	1	n	8:45AM	2/2/94
15.2	No fish			N/A	N/A	N/A	d	6:00 PM	2/9/94
15.1	Bluegill Sunfish	12	1	54	NC	NC	n	8:00 AM	2/9/94
15.1	Bluegill Sunfish	12	2	105	NC	NC	n	8:00 AM	2/9/94
15.1	Bluegill Sunfish	12	3	144	NC	NC	n	8:00 AM	2/9/94
15.1	Bluegill Sunfish	12	4	93	NC	NC	n	8:00 AM	2/9/94
15.1	Bluegill Sunfish	12	5	111	NC	NC	n	8:00 AM	2/9/94
15.1	Bluegill Sunfish	12	6	55	NC	NC	n	8:00 AM	2/9/94
15.1	Threadfin Shad	22	1	98	NC	NC	n	8:00 AM	2/9/94
15.1	Threadfin Shad	22	2	89	NC	NC	n	8:00 AM	2/9/94
15.1	Threadfin Shad	22	3	76	NC	NC	n	8:00 AM	2/9/94
15.1	Threadfin Shad	22	4	80	NC	NC	n	8:00 AM	2/9/94
16.2	Bluegill Sunfish	12	1	50	1	1	d	5:00 PM	2/16/94
16.2	Bluegill Sunfish	12	2	110	17	1	d	5:00 PM	2/16/94
16.2	Threadfin Shad	22	1	85	3	1	d	5:00 PM	2/16/94
16.2	Threadfin Shad	22	2	93	4	1	d	5:00 PM	2/16/94
16.1	Channel Catfish	7	1	110	12	1	n	8:00 AM	2/16/94
6.1	Green Sunfish	21	1	59	3	1	n	8:00 AM	2/16/94
16.1	Largemouth Bass	1	1	136	20	1	n	8:00 AM	2/16/94
16.1	Threadfin Shad	22	1	89	4	1	n	8:00 AM	2/16/94
16.1	Threadfin Shad	22	2	102	8	1	n	8:00 AM	2/16/94
16.1	Threadfin Shad	22	3	93	4	1	n	8:00 AM	2/16/94
17.2	Bluegill Sunfish	12	1	131	37	1	d	4:50PM	2/23/94
17.2	Bluegill Sunfish	12	2	140	51	2	d	4:50PM	2/23/94
17.2	Green Sunfish	21	1	46	2	1	d	4:50PM	2/23/94
17.2	Inland Silversides	27	1	104	4	1	d	4:50PM	2/23/94
17.2	Threadfin Shad	22	1	83	2	1	d	4:50PM	2/23/94
17.1	Bluegill Sunfish	12	1	116	53	1	n	8:00 AM	2/23/94
17.1	Bluegill Sunfish	12	2	86	9	1	n	8:00 AM	2/23/94
17.1	Bluegill Sunfish	12	3	101	13	1	n	8:00 AM	2/23/94
17.1	Bluegill Sunfish	12	4	116	21	2	n	8:00 AM	2/23/94
17.1	Bluegill Sunfish	12	5	73	6	1	n	8:00 AM	2/23/94
17.1	Bluegill Sunfish	12	6	45	2	1	n	8:00 AM	2/23/94
17.1	Bluegill Sunfish	12	7	49	2	1	n	8:00 AM	2/23/94
17.1	Bluegill Sunfish	12	8	56	2	1	n	8:00 AM	2/23/94
17.1	Bluegill Sunfish	12	9	55	2	1	n	8:00 AM	2/23/94
17.1	Green Sunfish	21	1	58	3	1	n	8:00 AM	2/23/94
17.1	Inland Silversides	27	1	114	6	1	n	8:00 AM	2/23/94
17.1	Inland Silversides	27	2	112	6	1	n	8:00 AM	2/23/94
17.1	Threadfin Shad	22	1	83	2	1	n	8:00 AM	2/23/94
7.1	Threadfin Shad	22	2	85	4	1	n	8:00 AM	2/23/94

17.1	Threadfin Shad	22	3	73	2	1	n	8:00 AM	2/23/94
18.2	Inland Silverside	27	1	85	4	1	d	6:00 PM	3/2/94
18.1	Bluegill Sunfish	12	1	122	30	1	n	8:00 AM	3/2/94
18.1	Bluegill Sunfish	12	2	89	10	1	n	8:00 AM	3/2/94
18.1	Bluegill Sunfish	12	3	66	4	1	n	8:00 AM	3/2/94
18.1	Freshwater Drum	17	1	250	169	1	n	8:00 AM	3/2/94
18.1	Green Sunfish	21	1	80	8	1	n	8:00 AM	3/2/94
18.1	Inland Silversides	27	1	104	6	1	n	8:00 AM	3/2/94
18.1	Inland Silversides	27	2	112	8	1	n	8:00 AM	3/2/94
18.1	Threadfin Shad	22	1	76	3	1	n	8:00 AM	3/2/94
18.1	Threadfin Shad	22	2	76	3	1	n	8:00 AM	3/2/94
18.1	Threadfin Shad	22	3	87	5	1	n	8:00 AM	3/2/94
18.1	Threadfin Shad	22	4	82	3	1	n	8:00 AM	3/2/94
18.1	White Bass	3	1	351	359	3	n	8:00 AM	3/2/94
19.2	Gizzard Shad	8	1	306	166	1	d	4:45 PM	3/9/94
19.2	Threadfin Shad	22	1	76	2	1	d	4:45 PM	3/9/94
19.1	Bluegill Sunfish	12	1	75	6	1	n	8:00 AM	3/9/94
19.1	Gizzard Shad	8	1	407	429	3	n	8:00 AM	3/9/94
19.1	Green Sunfish	21	1	104	17	1	n	8:00 AM	3/9/94
19.1	Threadfin Shad	22	1	89	5	1	n	8:00 AM	3/9/94
19.1	Threadfin Shad	22	2	102	4	1	n	8:00 AM	3/9/94
20.2	Inland Silverside	27	1	110	6	1	d	5:00 PM	3/16/94
20.2	Threadfin Shad	22	1	110	10	1	d	5:00 PM	3/16/94
20.2	Threadfin Shad	22	2	101	7	1	d	5:00 PM	3/16/94
20.2	Threadfin Shad	22	3	86	4	1	d	5:00 PM	3/16/94
0.1	Bluegill Sunfish	12	1	165	84	3	n	8:15 AM	3/16/94
20.1	Bluegill Sunfish	12	2	153	70	3	n	8:15 AM	3/16/94
20.1	Bluegill Sunfish	12	3	50	62	1	n	8:15 AM	3/16/94
20.1	Bluegill Sunfish	12	4	119	24	1	n	8:15 AM	3/16/94
20.1	Golden Shiner	19	1	73	2	1	n	8:15 AM	3/16/94
20.1	Golden Shiner	19	2	73	2	1	n	8:15 AM	3/16/94
20.1	Golden Shiner	19	3	72	3	1	n	8:15 AM	3/16/94
20.1	Inland Silverside	27	1	106	5	1	n	8:15 AM	3/16/94
20.1	Inland Silverside	27	2	94	4	1	n	8:15 AM	3/16/94
20.1	Threadfin Shad	22	1	99	6	1	n	8:15 AM	3/16/94
20.1	Threadfin Shad	22	2	101	8	1	n	8:15 AM	3/16/94
20.1	Threadfin Shad	22	3	105	8	1	n	8:15 AM	3/16/94
20.1	Threadfin Shad	22	4	90	6	1	n	8:15 AM	3/16/94
20.1	Threadfin Shad	22	5	89	6	1	n	8:15 AM	3/16/94
21.2	Bluegill Sunfish	12	1	112	19	1	d	4:00 PM	3/23/94
21.2	Threadfin Shad	22	1	85	4	1	d	4:00 PM	3/23/94
21.1	Bluegill Sunfish	12	1	120	24	1	n	8:00 AM	3/23/94
21.1	Bluegill Sunfish	12	2	106	15	1	n	8:00 AM	3/23/94
21.1	Bluegill Sunfish	12	3	73	6	1	n	8:00 AM	3/23/94
21.1	Bluegill Sunfish	12	4	53	2	1	n	8:00 AM	3/23/94
21.1	Green Sunfish	21	1	48	2	1	n	8:00 AM	3/23/94
21.1	Green Sunfish	21	2	78	6	1	n	8:00 AM	3/23/94
21.1	Green Sunfish	21	3	75	5	1	n	8:00 AM	3/23/94
1.1	Threadfin Shad	22	1	93	6	1	n	8:00 AM	3/23/94

21.1	Threadfin Shad	22	2	85	4	1	n	8:00 AM	3/23/94
21.1	Threadfin Shad	22	3	92	6	1	n	8:00 AM	3/23/94
21.1	Threadfin Shad	22	4	88	5	1	n	8:00 AM	3/23/94
22.1	Gizzard Shad	8	1	375	340	1	n	8:00AM	3/30/94
22.1	Threadfin Shad	22	1	88	4	1	n	8:00AM	3/30/94
22.1	Bluegill Sunfish	12	1	63	3	1	n	8:00AM	3/30/94
22.1	Bluegill Sunfish	12	2	58	3	1	n	8:00AM	3/30/94
22.1	Bluegill Sunfish	12	3	51	2	1	n	8:00AM	3/30/94
22.1	Bluegill Sunfish	12	4	57	3	1	n	8:00AM	3/30/94
22.1	Bluegill Sunfish	12	5	74	6	1	n	8:00AM	3/30/94
22.1	Bluegill Sunfish	12	6	123	27	1	n	8:00AM	3/30/94
22.1	Bluegill Sunfish	12	7	85	8	1	n	8:00AM	3/30/94
22.1	Warmouth	16	1	111	17	1	n	8:00AM	3/30/94
22.1	Green Sunfish	21	1	102	14	1	n	8:00AM	30-Mar
22.1	Green Sunfish	21	2	82	7	1	n	8:00AM	3/30/94
22.2	Bluegill Sunfish	12	1	68	4	1	d	5:00PM	3/30/94
22.2	Bluegill Sunfish	12	2	55	2	1	d	5:00PM	3/30/94
22.2	Bluegill Sunfish	12	3	56	2	1	d	5:00PM	3/30/94
22.2	Gizzard Shad	8	1	340	231	1	d	5:00PM	3/30/94
23.2	Bluegill Sunfish	12	1	50	2	1	d	8:15 PM	4/6/94
23.2	Bluegill Sunfish	12	2	51	2	1	d	8:15 PM	4/6/94
23.2	Gizzard Shad	8	1	236	69	1	d	8:15 PM	4/6/94
23.2	Warmouth	16	1	80	7	1	d	8:15 PM	4/6/94
23.1	Bluegill Sunfish	12	1	139	32	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	2	128	30	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	3	69	4	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	4	63	3	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	5	49	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	6	68	4	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	7	82	8	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	8	67	4	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	9	50	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	10	69	4	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	11	92	11	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	12	62	4	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	13	54	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	14	49	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	15	76	6	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	16	87	8	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	17	68	5	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	18	59	3	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	19	38	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	20	73	6	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	21	64	4	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	22	54	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	23	70	4	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	24	113	18	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	25	56	2	1	n	8:15 AM	4/6/94
3.1	Bluegill Sunfish	12	26	53	2	1	n	8:15 AM	4/6/94

23.1	Bluegill Sunfish	12	27	53	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	28	69	4	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	29	50	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	30	56	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	31	50	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	32	52	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	33	63	4	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	34	82	6	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	35	65	4	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	36	64	3	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	37	98	9	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	38	60	3	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	39	108	21	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	40	78	6	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	41	87	9	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	42	53	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	43	63	3	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	44	64	4	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	45	50	2	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	46	114	21	1	n	8:15 AM	4/6/94
23.1	Bluegill Sunfish	12	47	42	1	1	n	8:15 AM	4/6/94
23.1	Channel Catfish	12	1	154	29	1	n	8:15 AM	4/6/94
23.1	Green Sunfish	7	1	49	2	1	n	8:15 AM	4/6/94
23.1	Inland Silverside	27	1	107	5	1	n	8:15 AM	4/6/94
23.1	Inland Silverside	27	2	118	7	1	n	8:15 AM	4/6/94
23.1	Inland Silverside	27	3	114	7	1	n	8:15 AM	4/6/94
23.1	Longear Sunfish	21	1	107	24	1	n	8:15 AM	4/6/94
23.1	Threadfin Shad	22	1	92	6	1	n	8:15 AM	4/6/94
24.2	Bluegill Sunfish	12	1	134	38	1	d	8:15 PM	4/20/94
24.2	Bluegill Sunfish	12	2	69	5	1	d	8:15 PM	4/20/94
24.2	Gizzard Shad	8	1	112	10	1	d	8:15 PM	4/20/94
24.2	Gizzard Shad	8	2	114	11	1	d	8:15 PM	4/20/94
24.2	Gizzard Shad	8	3	337	286	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	1	96	6	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	2	97	6	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	3	84	5	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	4	96	6	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	5	93	5	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	6	87	4	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	7	92	5	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	8	88	4	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	9	86	5	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	10	84	4	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	11	95	7	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	12	95	6	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	13	96	7	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	14	108	10	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	15	86	4	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	16	85	4	1	d	8:15 PM	4/20/94

24.2	Threadfin Shad	22	17	86	5	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	18	112	9	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	19	87	5	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	20	85	4	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	21	95	7	1	d	8:15 PM	4/20/94
24.2	Threadfin Shad	22	22	86	4	1	d	8:15 PM	4/20/94
24.2	White Crappie	24	1	315	479	3	d	8:15 PM	4/20/94
24.1	Bluegill Sunfish	12	1	120	24	1	n	8:00 AM	4/20/94
24.1	Bluegill Sunfish	12	2	87	9	1	n	8:00 AM	4/20/94
24.1	Bluegill Sunfish	12	3	190	137	1	n	8:00 AM	4/20/94
24.1	Green Sunfish	21	1	78	7	1	n	8:00 AM	4/20/94
24.1	Green Sunfish	21	2	67	5	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	1	93	6	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	2	105	8	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	3	88	4	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	4	102	8	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	5	93	7	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	6	101	7	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	7	85	5	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	8	91	6	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	9	90	5	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	10	93	6	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	11	90	5	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	12	84	4	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	13	91	6	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	14	92	6	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	15	87	6	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	16	89	5	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	17	89	5	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	18	89	5	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	19	85	4	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	20	91	5	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	21	87	5	1	n	8:00 AM	4/20/94
24.1	Threadfin Shad	22	22	87	5	1	n	8:00 AM	4/20/94
25.2	Bluegill Sunfish	12	1	131	42	1	d	8:00 PM	5/4/94
25.2	Gizzard Shad	8	1	319	274	1	d	8:00 PM	5/4/94
25.2	Gizzard Shad	8	2	332	284	2	d	8:00 PM	5/4/94
25.2	Gizzard Shad	8	3	167	32	3	d	8:00 PM	5/4/94
25.2	Gizzard Shad	8	4	356	243	1	d	8:00 PM	5/4/94
25.2	Threadfin Shad	22	1	96	7	1	d	8:00 PM	5/4/94
25.1	Gizzard Shad	8	1	155	26	1	n	8:00 AM	5/4/94
25.1	Gizzard Shad	8	2	129	14	1	n	8:00 AM	5/4/94
25.1	Gizzard Shad	8	3	137	16	1	n	8:00 AM	5/4/94
25.1	Gizzard Shad	8	4	142	19	1	n	8:00 AM	5/4/94
25.1	Gizzard Shad	8	5	139	18	1	n	8:00 AM	5/4/94
26.1	Green Sunfish	21	1	54	2	1	n	8:00 AM	5/18/94
26.1	Green Sunfish	21	2	51	2	1	n	8:00 AM	5/18/94
26.1	Green Sunfish	21	3	49	2	1	n	8:00 AM	5/18/94
26.1	Green Sunfish	21	4	48	2	1	n	8:00 AM	5/18/94

26.1	Green Sunfish	21	5	57	3	1	n	8:00 AM	5/18/94
6.1	Green Sunfish	21	6	27	1	1	n	8:00 AM	5/18/94
26.1	Green Sunfish	21	7	57	2	1	n	8:00 AM	5/18/94
26.1	Inland Silverside	27	1	96	4	1	n	8:00 AM	5/18/94
26.1	Inland Silverside	27	2	111	6	1	n	8:00 AM	5/18/94
26.1	Inland Silverside	27	3	55	1	1	n	8:00 AM	5/18/94
26.1	Largemouth Bass	1	1	60	2	1	n	8:00 AM	5/18/94
26.1	Largemouth Bass	1	2	51	2	1	n	8:00 AM	5/18/94
26.1	Largemouth Bass	1	3	63	2	1	n	8:00 AM	5/18/94
26.1	Largemouth Bass	1	4	38	1	1	n	8:00 AM	5/18/94
26.1	Largemouth Bass	1	5	54	2	1	n	8:00 AM	5/18/94
26.1	Largemouth Bass	1	6	55	1	1	n	8:00 AM	5/18/94
26.1	Largemouth Bass	1	7	45	1	1	n	8:00 AM	5/18/94
26.1	Longear Sunfish	11	1	135	68	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	1	87	4	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	2	89	5	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	3	90	4	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	4	112	7	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	5	93	4	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	6	85	4	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	7	92	5	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	8	85	4	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	9	93	5	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	10	85	4	1	n	8:00 AM	5/18/94
6.1	Threadfin Shad	22	11	107	8	1	n	8:00 AM	5/18/94
6.1	Threadfin Shad	22	12	93	3	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	13	95	5	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	14	103	8	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	15	108	7	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	16	88	4	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	17	102	7	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	18	85	4	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	19	102	9	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	20	105	6	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	21	85	4	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	22	83	4	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	23	89	5	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	24	91	4	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	22	25	85	4	1	n	8:00 AM	5/18/94
26.1	Threadfin Shad	26 out of 7		85	3	1	n	8:00AM	5/18/94
26.1	Bluegill Sunfish	12	1	164	85	2	n	8:00AM	5/18/94
26.1	Bluegill Sunfish	12	2	173	95	3	n	8:00AM	5/18/94
26.1	Bluegill Sunfish	12	3	137	37	1	n	8:00AM	5/18/94
26.1	Bluegill Sunfish	12	4	120	27	1	n	8:00AM	5/18/94
26.1	Bluegill Sunfish	12	5	47	2	1	n	8:00AM	5/18/94
26.1	F.W. Drum	17	1	273	208	3	n	8:00AM	5/18/94
26.1	Gizzard Shad	8	1	166	30	1	n	8:00AM	5/18/94
26.2	Gizzard Shad	8	1	307	223	1	d	8:15PM	5/18/94
6.2	Gizzard Shad	8	2	149	18	1	d	8:15PM	5/18/94

26.2	Threadfin Shad	22	1	72	2	1	d	8:15PM	5/18/94
6.2	Threadfin Shad	22	2	92	4	1	d	8:15PM	5/18/94
26.2	Threadfin Shad	22	3	98	4	1	d	8:15PM	5/18/94
26.2	Threadfin Shad	22	4	99	5	1	d	8:15PM	5/18/94
26.2	Threadfin Shad	22	5	92	5	1	d	8:15PM	5/18/94
26.2	Threadfin Shad	22	6	92	4	1	d	8:15PM	5/18/94
26.2	Threadfin Shad	22	7	96	5	1	d	8:15PM	5/18/94
26.2	Threadfin Shad	22	8	95	5	1	d	8:15PM	5/18/94
26.2	Threadfin Shad	22	9	93	4	1	d	8:15PM	5/18/94
26.2	Threadfin Shad	22	10	92	4	1	d	8:15PM	5/18/94
26.2	Largemouth Bass	1	1	67	3	1	d	8:15PM	5/18/94
26.2	Largemouth Bass	1	2	49	1	1	d	8:15PM	5/18/94
26.2	Bluegill Sunfish	12	1	190	158	3	d	8:15PM	5/18/94
26.2	Bluegill Sunfish	12	2	190	152	3	d	8:15PM	5/18/94
26.2	Bluegill Sunfish	12	3	177	106	2	d	8:15PM	5/18/94
26.2	White Bass	3	1	340	386	3	d	8:15PM	5/18/94
27.2	Bluegill Sunfish	12	1	60	3	1	d	8:15 PM	6/1/94
27.2	Bluegill Sunfish	12	2	146	55	1	d	8:15 PM	6/1/94
27.2	Bluegill Sunfish	12	3	67	5	1	d	8:15 PM	6/1/94
27.2	Bluegill Sunfish	12	4	82	8	1	d	8:15 PM	6/1/94
27.2	Bluegill Sunfish	12	5	69	5	1	d	8:15 PM	6/1/94
27.2	Bluegill Sunfish	12	6	201	184	1	d	8:15 PM	6/1/94
27.2	Bluegill Sunfish	12	7	175	104	1	d	8:15 PM	6/1/94
27.2	Bluegill Sunfish	12	8	210	232	1	d	8:15 PM	6/1/94
7.2	Bluegill Sunfish	12	9	168	86	1	d	8:15 PM	6/1/94
7.2	Bluegill Sunfish	12	10	149	61	1	d	8:15 PM	6/1/94
27.2	Gizzard Shad	8	1	385	316	1	d	8:15 PM	6/1/94
27.2	Gizzard Shad	8	2	281	148	1	d	8:15 PM	6/1/94
27.2	Gizzard Shad	8	3	104	6	1	d	8:15 PM	6/1/94
27.2	Green Sunfish	12	1	49	2	1	d	8:15 PM	6/1/94
27.2	Green Sunfish	12	2	43	1	1	d	8:15 PM	6/1/94
27.2	Green Sunfish	21	3	41	1	1	d	8:15 PM	6/1/94
27.2	Inland Silverside	27	1	53	1	1	d	8:15 PM	6/1/94
27.2	Inland Silverside	27	2	67	1	1	d	8:15 PM	6/1/94
27.2	Inland Silverside	27	3	46	1	1	d	8:15 PM	6/1/94
27.2	Inland Silverside	27	4	45	1	1	d	8:15 PM	6/1/94
27.2	Inland Silverside	27	5	43	1	1	d	8:15 PM	6/1/94
27.2	Largemouth Bass	1	1	63	3	1	d	8:15 PM	6/1/94
27.2	Largemouth Bass	1	2	51	2	1	d	8:15 PM	6/1/94
27.2	Threadfin Shad	22	1	26	1	1	d	8:15 PM	6/1/94
27.2	Threadfin Shad	22	2	39	1	1	d	8:15 PM	6/1/94
27.2	Threadfin Shad	22	3	46	1	1	d	8:15 PM	6/1/94
27.2	Threadfin Shad	22	4	47	1	1	d	8:15 PM	6/1/94
27.1	Bluegill Sunfish	12	1	170	105	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	2	152	65	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	3	136	37	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	4	104	20	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	5	130	36	1	n	8:20 AM	6/1/94
7.1	Bluegill Sunfish	12	6	95	16	1	n	8:20 AM	6/1/94

27.1	Bluegill Sunfish	12	7	95	12	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	8	83	9	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	9	93	12	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	10	80	8	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	11	68	5	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	12	72	6	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	13	62	4	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	14	58	3	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	15	52	2	1	n	8:20 AM	6/1/94
27.1	Bluegill Sunfish	12	16	47	1	1	n	8:20 AM	6/1/94
27.1	Gizzard Shad	8	1	294	158	1	n	8:20 AM	6/1/94
27.1	Gizzard Shad	8	2	91	4	1	n	8:20 AM	6/1/94
27.1	Green Sunfish	21	1	96	12	1	n	8:20 AM	6/1/94
27.1	Green Sunfish	21	2	66	5	1	n	8:20 AM	6/1/94
27.1	Green Sunfish	21	3	52	2	1	n	8:20 AM	6/1/94
27.1	Green Sunfish	21	4	53	2	1	n	8:20 AM	6/1/94
27.1	Green Sunfish	21	5	49	2	1	n	8:20 AM	6/1/94
27.1	Green Sunfish	21	6	53	2	1	n	8:20 AM	6/1/94
27.1	Green Sunfish	21	7	55	2	1	n	8:20 AM	6/1/94
27.1	Inland Silverside	27	1	64	1	1	n	8:20 AM	6/1/94
27.1	Inland Silverside	27	2	62	1	1	n	8:20 AM	6/1/94
27.1	Inland Silverside	27	3	54	1	1	n	8:20 AM	6/1/94
27.1	Inland Silverside	27	4	59	1	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	1	55	2	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	2	50	2	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	3	64	3	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	4	52	2	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	5	56	2	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	6	61	2	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	7	44	1	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	8	35	1	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	9	52	2	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	10	45	1	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	11	36	1	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	12	35	1	1	n	8:20 AM	6/1/94
27.1	Largemouth Bass	1	13	35	1	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	1	96	4	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	2	115	10	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	3	90	4	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	4	92	5	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	5	63	2	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	6	83	3	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	7	43	1	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	8	40	1	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	9	44	1	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	10	34	1	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	11	23	1	1	n	8:20 AM	6/1/94
27.1	Threadfin Shad	22	12	24	1	1	n	8:20 AM	6/1/94
3.2	Bluegill	12	1	64	4	1	d	8:00 PM	6/15/94

28.2	Bluegill	12	2	44	1	1	d	8:00 PM	6/15/94
28.2	Bluegill	12	3	105	20	1	d	8:00 PM	6/15/94
28.2	Bluegill	12	4	161	82	1	d	8:00 PM	6/15/94
28.2	Bluegill	12	5	193	182	1	d	8:00 PM	6/15/94
28.2	Channel Catfish	7	1	247	110	1	d	8:00 PM	6/15/94
28.2	Freshwater Drum	17	1	227	NC	1	d	8:00 PM	6/15/94
28.2	Inland Silverside	27	1	44	1	1	d	8:00 PM	6/15/94
28.2	Inland Silverside	27	2	62	2	1	d	8:00 PM	6/15/94
28.2	Inland Silverside	27	3	49	1	1	d	8:00 PM	6/15/94
28.2	Largemouth Bass	1	1	90	7	1	d	8:00 PM	6/15/94
28.2	Largemouth Bass	1	2	69	4	1	d	8:00 PM	6/15/94
28.2	Threadfin Shad	22	1	60	2	1	d	8:00 PM	6/15/94
28.2	Threadfin Shad	22	2	64	2	1	d	8:00 PM	6/15/94
28.2	Threadfin Shad	22	3	90	3	1	d	8:00 PM	6/15/94
28.2	Threadfin Shad	22	4	89	4	1	d	8:00 PM	6/15/94
28.2	Threadfin Shad	22	5	91	4	1	d	8:00 PM	6/15/94
28.1	Bluegill	12	1	79	9	1	n	8:00 AM	6/15/94
28.1	Bluegill	12	2	86	10	1	n	8:00 AM	6/15/94
28.1	Bluegill	12	3	109	20	1	n	8:00 AM	6/15/94
28.1	Bluegill	12	4	172	98	1	n	8:00 AM	6/15/94
28.1	Channel Catfish	7	1	44	1	1	n	8:00 AM	6/15/94
28.1	Inland Silverside	27	1	53	1	1	n	8:00 AM	6/15/94
28.1	Inland Silverside	27	2	71	2	1	n	8:00 AM	6/15/94
28.1	Inland Silverside	27	3	51	1	1	n	8:00 AM	6/15/94
28.1	Largemouth Bass	1	1	42	1	1	n	8:00 AM	6/15/94
28.1	Largemouth Bass	1	2	57	2	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	1	102	6	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	2	109	5	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	3	80	2	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	4	89	3	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	5	90	5	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	6	107	6	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	7	88	4	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	8	108	8	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	9	83	2	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	10	91	4	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	11	83	2	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	12	56	1	1	n	8:00 AM	6/15/94
28.1	Threadfin Shad	22	13	45	1	1	n	8:00 AM	6/15/94
29.2	Bluegill Sunfish	12	1	95	13	1	d	8:00 PM	6/29/94
29.2	Bluegill Sunfish	12	2	57	2	1	d	8:00 PM	6/29/94
29.2	Largemouth Bass	1	1	89	7	1	d	8:00 PM	6/29/94
29.2	Threadfin Shad	22	1	52	1	1	d	8:00 PM	6/29/94
29.2	Threadfin Shad	22	2	51	1	1	d	8:00 PM	6/29/94
29.2	Threadfin Shad	22	3	45	1	1	d	8:00 PM	6/29/94
29.2	Threadfin Shad	22	4	63	2	1	d	8:00 PM	6/29/94
29.1	Bluegill Sunfish	12	3	50	1	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	4	100	16	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	5	60	4	1	n	8:20 AM	6/29/94

29.1	Bluegill Sunfish	12	6	78	8	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	7	78	7	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	8	110	22	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	9	56	3	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	10	109	20	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	11	79	8	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	12	83	10	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	13	56	2	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	14	77	8	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	15	68	4	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	16	63	4	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	17	87	9	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	18	84	9	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	19	59	3	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	20	56	3	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	21	63	4	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	22	73	8	1	n	8:20 AM	6/29/94
29.1	Bluegill Sunfish	12	23	63	4	1	n	8:20 AM	6/29/94
29.1	Freshwater Drum	17	1	309	178	1	n	8:20 AM	6/29/94
29.1	Green Sunfish	21	1	78	8	1	n	8:20 AM	6/29/94
29.1	Inland Silverside	27	1	20	1	1	n	8:20 AM	6/29/94
29.1	Inland Silverside	27	2	45	1	1	n	8:20 AM	6/29/94
29.1	Inland Silverside	27	3	36	1	1	n	8:20 AM	6/29/94
29.1	Inland Silverside	27	4	64	1	1	n	8:20 AM	6/29/94
9.1	Inland Silverside	27	5	54	1	1	n	8:20 AM	6/29/94
9.1	Inland Silverside	27	6	47	1	1	n	8:20 AM	6/29/94
29.1	Largemouth Bass	1	1	68	4	1	n	8:20 AM	6/29/94
29.1	Largemouth Bass	1	2	42	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	1	100	6	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	2	46	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	3	38	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	4	56	2	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	5	54	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	6	65	2	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	7	47	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	8	84	4	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	9	74	3	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	10	53	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	11	89	4	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	12	55	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	13	96	6	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	14	54	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	15	50	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	16	47	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	17	44	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	18	50	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	19	85	2	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	20	58	1	1	n	8:20 AM	6/29/94
.1	Threadfin Shad	22	21	84	4	1	n	8:20 AM	6/29/94

29.1	Threadfin Shad	22	22	93	5	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	23	55	2	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	24	48	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	25	68	2	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	26	51	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	27	42	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	28	55	2	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	29	35	1	1	n	8:20 AM	6/29/94
29.1	Threadfin Shad	22	30	46	1	1	n	8:20 AM	6/29/94
29.1	Warmouth	16	1	88	11	1	n	8:20 AM	6/29/94
30.2	Bluegill Sunfish	12	1	163	96	1	d	8:20 PM	7/13/94
30.2	Bluegill Sunfish	12	2	179	84	1	d	8:20 PM	7/13/94
30.2	Bluegill Sunfish	12	3	130	46	1	d	8:20 PM	7/13/94
30.2	Bluegill Sunfish	12	4	111	28	1	d	8:20 PM	7/13/94
30.2	Bluegill Sunfish	12	5	84	10	1	d	8:20 PM	7/13/94
30.2	Channel Catfish	7	1	197	49	1	d	8:20 PM	7/13/94
30.2	Freshwater Drum	17	1	293	228	1	d	8:20 PM	7/13/94
30.2	Inland Silverside	27	1	73	2	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	1	50	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	2	50	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	3	42	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	4	54	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	5	47	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	6	60	2	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	7	47	1	1	d	8:20 PM	7/13/94
0.2	Threadfin Shad	22	8	57	2	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	9	53	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	10	51	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	11	43	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	12	49	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	13	46	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	14	53	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	15	48	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	16	48	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	17	54	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	18	56	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	19	49	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	20	53	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	21	47	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	22	35	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	23	49	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	24	54	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	25	44	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	26	54	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	27	50	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	28	48	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	29	41	1	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	30	44	1	1	d	8:20 PM	7/13/94
0.2	Threadfin Shad	22	31	84	4	1	d	8:20 PM	7/13/94

30.2	Threadfin Shad	22	32	93	3	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	33	114	9	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	34	88	3	1	d	8:20 PM	7/13/94
30.2	Threadfin Shad	22	35	64	2	1	d	8:20 PM	7/13/94
Note: The threadfin shad 1-30 represent a subsample of the total haul for the size classes identified.									
Total catch weight equals 45 g; total subsample weight equals 30 g.									
30.1	Bluegill Sunfish	12	1	53	2	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	2	41	1	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	3	43	1	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	4	75	6	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	5	87	11	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	6	97	17	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	7	93	12	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	8	89	10	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	9	72	6	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	10	63	5	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	11	82	8	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	12	77	7	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	13	78	8	1	n	8:15 AM	7/13/94
30.1	Bluegill Sunfish	12	14	59	3	1	n	8:15 AM	7/13/94
30.1	Inland Silverside	27	1	74	2	1	n	8:15 AM	7/13/94
30.1	Inland Silverside	27	2	60	1	1	n	8:15 AM	7/13/94
30.1	Inland Silverside	27	3	33	1	1	n	8:15 AM	7/13/94
30.1	Inland Silverside	27	4	32	4	1	n	8:15 AM	7/13/94
30.1	Largemouth Bass	1	1	76	4	1	n	8:15 AM	7/13/94
0.1	Largemouth Bass	1	2	59	2	1	n	8:15 AM	7/13/94
30.1	Largemouth Bass	1	3	55	2	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	1	73	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	2	89	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	3	93	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	4	90	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	5	94	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	6	113	6	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	7	92	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	8	88	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	9	85	3	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	10	82	3	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	11	84	3	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	12	98	2	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	13	93	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	14	87	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	15	105	5	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	16	121	9	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	17	85	3	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	18	99	5	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	19	95	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	20	91	3	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	21	113	7	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	22	67	3	1	n	8:15 AM	7/13/94

30.1	Threadfin Shad	22	23	87	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	24	94	3	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	25	92	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	26	88	4	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	27	63	2	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	28	90	3	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	29	91	2	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	30	86	3	1	n	8:15 AM	7/13/94
Note: The above thirty threadfin shad represent a subsample of the total haul collected of this species									
size group. Total mass of the the haul was 151 g and mass of the subsample was 116 g.									
30.1	Threadfin Shad	22	31	65	2	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	32	55	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	33	43	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	34	43	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	35	47	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	36	40	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	37	47	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	38	43	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	39	49	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	40	43	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	41	49	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	42	49	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	43	45	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	44	45	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	45	44	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	46	56	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	47	53	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	48	46	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	49	31	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	50	44	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	51	53	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	52	48	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	53	44	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	54	48	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	55	51	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	56	50	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	57	45	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	58	44	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	59	45	1	1	n	8:15 AM	7/13/94
30.1	Threadfin Shad	22	60	42	1	1	n	8:15 AM	7/13/94
Note: The above thirty threadfin shad (#31-60) represent a subsample of fish from the total haul for this									
size class. Total mass of the haul was 152 g and total subsample mass was 30 g.									
30.1	Warmouth	16	1	139	48	1	n	8:15 AM	7/13/94
31.1	Bluegill Sunfish	12	1	102	18	1	n	8:00 AM	7/28/94.
31.1	Bluegill Sunfish	12	2	111	23	1	n	8:00 AM	7/28/94.
31.1	Bluegill Sunfish	12	3	124	33	1	n	8:00 AM	7/28/94.
31.1	Bluegill Sunfish	12	4	99	17	2	n	8:00 AM	7/28/94.
31.1	Bluegill Sunfish	12	5	51	2	1	n	8:00 AM	7/28/94.
Note: The above five bluegill represented one eigth of total number collected = 40 individuals									

31.1	Green Sunfish	21	1	82	8	1	n	8:00 AM	7/28/94.
31.1	Green Sunfish	21	2	88	11	1	n	8:00 AM	7/28/94.
31.1	Green Sunfish	21	3	105	18	1	n	8:00 AM	7/28/94.
Note: The above three green sunfish represented on eigth of total number collected = 24 individuals									
31.1	Largemouth Bass	1	1	62	2	1	n	8:00 AM	7/28/94.
Note: The above largemouth bass represented one eigth of total number collected = 8 individuals									
31.1	Inland Silverside	27	1	88	2	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	2	70	1	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	3	56	1	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	4	82	2	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	5	80	2	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	6	75	2	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	7	72	2	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	8	79	2	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	9	69	1	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	10	65	1	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	11	85	3	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	12	66	1	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	13	87	3	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	14	64	1	1	n	8:00AM	7/28/94.
31.1	Inland Silverside	27	15	64	1	1	n	8:00AM	7/28/94.
Note: The above fifteen inland silversides represent one eigth of the total number collected = 120									
31.1	Threadfin Shad	22	1	83	3	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	2	90	3	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	3	43	1	1	n	8:00AM	7/28/94.
1.1	Threadfin Shad	22	4	92	4	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	5	44	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	6	90	3	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	7	44	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	8	99	6	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	9	87	4	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	10	50	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	11	60	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	12	54	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	13	94	5	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	14	44	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	15	96	4	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	16	44	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	17	70	2	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	18	56	2	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	19	47	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	20	43	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	21	53	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	22	45	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	23	55	2	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	24	83	3	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	25	40	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	26	51	1	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	27	47	1	1	n	8:00AM	7/28/94.

31.1	Threadfin Shad	22	28	88	4	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	29	56	2	1	n	8:00AM	7/28/94.
31.1	Threadfin Shad	22	30	43	1	1	n	8:00AM	7/28/94.
Note: The above thirty threadfin shad represents a subsample of the total haul of this species collected									
total mass of all individuals collected = 5.6 kg and total mass of subsample = 63 g.									
31.2	White Bass	3	1	350	466	1	d	8:20PM	7/27/94.
31.2	F.W. Drum	17	1	304	336	1	d	8:20PM	7/27/94.
31.2	Warmouth	16	1	91	12	1	d	8:20PM	7/27/94.
31.2	Redear Sunfish	13	1	152	58	1	d	8:20PM	7/27/94.
31.2	Bluegill Sunfish	12	1	103	19	1	d	8:20PM	7/27/94.
31.2	Bluegill Sunfish	12	2	142	44	1	d	8:20PM	7/27/94.
31.2	Channel Catfish	7	1	73	4	1	d	8:20PM	7/27/94.
31.2	Largemouth Bass	1	1	54	2	1	d	8:20PM	7/27/94.
31.2	Inland Silversides	27	1	81	2	1	d	8:20PM	7/27/94.
31.2	Inland Silversides	27	2	73	2	1	d	8:20PM	7/27/94.
31.2	Inland Silversides	27	3	61	1	1	d	8:20PM	7/27/94.
31.2	Inland Silversides	27	4	66	1	1	d	8:20PM	7/27/94.
31.2	Inland Silversides	27	5	65	1	1	d	8:20PM	7/27/94.
31.2	Inland Silversides	27	6	81	2	1	d	8:20PM	7/27/94.
Note: The above warmouth, redear sunfish, bluegill, channel catfish, largemouth bass and inland silverside									
numbers represent one sixth of the total number of individuals collected in the total haul.									
31.2	Threadfin Shad	22	1	88	3	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	2	55	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	3	52	1	1	d	8:20PM	7/27/94.
1.2	Threadfin Shad	22	4	97	4	1	d	8:20PM	7/27/94.
1.2	Threadfin Shad	22	5	61	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	6	52	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	7	58	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	8	50	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	9	51	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	10	45	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	11	64	2	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	12	54	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	13	62	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	14	68	2	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	15	92	3	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	16	83	2	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	17	90	4	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	18	56	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	19	58	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	20	41	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	21	54	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	22	60	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	23	91	4	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	24	54	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	25	64	2	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	26	85	2	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	27	50	1	1	d	8:20PM	7/27/94.
.2	Threadfin Shad	22	28	50	1	1	d	8:20PM	7/27/94.

31.2	Threadfin Shad	22	29	45	1	1	d	8:20PM	7/27/94.
31.2	Threadfin Shad	22	30	45	1	1	d	8:20PM	7/27/94.
Note: The above thirty threadfin shad represent a subsample of the total collected. Weight of total haul for this species was 9.6 kg and total weight of subsample was 46 g.									
31.2	Green Sunfish	21	1	88	9	1	d	8:20PM	7/27/94.
32.1	White Crappie	24	1	284	402	1	n	8:05AM	8/10/94.
32.1	Largemouth Bass	1	1	111	15	1	n	8:05AM	8/10/94.
32.1	Largemouth Bass	1	2	136	30	1	n	8:05AM	8/10/94.
32.1	Largemouth Bass	1	3	78	5	1	n	8:05AM	8/10/94.
32.1	Bluegill Sunfish	12	1	167	85	1	n	8:05AM	8/10/94.
32.1	Bluegill Sunfish	12	2	125	30	1	n	8:05AM	8/10/94.
32.1	Bluegill Sunfish	12	3	129	34	1	n	8:05AM	8/10/94.
32.1	Bluegill Sunfish	12	4	119	28	1	n	8:05AM	8/10/94.
32.1	Bluegill Sunfish	12	5	116	25	1	n	8:05AM	8/10/94.
32.1	Bluegill Sunfish	12	6	126	37	1	n	8:05AM	8/10/94.
32.1	Bluegill Sunfish	12	7	65	3	1	n	8:05AM	8/10/94.
32.1	Green Sunfish	21	1	77	6	1	n	8:05AM	8/10/94.
32.1	Green Sunfish	21	2	79	8	1	n	8:05AM	8/10/94.
32.1	Green Sunfish	21	3	76	6	1	n	8:05AM	8/10/94.
32.1	Green Sunfish	21	4	79	6	1	n	8:05AM	8/10/94.
32.1	Green Sunfish	21	5	80	7	1	n	8:05AM	8/10/94.
32.1	Green Sunfish	21	6	115	34	1	n	8:05AM	8/10/94.
32.1	Green Sunfish	21	7	85	10	1	n	8:05AM	8/10/94.
32.1	Inland Silverside	27	1	66	1	1	n	8:05AM	8/10/94.
32.1	Inland Silverside	27	2	70	2	1	n	8:05AM	8/10/94.
32.1	Inland Silverside	27	3	80	2	1	n	8:05AM	8/10/94.
32.1	Inland Silverside	27	4	69	2	1	n	8:05AM	8/10/94.
32.1	Inland Silverside	27	5	75	2	1	n	8:05AM	8/10/94.
32.1	Inland Silverside	27	6	60	0.9	1	n	8:05AM	8/10/94.
32.1	Inland Silverside	27	7	65	1	1	n	8:05AM	8/10/94.
32.1	Inland Silverside	27	8	61	0.9	1	n	8:05AM	8/10/94.
32.1	Inland Silverside	27	9	72	2	1	n	8:05AM	8/10/94.
32.1	Inland Silverside	27	10	52	0.9	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	1	46	0.9	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	2	48	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	3	54	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	4	53	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	5	84	3	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	6	47	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	7	49	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	8	46	0.9	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	9	90	3	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	10	45	0.9	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	11	47	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	12	50	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	13	51	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	14	47	0.9	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	15	52	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	16	45	1	1	n	8:05AM	8/10/94.

32.1	Threadfin Shad	22	17	43	0.9	1	n	8:05AM	8/10/94.
2.1	Threadfin Shad	22	18	48	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	19	47	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	20	48	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	21	45	0.9	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	22	40	0.9	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	23	44	0.9	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	24	48	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	25	48	0.9	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	26	74	2	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	27	44	0.9	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	28	73	2	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	29	50	1	1	n	8:05AM	8/10/94.
32.1	Threadfin Shad	22	30	47	1	1	n	8:05AM	8/10/94.
Note: The above 30 threadfin shad represented a subsample of total individuals captured, total weight of subsample was 30.0 g and total for catch was 5.1 kg .									
32.1	Gizzard Shad	8	1	50	1	1	n	8:05AM	8/10/94.
32.2	Bluegill Sunfish	12	1	148	64	1	d	8:00PM	8/10/94.
32.2	Bluegill Sunfish	12	2	94	13	1	d	8:00PM	8/10/94.
32.2	Green Sunfish	21	1	110	26	1	d	8:00PM	8/10/94.
32.2	Green Sunfish	21	2	83	9	1	d	8:00PM	8/10/94.
32.2	Inland Silverside	27	1	83	2	1	d	8:00PM	8/10/94.
32.2	Inland Silverside	27	2	69	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	1	54	1	1	d	8:00PM	8/10/94.
2.2	Threadfin Shad	22	2	57	1	1	d	8:00PM	8/10/94.
.2	Threadfin Shad	22	3	51	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	4	48	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	5	53	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	6	85	2	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	7	62	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	8	71	2	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	9	47	0.9	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	10	51	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	11	55	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	12	49	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	13	58	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	14	57	2	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	15	49	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	16	51	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	17	52	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	18	42	0.9	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	19	55	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	20	49	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	21	41	0.9	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	22	40	1	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	23	40	0.9	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	24	50	0.9	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	25	45	1	1	d	8:00PM	8/10/94.
.2	Threadfin Shad	22	26	47	0.9	1	d	8:00PM	8/10/94.

32.2	Threadfin Shad	22	27	52	1	1	d	8:00PM	8/10/94.
2.2	Threadfin Shad	22	28	48	0.9	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	29	45	0.9	1	d	8:00PM	8/10/94.
32.2	Threadfin Shad	22	30	86	3	1	d	8:00PM	8/10/94.
Note: The above 30 threadfin shad represent a subsample of a total haul for this species,									
total group weight of the haul was 1.32 kg and total subsample weight was 33.0 g.									
32.2	Inland Silverside	27	1	71	2	1	d	8:00PM	8/10/94.
32.2	Inland Silverside	27	2	54	1	1	d	8:00PM	8/10/94.
32.2	Inland Silverside	27	3	63	1.5	1	d	8:00PM	8/10/94.
32.2	Inland Silverside	27	4	63	1.5	1	d	8:00PM	8/10/94.
32.2	Inland Silverside	27	5	63	1.5	1	d	8:00PM	8/10/94.
32.2	Inland Silverside	27	6	63	1.5	1	d	8:00PM	8/10/94.
32.2	Largemouth Bass	1	1	54	1	1	d	8:00PM	8/10/94.
32.2	Largemouth Bass	1	2	54	1	1	d	8:00PM	8/10/94.
32.2	Largemouth Bass	1	3	54	1	1	d	8:00PM	8/10/94.
32.2	Largemouth Bass	1	4	54	1	1	d	8:00PM	8/10/94.
32.2	Bluegill Sunfish	12	1	73	6	1	d	8:00PM	8/10/94.
32.2	Bluegill Sunfish	12	2	73	6	1	d	8:00PM	8/10/94.
32.2	Bluegill Sunfish	12	3	73	6	1	d	8:00PM	8/10/94.
32.2	Bluegill Sunfish	12	4	73	6	1	d	8:00PM	8/10/94.
33.1	Largemouth Bass	1	1	63	2	1	n	8:15AM	8/24/94.
33.1	Largemouth Bass	1	2	65	2	1	n	8:15AM	8/24/94.
33.1	White Crappie	24	1	79	4	1	n	8:15AM	8/24/94.
33.1	White Crappie	24	2	69	2	1	n	8:15AM	8/24/94.
33.1	Bluegill Sunfish	12	1	57	3	1	n	8:15AM	8/24/94.
3.1	Bluegill Sunfish	12	2	123	26	1	n	8:15AM	8/24/94.
33.1	Bluegill Sunfish	12	3	119	28	1	n	8:15AM	8/24/94.
33.1	Bluegill Sunfish	12	4	88	7	1	n	8:15AM	8/24/94.
33.1	Bluegill Sunfish	12	5	132	43	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	1	103	14	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	2	112	26	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	3	112	22	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	4	95	9	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	5	67	4	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	6	80	7	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	7	81	7	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	8	87	8	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	9	100	16	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	10	71	5	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	11	91	13	1	n	8:15AM	8/24/94.
33.1	Green Sunfish	21	12	107	20	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	1	59	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	2	68	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	3	64	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	4	67	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	5	62	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	6	61	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	7	66	2	1	n	8:15AM	8/24/94.
3.1	Gizzard Shad	8	8	60	2	1	n	8:15AM	8/24/94.

33.1	Gizzard Shad	8	9	61	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	10	62	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	11	63	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	12	59	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	13	64	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	14	62	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	15	55	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	16	61	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	17	60	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	18	65	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	19	62	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	20	55	2	1	n	8:15AM	8/24/94.
33.1	Gizzard Shad	8	21	53	2	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	1	74	2	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	2	65	2	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	3	113	6	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	4	89	3	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	5	50	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	6	52	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	7	87	4	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	8	85	3	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	9	50	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	10	95	4	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	11	53	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	12	43	0.9	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	13	50	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	14	50	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	15	48	0.9	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	16	57	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	17	59	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	18	50	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	19	51	0.9	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	20	48	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	21	58	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	22	45	0.9	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	23	60	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	24	51	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	25	50	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	26	86	2	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	27	57	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	28	51	1	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	29	111	7	1	n	8:15AM	8/24/94.
33.1	Threadfin Shad	22	30	71	2	1	n	8:15AM	8/24/94.
Note: The above 30 Threadfin Shad represent a subsample of the total haul for this species. Total weight for the entire haul for this species was 796 g and total weight of the subsample was 54 g.									
33.2	Inland Silverside	27	1	86	2	1	d	8:00PM	8/24/94.
33.2	Inland Silverside	27	2	76	2	1	d	8:00PM	8/24/94.
33.2	Gizzard Shad	8	1	60	2	1	d	8:00PM	8/24/94.
33.2	Gizzard Shad	8	2	64	2	1	d	8:00PM	8/24/94.

33.2	Threadfin Shad	22	1	52	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	2	55	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	3	45	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	4	44	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	5	65	2	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	6	62	2	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	7	48	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	8	38	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	9	52	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	10	48	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	11	44	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	12	46	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	13	46	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	14	103	6	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	15	99	5	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	16	82	3	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	17	50	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	18	47	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	19	48	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	20	45	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	21	48	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	22	56	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	23	53	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	24	45	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	25	46	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	26	57	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	27	59	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	28	60	1	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	29	66	2	1	d	8:00PM	8/24/94.
33.2	Threadfin Shad	22	30	46	1	1	d	8:00PM	8/24/94.
Note: The above 30 Threadfin Shad represent a subsample of the total haul for this species. Total weight of the total haul was 196 g and total weight of the subsample was 40 g.									
34.1	Bluegill Sunfish	12	1	75	7	1	n	8:35AM	8/31/94.
34.1	Bluegill Sunfish	12	2	120	27	1	n	8:35AM	8/31/94.
34.1	Bluegill Sunfish	12	3	122	28	1	n	8:35AM	8/31/94.
34.1	Bluegill Sunfish	12	4	126	32	1	n	8:35AM	8/31/94.
34.1	Bluegill Sunfish	12	5	153	53	1	n	8:35AM	8/31/94.
34.1	Bluegill Sunfish	12	6	159	70	1	n	8:35AM	8/31/94.
34.1	Green Sunfish	21	1	115	24	1	n	8:35AM	8/31/94.
34.1	Inland Silverside	27	1	46	1	1	n	8:35AM	8/31/94.
Note: The above single Inland Silverside represents one quarter of the total number impinged during sampling or 4 individuals total.									
34.1	Threadfin Shad	22	1	46	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	2	53	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	3	62	2	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	4	42	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	5	45	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	6	50	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	7	48	1	1	n	8:35AM	8/31/94.

34.1	Threadfin Shad	22	8	60	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	9	45	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	10	41	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	11	53	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	12	62	2	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	13	53	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	14	43	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	15	45	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	16	95	5	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	17	45	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	18	45	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	19	48	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	20	54	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	21	60	2	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	22	57	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	23	43	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	24	43	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	25	49	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	26	55	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	27	55	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	28	52	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	29	48	1	1	n	8:35AM	8/31/94.
34.1	Threadfin Shad	22	30	57	1	1	n	8:35AM	8/31/94.
Note: The above thirty threadfin shad represent a subsample of the total number of indviduals of this species impinged. Total weight of subsample = 30 g ; total weight of total haul for this species = 2.73 kg.									
4.1	Gizzard Shad	8	1	70	3	1	n	8:35AM	8/31/94.
Note: The above single gizzard shad represents one quarter of the total number impinged (total = 4) for this species.									
34.2	Bluegill Sunfish	12	1	149	50	ND	d	6:00PM	8/31/94.
34.2	Bluegill Sunfish	12	2	130	39	ND	d	6:00PM	8/31/94.
34.2	Bluegill Sunfish	12	3	112	28	ND	d	6:00PM	8/31/94.
34.2	Bluegill Sunfish	12	4	47	2	ND	d	6:00PM	8/31/94.
34.2	Green Sunfish	21	1	99	16	ND	d	6:00PM	8/31/94.
34.2	Green Sunfish	21	2	102	20	ND	d	6:00PM	8/31/94.
34.2	Green Sunfish	21	3	93	12	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	1	46	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	2	93	3	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	3	55	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	4	51	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	5	56	2	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	6	53	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	7	65	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	8	50	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	9	55	2	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	10	47	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	11	45	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	12	48	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	13	56	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	14	46	1	ND	d	6:00PM	8/31/94.

34.2	Threadfin Shad	22	15	57	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	16	50	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	17	48	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	18	50	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	19	53	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	20	51	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	21	48	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	22	48	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	23	50	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	24	54	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	25	53	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	26	54	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	27	51	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	28	58	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	29	51	1	ND	d	6:00PM	8/31/94.
34.2	Threadfin Shad	22	30	64	2	ND	d	6:00PM	8/31/94.
Note: the above thirty threadfin shad represent a subsample of the total haul for this species. Total haul weight for this species was 466 g; subsample weight = 32 g.									
35.1	Gizzard Shad	8	1	342	250	ND	n	8:30AM	9/7/94.
35.1	Gizzard Shad	8	2	67	ND	ND	n	8:30AM	9/7/94.
35.1	Gizzard Shad	8	3	67	ND	ND	n	8:30AM	9/7/94.
35.1	Gizzard Shad	8	4	84	ND	ND	n	8:30AM	9/7/94.
35.1	Inland Silverside	27	1	55	ND	ND	n	8:30AM	9/7/94.
35.1	Inland Silverside	27	2	80	ND	ND	n	8:30AM	9/7/94.
35.1	Inland Silverside	27	3	68	ND	ND	n	8:30AM	9/7/94.
35.1	Inland Silverside	27	4	78	ND	ND	n	8:30AM	9/7/94.
35.1	Inland Silverside	27	5	57	ND	ND	n	8:30AM	9/7/94.
35.1	Inland Silverside	27	6	70	ND	ND	n	8:30AM	9/7/94.
35.1	Inland Silverside	27	7	58	ND	ND	n	8:30AM	9/7/94.
35.1	Inland Silverside	27	8	71	ND	ND	n	8:30AM	9/7/94.
35.1	Inland Silverside	27	9	61	ND	ND	n	8:30AM	9/7/94.
35.1	Inland Silverside	27	10	70	ND	ND	n	8:30AM	9/7/94.
35.1	Bluegill Sunfish	12	1	54	ND	ND	n	8:30AM	9/7/94.
35.1	Bluegill Sunfish	12	2	117	ND	ND	n	8:30AM	9/7/94.
35.1	Bluegill Sunfish	12	3	121	ND	ND	n	8:30AM	9/7/94.
35.1	Bluegill Sunfish	12	4	115	ND	ND	n	8:30AM	9/7/94.
35.1	Bluegill Sunfish	12	5	85	ND	ND	n	8:30AM	9/7/94.
35.1	Bluegill Sunfish	12	6	118	ND	ND	n	8:30AM	9/7/94.
35.1	Bluegill Sunfish	12	7	63	ND	ND	n	8:30AM	9/7/94.
35.1	Bluegill Sunfish	12	8	39	ND	ND	n	8:30AM	9/7/94.
35.1	Bluegill Sunfish	12	9	24	ND	ND	n	8:30AM	9/7/94.
35.1	Green Sunfish	21	1	87	ND	ND	n	8:30AM	9/7/94.
35.1	Green Sunfish	21	2	110	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	1	55	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	2	54	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	3	92	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	4	45	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	5	50	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	6	91	ND	ND	n	8:30AM	9/7/94.

35.1	Threadfin Shad	22	7	61	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	8	40	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	9	40	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	10	45	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	11	55	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	12	49	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	13	52	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	14	42	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	15	53	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	16	50	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	17	48	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	18	35	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	19	54	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	20	45	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	21	47	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	22	53	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	23	43	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	24	59	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	25	58	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	26	48	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	27	38	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	28	50	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	29	41	ND	ND	n	8:30AM	9/7/94.
35.1	Threadfin Shad	22	30	85	ND	ND	n	8:30AM	9/7/94.
Note: ND for weight- electric scale not working; spring scale in 20 g intervals only.									
D for Age/Sex- not determined or recorded.									
ne above thirty threadfin shad represent a subsample of a total 155 individuals for this species in haul.									
35.2	Bluegill Sunfish	12	1	99	ND	ND	d	7:00PM	9/7/94.
35.2	Bluegill Sunfish	12	2	49	ND	ND	d	7:00PM	9/7/94.
35.2	Bluegill Sunfish	12	3	59	ND	ND	d	7:00PM	9/7/94.
35.2	Bluegill Sunfish	12	4	108	ND	ND	d	7:00PM	9/7/94.
35.2	Bluegill Sunfish	12	5	175	ND	ND	d	7:00PM	9/7/94.
35.2	Bluegill Sunfish	12	6	136	ND	ND	d	7:00PM	9/7/94.
35.2	Bluegill Sunfish	12	7	110	ND	ND	d	7:00PM	9/7/94.
35.2	Bluegill Sunfish	12	8	189	ND	ND	d	7:00PM	9/7/94.
35.2	Bluegill Sunfish	12	9	39	ND	ND	d	7:00PM	9/7/94.
35.2	Bluegill Sunfish	12	10	43	ND	ND	d	7:00PM	9/7/94.
35.2	Bluegill Sunfish	12	11	51	ND	ND	d	7:00PM	9/7/94.
35.2	Green Sunfish	21	1	91	ND	ND	d	7:00PM	9/7/94.
35.2	Green Sunfish	21	2	112	ND	ND	d	7:00PM	9/7/94.
35.2	Green Sunfish	21	3	107	ND	ND	d	7:00PM	9/7/94.
35.2	Green Sunfish	21	4	123	ND	ND	d	7:00PM	9/7/94.
35.2	Green Sunfish	21	5	102	ND	ND	d	7:00PM	9/7/94.
35.2	Green Sunfish	21	6	100	ND	ND	d	7:00PM	9/7/94.
35.2	Green Sunfish	21	7	93	ND	ND	d	7:00PM	9/7/94.
35.2	Green Sunfish	21	8	120	ND	ND	d	7:00PM	9/7/94.
35.2	Inland Silverside	27	1	69	ND	ND	d	7:00PM	9/7/94.
35.2	Gizzard Shad	8	1	93	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	1	96	ND	ND	d	7:00PM	9/7/94.

35.2	Threadfin Shad	22	2	53	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	3	41	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	4	50	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	5	52	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	6	53	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	7	46	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	8	48	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	9	55	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	10	54	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	11	46	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	12	44	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	13	44	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	14	53	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	15	57	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	16	50	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	17	63	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	18	66	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	19	47	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	20	49	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	21	47	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	22	51	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	23	55	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	24	54	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	25	46	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	26	45	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	27	43	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	28	62	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	29	50	ND	ND	d	7:00PM	9/7/94.
35.2	Threadfin Shad	22	30	50	ND	ND	d	7:00PM	9/7/94.
Note: The above thirty threadfin shad represent a subsample of the total haul for this species.									
Total weight for 1,050 individuals was 1.2; Subsample weighed using spring scale = <509 g.									
36.1	Largemouth Bass	1	1	81	4	1	n	8:00AM	9/14/94.
36.1	Bluegill	12	1	155	61	1	n	8:00AM	9/14/94.
36.1	Bluegill	12	2	174	70	1	n	8:00AM	9/14/94.
36.1	Bluegill	12	3	149	58	1	n	8:00AM	9/14/94.
36.1	Bluegill	12	4	86	10	1	n	8:00AM	9/14/94.
36.1	Bluegill	12	5	45	1	1	n	8:00AM	9/14/94.
36.1	Bluegill	12	6	23	1	1	n	8:00AM	9/14/94.
36.1	Bluegill	12	7	23	1	1	n	8:00AM	9/14/94.
36.1	Bluegill	12	8	27	1	1	n	8:00AM	9/14/94.
36.1	Bluegill	12	9	38	1	1	n	8:00AM	9/14/94.
36.1	White Bass	3	1	324	411	1	n	8:00AM	9/14/94.
36.1	Channel Catfish	7	1	162	28	1	n	8:00AM	9/14/94.
36.1	Gizzard Shad	8	1	72	2	1	n	8:00AM	9/14/94.
36.1	Inland Silverside	27	1	72	1	1	n	8:00AM	9/14/94.
36.1	Inland Silverside	27	2	73	2	1	n	8:00AM	9/14/94.
36.1	Inland Silverside	27	3	57	1	1	n	8:00AM	9/14/94.
36.1	Inland Silverside	27	4	62	1	1	n	8:00AM	9/14/94.
36.1	Inland Silverside	27	5	63	1	1	n	8:00AM	9/14/94.

36.1	Inland Silverside	27	6	54	1	1	n	8:00AM	9/14/94.
36.1	Inland Silverside	27	7	69	1	1	n	8:00AM	9/14/94.
36.1	Inland Silverside	27	8	55	1	1	n	8:00AM	9/14/94.
36.1	Inland Silverside	27	9	57	1	1	n	8:00AM	9/14/94.
36.1	Inland Silverside	27	10	72	2	1	n	8:00AM	9/14/94.
36.1	Inland Silverside	27	11	51	1	1	n	8:00AM	9/14/94.
36.1	Inland Silverside	27	12	48	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	1	51	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	2	55	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	3	53	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	4	60	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	5	65	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	6	68	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	7	61	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	8	53	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	9	64	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	10	62	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	11	58	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	12	60	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	13	56	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	14	60	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	15	51	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	16	48	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	17	70	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	18	64	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	19	44	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	20	67	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	21	56	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	22	39	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	23	54	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	24	51	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	25	55	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	26	60	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	27	62	2	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	28	47	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	29	50	1	1	n	8:00AM	9/14/94.
36.1	Threadfin Shad	22	30	46	1	1	n	8:00AM	9/14/94.
Note: The above thirty Threadfin Shad represent a subsample of the total number of individuals collected in the haul. Total mass of this species collected = 138 g; total subsample mass = 40 g (N = 108)									
36.2	Gizzard Shad	8	1	245	144	1	d	5:15PM	9/14/94.
36.2	Gizzard Shad	8	2	64	2	1	d	5:15PM	9/14/94.
36.2	Bluegill Sunfish	12	1	147	63	1	d	5:15PM	9/14/94.
36.2	Bluegill Sunfish	12	2	29	1	1	d	5:15PM	9/14/94.
36.2	Bluegill Sunfish	12	3	25	1	1	d	5:15PM	9/14/94.
36.2	Bluegill Sunfish	12	4	25	1	1	d	5:15PM	9/14/94.
36.2	Inland Silverside	27	1	59	1	1	d	5:15PM	9/14/94.
36.2	Inland Silverside	27	2	81	2	1	d	5:15PM	9/14/94.
36.2	Inland Silverside	27	3	41	1	1	d	5:15PM	9/14/94.
36.2	Inland Silverside	27	4	35	1	1	d	5:15PM	9/14/94.

36.2	Inland Silverside	27	5	34	1	1	d	5:15PM	9/14/94.
36.2	Inland Silverside	27	6	35	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	1	50	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	2	56	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	3	55	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	4	54	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	5	48	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	6	53	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	7	43	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	8	50	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	9	51	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	10	55	2	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	11	52	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	12	54	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	13	72	3	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	14	50	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	15	51	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	16	58	2	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	17	45	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	18	45	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	19	45	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	20	50	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	21	59	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	22	67	2	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	23	52	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	24	54	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	25	58	2	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	26	62	2	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	27	50	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	28	45	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	29	69	2	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	30	53	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	31	49	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	32	47	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	33	58	2	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	34	55	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	35	61	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	36	53	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	37	55	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	38	40	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	39	56	1	1	d	5:15PM	9/14/94.
36.2	Threadfin Shad	22	40	32	1	1	d	5:15PM	9/14/94.
37.1	Channel Catfish	7	1	156	29	1	n	8:05AM	9/21/94.
37.1	Gizzard Shad	8	1	335	317	1	n	8:05AM	9/21/94.
37.1	Gizzard Shad	8	2	70	3	1	n	8:05AM	9/21/94.
37.1	F.W. Drum	17	1	366	320	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	1	97	16	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	2	66	4	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	3	80	8	1	n	8:05AM	9/21/94.

37.1	Bluegill Sunfish	12	4	83	9	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	5	52	2	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	6	54	2	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	7	49	2	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	8	66	5	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	9	47	2	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	10	37	1	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	11	27	1	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	12	61	3	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	13	63	4	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	14	65	4	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	15	23	1	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	16	48	2	1	n	8:05AM	9/21/94.
37.1	Bluegill Sunfish	12	17	59	3	1	n	8:05AM	9/21/94.
37.1	Green Sunfish	21	1	94	8	1	n	8:05AM	9/21/94.
37.1	Green Sunfish	21	2	92	12	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	1	50	2	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	2	94	5	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	3	45	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	4	47	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	5	57	2	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	6	48	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	7	58	2	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	8	64	2	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	9	55	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	10	56	2	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	11	55	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	12	41	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	13	51	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	14	54	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	15	45	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	16	54	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	17	58	2	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	18	56	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	19	58	2	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	20	39	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	21	49	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	22	48	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	23	52	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	24	55	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	25	49	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	26	50	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	27	48	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	28	45	1	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	29	61	2	1	n	8:05AM	9/21/94.
37.1	Threadfin Shad	22	30	58	2	1	n	8:05AM	9/21/94.
Note: The above thirty threadfin shad represent a subsample of the total haul for this species. Total mass for total haul was 92 g; total mass for subsample was 36 g.									
.2	Bluegill Sunfish	12	1	187	123	1	d	7:03PM	9/21/94.

37.2	Bluegill Sunfish	12	2	152	53	1	d	7:03PM	9/21/94.
37.2	Bluegill Sunfish	12	3	128	30	1	d	7:03PM	9/21/94.
37.2	Bluegill Sunfish	12	4	152	77	1	d	7:03PM	9/21/94.
37.2	Bluegill Sunfish	12	5	64	4	1	d	7:03PM	9/21/94.
37.2	Bluegill Sunfish	12	6	62	4	1	d	7:03PM	9/21/94.
37.2	Green Sunfish	21	1	92	13	1	d	7:03PM	9/21/94.
37.2	Green Sunfish	21	1	80	7	1	d	7:03PM	9/21/94.
37.2	Green Sunfish	21	1	89	9	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	1	63	2	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	2	47	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	3	55	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	4	58	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	5	60	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	6	49	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	7	45	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	8	54	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	9	58	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	10	57	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	11	61	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	12	58	2	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	14	13	55	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	15	14	66	2	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	15	41	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	16	49	1	1	d	7:03PM	9/21/94.
7.2	Threadfin Shad	22	17	46	1	1	d	7:03PM	9/21/94.
7.2	Threadfin Shad	22	18	57	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	19	63	2	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	20	53	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	21	50	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	22	65	2	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	23	55	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	24	48	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	25	44	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	26	49	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	27	47	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	28	44	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	29	60	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	30	55	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	31	55	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	32	49	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	33	43	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	34	55	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	35	49	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	36	60	1	1	d	7:03PM	9/21/94.
37.2	Threadfin Shad	22	37	58	1	1	d	7:03PM	9/21/94.
37.2	Gizzard Shad	8	1	76	3	1	d	7:03PM	9/21/94.
38.1	Channel Catfish	7	1	159	31	1	n	8:20AM	9/28/94.
38.1	Green Sunfish	21	1	72	4	1	n	8:20AM	9/28/94.
3.1	Green Sunfish	21	2	48	1	1	n	8:20AM	9/28/94.

38.1	Bluegill Sunfish	12	1	145	58	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	2	165	82	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	3	138	50	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	4	111	19	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	5	50	2	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	6	46	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	7	86	9	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	8	52	2	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	9	37	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	10	28	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	11	36	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	12	3.1	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	13	25	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	14	34	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	15	32	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	16	28	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	17	32	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	18	34	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	19	28	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	20	38	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	21	34	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	22	36	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	23	37	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	24	40	1	1	n	8:20AM	9/28/94.
8.1	Bluegill Sunfish	12	25	36	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	26	48	2	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	27	42	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	28	40	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	29	45	1	1	n	8:20AM	9/28/94.
38.1	Bluegill Sunfish	12	30	45	1	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	1	56	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	2	68	3	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	3	88	3	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	4	60	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	5	56	1	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	6	53	1	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	7	61	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	8	50	1	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	9	60	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	10	55	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	11	83	3	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	12	64	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	13	59	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	14	65	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	15	52	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	16	57	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	17	65	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	18	54	1	1	n	8:20AM	9/28/94.
3.1	Threadfin Shad	22	19	61	2	1	n	8:20AM	9/28/94.

38.1	Threadfin Shad	22	20	58	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	21	63	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	22	60	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	23	52	1	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	24	59	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	25	62	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	26	60	2	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	27	55	1	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	28	49	1	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	29	52	1	1	n	8:20AM	9/28/94.
38.1	Threadfin Shad	22	30	58	2	1	n	8:20AM	9/28/94.
Note: The above thirty threadfin shad represent a subsample of the total haul of this species collected .									
Total mass of all individuals = 117 g and total mass of subsample = 54 g.									
38.1	Gizzard Shad	8	1	66	2	1	n	8:20AM	9/28/94.
38.1	Gizzard Shad	8	2	64	2	1	n	8:20AM	9/28/94.
38.1	Gizzard Shad	8	3	56	2	1	n	8:20AM	9/28/94.
38.1	Gizzard Shad	8	4	70	2	1	n	8:20AM	9/28/94.
38.1	Gizzard Shad	8	5	63	2	1	n	8:20AM	9/28/94.
38.2	Bluegill Sunfish	12	1	117	27	1	d	5:00PM	9/28/94.
38.2	Bluegill Sunfish	12	2	115	23	1	d	5:00PM	9/28/94.
38.2	Bluegill Sunfish	12	3	124	34	1	d	5:00PM	9/28/94.
38.2	Bluegill Sunfish	12	4	35	1	1	d	5:00PM	9/28/94.
38.2	Threadfin Shad	22	1	61	2	1	d	5:00PM	9/28/94.
38.2	Threadfin Shad	22	2	54	1	1	d	5:00PM	9/28/94.
8.2	Threadfin Shad	22	3	55	1	1	d	5:00PM	9/28/94.
38.2	Threadfin Shad	22	4	58	1	1	d	5:00PM	9/28/94.
38.2	Threadfin Shad	22	5	47	1	1	d	5:00PM	9/28/94.
38.2	Threadfin Shad	22	6	51	1	1	d	5:00PM	9/28/94.
38.2	Threadfin Shad	22	7	47	1	1	d	5:00PM	9/28/94.
38.2	Threadfin Shad	22	8	40	1	1	d	5:00PM	9/28/94.
39.1	Longear Sunfish	11	1	91	12	1	n	8:40AM	10/5/94.
39.1	Green Sunfish	21	1	91	11	1	n	8:40AM	10/5/94.
39.1	Green Sunfish	21	2	87	10	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	1	148	65	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	2	130	30	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	3	71	4	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	4	34	1	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	5	35	1	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	6	32	1	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	7	35	1	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	8	37	1	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	9	23	1	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	10	36	1	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	11	27	1	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	12	45	1	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	13	28	1	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	14	49	1	1	n	8:40AM	10/5/94.
39.1	Bluegill Sunfish	12	15	47	2	1	n	8:40AM	10/5/94.
9.1	Bluegill Sunfish	12	16	48	1	1	n	8:40AM	10/5/94.

39.1	Bluegill Sunfish	12	17	41	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	1	59	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	2	56	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	3	62	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	4	63	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	5	53	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	6	50	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	7	59	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	8	57	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	9	55	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	10	53	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	11	54	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	12	55	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	13	55	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	14	49	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	15	56	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	16	59	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	17	58	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	18	55	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	19	56	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	20	57	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	21	52	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	22	60	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	23	51	2	1	n	8:40AM	10/5/94.
9.1	Threadfin Shad	22	24	56	1	1	n	8:40AM	10/5/94.
9.1	Threadfin Shad	22	25	57	1	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	26	63	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	27	57	2	1	n	8:40AM	10/5/94.
39.1	Threadfin Shad	22	28	44	1	1	n	8:40AM	10/5/94.
39.2	Channel Catfish	7	1	154	31	1	d	6:00PM	10/5/94.
39.2	Green Sunfish	21	1	115	20	1	d	6:00PM	10/5/94.
39.2	Green Sunfish	21	2	92	14	1	d	6:00PM	10/5/94.
39.2	Gizzard Shad	8	1	70	3	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	1	163	74	3	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	2	132	38	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	3	136	57	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	4	178	125	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	5	168	78	3	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	6	110	21	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	7	85	9	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	8	52	2	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	9	42	1	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	10	42	1	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	11	36	1	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	12	38	1	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	13	35	1	1	d	6:00PM	10/5/94.
39.2	Bluegill Sunfish	12	14	73	6	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	1	52	1	1	d	6:00PM	10/5/94.
1.2	Threadfin Shad	22	2	51	1	1	d	6:00PM	10/5/94.

39.2	Threadfin Shad	22	3	53	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	4	52	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	5	53	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	6	59	2	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	7	53	2	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	8	48	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	9	52	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	10	50	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	11	52	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	12	72	3	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	13	46	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	14	45	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	15	54	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	16	51	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	17	53	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	18	54	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	19	52	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	20	53	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	21	50	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	22	49	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	23	58	2	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	24	47	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	25	57	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	26	52	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	27	56	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	28	49	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	29	45	1	1	d	6:00PM	10/5/94.
39.2	Threadfin Shad	22	30	53	1	1	d	6:00PM	10/5/94.
Note: The above thirty threadfin shad represent a subsample of the total haul for this species. Total mass for the haul was 78 g; total mass of the subsample was 36 g.									
40.1	Threadfin Shad	22	1	58	1	1	n	8:00AM	10/12/94.
40.1	Threadfin Shad	22	2	62	2	1	n	8:00AM	10/12/94.
40.1	Threadfin Shad	22	3	70	3	1	n	8:00AM	10/12/94.
40.1	Threadfin Shad	22	4	62	2	1	n	8:00AM	10/12/94.
40.1	Threadfin Shad	22	5	57	2	1	n	8:00AM	10/12/94.
40.1	Threadfin Shad	22	6	54	2	1	n	8:00AM	10/12/94.
40.1	Threadfin Shad	22	7	64	2	1	n	8:00AM	10/12/94.
40.1	Green Sunfish	21	1	51	2	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	1	159	77	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	2	148	58	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	3	81	10	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	4	60	3	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	5	51	2	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	6	35	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	7	78	10	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	8	49	2	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	9	47	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	10	43	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	11	41	1	1	n	8:00AM	10/12/94.

40.1	Bluegill Sunfish	12	12	41	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	13	39	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	14	39	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	15	35	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	16	38	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	17	36	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	18	39	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	19	34	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	20	27	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	21	29	1	1	n	8:00AM	10/12/94.
40.1	Bluegill Sunfish	12	22	25	1	1	n	8:00AM	10/12/94.
40.2	Green Sunfish	21	1	70	5	1	d	8:15PM	10/12/94.
40.2	Threadfin Shad	22	1	68	2	1	d	8:15PM	10/12/94.
40.2	Bluegill Sunfish	12	1	132	48	1	d	8:15PM	10/12/94.
40.2	Bluegill Sunfish	12	2	41	1	1	d	8:15PM	10/12/94.
40.2	Bluegill Sunfish	12	3	37	1	1	d	8:15PM	10/12/94.
40.2	Bluegill Sunfish	12	4	39	1	1	d	8:15PM	10/12/94.
40.2	Bluegill Sunfish	12	5	48	2	1	d	8:15PM	10/12/94.
40.2	Bluegill Sunfish	12	6	38	1	1	d	8:15PM	10/12/94.
40.2	Bluegill Sunfish	12	7	42	1	1	d	8:15PM	10/12/94.
40.2	Bluegill Sunfish	12	8	30	1	1	d	8:15PM	10/12/94.
40.2	Bluegill Sunfish	12	9	31	1	1	d	8:15PM	10/12/94.
40.2	Bluegill Sunfish	12	10	29	1	1	d	8:15PM	10/12/94.

APPENDIX D

Raw Data for Entrainment Sampling for CPSES 316(b)

Appendix D. Raw Data for Entrainment Sampling for Commanche Peak 316(b)

Date	Sample	Depth	Rep	Genus	Code	# Eggs	# Larvae	Stage
4/6/94	1D1	3	1			0	0	N/A
	1D1	3	2			0	0	N/A
	1D1	3	3	Damaged		1	0	ND
	1N1	3	1	Dorosoma sp.		0	7	Post
	1N1	3	2	Dorosoma sp.		0	4	Post
	1N1	3	2	Menidia sp.		0	1	Pre
	1N1	3	3	Dorosoma sp.		0	6	Post
	1D2	3	1	Aplodinotus sp.		1	0	Egg
	1D2	3	2	Aplodinotus sp.		2	0	Egg
	1D2	3	2	Damaged		2	0	Egg
	1D2	3	3	Aplodinotus sp.		1	0	Egg
	1N2	3	1	Aplodinotus sp.		1	0	Egg
	1N2	3	1	Menidia		1	0	Egg
	1N2	3	1	Dorosoma sp.		0	3	ND
	1N2	3	2	Dorosoma sp.		0	2	Post
	1N2	3	2	Damaged		1	0	Egg
	1N2	3	3			0	0	N/A
4/13/94	2D1	3	1			0	0	N/A
	2D1	3	2			0	0	N/A
	2D1	3	3	Aplodinotus sp.		2	0	Egg
	2N1	3	1	Menidia sp.		1	0	Egg
	2N1	3	1	Dorosoma sp.		0	3	Post
	2N1	3	2	Dorosoma sp.		0	4	Post
	2N1	3	2	Damaged		1	0	Egg
	2N1	3	3	Dorosoma sp.		0	1	Post
	2D2	3	1	Dorosoma sp.		0	1	Post
	2D2	3	2	Damaged		1	0	Egg
	2D2	3	3	Damaged		1	0	Egg
	2N2	3	1	Dorosoma sp.		0	1	Post
	2N2	3	2	Dorosoma sp.		0	1	Post
	2N2	3	3	Dorosoma sp.		0	3	Post
4/20/94	3D1	3	1	Dorosoma sp.		0	3	Post
	3D1	3	2			0	0	N/A
	3D1	3	3			0	0	N/A
	3D2	3	1			0	0	N/A
	3D2	3	2	Dorosoma sp.		0	1	Post
	3D2	3	3	Menidia sp.		1	0	Egg
	3N1	3	1			0	0	N/A
	3N1	3	2			0	0	N/A
	3N1	3	3			0	0	N/A
	3N2	3	1	Damaged		1	0	Egg
	3N2	3	2			0	0	N/A
	3N2	3	3			0	0	N/A
4/27/94	4D1	3	1	Damaged		1	0	Egg
	4D1	3	2	Damaged		1	0	Egg
	4D1	3	3	Damaged		1	0	Egg
	4N1	3	1	Damaged		9	0	Egg
	4N1	3	2	Damaged		9	0	Egg

	4N1	3	2	Menidia sp.		1	0	Egg
	4N1	3	2	Dorosoma sp.		0	1	Post
	4N1	3	2	Dorosoma sp.		0	1	Juv
	4N1	3	3	Damaged		16	0	Egg
5/4/94	5D1	3	1			0	0	N/A
	5D1	3	2	Aplodinotus		1	0	Egg
	5D1	3	3	Damaged		1	0	Egg
	5D1	25	1	Dorosoma sp.		0	6	Post
	5D1	25	2	Dorosoma sp.		0	1	ND
	5D1	25	3	Damaged		2	0	Egg
	5D1	50	1	Damaged		0	1	ND
	5D1	50	1	Dorosoma sp.		0	1	Post
	5D1	50	2	Dorosoma sp.		0	3	Pre
	5D1	50	2	Dorosoma sp.		0	2	Post
	5D1	50	2	Damaged		1	0	Egg
	5D1	50	3	Dorosoma sp.		0	1	Pre
	5N1	3	1	Dorosoma sp.		0	1	Juv
	5N1	3	1	Dorosoma sp.		0	1	Post
	5N1	3	1	Damaged		2	0	Egg
	5N1	3	1	Aplodinotus sp.		6	0	Egg
	5N1	3	2	Aplodinotus sp.		1	0	Egg
	5N1	3	2	Pomoxis sp.		0	1	Pre
	5N1	3	2	Menidia sp.		0	1	ND
	5N1	3	2	Damaged		0	3	ND
	5N1	3	2	Dorosoma sp.		0	2	Post
	5N1	3	3	Damaged		0	1	ND
	5N1	25	1	Dorosoma sp.		0	7	Juv
	5N1	25	1	Dorosoma sp.		0	4	Post
	5N1	25	1	Dorosoma sp.		0	11	Pre
	5N1	25	1	Damaged		2	3	ND
	5N1	25	1	Aplodinotus sp.		47	0	Egg
	5N1	25	2	Aplodinotus sp.		15	0	Egg
	5N1	25	2	Dorosoma sp.		0	1	Juv
	5N1	25	2	Dorosoma sp.		0	5	Pre
	5N1	25	2	Dorosoma sp.		0	1	Post
	5N1	25	2	Damaged		6	0	ND
	5N1	25	3	Dorosoma sp.		0	4	Post
	5N1	25	3	Aplodinotus sp.		11	0	Egg
	5N1	25	3	Damaged		11	0	Egg
	5N1	50	1	Damaged		29	0	Egg
	5N1	50	1	Aplodinotus sp.		146	0	Egg
	5N1	50	1	Dorosoma sp.		0	5	Pre
	5N1	50	1	Dorosoma sp.		0	3	Post
	5N1	50	2	Dorosoma sp.		0	1	Juv
	5N1	50	2	Dorosoma sp.		0	5	Post
	5N1	50	2	Dorosoma sp.		0	1	Pre
	5N1	50	2	Cyprinus sp.		0	1	Juv
	5N1	50	2	Aplodinotus sp.		1	0	Egg
	5N1	50	2	Damaged		6	0	Egg

	5N1	50	3	Cyprinus sp.		0	1	Juv
	5N1	50	3	Dorosoma sp.		0	3	Pre
	5N1	50	3	Dorosoma sp.		0	2	Post
5/11/94	6D1	3	1	Damaged		2	0	Egg
	6D1	3	2			0	0	N/A
	6D1	3	3	Aplodinotus sp.		1	0	Egg
	6D1	3	3	Menidia sp.		2	0	Egg
	6D1	25	1	Aplodinotus sp.		1	0	Egg
	6D1	25	1	Unidentified		1	0	Egg
	6D1	25	1	Dorosoma sp.		0	1	Post
	6D1	25	2			0	0	N/A
	6D1	25	3			0	0	N/A
	6D1	50	1	Aplodinotus sp.		0	1	Pre
	6D1	50	2	Aplodinotus sp.		1	0	Egg
	6D1	50	2	Menidia sp.		1	0	Egg
	6D1	50	2	Dorosoma sp.		0	1	Post
	6D1	50	3			0	0	N/A
	6N1	3	1	Aplodinotus sp.		1	0	Egg
	6N1	3	1	Dorosoma sp.		0	1	Post
	6N1	3	2	Damaged		1	0	Egg
	6N1	3	2	Dorosoma sp.		0	1	Pre
	6N1	3	3	Aplodinotus sp.		2	0	Egg
	6N1	3	3	Damaged		2	0	Egg
	6N1	3	3	Dorosoma sp.		0	1	Post
5/18/94	7D1	3	1	Aplodinotus sp.		2	0	Egg
	7D1	3	2	Dorosoma sp.		0	1	Post
	7D1	3	2	Aplodinotus sp.		2	0	Egg
	7D1	3	3	Aplodinotus sp.		4	0	Egg
	7D1	3	3	Dorosoma sp.		0	1	Post
	7D1	25	1			0	0	N/A
	7D1	25	2	Dorosoma sp.		0	5	Post
	7D1	25	3	Dorosoma sp.		0	2	Post
	7D1	50	1	Damaged		6	0	Egg
	7D1	50	2	Damaged		1	0	Egg
	7N1	3	1	Aplodinotus sp.		4	0	Egg
	7N1	3	2	Aplodinotus sp.		6	0	Egg
	7N1	25	1	Damaged		1	0	Egg
	7N1	25	1	Aplodinotus sp.		1	0	Egg
	7N1	25	1	Menidia sp.		0	1	Pre
	7N1	25	1	Dorosoma sp.		0	4	Pre
	7N1	25	1	Dorosoma sp.		0	2	Post
	7N1	25	2	Dorosoma sp.		0	2	Pre
	7N1	25	2	Dorosoma sp.		0	7	Post
	7N1	25	2	Dorosoma sp.		0	1	Juv
	7N1	25	2	Aplodinotus sp.		0	1	Pre
	7N1	25	2	Aplodinotus sp.		1	0	Egg
	7N1	25	2	Cyprinidae		0	1	Juv
	7N1	25	3	Dorosoma sp.		0	6	Pre
	7N1	25	3	Dorosoma sp.		0	25	Post

	7N1	25	3	Dorosoma sp.		0	1	Juv
	7N1	25	3	Cyprinidae		0	1	Juv
	7N1	50	1	Dorosoma sp.		0	2	Pre
	7N1	50	1	Dorosoma sp.		0	6	Post
	7N1	50	1	Menidia sp.		0	1	Pre
	7N1	50	1	Centrarchidae		0	2	Pre
	7N1	50	1	Cyprinidae		0	1	Juv
	7N1	50	1	Dorosoma sp.		0	1	Juv
	7N1	50	2	Dorosoma sp.		0	9	Pre
	7N1	50	2	Dorosoma sp.		0	15	Post
	7N1	50	2	Dorosoma sp.		0	3	Juv
	7N1	50	2	Aplodinotus sp.		0	1	Post
	7N1	50	3	Dorosoma sp.		0	10	Pre
	7N1	50	3	Dorosoma sp.		0	24	Post
	7N1	50	3	Dorosoma sp.		0	1	Juv
	7N1	50	3	Aplodinotus sp.		1	0	Egg
	7N1	50	3	Aplodinotus sp.		0	2	Pro
5/25/94	8D1	3	1			0	0	N/A
	8D1	3	2			0	0	N/A
	8D1	3	3			0	0	N/A
	8D1	25	1			0	0	N/A
	8D1	25	2			0	0	N/A
	8D1	25	3			0	0	N/A
	8D1	50	1	Aplodinotus sp.		1	0	Egg
	8D1	50	2			0	0	N/A
	8D1	50	3			0	0	N/A
6/1/94	9D1	3	1			0	0	N/A
	9D1	3	2			0	0	N/A
	9D1	3	3			0	0	N/A
	9D1	25	1	Dorosoma sp.		0	2	Post
	9D1	25	2			0	0	N/A
	9D1	25	3			0	0	N/A
	9D1	50	1			0	0	N/A
	9D1	50	2			0	0	N/A
	9D1	50	3			0	0	N/A
	9N1	3	1			0	0	N/A
	9N1	3	2			0	0	N/A
	9N1	3	3			0	0	N/A
	9N1	25	1	Dorosoma sp.		0	14	Post
	9N1	25	1	Dorosoma sp.		0	2	Juv
	9N1	25	2	Dorosoma sp.		0	18	Post
	9N1	25	2	Dorosoma sp.		0	1	Juv
	9N1	25	3	Dorosoma sp.		0	6	Post
	9N1	25	3	Dorosoma sp.		0	3	Juv
	9N1	50	1	Dorosoma sp.		0	4	Post
	9N1	50	1	Dorosoma sp.		0	2	Juv
	9N1	50	2	Dorosoma sp.		0	9	Post
	9N1	50	2	Dorosoma sp.		0	6	Juv
	9N1	50	3	Dorosoma sp.		0	4	Post

6/8/94	10D1	3	1			0	0	N/A
	10D1	3	2			0	0	N/A
	10D1	3	3	Aplodinotus sp.		0	1	Post
	10D1	25	1	Dorosoma sp.		0	1	Post
	10D1	25	2			0	0	N/A
	10D1	25	3			0	0	N/A
	10D1	50	1			0	0	N/A
	10D1	50	2			0	0	N/A
	10D1	50	3			0	0	N/A
	10N1	3	1			0	0	N/A
	10N1	3	2			0	0	N/A
	10N1	3	3			0	0	N/A
	10N1	25	1	Dorosoma sp.		0	1	Post
	10N1	25	2	Dorosoma sp.		0	2	Post
	10N1	25	2	Dorosoma sp.		0	4	Juv
	10N1	25	3	Dorosoma sp.		0	1	Post
	10N1	25	3	Dorosoma sp.		0	2	Juv
	10N1	50	1	Dorosoma sp.		0	1	Post
	10N1	50	2	Dorosoma sp.		0	1	Post
	10N1	50	3	Dorosoma sp.		0	1	Post
6/15/94	11D1	3	1			0	0	N/A
	11D1	3	2	Aplodinotus sp.		0	1	Post
	11D1	3	3	Aplodinotus sp.		0	1	Post
	11N1	3	1	Aplodinotus sp.		3	0	Egg
	11N1	3	1	Damaged		0	9	ND
	11N1	3	2	Aplodinotus sp.		1	0	Egg
	11N1	3	2	Damaged		2	0	Egg
	11N1	3	3	Aplodinotus sp.		1	0	Egg
	11N1	3	3	Damaged		1	0	Egg
	11N1	25	1	Dorosoma sp.		0	1	Post
	11N1	25	2	Dorosoma sp.		0	2	Post
	11N1	25	2	Aplodinotus sp.		0	1	Post
	11N1	25	3	Dorosoma sp.		0	1	Post
	11N1	25	3	Aplodinotus sp.		0	6	Post
6/22/94	12D1	3	1			0	0	N/A
	12D1	3	2	Aplodinotus sp.		0	1	ND
	12D1	3	2	Damaged		1	0	Egg
	12D2	3	1			0	0	N/A
	12D2	3	2			0	0	N/A
	12D2	3	3			0	0	N/A
	12N1	3	1	Aplodinotus sp.		0	3	ND
	12N1	3	1	Morone sp.		0	1	ND
	12N1	3	1	Menidia sp.		0	1	ND
	12N1	3	2	Aplodinotus sp.		0	5	ND
	12N1	3	2	Centrarchidae		0	10	ND
	12N1	3	3	Aplodinotus sp.		0	1	ND
	12N1	3	3	Menidia sp.		1	0	Egg
	12N1	3	3	Centrarchidae		0	6	ND
	12N1	25	1			0	0	N/A

	12N1	25	2	Aplodinotus sp.		0	2	ND
	12N1	25	2	Centrarchidae		0	1	ND
	12N1	25	3	Centrarchidae		0	2	ND
	12N2	3	1	Centrarchidae		0	1	ND
	12N2	3	2	Centrarchidae		0	4	ND
	12N2	3	3	Centrarchidae		0	4	ND
	12N2	3	3	Aplodinotus sp.		0	1	ND
6/29/94	13D1	3	1			0	0	N/A
	13D1	3	2			0	0	N/A
	13D1	3	3			0	0	N/A
	13D2	3	1			0	0	N/A
	13D2	3	2			0	0	N/A
	13D2	3	3			0	0	N/A
	13N1	3	1			0	0	N/A
	13N1	3	2			0	0	N/A
	13N1	3	3			0	0	N/A
	13N2	3	1			0	0	N/A
	13N2	3	2			0	0	N/A
	13N2	3	3	Lepomis sp.		0	1	ND
7/6/94	14D1	3	1			0	0	N/A
	14D1	3	2	Lepomis sp.		0	2	ND
	14D1	3	3	Lepomis sp.		0	4	Post
	14D2	3	1	Lepomis sp.		0	1	Post
	14D2	3	2	Pomoxis sp.		0	1	Post
	14D2	3	3	Pomoxis sp.		0	1	Pre
	14N1	3	1			0	0	N/A
	14N1	3	2			0	0	N/A
	14N1	3	3			0	0	N/A
	14N2	3	1			0	0	N/A
	14N2	3	2			0	0	N/A
	14N2	3	3			0	0	N/A
7/13/94	15D1	3	1	Pomoxis sp.		0	1	ND
	15D1	3	2	Pomoxis sp.		0	4	ND
	15D1	3	2	Lepomis sp.		0	1	ND
	15D1	3	3	Lepomis sp.		0	1	ND
	15D2	3	1	Lepomis sp.		0	1	ND
	15D2	3	1	Pomoxis sp.		0	1	ND
	15D2	3	2	Pomoxis sp.		0	2	ND
	15D2	3	3			0	0	N/A
	15N1	3	1	Pomoxis sp.		0	1	ND
	15N1	3	2	Pomoxis sp.		0	1	ND
	15N1	3	2	Centrachidae		0	1	Pre
	15N1	3	3	Pomoxis sp.		0	2	ND
	15N1	3	3	Centrarchidae		0	1	Pre
	15N2	3	1			0	0	N/A
	15N2	3	2			0	0	N/A
	15N2	3	3			0	0	N/A
7/20/94	16D1	3	1			0	0	N/A
	16D1	3	2			0	0	N/A

	16D1	3	3			0	0	N/A
	16D2	3	1			0	0	N/A
	16D2	3	2			0	0	N/A
	16D2	3	3			0	0	N/A
	16N1	3	1			0	0	N/A
	16N1	3	2			0	0	N/A
	16N1	3	3			0	0	N/A
	16N2	3	1			0	0	N/A
	16N2	3	2			0	0	N/A
	16N2	3	3			0	0	N/A
7/27/94	17D1	3	1			0	0	N/A
	17D1	3	2			0	0	N/A
	17D1	3	3			0	0	N/A
	17D2	3	1			0	0	N/A
	17D2	3	2			0	0	N/A
	17D2	3	3			0	0	N/A
	17N1	3	1			0	0	N/A
	17N1	3	2			0	0	N/A
	17N1	3	3			0	0	N/A
	17N2	3	1			0	0	N/A
	17N2	3	2			0	0	N/A
	17N2	3	3			0	0	N/A
8/3/94	18D1	3	1	Aplodinotus sp.		0	3	Post
	18D1	3	1	Lepomis sp.		0	1	Post
	18D1	3	2	Aplodinotus sp.		0	1	Post
	18D1	3	3	Aplodinotus sp.		0	3	Post
	18D2	3	1	Aplodinotus sp.		0	1	Post
	18D2	3	2			0	0	N/A
	18D2	3	3	Aplodinotus sp.		0	3	Post
	18N1	3	1	Aplodinotus sp.		0	2	Post
	18N1	3	1	Pomoxis sp.		0	1	Post
	18N1	3	2	Aplodinotus sp.		0	3	Post
	18N1	3	2	Pomoxis sp.		0	1	Post
	18N1	3	2	Centrarchidae		0	1	Pre
	18N1	3	3			0	0	N/A
	18N2	3	1	Aplodinotus sp.		0	3	Post
	18N2	3	2	Centrachidae		0	2	Pre
	18N2	3	3	Pomoxis sp.		0	4	Post
8/10/94	19D1	3	1	Lepomis sp.		0	1	Post
	19D1	3	1	Pomoxis sp.		0	1	Post
	19D1	3	2	Lepomis sp.		0	4	Post
	19D1	3	2	Pomoxis sp.		0	3	Post
	19D1	3	3	Lepomis sp.		0	4	Post
	19D1	3	3	Pomoxis sp.		0	2	Post
	19D1	3	3	Morone chrysops		0	7	Post
	19D2	3	1	Lepomis sp.		0	2	Post
	19D2	3	1	Morone chrysops		0	2	Post
	19D2	3	2	Lepomis sp.		0	9	Post
	19D2	3	2	Pomoxis sp.		0	2	Post

	19D2	3	3	Lepomis sp.		0	2	Post
	19D2	3	3	Pomoxis sp.		0	2	Post
	19D2	3	3	Morone chrysops		0	4	Post
	19N1	3	1	Lepomis sp.		0	1	Post
	19N1	3	1	Morone chrysops		0	4	Post
	19N1	3	2	Lepomis sp.		0	2	Post
	19N1	3	2	Pomoxis sp.		0	1	Post
	19N1	3	3	Lepomis sp.		0	1	Post
	19N2	3	1	Pomoxis sp.		0	1	Post
	19N2	3	2	Morone chrysops		0	1	Post
	19N2	3	3			0	0	N/A
8/17/94	20D1	3	1	Pomoxis sp.		0	8	Post
	20D1	3	1	Lepomis sp.		0	3	Post
	20D1	3	1	Morone sp.		0	6	Post
	20D1	3	2	Pomoxis sp.		0	2	Post
	20D1	3	2	Lepomis sp.		0	3	Post
	20D1	3	2	Morone sp.		0	2	Post
	20D1	3	3	Pomoxis sp.		0	4	Post
	20D1	3	3	Lepomis sp.		0	3	Post
	20D1	3	3	Lepomis sp.		0	2	Juv.
	20D1	3	3	Morone sp.		0	2	Post
	20D2	3	1	Lepomis sp.		0	1	Post
	20D2	3	2			0	0	N/A
	20D2	3	3	Lepomis sp.		0	2	Post
	20N1	3	1	Pomoxis sp.		0	2	Post
	20N1	3	1	Pomoxis sp.		0	1	Juv.
	20N1	3	1	Lepomis sp.		0	1	Post
	20N1	3	2	Damaged		0	1	Post
	20N1	3	2	Lepomis sp.		0	2	Post
	20N1	3	3			0	0	N/A
	20N2	3	1	Lepomis sp.		0	1	Post
	20N2	3	2	Lepomis sp.		0	2	Post
	20N2	3	3	Lepomis sp.		0	1	Post
	20N2	3	3	Pomoxis sp.		0	1	Juv.
8/24/94	21D1	3	1	Lepomis sp.		0	4	Post
	21D1	3	1	Pomoxis sp.		0	1	Post
	21D1	3	1	Damaged		1	0	N/A
	21D1	3	2	Morone sp.		0	2	Post
	21D1	3	2	Damaged		1	0	N/A
	21N1	3	2	Damaged		0	1	Juv.
	21D1	3	3	Pomoxis sp.		0	2	Post
	21D2	3	1	Lepomis sp.		0	2	Post
	21D2	3	1	Pomoxis sp.		0	2	Post
	21D2	3	2			0	0	N/A
	21D2	3	3			0	0	N/A
	21N1	3	1	Morone sp.		0	2	Post
	21N1	3	1	Lepomis sp.		0	1	Post
	21N1	3	2	Morone sp.		0	1	Post
	21N1	3	3	Lepomis sp.		0	2	Post

	21N1	3	3	Morone sp.		0	1	Post
	21N2	3	1	Pomoxis sp.		0	1	Post
	21N2	3	2			0	0	N/A
	21N2	3	3			0	0	N/A
Note: A blank in the genus column denotes the replicate as devoid of larvae and eggs.								
Egg-Egg stage of development.								
Post-Postlarvae stage of development.								
Pre-Prelarvae stage of development.								
N/A-Not Applicable.								
ND-Not Determined.								

APPENDIX E

ANOVA Summaries for Ichthyoplankton Data

Appendix E1. ANOVA summary results for depth distribution of fish eggs and larvae in front of the Unit 1 trash rack.

ANOVA Fish Eggs Across Sample Depths						
Sampling Date	**Source of Variance**	**df**	**SS**	**MS**	**F-Value**	**P-Value**
May 4, 1994 (Day)	Between Groups	2	56.18	28.09	1	0.421
	Within Groups	6	168.54	28.09		
(Night)	Between Groups	2	1566891	783445.3	0.66	0.543
	Within Groups	6	7053323	1175554		
May 11, 1994 (Day)	Between Groups	2	1069.6	534.8	0.494	0.632
	Within Groups	6	6494.7	1082.4		
May 18, 1994 (Day)	**Between Groups**	**2**	**3216.02**	**1608.01**	**288**	**1.10E-06**
	Within Groups	**6**	**33.5**	**5.583**		
(Night)	Between Groups	2	6200	3100	2.75	0.142
	Within Groups	6	6766	1127.6		
May 25, 1994 (Day)	Between Groups	2	162	81	1	0.422
	Within Groups	6	486	81		
June 1, 1994 (Day)	Between Groups	2	0	0	0	0
	Within Groups	6	0	0		
(Night)	Between Groups	2	0	0	0	0
	Within Groups	6	0	0		
June 8, 1994 (Day)	Between Groups	2	0	0	0	0
	Within Groups	6	0	0		
(Night)	Between Groups	2	0	0	0	0
	Within Groups	6	0	0		
ANOVA for Larvae Density Across Depths Sampled:						
May 4, 1994 (Day)	Between Groups	2	3330.9	1665.4	1.17	0.372
	Within Groups	6	8532.7	1422.1		
(Night)	Between Groups	2	51890.9	25945.4	1.97	0.222
	Within Groups	6	79107	13184.6		
May 11, 1994(Day)	Between Groups	2	934.9	468.4	2.07	0.207
	Within Groups	6	1355.3	225.9		
(Night)	Between Groups	2	333024	161512	3.16	0.115
	Within Groups	6	315680	52613.3		
May 25, 1994(Day)	Between Groups	2	0	0	0	0
	Within Groups	6	0	0		
June 1, 1994 (Day)	Between Groups	2	430.2	215.1	1	0.0422
	Within Groups	6	1290.7	215.1		
(Night)	**Between Groups**	**2**	**161909.6**	**80954.8**	**12.01**	**0.0079**
	Within Groups	**6**	**40424.7**	**6737.4**		
June 8, 1994 (Day)	Between Groups	2	84.7	42.3	0.5	0.629
	Within Groups	6	507.3	84.5		
(Night)	**Between Groups**	**2**	**1490.7**	**745.3**	**15.7**	**0.00415**
	Within Groups	**6**	**285.3**	**47.5**		

Note: Bolded values denote significant difference between sample depth densities of ichthyoplankton.

Statistical Analysis of Depth Distribution of Ichthyoplankton

Knowns and Assumptions:

1. Eggs and Larvae will be analyzed separately.
2. ANOVA will be applied to total density of ichthyoplankton (all species)
3. Density will be transformed to units of no./1000 m3.
4. Day and night samples will be considered as separate data sets
5. Damaged eggs/larvae will not be included in the data set.

Eggs

Date: 5/4/94 day

Rep.	3.0 ft.	25.0 ft	50.0 ft.
1	0	0	0
2	15.9	0	0
3	0	0	0

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	15.9	5.3	84.27
Column 2	3	0	0	0
Column 3	3	0	0	0

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	56.18	2	28.09	1	0.421875	5.143249
Within Groups	168.54	6	28.09			
Total	224.72	8				

5/4/94 night

Rep.	3 ft.	25 ft.	50 ft.
1	132	944	3188
2	22	301	22
3	0	221	0

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Column 1	3	154	51.33333	5001.333
Column 2	3	1466	488.6667	157096.3
Column 3	3	3210	1070	3364564

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1566891	2	783445.3	0.666448	0.547807	5.143249
Within Groups	7053323	6	1175554			
Total	8620214	8				

5/11/94 day

Rep.	3 ft	25 ft	50 ft.
1	0	11	0
2	0	0	90
3	39	0	0

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Column 1	3	39	13	507
Column 2	3	11	3.666667	40.33333
Column 3	3	90	30	2700

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1069.556	2	534.7778	0.494046	0.632962	5.143249
Within Groups	6494.667	6	1082.444			
Total	7564.222	8				

5/11/94 night

Rep.	3	25	50
1			
2			
3			

5/18/94 day

Rep.	3 ft.	25ft.	50ft.
1	39.1	0	0
2	36.6	0	0
3	44.6	0	0

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	120.3	40.1	16.75
Column 2	3	0	0	0
Column 3	3	0	0	0

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3216.02	2	1608.01	288.0018	1.1E-06	5.143249
Within Groups	33.5	6	5.583333			
Total	3249.52	8				

5/18/94 night

Rep.	3ft.	25ft.	50ft.
1	86	25	0
2	106	17	0
3	0	0	12

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Column 1	3	192	64	3172
Column 2	3	42	14	163
Column 3	3	12	4	48

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	6200	2	3100	2.749039	0.142095	5.143249
Within Groups	6766	6	1127.667			
Total	12966	8				

Date: 5/25/94 day

Rep.	3ft.	25ft.	50ft.
1	0	0	27
2	0	0	0
3	0	0	0

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Column 1	3	0	0	0
Column 2	3	0	0	0
Column 3	3	27	9	243

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	162	2	81	1	0.421875	5.143249
Within Groups	486	6	81			
Total	648	8				

5/25/94 night-No sample collected because of severe weather.

Date: 6/1/94 day

Rep.	3ft.	25ft.	50ft.
1	0	0	0
2	0	0	0
3	0	0	0

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	0	0	0
Column 2	3	0	0	0
Column 3	3	0	0	0

6/1/94 night

Rep	3ft.	25ft.	50ft.
1	0	0	0
2	0	0	0
3	0	0	0

See above ANOVA for result

Date: 6/8/94 day

Rep	3ft.	25ft.	50ft.
1	0	0	0
2	0	0	0
3	0	0	0

See above ANOVA for result

6/8/94 night

Rep.	3ft.	25ft.	50ft.
1	0	0	0
2	0	0	0
3	0	0	0

See above ANOVA for result

Larvae Density vs. Depth

Date: 5/4/94 day

Rep.	3ft.	25ft.	50ft.
1	0	91	19
2	0	17	95
3	0	0	19

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	0	0	0
Column 2	3	108	36	2341
Column 3	3	133	44.33333	1925.333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3330.889	2	1665.444	1.171107	0.372057	5.143249
Within Groups	8532.667	6	1422.111			
Total	11863.56	8				

5/4/94 night

Rep.	3ft.	25ft.	50ft.
1	44	442	175
2	70	140	174
3	0	80	130

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	114	38	1252
Column 2	3	662	220.6667	37641.33

Column 3	3	479	159.6667	660.3333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	51890.89	2	25945.44	1.967866	0.220219	5.143249
Within Groups	79107.33	6	13184.56			
Total	130998.2	8				

Date: 5/11/94 day

Rep.	3ft.	25ft.	50ft.
1	0	22	28
2	0	0	45
3	0	0	0

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	0	0	0
Column 2	3	22	7.333333	161.3333
Column 3	3	73	24.33333	516.3333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	934.8889	2	467.4444	2.069356	0.207255	5.143249
Within Groups	1355.333	6	225.8889			
Total	2290.222	8				

5/11/94 night Note: No 25ft. or 50ft. sample collected

Rep.	3ft.	25ft.	50ft.
1	13	-	-
2	21	-	-
3	19	-	-

5/18/94 day

Rep.	3ft.	25ft.	50ft.
1	0	0	0
2	18	85	0
3	11	34	0

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	29	9.666667	82.33333
Column 2	3	119	39.66667	1830.333
Column 3	3	0	0	0

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2566.889	2	1283.444	2.013071	0.214315	5.143249
Within Groups	3825.333	6	637.5556			
Total	6392.222	8				

5/18/94 night

Rep.	3ft.	25ft.	50ft.
1	0	176	279
2	0	207	462
3	0	853	471

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Column 1	3	0	0	0
Column 2	3	1236	412	146101
Column 3	3	1212	404	11739

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	333024	2	166512	3.164825	0.11524	5.143249
Within Groups	315680	6	52613.33			
Total	648704	8				

Date: 5/25/94 day

Rep.	3ft.	25ft.	50ft.
1	0	0	0
2	0	0	0
3	0	0	0

No larvae or juveniles collected in any samples.

5/25/94 night

No sampling due to severe weather.

Date: 6/1/94 day

Rep	3ft.	25ft.	50ft.
1	0	44	0
2	0	0	0
3	0	0	0

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Column 1	3	0	0	0

Column 2	3	44	14.66667	645.3333
Column 3	3	0	0	0

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	430.2222	2	215.1111	1	0.421875	5.143249
Within Groups	1290.667	6	215.1111			
Total	1720.889	8				

6/1/94 night

Rep.	3ft.	25ft.	50ft.
1	0	382	123
2	0	401	247
3	0	201	73

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	0	0	0
Column 2	3	984	328	12187
Column 3	3	443	147.6667	8025.333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	161909.6	2	80954.78	12.01565	0.007975	5.143249
Within Groups	40424.67	6	6737.444			
Total	202334.2	8				

6/8/94 day

Rep.	3ft.	25ft.	50ft.
1	0	19	0
2	0	0	0
3	20	0	0

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	20	6.666667	133.3333
Column 2	3	19	6.333333	120.3333
Column 3	3	0	0	0

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	84.66667	2	42.33333	0.500657	0.629383	5.143249
Within Groups	507.3333	6	84.55556			
Total	592	8				

6/8/94 night

Rep.	3ft	25ft.	50ft.
1	0	23	26
2	0	43	23
3	0	22	25

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	0	0	0
Column 2	3	88	29.33333	140.3333
Column 3	3	74	24.66667	2.333333

Appendix E2. ANOVA for Depth vs. D Distribution in front of the Unit 1 Intake

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1490.667	2	745.3333	15.6729	0.004147	5.143249
Within Groups	285.3333	6	47.55556			
Total	1776	8				

APPENDIX F

Descriptive Statistics for CPSES Ichthyoplankton Density Data

Date : 4/6/94										
Sample: 1D1		No Larvae collected; only eggs)								
Rep.	Vol. (m3)	Damaged	Eggs/m3	Eggs/1000						
1	16.3	0	0	0						
2	13.7	0	0	0						
3	36.11	1	0.0276	27.6						
Sum	66.11	1	0.0276	27.6						
Mean	22.03667	0.3333333	0.0092	9.2						
Variance		0.3333333	0.000254	253.92						
Sample: 1N1		No eggs collected; only larvae								
		Dorosoma	Larvae per	Larvae per	Menidia	Larvae per	Larvae per			
Rep.	Vol. (m3)	Larvae	m3	1000m3	Larvae	m3	1000m3			
1	42.6	7	0.164319	164.3	0	0	0			
2	31.6	4	0.126582	126.6	1	0.031646	31.6			
3	44.7	6	0.134228	134.2	0	0	0			
Sum	118.9	17	0.42513	425.1	1	0.031646	31.6			
Mean	39.63333	5.6666667	0.14171	141.7	0.333333	0.010549	10.53333			
Variance	49.50333	2.3333333	0.000398	397.51	0.333333	0.000334	332.8533			
Date: 4/13/94										
Sample: 2D1		No larvae only eggs.								
		Aplodinotus		Eggs per						
Rep.	Vol. (m3)	Eggs	Eggs/m3	1000m3						
1	55.1	0	0	0						
2	54.5	0	0	0						
3	55.7	2	0.035907	35.9						
Sum	165.3	2	0.035907	35.9						
Mean	55.1	0.6666667	0.011969	11.96667						
Variance	0.36	1.3333333	0.00043	429.6033						
Sample: 2N1 Eggs and Larvae Collected.										
		Dorsoma	Larvae per	Larvae per	Menidia		Eggs per	Damaged		Eggs per
Rep.	Vol.(m3)	Larvae	m3	1000m3	Eggs	Eggs/m3	1000 m3	Eggs	Eggs/m3	1000m3
1	47.6	3	0.063025	63	1	0.021008	21	0	0	0
2	44	4	0.090909	90.9	0	0	0	1	0.022727	22.7
3	45.8	1	0.021834	21.8	0	0	0	0	0	0
Sum	137.4	8	0.175768	175.7	1	0.021008	21	1	0.022727	22.7
Mean	45.8	2.6666667	0.058589	58.56667	0.333333	0.007003	7	0.333333	0.007576	7.566667
Variance	3.24	2.3333333	0.001208	1208.443	0.333333	0.000147	147	0.333333	0.000172	171.7633
Date: 4/20/94										
Sample: 3D1 Only Larvae Collected.										
		Dorosoma	Larvae per	Larvae per						
Rep.	Vol. (m3)	Larvae	m3	1000 m3						
1	49.2	3	0.060976	60.9						
2	49.2	0	0	0						
3	49.2	0	0	0						
Sum	147.6	3	0.060976	60.9						
Mean	49.2	1	0.020325	20.3						
Variance	0	3	0.001239	1236.27						
Sample: 3N1 No Eggs or Larvae Collected in Samples.										

Date: 4/27/94

Sample: 4D1 Damaged Eggs Collected Only in Samples.

Rep.	Vol. (m3)	Damaged Eggs	Eggs/m3	Eggs per 1000m3
1	60.9	1	0.01642	16.4
2	61	1	0.016393	16.4
3	58	1	0.017241	17.2
Sum	179.9	3	0.050055	50
Mean	59.96667	1	0.016685	16.66667
Variance	2.903333	0	2.32E-07	0.213333

Sample : 4N1 Eggs, Larvae and Juveniles Collected.

Rep.	Vol. (m3)	Damaged Eggs	Eggs/m3	Eggs per 1000 m3	Dorosoma Larvae	Larvae per m3	Larvae per 1000m3	Dorosoma Juveniles	Juveniles per m3	Juveniles per1000m	Menidia Eggs	Eggs/m3	Eggs per 1000 m3
1	50.1	9	0.179641	179.6	0	0	0	0	0	0	0	0	0
2	51.9	9	0.17341	173.4	1	0.019268	19.3	1	0.019268	19.3	1	0.019268	19.3
3	51.4	16	0.311284	311.3	0	0	0	0	0	0	0	0	0
Sum	153.4	34	0.664335	664.3	1	0.019268	19.3	1	0.019268	19.3	1	0.019268	19.3
Mean	51.13333	11.333333	0.221445	221.4333	0.333333	0.006423	6.433333	0.333333	0.006423	6.433333	0.333333	0.006423	6.433333
Variance	0.863333	16.333333	0.006063	6066.623	0.333333	0.000124	124.1633	0.333333	0.000124	124.1633	0.333333	0.000124	124.1633

Date: 5/4/94

Sample: 5D1 Only Eggs Collected in Samples.

Rep.	Vol. (m3)	Damaged Eggs	Eggs/m3	Eggs per 1000m3	Aplodinotus Eggs	Eggs/m3	Eggs per 1000m3
1	59.7	0	0	0	0	0	0
2	62.6	0	0	0	1	0.015974	15.9
3	53.2	1	0.018797	18.8	0	0	0
Sum	175.5	1	0.018797	18.8	1	0.015974	15.9
Mean	58.5	0.3333333	0.006266	6.266667	0.333333	0.005325	5.3
Variance	23.17	0.3333333	0.000118	117.8133	0.333333	8.51E-05	84.27

Sample: 5N1 Eggs, Larvae and Juveniles Collected in Samples.

Rep.	Vol.(m3)	Dorosoma Larvae	Larvae per m3	Larvae per 1000m3	Dorosoma Juvenile	Juveniles pe m3	Juveniles per 1000m	Menidia Larvae	Larvae per m3	Larvae per 1000m3	Aplodinotu Eggs	Eggs/m3	Eggs per 1000m3	Damaged Eggs	Eggs/m3	Eggs per 1000 m3	Damaged Larvae	Larvae per m3	Larvae per 1000 m3
1	45.5	1	0.021978	21.9	1	0.021978	21.9	0	0	0	6	0.131868	131.9	1	0.021978	21.9	1	0.021978	21.9
2	45.5	2	0.043956	43.9	0	0	0	1	0.021978	21.9	1	0.021978	21.9	0	0	0	3	0.065934	65.9
3	45.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.9	1	0.021978	21.9
Sum	136.5	3	0.065934	65.8	1	0.021978	21.9	1	0.021978	21.9	7	0.153846	153.8	1	0.021978	43.8	5	0.10989	109.7
Mean	45.5	1	0.021978	21.93333	0.333333	0.007326	7.3	0.333333	0.007326	7.3	2.333333	0.051282	51.26667	0.333333	0.007326	14.6	1.666667	0.03663	36.56667
Variance	0	1	0.000483	481.8033	0.333333	0.000161	159.87	0.333333	0.000161	159.87	10.33333	0.004991	4996.203	0.333333	0.000161	159.87	1.333333	0.000644	645.3333

Sample 5N1 continued

Rep	Vol.(m3)	Pomoxis Larvae	Larvae per m3	Larvae per 1000 m3
1	45.5	0	0	0
2	45.5	1	0.021978	21.97802
3	45.5	0	0	0
Sum	136.5	1	0.021978	21.97802
Mean	45.5	0.3333333	0.007326	7.326007
Variance	0	0.3333333	0.000161	161.0112

Date: 5/11/94

Sample: 6D1 Eggs only Collected in Samples.

Rep.	Vol. (m3)	Damaged Eggs	Eggs/m3	Eggs per 1000m3	Aplodinotu Eggs	Eggs/m3	Eggs per 1000m3	Menidia Eggs	Eggs/m3	Eggs per 1000 m3
1	72.13	2	0.027728	27.7	0	0	0	0	0	0
2	53.29	0	0	0	0	0	0	0	0	0
3	51.12	0	0	0	1	0.019562	19.5	2	0.039124	39.1
Sum	176.54	2	0.027728	27.7	1	0.019562	19.5	2	0.039124	39.1
Mean	58.84667	0.6666667	0.009243	9.233333	0.333333	0.006521	6.5	0.666667	0.013041	13.03333
Variance	133.5124	1.3333333	0.000256	255.7633	0.333333	0.000128	126.75	1.333333	0.00051	509.6033

Sample: 6N1 Eggs and Larvae Collected in Samples.

Rep.	Vol. (m3)	Damaged Eggs	Eggs/m3	Eggs per 1000m3	Dorosoma Larvae	Larvae per m3	Larvae per 1000m3	Aplodinotu Eggs	Eggs/m3	Eggs per 1000 m3
1	79.19	0	0	0	1	0.012628	12.6	1	0.012628	12.6
2	48.25	1	0.020725	20.7	1	0.020725	20.7	0	0	0
3	51.51	2	0.038827	38.8	1	0.019414	19.4	2	0.038827	38.8
Sum	178.95	3	0.059553	59.5	3	0.052767	52.7	3	0.051455	51.4
Mean	59.65	1	0.019851	19.83333	1	0.017589	17.56667	1	0.017152	17.13333
Variance	289.0156	1	0.000377	376.9233	0	1.89E-05	18.92333	1	0.000392	391.7733

Date: 5/18/94

Sample: 7D1 Eggs and Larvae Collected in Samples.

Rep.	Vol. (m3)	Aplodinotu Eggs	Eggs/m3	Eggs per 1000 m3	Dorosoma Larvae	Larvae per m3	Larvae per 1000 m3
1	51.12	2	0.039124	39.1	0	0	0
2	54.72	2	0.03655	36.6	1	0.018275	18.3
3	89.63	4	0.044628	44.6	1	0.011157	11.1
Sum	195.47	8	0.120301	120.3	2	0.029432	29.4
Mean	65.15667	2.6666667	0.0401	40.1	0.666667	0.009811	9.8
Variance	452.448	1.3333333	1.7E-05	16.75	0.333333	8.49E-05	84.99

Sample: 7N1 Eggs Only Collected in Samples.

Rep.	Vol. (m3)	Aplocinotu Eggs	Eggs/m3	Eggs per 1000 m3
1	46.68	4	0.08569	85.7
2	56.54	6	0.10612	106.1
3	74.23	0	0	0
Sum	177.45	10	0.191809	191.8
Mean	59.15	3.3333333	0.063936	63.93333
Variance	194.8597	9.3333333	0.00317	3169.643

Date: 5/25/94

Sample: 8D1 No Eggs, Larvae or Juveniles Collected in Samples.

Sample 8N1 Called Off Sampling Due to Severe Weather-No Samples Collected.

Date: 6/1/94

Sample: 9D1 No Eggs, Larvae or Juveniles Collected in Samples.

Sample 9N1 No Eggs, Larvae or Juveniles Collected in Samples.

Date: 6/8/94

Sample: 10D1 Only larvae collected

Rep.	Vol. (m3)	Aplodinotus Larvae	Larvae per m3	Larvae per 1000 m3
1	51.24	0	0	0
2	49.17	0	0	0
3	50.12	1	0.019952	19.9
Sum	150.53	1	0.019952	19.9
Mean	50.17667	0.3333333	0.006651	6.633333
Variance	1.073633	0.3333333	0.000133	132.0033

Sample: 10N1 No Eggs, Larvae or Juveniles Collected in Samples.

Date: 6/15/94

Sample: 11D1 Drum Larvae only Collected.

Rep.	Vol.(m3)	Aplodinotus Larvae	Larvae per m3	Larvae per 1000 m3
1	50.2	0	0	0
2	56.9	1	0.017575	17.6
3	57.7	1	0.017331	17.3
Sum	164.8	2	0.034906	34.9
Mean	54.93333	0.6666667	0.011635	11.63333
Variance	16.96333	0.3333333	0.000102	101.5233

Sample: 11N1 Eggs only Collected in Samples.

Rep.	Vol. (m3)	Aplodinotus Eggs	Eggs/m3	Eggs per 1000 m3	Damaged Eggs	Eggs/m3	Eggs per 1000 m3
1	42.3	3	0.070922	70.9	9	0.212766	212.7
2	46.9	1	0.021322	21.3	2	0.042644	42.6
3	44.6	1	0.022422	22.4	1	0.022422	22.4
Sum	133.8	5	0.114665	114.6	12	0.277831	277.7
Mean	44.6	1.6666667	0.038222	38.2	4	0.09261	92.56667
Variance	5.29	1.3333333	0.000802	802.27	19	0.01093	10926.02

Date: 6/22/94

Sample: 12D1 Eggs and Larvae Collected in Samples.

Rep.	Vol. (m3)	Aplodinotus Larvae	Larvae per m3	Larvae per 1000 m3	Damaged Eggs	Eggs/m3	Eggs per 1000 m3
1	33.74	0	0	0	0	0	0
2	58.31	1	0.01715	17.2	1	0.01715	17.2
3	46.02	0	0	0	0	0	0
Sum	138.07	1	0.01715	17.2	1	0.01715	17.2
Mean	46.02333	0.3333333	0.005717	5.733333	0.333333	0.005717	5.733333
Variance	150.9212	0.3333333	9.8E-05	98.61333	0.333333	9.8E-05	98.61333

Sample: 12N1 Eggs and Larvae Collected in Samples.

Rep.	Vol (m3)	Aplodinotus Larvae	Larvae per m3	Larvae per 1000 m3	Morone Larvae	Larvae per m3	Larvae per 1000 m3	Menidia Larvae	Larvae per m3	Larvae per 1000 m3	Menidia Eggs	Eggs/m3	Eggs per 1000 m3	Centrarct. Larvae	Larvae per m3	Larvae per 1000 m3
1	40.98	3	0.073206	73.2	1	0.024402	24.4	1	0.024402	24.4	0	0	0	0	0	0
2	40.55	5	0.123305	123.3	0	0	0	0	0	0	0	0	0	10	0.246609	246.6
3	41.41	1	0.024149	24.1	0	0	0	0	0	0	1	0.024149	24.1	6	0.144893	144.9
Sum	122.94	9	0.22066	220.6	1	0.024402	24.4	1	0.024402	24.4	1	0.024149	24.1	16	0.391502	391.5
Mean	40.98	3	0.073553	73.53333	0.333333	0.008134	8.133333	0.333333	0.008134	8.133333	0.333333	0.00805	8.033333	5.333333	0.130501	130.5
Variance	0.1849	4	0.002458	2460.243	0.333333	0.000198	198.4533	0.333333	0.000198	198.4533	0.333333	0.000194	193.6033	25.33333	0.015359	15358.41

Date: 6/29/94

Sample: 13D1 No eggs or larvae collected in samples.

Sample: 13N1 Larvae Collected in Samples Only.

Rep.	Vol. (m3)	Lepomis Larvae	Larvae per m3	Larvae per 1000 m3
1	29.2	0	0	0
2	50.26	2	0.039793	39.8
3	52.94	0	0	0
Sum	132.4	2	0.039793	39.8
Mean	44.13333	0.6666667	0.013264	13.26667
Variance	169.0489	1.3333333	0.000528	528.0133

Date: 7/6/94

Sample: 14D1 Larvae Collected Only in Samples.

Rep.	Vol.(m3)	Lepomis Larvae	Larvae per m3	Larvae per 1000 m3
1	46.95	0	0	0
2	49.32	2	0.040552	40.6
3	38.09	4	0.105014	105
Sum	134.36	6	0.145566	145.6
Mean	44.78667	2	0.048522	48.53333
Variance	35.03823	4	0.002805	2803.453

Sample: 14N1 No Eggs or Larvae Collected in Samples.

Date: 7/13/94

Sample: 15D1 Only Larvae Collected in Samples.

Rep.	Vol. (m3)	Lepomis Larvae	Larvae per m3	Larvae per 1000 m3	Pomoxis Larvae	Larvae per m3	Larvae per 1000 m3
1	53.07	0	0	0	1	0.018843	18.8
2	53.23	1	0.018786	18.8	4	0.075146	75.1
3	43.88	1	0.022789	22.7	0	0	0
Sum	150.18	2	0.041576	41.5	5	0.093989	93.9
Mean	50.06	0.6666667	0.013859	13.83333	1.666667	0.03133	31.3
Variance	28.6507	0.3333333	0.000148	147.3233	4.333333	0.001529	1527.19

Sample: 15N1 Only Larvae Collected in Samples.

Rep.	Vol.(m3)	Pomoxis Larvae	Larvae per m3	Larvae per 1000 m3	Centrarc. Larvae	Larvae per m3	Larvae per 1000 m3
1	52.94	1	0.018889	18.9	0	0	0
2	57.09	1	0.017516	17.5	1	0.017516	17.5
3	42.36	2	0.047214	47.2	1	0.023607	23.6
Sum	152.39	4	0.08362	83.6	2	0.041123	41.1
Mean	50.79667	1.3333333	0.027873	27.86667	0.666667	0.013708	13.7

Variance	57.68863	0.3333333	0.000281	280.8233	0.333333	0.00015	150.07

Date: 7/20/94

Sample: 16D1 No Eggs or Larvae Collected in Samples.

Sample: 16N1 No Eggs or Larvae Collected in Samples.

7/27/94

Sample: 17D1 No Eggs or Larvae Collected in Samples.

Sample: 17N1 No Eggs or Larvae Collected in Samples.

Date: 8/3/94

Sample: 18D1 Only Larvae Collected in Samples.

Rep.	Vol. (m3)	Aplodinotus Larvae	Larvae per m3	Larvae per 1000 m3	Lepomis Larvae	Larvae per m3	Larvae per 1000 m3
1	55.4	3	0.054152	54.1	1	0.018051	18.1
2	58.56	1	0.017077	17.1	0	0	0
3	54.08	3	0.055473	55.5	0	0	0
Sum	168.04	7	0.126702	126.7	1	0.018051	18.1
Mean	56.01333	2.3333333	0.042234	42.23333	0.333333	0.006017	6.033333
Variance	5.299733	1.3333333	0.000475	474.2533	0.333333	0.000109	109.2033

Sample: 18N1 Only Larvae Collected in Sample.

Rep.	Vol. (m3)	Aplodinotus Larvae	Larvae per m3	Larvae per 1000 m3	Pomoxis Larvae	Larvae per m3	Larvae per 1000 m3	Centrarc. Larvae	Larvae per m3	Larvae per 1000 m3
1	59.62	2	0.033546	33.5	1	0.016773	16.8	0	0	0
2	63.62	3	0.047155	47.2	1	0.015718	15.7	1	0.015718	15.7
3	64.55	0	0	0	0	0	0	0	0	0
Sum	187.79	5	0.080701	80.7	2	0.032491	32.5	1	0.015718	15.7
Mean	62.59667	1.6666667	0.0269	26.9	0.666667	0.01083	10.83333	0.333333	0.005239	5.233333
Variance	6.861633	2.3333333	0.000589	589.63	0.333333	8.83E-05	88.32333	0.333333	8.24E-05	82.16333

Date:8/10/94

Sample: 19D1 Only Larvae Collected in Samples.

Rep.	Vol.(m3)	Lepomis Larvae	Larvae per m3	Larvae per 1000 m3	Pomoxis Larvae	Larvae per m3	Larvae per 1000 m3	Morone Larvae	Larvae per m3	Larvae per 1000 m3
1	48.86	1	0.020467	20.5	1	0.020467	20.5	0	0	0
2	52.9	4	0.075614	75.6	3	0.056711	56.7	0	0	0
3	49.36	4	0.081037	81	2	0.040519	40.5	7	0.141815	141.8
Sum	151.12	9	0.177118	177.1	6	0.117696	117.7	7	0.141815	141.8
Mean	50.37333	3	0.059039	59.03333	2	0.039232	39.23333	2.333333	0.047272	47.26667
Variance	4.850533	3	0.001123	1120.903	1	0.00033	328.8133	16.33333	0.006704	6702.413

Sample: 19N1 Only Larvae Collected in Samples.

Rep.	Vol. (m3)	Lepomis Larvae	Larvae per m3	Larvae per 1000 m3	Pomoxis Larvae	Larvae per m3	Larvae per 1000 m3	Morone Larvae	Larvae per m3	Larvae per 1000 m3
1	52.39	1	0.019088	19.1	0	0	0	4	0.07635	76.4
2	53.36	2	0.037481	37.5	1	0.018741	18.7	0	0	0
3	51.79	1	0.019309	19.3	0	0	0	0	0	0

Sum	157.54	4	0.075878	75.9	1	0.018741	18.7	4	0.07635	76.4									
Mean	52.51333	1.3333333	0.025293	25.3	0.333333	0.006247	6.233333	1.333333	0.02545	25.46667									
Variance	0.627633	0.3333333	0.000111	111.64	0.333333	0.000117	116.5633	5.333333	0.001943	1945.653									
Date: 8/17/94																			
Sample: 20D1 Only Larvae and Juveniles Collected in Samples.																			
		Lepomis	Larvae per	Larvae per	Lepomis	Juveniles	Juveniles	Pomoxis	Larvae per	Larvae per	Morone	Larvae per	Larvae per						
Rep.	Vol.(m3)	Larvae	m3	1000 m3	Juveniles	per m3	per1000m	Larvae	m3	1000 m3	Larvae	m3	1000m3						
1	47.89	3	0.062644	62.6	0	0	0	8	0.167049	167	6	0.125287	125.3						
2	44.81	3	0.066949	66.9	0	0	0	2	0.044633	44.6	2	0.044633	44.6						
3	31.68	3	0.094697	94.7	2	0.063131	63.1	4	0.126263	126.3	2	0.063131	63.1						
Sum	124.38	9	0.22429	224.2	2	0.063131	63.1	14	0.337945	337.9	10	0.233051	233						
Mean	41.46	3	0.074763	74.73333	0.666667	0.021044	21.03333	4.666667	0.112648	112.6333	3.333333	0.077684	77.66667						
Variance	74.1079	0	0.000303	303.6233	1.333333	0.001329	1327.203	9.333333	0.003885	3885.523	5.333333	0.001785	1787.263						
Sample: 20N1 Only Larvae and Juveniles Collected in Samples.																			
		Pomoxis	Larvae per	Larvae per	Pomoxis	Juveniles	Juveniles	Lepomis	Larvae per	Larvae per	Damaged	Larvae per	Larvae per						
Rep.	Vol. (m3)	Larvae	m3	1000 m3	Juveniles	per m3	per1000m	Larvae	m3	1000 m3	Larvae	m3	1000 m3						
1	42.53	2	0.047026	47	1	0.023513	1.1	1	0.023513	23.5	0	0	0						
2	41.01	0	0	0	0	0	0	2	0.048769	48.7	1	0.024384	24.3						
3	35.56	0	0	0	0	0	0	0	0	0	0	0	0						
Sum	119.1	2	0.047026	47	1	0.023513	1.1	3	0.072281	72.2	1	0.024384	24.3						
Mean	39.7	0.6666667	0.015675	15.66667	0.333333	0.007838	0.366667	1	0.024094	24.06667	0.333333	0.008128	8.1						
Variance	13.4323	1.3333333	0.000737	736.3333	0.333333	0.000184	0.403333	1	0.000595	24.06667	0.333333	0.000198	196.83						
Date: 8/24/94																			
Sample: 21D1 Eggs and Larvae Collected in Samples.																			
		Lepomis	Larvae per	Larvae per	Pomoxis	Larvae per	Larvae per	Damaged		Eggs per	Damaged	Larvae per	Larvae per	Morone	Larvae per	Larvae per			
Rep.	Vol. (m3)	Larvae	m3	1000 m3	Larvae	m3	1000 m3	Eggs	Eggs/m3	1000 m3	Larvae	m3	1000 m3	Larvae	m3	1000 m3			
1	44.97	4	0.088948	88.9	1	0.022237	22.2	1	0.022237	22.2	0	0	0	0	0	0			
2	31.54	0	0	0	0	0	0	1	0.031706	31.7	1	0.031706	31.7	2	0.063412	63.4			
3	43.04	0	0	0	2	0.046468	46.5	0	0	0	0	0	0	0	0	0			
Sum	119.55	4	0.088948	88.9	3	0.068705	68.7	2	0.053943	53.9	1	0.031706	31.7	2	0.063412	63.4			
Mean	39.85	1.3333333	0.029649	29.63333	1	0.022902	22.9	0.666667	0.017981	17.96667	0.333333	0.010569	10.56667	0.666667	0.021137	21.13333			
Variance	52.7233	5.3333333	0.002637	2634.403	1	0.00054	540.93	0.333333	0.000265	264.6633	0.333333	0.000335	334.9633	1.333333	0.00134	1339.853			
Sample: 21N1 Only Larvae Collected in Samples.																			
		Lepomis	Larvae	Larvae per	Morone	Larvae per	Larvae per												
Rep.	Vol. (m3)	Larvae	per m3	1000 m3	Larvae	m3	1000 m3												
1	46.12	1	0.021683	21.7	2	0.043365	43.4												
2	48.54	0	0	0	1	0.020602	20.6												
3	40.58	2	0.049285	49.3	1	0.024643	24.6												
Sum	135.24	3	0.070968	71	4	0.088609	88.6												
Mean	45.08	1	0.023656	23.66667	1.333333	0.029536	29.53333												
Variance	16.6516	1	0.00061	610.5233	0.333333	0.000148	148.2133												

APPENDIX G

Raw Data for Gill Net and Electrofishing Surveys

Catch summary and calculated condition index for fish collected by gill net at station one on Nov. 17, 1993.

Species	Weight (grams)	Total Length (mm)	K Index of Conditon
Channel Catfish	2600	610	1.15
Channel Catfish	1050	490	0.89
Channel Catfish	1050	418	1.438
Channel Catfish	100	278	0.465
Channel Catfish	50	250	0.320
Channel Catfish	100	263	0.550
Channel Catfish	900	489	0.770
Channel Catfish	550	422	0.73
Channel Catfish	50	250	0.32
Channel Catfish	50	251	0.32
Channel Catfish	100	248	0.656
Channel Catfish	100	282	0.446
Channel Catfish	50	234	0.390
Channel Catfish	100	255	0.603
Channel Catfish	1300	502	1.028
Channel Catfish	500	378	0.926
Gizzard Shad	Eaten	Eaten	N/A
Gizzard Shad	500	278	2.327
Gizzard Shad	200	300	0.741
Gizzard Shad	350	300	1.296
White Bass	650	370	1.283
White Bass	750	390	1.264
White Bass	650	374	1.243
White Bass	550	360	1.179
White Bass	800	392	1.328
White Bass	300	271	1.507
White Bass	350	281	1.577
White Bass	250	273	1.229
White Bass	250	276	1.189
White Bass	300	278	1.396
White Crappie	450	308	1.540
White Crappie	550	321	1.663
Largemouth Bass	950	402	1.46
Largemouth Bass	500	341	1.26
Freshwater Drum	200	272	0.99
Carp	1600	524	1.11
Carp	1400	493	1.17
Carp	1300	482	1.16
Carp	1050	437	1.26
Threadfin Shad	10	100	1.00
Threadfin Shad	10	102	0.94
Threadfin Shad	10	99	N/A
Threadfin Shad	10	102	0.94
Threadfin Shad	10	100	1.00
Threadfin Shad	Eaten	Eaten	N/A

Catch summary and calculated condition index for fish collected by gill net at station two on Nov. 17, 1993.

Species	Weight (grams)	Total Length (mm)	K Index of Conditon
Channel Catfish	1500	537	0.97
Channel Catfish	150	276	0.71
Channel Catfish	100	229	0.833
Channel Catfish	1200	422	1.597
Channel Catfish	550	407	0.816
Channel Catfish	100	258	0.582
Channel Catfish	100	259	0.576
Channel Catfish	100	245	0.68
Channel Catfish	100	245	0.68
Channel Catfish	50	225	0.44
Channel Catfish	150	276	0.713
Channel Catfish	350	367	0.708
Carp	1150	426	1.488
Carp	1550	480	1.402
Carp	1050	426	1.358
Carp	1150	419	1.563
Carp	1150	424	1.509
Carp	1150	450	1.262
Carp	1200	440	1.409
Carp	950	413	1.349
Carp	1900	539	1.213
Carp	1200	430	1.509
Carp	1050	424	1.378
Carp	950	490	0.807
Carp	900	390	1.517
Carp	1350	483	1.198
Carp	1050	418	1.438
Carp	950	400	1.484
Largemouth Bass	150	240	1.085
Largemouth Bass	650	345	1.583
Largemouth Bass	400	318	1.244
Largemouth Bass	500	312	1.646
Largemouth Bass	550	332	1.50
Largemouth Bass	250	276	1.19
Largemouth Bass	600	335	1.60
Largemouth Bass	150	221	1.39
Smallmouth Bass	900	385	1.58
White Bass	850	417	1.17
White Bass	400	294	1.57
White Crappie	150	235	1.16
White Crappie	150	230	1.23
White Crappie	200	225	1.76
White Crappie	100	215	1.01
White Crappie	200	233	1.58
White Crappie	450	293	1.79
White Crappie	200	234	1.56
Black Crappie	200	238	1.48
Gizzard Shad	300	319	0.92

Catch summary and calculated condition index for fish collected by gill net at station two on Nov. 17, 1993.

Gizzard Shad	500	357	1.10
Gizzard Shad	150	259	0.86
Gizzard Shad	500	367	1.01
Gizzard Shad	500	338	1.29
Bluegill Sunfish	Eaten	Eaten	N/A

Catch summary and calculated condition index for fish collected by gill net at station three on Nov. 17, 1993.

Species	Weight (grams)	Total Length (mm)	K Index of Conditon
Freshwater Drum	3200	635	1.25
White Bass	850	403	1.30
White Bass	600	362	1.265
White Bass	300	283	1.324
White Bass	800	395	1.298
Largemouth Bass	150	225	1.317
Largemouth Bass	200	237	1.502
Largemouth Bass	150	214	1.53
White Crappie	600	295	2.34
White Crappie	250	237	1.88
Black Crappie	200	211	2.129
Channel Catfish	450	385	0.789
Channel Catfish	1000	486	0.871
Channel Catfish	1500	514	1.105
Channel Catfish	200	249	1.295
Channel Catfish	450	273	2.212
Gizzard Shad	452	350	1.054
Gizzard Shad	400	231	3.245
Gizzard Shad	1100	448	1.223
Carp	1150	425	1.498

Catch summary and calculated condition index for fish collected by gill net at station four on Nov. 17, 1993.

Species	Weight (grams)	Total Length (mm)	K Index of Conditon
Carp	1150	418	1.575
Carp	1800	530	1.209
Carp	1350	454	1.443
Gizzard Shad	150	273	0.737
Gizzard Shad	400	366	0.816
Gizzard Shad	300	347	0.718
Gizzard Shad	300	336	0.791
Gizzard Shad	350	342	0.875
Gizzard Shad	350	345	0.852
Gizzard Shad	450	349	1.059
White Bass	550	371	1.08
White Bass	700	384	1.236
White Bass	650	391	1.087
White Bass	700	395	1.136
White Bass	1050	349	2.470
White Crappie	300	269	1.54
White Crappie	250	240	1.81
White Crappie	150	226	1.30
Black Crappie	350	302	1.271
Channel Catfish	950	400	1.484
Channel Catfish	1200	441	1.399
Channel Catfish	50	255	0.302
Channel Catfish	450	409	0.658
Channel Catfish	1300	538	0.835
Channel Catfish	300	359	0.648
Channel Catfish	1700	528	1.155
Channel Catfish	250	342	0.625
Channel Catfish	250	331	0.689
Channel Catfish	150	284	0.655
Channel Catfish	100	266	0.531
Channel Catfish	50	253	0.309
Channel Catfish	50	252	0.312
Channel Catfish	100	271	0.502
Channel Catfish	1050	418	1.438
Channel Catfish	100	285	0.432
Channel Catfish	350	362	0.738
Channel Catfish	100	270	0.508
Channel Catfish	100	286	0.427
Channel Catfish	50	243	0.348
Gizzard Shad	150	274	0.729
Freshwater Drum	3900	660	1.357
Freshwater Drum	50	179	0.872
Bluegill Sunfish	50	124	2.622
Largemouth Bass	150	214	1.531
Smallmouth Bass	950	343	2.354
Smallmouth Bass	950	332	2.596

Catch summary and calculated condition index for fish collected by gill net at station five on Nov. 17, 1993.

Species	Weight (grams)	Total Length (mm)	K Index of Conditon
Carp	1500	500	1.200
Carp	1100	428	1.403
Carp	2050	531	1.369
Carp	1200	452	1.299
Carp	1250	445	1.419
Carp	1250	452	1.354
Carp	1200	447	1.344
Carp	2050	509	1.555
Carp	1800	540	1.143
Carp	400	366	0.816
Carp	1650	510	1.244
Carp	1350	488	1.162
Channel Catfish	2200	580	1.128
Channel Catfish	100	277	0.471
Channel Catfish	200	443	0.230
Channel Catfish	3200	589	1.566
Channel Catfish	450	370	0.888
Channel Catfish	300	370	0.592
Channel Catfish	300	361	0.638
Freshwater Drum	4150	680	1.320
Freshwater Drum	3900	589	1.909
Freshwater Drum	1900	507	1.458
Gizzard Shad	400	344	0.983
Gizzard Shad	350	345	0.852
Gizzard Shad	500	373	0.963
Gizzard Shad	150	270	0.762
Gizzard Shad	450	365	0.925
Gizzard Shad	400	361	0.850
White Crappie	350	296	1.350
White Crappie	100	220	0.939
White Crappie	450	297	1.718
White Crappie	500	310	1.678
White Crappie	350	290	1.435
White Crappie	200	242	1.411
White Crappie	450	301	1.650
Black Crappie	200	225	1.756
White Bass	600	365	1.234
White Bass	250	275	1.202
White Bass	250	278	1.164
Smallmouth Bass	700	384	1.236
Largemouth Bass	650	360	1.393
Largemouth Bass	450	325	1.311
Largemouth Bass	450	316	1.426

Catch summary and calculated condition index for fish collected by gill net at station one on June 22, 1994.

Species	Weight (grams)	Total Length (mm)	K Index of Conditon
Channel Catfish	2900	609	1.28
Channel Catfish	2100	586	1.04
Channel Catfish	500	400	0.781
Channel Catfish	50	190	0.729
Channel Catfish	700	432	0.868
Channel Catfish	1300	520	0.925
Channel Catfish	750	443	0.863
Channel Catfish	500	343	1.24
Channel Catfish	200	224	1.78
Channel Catfish	2250	602	1.03
Channel Catfish	400	385	0.701
Channel Catfish	100	227	0.855
Channel Catfish	450	404	0.682
Channel Catfish	100	218	0.965
Channel Catfish	500	395	0.811
Channel Catfish	900	469	0.872
Channel Catfish	500	283	2.21
Channel Catfish	300	342	0.750
Channel Catfish	250	287	1.06
Channel Catfish	200	305	0.705
Channel Catfish	50	193	0.696
Gizzard Shad	500	322	1.50
Gizzard Shad	450	363	0.941
Gizzard Shad	200	274	0.972
Gizzard Shad	200	295	0.779
Gizzard Shad	400	368	0.803
Gizzard Shad	450	365	0.925
Gizzard Shad	Eaten	Eaten	N/A
Gizzard Shad	450	348	1.07
Gizzard Shad	400	367	0.809
Gizzard Shad	500	365	1.03
Gizzard Shad	200	286	0.855
Largemouth Bass	1000	327	2.86
Largemouth Bass	400	301	1.467
Largemouth Bass	250	287	1.06
White Crappie	200	247	1.33
White Crappie	250	268	1.30
White Crappie	450	293	1.79
White Crappie	200	252	1.25
White Bass	500	303	1.80
White Bass	650	382	1.17
Carp	1800	530	1.21
Threadfin Shad	4	50	3.20
Threadfin Shad	4	50	3.20
Threadfin Shad	4	50	3.20
Threadfin Shad	4	50	3.20

Catch summary and calculated index of condition for fish collected by gill net at station two on June 22, 1994.

Species	Weight (grams)	Total Length (mm)	K Index of Conditon
Channel Catfish	5500	735	1.39
Channel Catfish	300	349	0.71
Channel Catfish	600	433	0.739
Channel Catfish	200	291	0.812
Channel Catfish	700	434	0.856
Channel Catfish	600	407	0.890
Gizzard Shad	500	370	0.99
Gizzard Shad	250	318	0.777
Largemouth Bass	500	310	1.68
Largemouth Bass	250	287	1.06
Smallmouth Bass	Eaten	Eaten	N/A
Smallmouth Bass	150	238	1.11
White Bass	1300	393	2.14
White Bass	1350	394	2.21
White Bass	900	404	1.36
White Bass	600	366	1.22
White Bass	500	341	1.26
Carp	3300	645	1.23
Carp	1850	535	1.21
Carp	2100	563	1.18
Carp	1000	413	1.42
Carp	1650	435	2.00
Carp	1200	342	3.00
Carp	1200	430	1.51
Carp	1200	440	1.41
Bluegill Sunfish	100	149	3.02
Freshwater Drum	200	255	1.21
Blacktail Shiner*	6	104	0.53

Catch summary and calculated index of condition for fish collected by gill net at station three on June 22, 1994.

Species	Weight (grams)	Total Length (mm)	K Index of Conditon
Channel Catfish	900	469	0.87
Channel Catfish	50	243	0.35
Channel Catfish	150	275	0.721
Gizzard Shad	350	386	0.61

Catch summary and calculated index of condition for fish collected by gill net at station four on June 22, 1994.

Species	Weight (grams)	Total Length (mm)	K Index of Conditon
Channel Catfish	2300	617	0.98
Channel Catfish	300	413	0.43
Channel Catfish	200	299	0.748
Channel Catfish	160	232	1.281
Channel Catfish	250	322	0.749
Channel Catfish	150	275	0.721
Channel Catfish	150	258	0.873
Channel Catfish	100	261	0.562
Channel Catfish	100	253	0.618
Channel Catfish	Eaten	Eaten	N/A
Carp	1950	526	1.34
Carp	1950	514	1.436
Freshwater Drum	200	312	0.66
Freshwater Drum	200	262	1.11
Freshwater Drum	200	302	N/A
Freshwater Drum	350	349	0.82
Freshwater Drum	300	351	0.69

Catch summary and calculated condition index for fish collected by gill net at station five on June 22, 1994.

Species	Weight (grams)	Total Length (mm)	K Index of Conditon
Channel Catfish	50	255	0.30
Channel Catfish	50	256	0.30
Channel Catfish	100	301	0.367
Channel Catfish	50	239	0.366
Channel Catfish	100	280	0.456
Channel Catfish	100	263	0.550
Channel Catfish	100	280	0.456
Channel Catfish	50	239	0.37
Channel Catfish	150	304	0.53
Channel Catfish	200	355	0.45
Channel Catfish	150	292	0.602
Channel Catfish	200	325	0.583
Channel Catfish	100	291	0.406
Channel Catfish	200	313	0.652
Channel Catfish	50	256	0.298
Channel Catfish	200	315	0.640
Channel Catfish	250	355	0.56
Channel Catfish	300	360	0.643
Channel Catfish	1300	426	1.68
Channel Catfish	950	481	0.854
Channel Catfish	500	416	0.695
Channel Catfish	150	285	0.648
Channel Catfish	1700	520	1.209
Channel Catfish	Eaten	Eaten	N/A
Gizzard Shad	200	305	0.70
Gizzard Shad	150	287	0.635
Gizzard Shad	100	266	0.531
Gizzard Shad	200	303	0.719
Gizzard Shad	350	364	0.726
Gizzard Shad	250	326	0.722
Gizzard Shad	150	282	N/A
Gizzard Shad	150	286	0.64
Gizzard Shad	300	331	0.827
Gizzard Shad	300	331	0.83
Gizzard Shad	200	295	0.779
Gizzard Shad	300	329	0.84
Gizzard Shad	Eaten	Eaten	N/A
Gizzard Shad	500	375	0.95
Gizzard Shad	450	385	0.79
Gizzard Shad	300	330	0.83
Smallmouth Bass	550	370	1.09
Smallmouth Bass	400	324	1.18
Smallmouth Bass	400	299	1.50
Smallmouth Bass	300	271	1.51
Smallmouth Bass	450	300	1.67
Smallmouth Bass	1050	397	1.68
Smallmouth Bass	200	237	1.50
Smallmouth Bass	800	429	1.01

Catch summary and calculated condition index for fish collected by gill net at station five on June 22, 1994.

Smallmouth Bass	100	212	1.05
Smallmouth Bass	Eaten	Eaten	N/A
Freshwater Drum	350	347	0.84
Freshwater Drum	200	268	1.04
Freshwater Drum	150	256	0.89
Carp	2800	575	1.47
Carp	1200	462	1.22
Carp	1200	455	1.27
Carp	1350	491	1.14
Carp	1450	483	1.29
Carp	2700	610	1.19
Carp	3700	665	1.26
Bluegill Sunfish	50	135	2.03
Bluegill Sunfish	50	173	0.97

Catch summary and calculated condition index for fish collected by gill net at station one on Feb. 23, 1995.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Channel Catfish	2750	640	1.05
Channel Catfish	1000	444	1.14
Channel Catfish	2100	565	1.16
Channel Catfish	150	267	0.788
Channel Catfish	350	366	0.714
Channel Catfish	3100	629	1.25
Channel Catfish	1600	525	1.11
Channel Catfish	50	190	0.729
Channel Catfish	150	316	0.475
Channel Catfish	300	340	0.763
Channel Catfish	650	420	0.877
Channel Catfish	150	510	0.113
Channel Catfish	350	338	0.906
Channel Catfish	50	232	0.400
Channel Catfish	150	263	0.825
Channel Catfish	350	334	0.939
Channel Catfish	2100	561	1.19
Channel Catfish	2200	593	1.06
Channel Catfish	1850	437	2.22
Channel Catfish	1850	454	1.98
Gizzard Shad(Note 1)	350	334	0.939
Gizzard Shad	300	320	0.916
Gizzard Shad	500	370	0.987
Gizzard Shad	500	405	0.753
Gizzard Shad	400	352	0.917
Gizzard Shad	300	320	0.916
Gizzard Shad	550	375	1.04
Gizzard Shad	550	370	1.09
Gizzard Shad	500	344	1.23
Gizzard Shad	600	400	0.938
Gizzard Shad	550	370	1.09
Gizzard Shad	350	329	0.983
Gizzard Shad	450	365	0.925
Gizzard Shad	550	380	1.00
Gizzard Shad	550	376	1.03
Gizzard Shad	450	354	1.01
Gizzard Shad	300	285	1.30
Gizzard Shad	150	217	1.47
Gizzard Shad	100	205	1.16
Gizzard Shad	550	385	0.964
Gizzard Shad	650	391	1.09
Gizzard Shad	550	366	1.12
Gizzard Shad	100	215	1.01
Gizzard Shad	100	185	1.58
Gizzard Shad	100	216	0.992
Gizzard Shad	100	176	1.83
Gizzard Shad	450	350	1.05
Gizzard Shad	700	406	1.05

Notes:

1) 250 additional gizzard shad were captured (all YOY) at a total weight of 200 grams.

Catch summary and calculated condition index for fish collected by gill net at station one on Feb. 23, 1995.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Gizzard Shad	400	353	0.909
Gizzard Shad	650	377	1.21
Gizzard Shad	750	413	1.06
Gizzard Shad	900	418	1.23
Gizzard Shad	850	435	1.03
Gizzard Shad	750	405	1.13
White Bass	200	242	1.41
White Bass	100	215	1.01
White Bass	600	357	1.32
White Bass	650	363	1.36
White Bass	950	386	1.65
Largemouth Bass	350	268	1.82
Largemouth Bass	250	253	1.54
Smallmouth Bass	500	326	1.44
Carp	1600	475	1.49
Carp	1800	510	1.36
Carp	2250	540	1.43
Freshwater Drum	400	328	1.13
Bluegill	50	70	14.6

Notes:

1) 250 additional gizzard shad were captured (all YOY) at a total weight of 200 grams.

Catch summary and calculated condition index for fish collected by gill net at station two on Feb. 23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Black Crappie	650	320	1.98
Channel Catfish	1350	495	1.11
Channel Catfish	850	459	0.88
Channel Catfish	250	320	0.76
Channel Catfish	450	365	0.93
Channel Catfish	150	288	0.63
Channel Catfish	100	247	0.66
Channel Catfish	100	262	0.56
Channel Catfish	200	310	0.67
Channel Catfish	150	273	0.74
Channel Catfish	250	325	0.73
Channel Catfish	50	253	0.31
Channel Catfish	100	267	0.53
Channel Catfish	350	339	0.90
Channel Catfish	150	282	0.67
Channel Catfish	150	288	0.63
Channel Catfish	100	222	0.91
Channel Catfish	400	373	0.77
Channel Catfish	1150	514	0.85
Channel Catfish	250	350	0.58
Channel Catfish	350	363	0.73
Channel Catfish	500	387	0.86
Channel Catfish	400	363	0.84
Freshwater Drum	350	315	1.12
Gizzard Shad	700	395	1.14
Gizzard Shad	450	348	1.07
Gizzard Shad	500	360	1.07
Gizzard Shad	400	365	0.82
Gizzard Shad	850	410	1.23
Gizzard Shad	500	352	1.15
Gizzard Shad	500	363	1.05
Gizzard Shad	500	353	1.14
Gizzard Shad	150	194	2.05
Gizzard Shad	100	188	1.50
Gizzard Shad	700	393	1.15
Gizzard Shad	900	422	1.20
Gizzard Shad	800	415	1.12
Gizzard Shad	650	387	1.12
Gizzard Shad	600	384	1.06
Gizzard Shad	100	196	1.33
Gizzard Shad	550	370	1.09
Gizzard Shad	100	202	1.21
Gizzard Shad	100	210	1.08
Gizzard Shad	100	202	1.21
Gizzard Shad (Note 1)	550	365	1.13
Largemouth	450	335	1.20
Largemouth	800	373	1.54
White Bass	700	370	1.38

Note:

(1) 65 additional Gizzard Shad ranging from 50-20mm at a weight of 50g

Catch summary and calculated condition index for fish collected by gill net at station two on Feb. 23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
White Bass	450	338	1.17
White Bass	300	387	0.52
White Bass	750	373	1.45
White Bass	750	365	1.54
White Bass	500	348	1.19
White Bass	700	368	1.40

Note:
(1) 65 additional Gizzard Shad ranging from 50-20mm at a weight of 50g

Catch summary and calculated condition index for fish collected by gill net at station three on Feb. 23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Black Crappie	600	320	1.83
Bluegill	100	148	3.08
Largemouth Bass	200	267	1.05
White Bass	550	360	1.18
White Crappie	100	172	1.97

Catch summary and calculated condition index for fish collected by gill net at station four on Feb. 23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Blacktail Shinner	<50	11	
Bluegill	100	165	2.23
Bluegill	100	154	2.74
Bluegill	50	156	1.32
Carp	1850	512	1.38
Carp	1800	511	1.35
Carp	1950	449	2.15
Carp	2000	520	1.42
Carp	2650	586	1.32
Carp	1450	505	1.13
Carp	2100	535	1.37
Carp	1650	492	1.39
Carp	1850	512	1.38
Channel Catfish	3600	511	2.70
Channel Catfish	150	288	0.63
Channel Catfish	450	418	0.62
Channel Catfish	500	394	0.82
Channel Catfish	100	263	0.55
Channel Catfish	150	291	0.61
Channel Catfish	150	271	0.75
Channel Catfish	200	294	0.79
Channel Catfish	350	378	0.65
Channel Catfish	450	385	0.79
Channel Catfish	150	290	0.62
Channel Catfish	300	337	0.78
Channel Catfish	200	303	0.72
Channel Catfish	300	349	0.71
Channel Catfish	150	291	0.61
Channel Catfish	200	293	0.80
Channel Catfish	200	275	0.96
Channel Catfish	100	235	0.77
Channel Catfish	350	350	0.82
Channel Catfish	250	305	0.88
Channel Catfish	150	240	1.09
Channel Catfish	500	370	0.99
Channel Catfish	200	312	0.66
Channel Catfish	1350	485	1.18
Channel Catfish	100	212	1.05
Channel Catfish	50	217	0.49
Gizzard Shad	450	365	0.93
Gizzard Shad	400	364	0.83
Gizzard Shad	550	367	1.11
Gizzard Shad	550	393	0.91
Gizzard Shad	550	389	0.93
Gizzard Shad	400	350	0.93
Gizzard Shad	500	380	0.91
Gizzard Shad	500	388	0.86
Gizzard Shad	350	331	0.97

Note 1: Threadfin Shad Count was 84, Total weight 70g, all under 20mm

Catch summary and calculated condition index for fish collected by gill net at station four on Feb. 23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Gizzard Shad	50	191	0.72
Gizzard Shad	600	379	1.10
Gizzard Shad	500	373	0.96
Gizzard Shad	600	382	1.08
Gizzard Shad	450	358	0.98
Gizzard Shad	400	326	1.15
Gizzard Shad	650	382	1.17
Gizzard Shad	500	367	1.01
Gizzard Shad	550	372	1.07
Gizzard Shad	500	357	1.10
Gizzard Shad	500	356	1.11
Gizzard Shad	500	361	1.06
Gizzard Shad	450	362	0.95
Gizzard Shad	600	354	1.35
Gizzard Shad	600	371	1.17
Gizzard Shad	250	326	0.72
Gizzard Shad	400	348	0.95
Gizzard Shad	350	344	0.86
Gizzard Shad	400	356	0.89
Gizzard Shad	450	349	1.06
Gizzard Shad	350	322	1.05
Gizzard Shad	300	324	0.88
Gizzard Shad	450	356	1.00
Gizzard Shad	450	361	0.96
Gizzard Shad	500	345	1.22
Gizzard Shad	400	352	0.92
Gizzard Shad	500	363	1.05
Gizzard Shad	450	385	0.79
Gizzard Shad	350	316	1.11
Gizzard Shad	500	362	1.05
Gizzard Shad	500	345	1.22
Gizzard Shad	50	202	0.61
Gizzard Shad	500	368	1.00
Gizzard Shad	600	383	1.07
Gizzard Shad	550	366	1.12
Gizzard Shad	450	364	0.93
Gizzard Shad	500	357	1.10
Gizzard Shad	450	356	1.00
Gizzard Shad	600	398	0.95
Gizzard Shad	400	346	0.97
Gizzard Shad	100	203	1.20
Gizzard Shad	600	391	1.00
Gizzard Shad	650	395	1.05
Gizzard Shad	450	360	0.96
Threadfin Shad (Note1)	0.83	<20	
White Bass	200	273	0.98

Note 1: Threadfin Shad Count was 84, Total weight 70g, all under 20mm

Catch summary and calculated condition for fish collected by gill net at station five on Feb. 23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Bluegill	100	139	3.72
Channel Catfish	2800	610	1.23
Channel Catfish	500	362	1.05
Channel Catfish	200	280	0.91
Channel Catfish	450	376	0.85
Channel Catfish	150	265	0.81
Channel Catfish	300	335	0.80
Channel Catfish	100	220	0.94
Channel Catfish	400	353	0.91
Channel Catfish	200	302	0.73
Channel Catfish	250	312	0.82
Channel Catfish	200	286	0.85
Channel Catfish	400	348	0.95
Channel Catfish	450	355	1.01
Channel Catfish	700	406	1.05
Channel Catfish	500	364	1.04
Channel Catfish	300	316	0.95
Channel Catfish	200	271	1.00
Channel Catfish	200	265	1.07
Channel Catfish	250	303	0.90
Channel Catfish	200	287	0.85
Channel Catfish	200	287	0.85
Channel Catfish	100	238	0.74
Channel Catfish	650	425	0.85
Channel Catfish	950	465	0.94
Channel Catfish	250	312	0.82
Channel Catfish	400	365	0.82
Channel Catfish	400	365	0.82
Channel Catfish	300	320	0.92
Freshwater Drum	650	399	1.02
Gizzard Shad (Note1)	300	318	0.93
Gizzard Shad	600	387	1.04
Gizzard Shad	150	216	1.49
Gizzard Shad	150	234	1.17
Gizzard Shad	150	364	0.31
Gizzard Shad	600	392	1.00
Gizzard Shad	400	346	0.97
Gizzard Shad	500	363	1.05
Gizzard Shad	500	366	1.02
Gizzard Shad	550	370	1.09
Gizzard Shad	500	367	1.01
Gizzard Shad	550	353	1.25
Largemouth Bass	400	293	1.59
Smallmouth Bass	800	385	1.40
Smallmouth Bass	200	256	1.19
Smallmouth Bass	200	263	1.10
Threadfin Shad	<50	<20	
Threadfin Shad (Note 2)	<50	<20	

Note 1: 3 Gizzard Shad Where Eaten

Note 2: 2 Threadfin Shad, Weight <50g, Length <20mm

Catch summary and calculated condition for fish collected by gill net at station five on Feb. 23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
White Bass	700	355	1.56
White Bass	550	343	1.36
White Bass	650	356	1.44
White Bass	750	389	1.27
White Bass	350	400	0.55
White Bass	600	360	1.29
White Bass	600	360	1.29
White Bass	450	325	1.31
White Bass	600	363	1.25
White Bass	950	379	1.75
White Bass	650	365	1.34
White Bass	750	370	1.48
White Crappie	500	319	1.54

Note 1: 3 Gizzard Shad Where Eaten

Note 2: 2 Threadfin Shad, Weight <50g, Length <20mm

Catch summary and calculated condition index for fish collected by gill net at station one on June 21, 1995.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Channel Catfish	200	315	0.640
Channel Catfish	150	292	0.602
Channel Catfish	1150	435	1.397
Channel Catfish	400	370	0.790
Channel Catfish	300	340	0.763
Channel Catfish	1200	490	1.020
Channel Catfish	200	296	0.771
Channel Catfish	400	355	0.894
Channel Catfish	100	232	0.801
Channel Catfish	50	232	0.400
Channel Catfish	500	380	0.911
Channel Catfish	50	230	0.411
Channel Catfish	900	450	0.988
Channel Catfish	400	360	0.857
Channel Catfish	50	230	0.411
Channel Catfish	400	365	0.823
Channel Catfish	200	315	0.640
Channel Catfish	350	382	0.628
Channel Catfish	200	250	1.280
Channel Catfish	150	270	0.762
Gizzard Shad	400	374	0.765
Gizzard Shad	300	330	0.835
Gizzard Shad	450	365	0.925
Gizzard Shad	650	406	0.971
Gizzard Shad	50	200	0.625
Gizzard Shad	500	375	0.948
Gizzard Shad	500	400	0.781
Gizzard Shad	500	380	0.911
Gizzard Shad	500	385	0.876
Gizzard Shad	100	200	1.250
Gizzard Shad	100	205	1.161
Gizzard Shad	700	428	0.893
Gizzard Shad	500	369	0.995
Gizzard Shad	300	345	0.731
Gizzard Shad	200	285	0.864
Gizzard Shad	450	382	0.807
Gizzard Shad	450	380	0.820
Gizzard Shad	450	370	0.888
Gizzard Shad	200	275	0.962
Gizzard Shad	450	375	0.853
Gizzard Shad	450	370	0.888
Gizzard Shad	500	390	0.843
Gizzard Shad	400	340	1.018
Gizzard Shad	450	370	0.888
Gizzard Shad	450	380	0.820
Gizzard Shad	500	360	1.072
Gizzard Shad	200	275	0.962
Gizzard Shad	500	372	0.971

Note:
Two gizzard shad and one channel catfish were damaged/eaten and no measurements were collected.

Catch summary and calculated condition index for fish collected by gill net at station one on June 21, 1995.

Gizzard Shad	450	370	0.888
Gizzard Shad	400	345	0.974
Gizzard Shad	450	360	0.965
Gizzard Shad	500	387	0.863
Gizzard Shad	200	280	0.911
Gizzard Shad	100	195	1.349
Gizzard Shad	100	195	1.349
Gizzard Shad	100	180	1.715
Gizzard Shad	200	292	0.803
Gizzard Shad	50	170	1.018
White Bass	300	294	1.181
White Bass	900	417	1.241
White Bass	950	415	1.329
White Bass	550	385	0.964
White Bass	500	370	0.987
White Bass	1050	425	1.368
White Bass	700	390	1.180
White Bass	800	380	1.458
Largemouth Bass	300	300	1.111
Largemouth Bass	150	235	1.156
Largemouth Bass	500	330	1.391
Largemouth Bass	450	320	1.373
Largemouth Bass	250	275	1.202
Largemouth Bass	400	310	1.343
Smallmouth Bass	150	260	0.853
Smallmouth Bass	400	297	1.527
Smallmouth Bass	450	312	1.482
Smallmouth Bass	450	320	1.373
FW Drum	350	320	1.068
FW Drum	150	270	0.762
Carp	1400	480	1.266
Blacktail Shiner	50	10.2	4711.612

Note:
Two gizzard shad and one
channel catfish were damaged/eaten
and no measurements were collected.

Catch summary and calculated condition index for fish collected by gill net at station two on June 21, 1995 from Squaw Creek Reservoir.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Channel Catfish	900	460	0.925
Channel Catfish	450	370	0.888
Channel Catfish	550	390	0.927
Channel Catfish	300	316	0.951
Channel Catfish	150	227	1.28
Gizzard Shad	400	334	1.07
Gizzard Shad	600	397	0.959
Gizzard Shad	500	362	1.05
Gizzard Shad	550	386	0.956
Gizzard Shad	300	295	1.17
Gizzard Shad	400	335	1.06
Largemouth Bass	200	220	1.88
Largemouth Bass	450	295	1.75
Largemouth Bass	500	315	1.60
Smallmouth Bass	150	230	1.23
Smallmouth Bass	150	220	1.41
Smallmouth Bass	600	350	1.40
Smallmouth Bass	600	340	1.53
Smallmouth Bass	500	340	1.27
Smallmouth Bass	550	320	1.68
White Bass	800	380	1.46
White Bass	950	390	1.60
White Bass	600	390	1.01
Carp	3000	600	1.39
Bluegill	100	173	1.93
FW Drum	350	300	1.30

Catch summary and calculated condition index for fish collected by gill net at station three on June 21, 1995 from Squaw Creek Reservoir.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Channel Catfish	100	258	0.582
Channel Catfish	100	236	0.761
Channel Catfish	200	262	1.11
Channel Catfish	150	245	1.02
Channel Catfish	300	320	0.916
Channel Catfish	200	266	1.06
Channel Catfish	200	260	1.14
Channel Catfish	850	456	0.896
Channel Catfish	400	358	0.872
Channel Catfish	350	329	0.983
Gizzard Shad	500	349	1.18
Gizzard Shad	450	356	0.997
Gizzard Shad	500	353	1.14
Gizzard Shad	100	176	1.83
Threadfin Shad	50	101	4.85
Threadfin Shad	50	104	4.44
Threadfin Shad	50	107	4.08
Threadfin Shad	50	105	4.32
Largemouth Bass	50	105	4.32
FW Drum	250	267	1.31

Catch summary and calculated condition index for fish collected by gill net at station four on June 21, 1995 from Squaw Creek Reservoir.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Channel Catfish	500	386	0.869
Channel Catfish	350	358	0.763
Channel Catfish	350	326	1.010
Channel Catfish	300	320	0.92
Channel Catfish	200	247	1.33
Channel Catfish	200	285	0.864
Channel Catfish	200	285	0.864
Channel Catfish	250	280	1.14
Channel Catfish	150	227	1.28
Channel Catfish	150	237	1.13
Channel Catfish	150	270	0.762
Channel Catfish	100	230	0.822
Channel Catfish	100	249	0.648
Channel Catfish	1000	448	1.11
Channel Catfish	450	351	1.04
Channel Catfish	100	240	0.723
Channel Catfish	400	323	1.19
Channel Catfish	1700	491	1.44
Channel Catfish	300	315	0.960
Channel Catfish	400	332	1.09
Channel Catfish	450	365	0.925
Blue Catfish	1100	536	0.714
Carp	2400	581	1.22
Bluegill Sunfish	100	168	2.11
Redbreast Sunfish	150	196	1.99
Green Sunfish	50	130	2.28
Gizzard Shad	100	194	1.37
Gizzard Shad	450	354	1.01
Gizzard Shad	500	341	1.26
Gizzard Shad	400	329	1.12
Gizzard Shad	300	303	1.08
Gizzard Shad	500	373	0.963
Gizzard Shad	200	266	1.06
Gizzard Shad	200	255	1.21
Gizzard Shad	500	356	1.11
Gizzard Shad	200	271	1.00
Gizzard Shad	550	350	1.28
Gizzard Shad	450	351	1.04
Gizzard Shad	556	386	0.967
Gizzard Shad	450	355	1.01
Gizzard Shad	450	341	1.13
Gizzard Shad	450	354	1.01
Gizzard Shad	550	379	1.01
Gizzard Shad	400	326	1.15
Gizzard Shad	350	282	1.56
Gizzard Shad	350	280	1.59
Gizzard Shad	250	279	1.15
Gizzard Shad	300	285	1.30

Note:
Two gizzard shad and one channel catfish were retrieved partially eaten from net.

Catch summary and calculated condition index for fish collected by gill net at station four on June 21, 1995 from Squaw Creek Reservoir.

Gizzard Shad	500	384	0.883
Gizzard Shad	500	369	0.995
Gizzard Shad	200	271	1.00
Largemouth Bass	550	331	1.52
Smallmouth Bass	500	336	1.32

Note:
Two gizzard shad and one channel catfish were retrieved partially eaten from net.

Catch summary and calculated condition index for fish collected by gill net at station five on June 21, 1995 from Squaw Creek Reservoir.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Channel Catfish	900	428	1.15
Channel Catfish	250	300	0.926

Notes:
Only two specimens of
channel catfish were collected at this station.

Calculated summary and calculated condition index for fish collected by gill net at station one on Aug 7 1995

Species	Weight (g)	Total Length (mm)	Index of Condition (K)
Largemouth Bass	50	111	3.7
Largemouth Bass	100	195	1.3
Largemouth Bass	150	252	0.9
Largemouth Bass	150	210	1.6
Largemouth Bass	150	210	1.6
Largemouth Bass	300	332	0.8
Largemouth Bass	350	292	1.4
Largemouth Bass	600	323	1.8
Largemouth Bass	550	322	1.6
Largemouth Bass	500	325	1.5
Largemouth Bass	550	330	1.5
Largemouth Bass	700	370	1.4
Largemouth Bass	400	323	1.2
Channel Catfish	200	354	0.5
Channel Catfish	100	245	0.7
Channel Catfish	200	310	0.7
Channel Catfish	50	113	3.5
Channel Catfish	100	268	0.5
Channel Catfish	150	280	0.7
Channel Catfish	250	343	0.6
Channel Catfish	100	260	0.6
Channel Catfish	100	233	0.8
Channel Catfish	300	351	0.7
Channel Catfish	100	250	0.6
Channel Catfish	150	253	0.9
Channel Catfish	300	345	0.7
Channel Catfish	100	240	0.7
Channel Catfish	250	335	0.7
Channel Catfish	250	299	0.9
Channel Catfish	200	270	1.0
Channel Catfish	100	238	0.7
Channel Catfish	250	300	0.9
Channel Catfish	100	230	0.8
Channel Catfish	300	350	0.7
Channel Catfish	150	249	1.0
Channel Catfish	150	252	0.9
Channel Catfish	200	296	0.8
Channel Catfish	150	254	0.9
Channel Catfish	250	321	0.8
Channel Catfish	150	290	0.6
Channel Catfish	350	343	0.9
Channel Catfish	200	291	0.8
Channel Catfish	200	312	0.7
Channel Catfish	400	350	0.9
Channel Catfish	650	424	0.9
Channel Catfish	450	375	0.9
Channel Catfish	350	357	0.8
Channel Catfish	1400	492	1.2

Calculated summary and calculated condition index for fish collected by gill net at station one on Aug 7 1995

Largemouth Bass	50	111	3.7
Channel Catfish	800	455	0.8
Bluegill Sunfish	50	142	1.7
Bluegill Sunfish	50	129	2.3
Bluegill Sunfish	50	140	1.8
Bluegill Sunfish	50	144	1.7
Bluegill Sunfish	Eaten	Eaten	N/A
Bluegill Sunfish	50	143	1.7
Bluegill Sunfish	50	128	2.4
Bluegill Sunfish	50	135	2.0
Bluegill Sunfish	50	136	2.0
Bluegill Sunfish	50	134	2.1
Bluegill Sunfish	50	143	1.7
Bluegill Sunfish	50	127	2.4
Bluegill Sunfish	100	175	1.9
Bluegill Sunfish	100	173	1.9
Bluegill Sunfish	Eaten	Eaten	N/A
Gizzard Shad	50	180	0.9
Gizzard Shad	50	186	0.8
Gizzard Shad	100	207	1.1
Gizzard Shad	100	204	1.2
Gizzard Shad	50	195	0.7
Gizzard Shad	50	190	0.7
Gizzard Shad	50	186	0.8
Gizzard Shad	50	177	0.9
Gizzard Shad	100	213	1.0
Gizzard Shad	150	252	0.9
Gizzard Shad	100	232	0.8
Gizzard Shad	100	240	0.7
Gizzard Shad	50	190	0.7
Gizzard Shad	50	183	0.8
Gizzard Shad	100	213	1.0
Gizzard Shad	150	252	0.9
Gizzard Shad	100	232	0.8
Gizzard Shad	100	240	0.7
Gizzard Shad	50	190	0.7
Gizzard Shad	50	183	0.8
Gizzard Shad	100	208	1.1
Gizzard Shad	50	188	0.8
Gizzard Shad	50	184	0.8
Gizzard Shad	50	190	0.7
Gizzard Shad	100	226	0.9
Gizzard Shad	50	195	0.7
Gizzard Shad	50	210	0.5
Gizzard Shad	50	193	0.7
Gizzard Shad	100	219	1.0
Gizzard Shad	50	214	0.5
Gizzard Shad	50	220	0.5
Gizzard Shad	50	207	0.6

Calculated summary and calculated condition index for fish collected by gill net at station one on Aug 7 1995

Largemouth Bass	50	111	3.7
Gizzard Shad	50	213	0.5
Gizzard Shad	300	386	0.5
Gizzard Shad	250	316	0.8
Gizzard Shad	200	275	1.0
Gizzard Shad	150	290	0.6
Gizzard Shad	150	251	0.9
Gizzard Shad	150	272	0.7
Gizzard Shad	150	270	0.8
Gizzard Shad	50	200	0.6
Gizzard Shad	400	385	0.7
Gizzard Shad	400	373	0.8
Gizzard Shad	350	381	0.6
Gizzard Shad	600	360	1.3
Gizzard Shad	550	408	0.8
Gizzard Shad	450	380	0.8
Gizzard Shad	400	364	0.8
Gizzard Shad	300	340	0.8
Gizzard Shad	Eaten	Eaten	N/A
Gizzard Shad	400	360	0.9
Gizzard Shad	150	254	0.9
Gizzard Shad	450	406	0.7
Gizzard Shad	450	380	0.8
Gizzard Shad	400	382	0.7
Gizzard Shad	150	264	0.8
Gizzard Shad	150	279	0.7
Gizzard Shad	400	353	0.9
Gizzard Shad	600	394	1.0
Gizzard Shad	450	381	0.8
Gizzard Shad	250	354	0.6
Gizzard Shad	400	371	0.8
Gizzard Shad	250	335	0.7
Gizzard Shad	150	277	0.7
Gizzard Shad	200	272	1.0
Gizzard Shad	200	279	0.9
Gizzard Shad	150	277	0.7
Gizzard Shad	150	301	0.6
Smallmouth Bass	300	290	1.2
White Bass	600	373	1.2
White Bass	600	371	1.2
FW Drum	650	362	1.4
FW Drum	450	340	1.1
FW Drum	250	270	1.3
FW Drum	2100	581	1.1
FW Drum	500	340	1.3
FW Drum	650	370	1.3
FW Drum	400	338	1.0
FW Drum	400	338	1.0
FW Drum	500	330	1.4

Calculated summary and calculated condition index for fish collected by gill net at station one on Aug 7 1995

Largemouth Bass	50	111	3.7
FW Drum	600	370	1.2
FW Drum	450	330	1.3
FW Drum	450	327	1.3
FW Drum	550	345	1.3
FW Drum	550	345	1.3
FW Drum	600	365	1.2
FW Drum	500	345	1.2
FW Drum	900	423	1.2
FW Drum	800	383	1.4
Carp	1750	486	1.5
Carp	2000	540	1.3

Catch summary and calculated condition for fish collected by gill net at station two on Aug 7 1995

Species	Weight (g)	Total Length (mm)	Index of Condition (K)
Bluegill	50	142	1.7
Bluegill	50	147	1.6
Bluegill	50	128	2.4
Bluegill	50	127	2.4
Bluegill	50	130	2.3
Bluegill	50	127	2.4
Bluegill	50	137	1.9
Bluegill*	50	125	2.6
Bluegill*	50	125	2.6
Largemouth	400	310	1.3
Largemouth	100	187	1.5
Channel Catfish	150	270	0.8
Channel Catfish	300	310	1.0
Channel Catfish	700	396	1.1
Channel Catfish	550	405	0.8
Channel Catfish	250	282	1.1
Channel Catfish	200	308	0.7
Channel Catfish	100	235	0.8
Channel Catfish	100	247	0.7
Channel Catfish	100	240	0.7
Channel Catfish	100	237	0.8
Channel Catfish	100	267	0.5
Channel Catfish	100	246	0.7
Carp	3300	610	1.5
Blue Catfish **	500	395	0.8
Channel Catfish	100	231	0.8
Channel Catfish	100	242	0.7
Channel Catfish	300	346	0.7
Channel Catfish	100	225	0.9
Channel Catfish	350	371	0.7
Channel Catfish	100	266	0.5
Largemouth Bass	100	195	1.3
Bluegill	50	139	1.9
Bluegill	50	144	1.7
Bluegill	50	134	2.1
Bluegill	50	136	2.0
Bluegill	50	142	1.7
Channel Catfish	100	237	0.8
Channel Catfish	100	249	0.6
Channel Catfish	100	234	0.8
Channel Catfish	100	249	0.6
Channel Catfish	150	238	1.1
Channel Catfish	550	416	0.8
Channel Catfish	150	256	0.9
Channel Catfish	350	349	0.8
Channel Catfish	100	235	0.8
Channel Catfish	150	259	0.9
Channel Catfish	550	426	0.7

Catch summary and calculated condition for fish collected by gill net at station two on Aug 7 1995

Bluegill	50	142	1.7
Bluegill	50	128	2.4
Bluegill	50	139	1.9
Bluegill	50	147	1.6
Bluegill	50	144	1.7

Catch summary and calculated condition index for fish collected by gill net at station three on Aug 7 1995

Species	Weight (g)	Total Length (mm)	Index of Condition (K)
Bluegill	50	140	1.8
Bluegill	50	120	2.9
Bluegill	50	132	2.2
Bluegill	50	141	1.8
Bluegill	50	126	2.5
Bluegill	50	124	2.6
Bluegill	50	140	1.8
Bluegill	50	131	2.2
Bluegill	50	128	2.4
Bluegill	50	129	2.3
Bluegill	50	122	2.8
Bluegill	50	124	2.6
Bluegill	100	175	1.9
Bluegill	100	179	1.7
Channel Catfish	100	241	0.7
Channel Catfish	100	250	0.6
Channel Catfish	150	266	0.8
Channel Catfish	150	265	0.8
Channel Catfish	150	270	0.8
Channel Catfish	100	249	0.6
Channel Catfish	100	252	0.6
Channel Catfish	450	373	0.9
Channel Catfish	350	323	1.0
Largemouth Bass	50	195	0.7
Largemouth Bass	100	215	1.0
Largemouth Bass	150	235	1.2
Largemouth Bass	550	330	1.5
Largemouth Bass*	50	115	3.3
Channel Catfish	600	398	1.0
Channel Catfish	150	253	0.9
Largemouth Bass	800	430	1.0
Largemouth Bass	100	215	1.0
Largemouth Bass	150	235	1.2

Catch summary and calculated condition index for fish collected by gill net at station four on Aug, 7 1995

Species	Weight (g)	Total Length (mm)	Index of Conditon (K)
Channel Catfish	550	409	0.8
Channel Catfish	150	264	0.8
Channel Catfish	200	326	0.6
Channel Catfish	150	242	1.1
Channel Catfish	800	435	1.0
Channel Catfish	50	222	0.5
Channel Catfish	100	232	0.8
Channel Catfish	150	245	1.0
Channel Catfish	100	221	0.9
Bluegill	100	161	2.4

Catch summary and calculated condition index for fish collected by gill net at station five on Aug 7 1995

Species	Weight (g)	Total Length (mm)	Index of Condition (K)
Flathead Catfish	4200	695	1.3
FW Drum	1900	556	1.1
FW Drum	2450	604	1.1
Channel Catfish	3350	645	1.2
Largemouth Bass	2750	545	1.7

Catch summary and calculated condition index for fish collected by boat electroshocking at station one on Nov. 15 16, 1993.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Carp	1650	510	1.24
Bluegill Sunfish	50	137	1.94
Bluegill Sunfish	50	138	1.90
Bluegill Sunfish	<50	107	4.08*
Bluegill Sunfish	50	143	1.71
Bluegill Sunfish	<50	111	3.66*
Bluegill Sunfish	50	131	2.22
Bluegill Sunfish	50	131	2.22
Bluegill Sunfish	<50	66	17.4*
Bluegill Sunfish	<50	65	18.2*
Bluegill Sunfish	<50	81	9.41*
Longear Sunfish	<50	119	2.97*
Green Sunfish	<50	116	3.20*
Green Sunfish	<50	99	5.15*
Green Sunfish	<50	100	5.00*
Green Sunfish	<50	78	10.5*
Green Sunfish	<50	93	6.22*
Threadfin Shad	<50	78	10.5*
Threadfin Shad	<50	106	4.20*
Threadfin Shad	<50	93	6.22*
Threadfin Shad	<50	97	5.48*
Largemouth Bass	50	156	1.32

* K calculated for the weight of 50 grams.

Catch summary and calculated condition index for fish collected by boat electroshocking at station two on Nov. 15-16, 1993.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Bluegill Sunfish	50	150	1.48
Bluegill Sunfish	<50	126	2.50*
Bluegill Sunfish	<50	115	3.29*
Bluegill Sunfish	<50	126	2.50*
Bluegill Sunfish	50	160	1.22
Bluegill Sunfish	<50	128	2.38*
Bluegill Sunfish	<50	118	3.04*
Bluegill Sunfish	<50	125	2.56*
Bluegill Sunfish	<50	72	13.4*
Bluegill Sunfish	<50	119	2.97*
Bluegill Sunfish	50	152	1.42
Bluegill Sunfish	50	154	1.37
Bluegill Sunfish	50	155	1.34
Bluegill Sunfish	50	154	1.37
Bluegill Sunfish	50	150	1.48
Bluegill Sunfish	<50.	135	2.03*
Bluegill Sunfish	<50.	147	1.57*
Bluegill Sunfish	<50.	116	3.20*
Bluegill Sunfish	<50.	142	1.75*
Bluegill Sunfish	<50.	115	3.29*
Bluegill Sunfish	<50.	133	2.13*
Bluegill Sunfish	<50.	131	2.22*
Bluegill Sunfish	<50.	138	1.90*
Bluegill Sunfish	<50.	134	2.08*
Bluegill Sunfish	<50.	115	3.29*
Bluegill Sunfish	<50.	118	3.04*
Bluegill Sunfish	<50.	113	3.47*
Bluegill Sunfish	<50.	75	11.9*
Bluegill Sunfish	<50.	68	15.9
Bluegill Sunfish	<50.	61	22.0*
Bluegill Sunfish	<50.	66	17.4*
Bluegill Sunfish	<50.	76	11.4*
Bluegill Sunfish	<50.	125	2.56*
Bluegill Sunfish	<50.	91	6.64*
Bluegill Sunfish	<50.	100	5.00*
Bluegill Sunfish	<50.	124	2.62*
Bluegill Sunfish	<50.	123	2.69*
Bluegill Sunfish	<50.	65	18.2*
Bluegill Sunfish	<50.	131	2.22*
Bluegill Sunfish	<50.	116	3.20*
Bluegill Sunfish	<50.	120	2.89*
Bluegill Sunfish	<50.	124	2.62*
Bluegill Sunfish	<50.	63	20.0*
Bluegill Sunfish	<50.	85	8.14*
Bluegill Sunfish	<50.	57	27.0*
Bluegill Sunfish	<50.	53	33.6*
Bluegill Sunfish	<50.	126	2.50*
Bluegill Sunfish	<50.	125	2.56*

* K calculated for the weight of 50 grams.

Catch summary and calculated condition index for fish collected by boat electroshocking at station two on Nov. 15-16, 1993.

Bluegill Sunfish	<50.	66	17.4*
Bluegill Sunfish	<50.	65	18.2*
Bluegill Sunfish	<50.	135	2.03*
Bluegill Sunfish	<50.	123	2.69*
Bluegill Sunfish	<50.	135	2.03*
Bluegill Sunfish	<50.	135	2.03*
Bluegill Sunfish	<50.	118	3.04*
Bluegill Sunfish	<50.	116	3.20*
Bluegill Sunfish	<50.	94	6.02*
Bluegill Sunfish	<50.	105	4.32*
Bluegill Sunfish	<50.	114	3.37*
Bluegill Sunfish	<50.	80	9.77*
Bluegill Sunfish	<50.	62	21.0*
Bluegill Sunfish	<50.	64	19.1*
Longear Sunfish	<50.	105	4.32*
Longear Sunfish	<50.	96	5.65*
Longear Sunfish	<50.	120	2.89*
Longear Sunfish	<50.	103	4.58*
Longear Sunfish	<50.	105	4.32*
Longear Sunfish	<50.	117	3.12*
Longear Sunfish	<50.	120	2.89*
Green Sunfish	<50.	86	7.86*
Green Sunfish	<50.	86	7.86*
Green Sunfish	<50.	88	7.34*
Green Sunfish	<50.	91	6.64*
Green Sunfish	<50.	125	2.56*
Green Sunfish	<50.	113	3.47*
Green Sunfish	<50.	126	2.50*
Green Sunfish	<50.	85	8.14*
Green Sunfish	50	148	1.54
Green Sunfish	<50.	104	4.44*
Green Sunfish	<50.	106	4.20*
Green Sunfish	<50.	76	11..4*
Largemouth Bass	<50.	130	2.00
Largemouth Bass	<50.	100	2.28*
Largemouth Bass	50	159	1.24
Threadfin Shad	<50.	91	6.64*
Threadfin Shad	<50.	92	6.42*
Threadfin Shad	<50.	100	5.00*
Channel Catfish	400	383	0.712
Channel Catfish	50	166	1.09
Channel Catfish	50	170	1.02
Channel Catfish	50	195	0.674
Channel Catfish	100	236	0.761
Channel Catfish	50	178	0.887
Channel Catfish	100	241	0.714

* K calculated for the weight of 50 grams.

Catch summary and calculated condition index for fish collected by boat electroshocking at station three on Nov. 15-16, 1993.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Bluegill Sunfish	<50	73	12.9*
Bluegill Sunfish	<50	61	22.0*

* K calculated for the weight of 50 grams.

Catch summary and calculated condition index for fish collected by boat electroshocking at station four on Nov. 15 16, 1993.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Bluegill Sunfish	<50.	131	2.22*
Bluegill Sunfish	<50.	125	2.56*
Bluegill Sunfish	<50.	66	17.4*
Bluegill Sunfish	<50.	115	3.29*
Bluegill Sunfish	<50.	76	11.4*
Bluegill Sunfish	<50.	70	14.6*
Bluegill Sunfish	<50.	78	10.5*
Bluegill Sunfish	<50.	74	12.3*
Bluegill Sunfish	<50.	65	18.2*
Bluegill Sunfish	<50.	62	21.0*
Bluegill Sunfish	<50.	66	17.4*
Bluegill Sunfish	<50.	73	12.9*
Bluegill Sunfish	<50.	75	11.9*
Bluegill Sunfish	<50.	33	139*
Inland Silverside	<50.	84	8.44*
Inland Silverside	<50.	84	8.44*
Inland Silverside	<50.	81	9.41*
Blacktail Shiner	<50.	N/A	N/A
Channel Catfish	100	255	0.603*
Largemouth Bass	100	208	1.11*

* K calculated for the weight of 50 grams.

Catch summary and calculated condition index for fish collected by boat electroshocking at station five on Nov. 15-16, 1993.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Bluegill Sunfish	50	69	15.2
Bluegill Sunfish	50	52	35.6
Bluegill Sunfish	50	49	42.5
Bluegill Sunfish	50	104	4.44
Bluegill Sunfish	50	113	3.47
Bluegill Sunfish	50	106	4.20
Bluegill Sunfish	50	45	54.9
Bluegill Sunfish	50	102	4.71
Bluegill Sunfish	11.5	100	1.15
Bluegill Sunfish	11.5	87	1.75
Bluegill Sunfish	11.5	116	0.737
Bluegill Sunfish	11.5	99	1.19
Bluegill Sunfish	11.5	95	1.34
Bluegill Sunfish	11.5	82	2.09
Bluegill Sunfish	11.5	82	2.09
Bluegill Sunfish	11.5	59	5.60
Bluegill Sunfish	11.5	45	12.6
Bluegill Sunfish	11.5	47	11.1
Bluegill Sunfish	11.5	48	10.4
Bluegill Sunfish	11.5	49	9.77
Bluegill Sunfish	11.5	116	0.737
Bluegill Sunfish	50	109	3.86
Bluegill Sunfish	50	98	5.31
Bluegill Sunfish	50	137	1.94
Bluegill Sunfish	50	112	3.56
Bluegill Sunfish	50	116	3.20
Bluegill Sunfish	50	110	3.76
Bluegill Sunfish	50	104	4.44
Bluegill Sunfish	50	94	6.02
Bluegill Sunfish	50	105	4.32
Bluegill Sunfish	50	95	5.83
Bluegill Sunfish	50	100	5.00
Bluegill Sunfish	50	79	10.1
Bluegill Sunfish	50	50	40.0
Bluegill Sunfish	50	95	5.83
Bluegill Sunfish	50	94	6.02
Bluegill Sunfish	50	71	14.0
Longear Sunfish	50	65	18.2
Longear Sunfish	50	83	8.74
Longear Sunfish	50	76	11.4
Green Sunfish	50	80	9.77
Green Sunfish	50	117	3.12
Green Sunfish	50	129	2.33
Green Sunfish	50	94	6.02
Green Sunfish	50	58	25.6
Green Sunfish	50	34	127
Channel Catfish	150	265	0.806
Channel Catfish	50	193	0.696

* K calculated for the weight of 50 grams.

Catch summary and calculated condition index for fish collected by boat electroshocking at station five on Nov. 15-16, 1993.

Channel Catfish	50	153	1.40
Channel Catfish	50	157	1.29
Channel Catfish	50	124	2.62
Gizzard Shad	550	384	0.971
Gizzard Shad	250	274	1.22
Gizzard Shad	250	265	1.34
Gizzard Shad	450	360	0.965
Carp	1100	457	1.15
Carp	2000	521	1.41
Threadfin Shad	50	81	9.41
Inland Silverside	50	88	7.34
Inland Silverside	50	79	10.1
Inland Silverside	50	76	11.4

* K calculated for the weight of 50 grams.

Catch summary and calculated condition index for fish collected by boat electroshocking at station one on June 21, 1994.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Threadfin Shad*	750	50-100	N/A
Inland Silverside*	10	50-100	N/A
Channel Catfish	5	90	0.686
Channel Catfish	3	70	0.875
Yellow Bullhead	4	82	0.725
Yellow Bullhead	20	175	0.373

*Total count of individuals:
203 threadfin shad
10 Inland silverside

Catch summary and calculated condition index for fish collected by boat electroshocking at station two on June 21, 1994.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Threadfin Shad*	240	50-100	N/A
Inland Silverside*	20	50-120	N/A
Channel Catfish	5	91	0.664
Channel Catfish	4	80	0.781
Channel Catfish	4	81	0.753
Channel Catfish	4	79	0.811
Channel Catfish	4	78	0.843
Channel Catfish	10	184	0.161
Green Sunfish	10	95	1.166
Green Sunfish	5	70	1.458

*Total count of individuals:
51 Threadfin shad
24 Inland silverside

Catch summary and calculated condition index for fish collected by boat electroshocking at station three on June 21, 1994.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Threadfin Shad*	330	50-100	N/A
Inland Silverside*	20	50-120	N/A
Channel Catfish	4	82	0.725
Channel Catfish	4	73	1.028

*Total count of individuals:
72 Threadfin shad
30 Inland silverside

Catch summary and calculated condition index for fish collected by boat electroshocking at station four on June 21, 1994.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Threadfin Shad*	150	50-100	N/A
Inland Silverside*	20	50-120	N/A
Channel Catfish	4	78	0.843
Channel Catfish	4	80	0.781
Channel Catfish	7	110	0.526
Channel Catfish	3	67	0.997

*Total count of individuals:
30 Threadfin shad
5 Inland silverside

Catch summary and calculated condition index for fish collected by boat electroshocking at station five on June 21, 1994.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Threadfin Shad*	7	50-100	N/A
Inland Silverside*	36	50-120	N/A
Channel Catfish	5	98	0.531
Channel Catfish	4	81	0.753
Channel Catfish	5	94	0.602
Channel Catfish	4	81	0.753
Green Sunfish	3	61	1.322

*Total count of individuals:
2 Threadfin shad
18 Inland silverside

Catch summary and calculated condition for fish collected by electroshocking at station one of Feb. 23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Threadfin Shad(Note 1)	7.14	100	0.7
Threadfin Shad	7.14	120	0.4
Threadfin Shad	7.14	110	0.5
Threadfin Shad	7.14	90	1.0
Threadfin Shad	7.14	100	0.7
Threadfin Shad	7.14	105	0.6
Threadfin Shad	7.14	70	2.1
Inland Silverside	50	70	14.6

Note:
(1) Weight value for threadfin shad represents an averaged value from a total weight of all individuals.

Catch summary and calculated condition index for fish collected by electroshocking at station two on Feb. 23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Threadfin Shad(Note1)	19.2	105	1.7
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	110	1.4
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	105	1.7
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	105	1.7
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	110	1.4
Threadfin Shad	19.2	110	1.4
Threadfin Shad	19.2	105	1.7
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	115	1.3
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	115	1.3
Threadfin Shad	19.2	105	1.7
Threadfin Shad	19.2	110	1.4
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	110	1.4
Threadfin Shad	19.2	120	1.1
Threadfin Shad	19.2	110	1.4
Threadfin Shad	19.2	115	1.3
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	115	1.3
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	90	2.6
Threadfin Shad	19.2	80	3.8
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	100	1.9
Threadfin Shad	19.2	105	1.7

Note

(1) Total weight of all threadfin shad was 1000 g.

Catch summary and calculated condition index for fish collected by electroshocking at station two on Feb. 23, 1995

Threadfin Shad	19.2	85	3.1
Threadfin Shad	19.2	95	2.2
Threadfin Shad	19.2	105	1.7
Threadfin Shad	19.2	105	1.7
Silverside*	50	105	4.3
Bluegill*	50	8.5	8141.7
Bluegill*	50	8.5	8141.7

Note
(1) Total weight of all threadfin shad was 1000 g.

Catch summary and calculated condition index for fish collected by electroshocking at station three on Feb. 23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Gizzard Shad	800	365	1.6
Gizzard Shad	800	355	1.8
Threadfin Shad	100	148	3.1
Threadfin Shad	50	142	1.7
Threadfin Shad(Note 1)	154 @ 3000	90 to 130	N/A
Bluegill	50	9.8	N/A
Golden Shiner	50	10.2	N/A

Notes:
(1) A single total weight value and size range were recorded due to the large number of shad collected.

Catch summary and calculated condition index for fish collected by electroshocking at station four on Feb.23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Carp	3100	490	2.6
Channel Catfish	1750	455	1.9
Green Sunfish	<50	115	3.3
Green Sunfish	<50	112	3.6
Green Sunfish	<50	100	5.0
Threadfin Shad	16.7	130	0.8
Threadfin Shad	16.7	95	1.9
Threadfin Shad	16.7	115	1.1
Threadfin Shad	16.7	112	1.2
Threadfin Shad	16.7	112	1.2
Threadfin Shad	16.7	110	1.3

Note: Threadfin Shad total weight for the above six individuals was 100g

Catch summary and calculated index for fish collected by electroshocking at station five on Feb. 23, 1995

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Gizzard Shad	750	175	14.0
Channel Catfish	4500	540	2.9
Carp	3250	495	2.7
Carp (Note1)	5500	460	5.7
Gizzard Shad	500	295	1.9
Bluegill	50	135	2.0
Bluegill	50	135	2.0
Bluegill	150	142	5.2
Bluegill	150	140	5.5
Bluegill (Note2)	33.3	85	5.4
Bluegill (Note2)	33.3	70	9.7
Bluegill (Note2)	33.3	72	8.9
Bluegill (Note2)	33.3	96	3.8
Bluegill (Note2)	33.3	90	4.6
Bluegill (Note2)	33.3	62	14.0
Bluegill (Note2)	33.3	70	9.7
Bluegill (Note2)	33.3	53	22.4
Bluegill (Note2)	33.3	65	12.1
Threadfin Shad	50	115	3.3
Threadfin Shad	50	120	2.9
Threadfin Shad	50	130	2.3
Threadfin Shad	50	135	2.0
Threadfin Shad	50	135	2.0
Threadfin Shad	50	115	3.3
Threadfin Shad	50	114	3.4
Threadfin Shad	30	106	2.5
Threadfin Shad	30	114	2.0
Threadfin Shad	30	108	2.4
Threadfin Shad	30	96	3.4
Threadfin Shad	30	109	2.3

Note
(1) One carp found tailless
(2) Total weight of 9 Bluegill was 300g

Catch summary and calculated condition index for fish collected by electroshocking at station one on June 21,1995.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Blacktail Shiner	50	70	14.6

Catach summary and calculated condition index for fish collected by electroshocking at station two on June 21, 1995.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Threadfin Shad (Note 1)	6.4	60-120	N/A
Inland Silverside	50	70	14.6
Inland Silverside	50	63	20.0
Blacktail Shiner	50	95	5.83
Channel Catfish	50	61	22.0
Channel Catfish	50	116	3.20
Channel Catfish	50	78	10.5

Note: The 6.8 g value represents a mean of 47 individuals collected at this station.

Catch summary and calculated condition index for fish collected by electroshocking at station three on June 21, 1995.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Threadfin Shad	7.7	60-120	N/A
Inland Silverside	50	66	17.4
Inland Silverside	50	65	18.2
Inland Silverside	50	70	14.6
Inland Silverside	50	82	9.07
Inland Silverside	50	72	13.4
Largemouth Bass	100	155	2.69
Bluegill Sunfish	NC	110	N/A
Channel Catfish	400	306	1.40
Channel Catfish	50	68	15.9
Channel Catfish	50	85	8.14
Channel Catfish	50	104	4.44
Channel Catfish	50	85	8.14
Channel Catfish	50	86	7.86
Channel Catfish	50	67	16.6

Catch summary and calculated condition index for fish collected by electroshocking at station four on June 21, 1995.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)
Threadfin Shad	5.7	60-120	N/A
Bluegill Sunfish	50	98	5.31
Bluegill Sunfish	50	144	1.67
Gizzard Shad	100	225	0.878
Channel Catfish	50	119	2.97
Channel Catfish	50	85	8.14
Channel Catfish	50	62	21.0

Note:
(1) The value of 5.7 g represents a mean weight of 98 fish at a total weight of 550 g.

Catch summary and calculated conditon index for fish collected by electroshocking at station five on June 21, 1995.

Species	Weight (grams)	Total Length (mm)	Index of Condition (K)(Note 1)
Largemouth Bass	<50	78	10.54
Green Sunfish	50	136	1.99
Green Sunfish	100	155	2.69
Threadfin Shad	<50	73	12.9
Threadfin Shad	<50	55	30.1

Note:
(1) K was calculated for those individuals with a <50 value using 50 g
Thus the K value for these individuals are only estimates of condition.

Catch summary and calculated index for fish collected by electroshocking at station one on Aug 7 1995

Species	Weight (g)	Total Length (mm)	Index of Condition (K)
Channel Catfish*	50	73	12.9
Channel Catfish*	50	76	11.4
Channel Catfish*	50	72	13.4
Channel Catfish*	50	74	12.3
Channel Catfish*	50	120	2.9
Channel Catfish*	50	99	5.2
Channel Catfish*	50	81	9.4
Channel Catfish*	50	72	13.4
Silverside*	50	53	33.6
Silverside*	50	110	3.8
Silverside*	50	105	4.3
TF Shad*	50	62	21.0
TF Shad*	50	142	1.7

Catch summary and calculated index for fish collected by electroshocking at station two on Aug 7, 1995

Species	Weight (g)	Total Length (mm)	Index of Condition (K)
Channel Catfish	150	25.3	926.3
Channel Catfish	100	190	1.5
Channel Catfish*	50	126	2.5
Channel Catfish*	50	93	6.2
Channel Catfish*	50	89	7.1
Channel Catfish*	50	120	2.9
Channel Catfish*	50	102	4.7
Channel Catfish*	50	118	3.0
Channel Catfish*	50	75	11.9
Channel Catfish*	50	128	2.4
Channel Catfish*	50	82	9.1
Channel Catfish*	50	86	7.9
Channel Catfish*	50	90	6.9
Channel Catfish*	50	94	6.0
Channel Catfish*	50	111	3.7
Channel Catfish*	50	136	2.0
Channel Catfish*	50	111	3.7
Channel Catfish*	50	75	11.9
Channel Catfish*	50	87	7.6
Channel Catfish*	50	84	8.4
Channel Catfish*	50	90	6.9
Channel Catfish*	50	125	2.6
Channel Catfish*	50	130	2.3
Channel Catfish*	50	104	4.4
Channel Catfish*	50	101	4.9
Channel Catfish*	50	100	5.0
Channel Catfish*	50	97	5.5
Channel Catfish*	50	106	4.2
Channel Catfish*	50	107	4.1
Channel Catfish*	50	108	4.0
Channel Catfish*	50	83	8.7
Channel Catfish*	50	85	8.1
Channel Catfish*	50	97	5.5
Channel Catfish*	50	117	3.1
Channel Catfish*	50	110	3.8
Channel Catfish*	50	94	6.0
Channel Catfish*	50	97	5.5
Channel Catfish*	50	95	5.8
Channel Catfish*	50	100	5.0
Channel Catfish*	50	95	5.8
Channel Catfish*	50	75	11.9
Channel Catfish*	50	75	11.9
Gizzard Shad	100	199	1.3
TF Shad*	50	75	11.9
TF Shad*	50	52	35.6
TF Shad*	50	56	28.5
TF Shad*	50	56	28.5
Yellow Bullhed*	50	75	11.9

Catch Summary and Calculated index for fish collected by electroshocking at station three on August 7, 1995.

Species	Weight (g)	Total Length (mm)	Index of Condition (K)
Bluegill*	50	97	5.5
Channel Catfish*	50	108	4.0
Channel Catfish*	50	100	5.0
Channel Catfish*	50	67	16.6
Channel Catfish*	50	73	12.9
Channel Catfish*	50	81	9.4
Channel Catfish*	50	55	30.1
Channel Catfish*	50	48	45.2
Channel Catfish*	50	66	17.4
Channel Catfish*	50	75	11.9
Channel Catfish*	50	82	9.1
Channel Catfish*	50	77	11.0
Channel Catfish*	50	75	11.9
Gizzard Shad	150	252	0.9
Gizzard Shad	150	246	1.0
Gizzard Shad	100	224	0.9
Gizzard Shad	100	222	0.9
Gizzard Shad	100	190	1.5
Gizzard Shad	150	269	0.8
Gizzard Shad	100	240	0.7
Gizzard Shad	150	262	0.8
Green Sunfish*	50	114	3.4
RedBreast Sunfish*	50	47	48.2
RedBreast Sunfish*	50	114	3.4
RedBreast Sunfish*	50	114	3.4
Threadfin Shad	50	62	21.0

Catch summary and calculated index for fish collected by electroshocking at station four on August 7, 1995.

Species	Weight (g)	Total Length (mm)	Index of Condition (K)
Green Sunfish	50	67	16.6
Green Sunfish	50	83	8.7

Catch summary and calculated index for fish collected by electroshocking at station five on August 7, 1995.

Species	Weight (g)	Total Length (mm)	Index of Condition (K)
NO FISH	-	-	-

APPENDIX H

Qualifications of Preparers and Agencies Consulted

Appendix H
Qualifications of Preparers and Agencies Consulted

Foster Wheeler Environmental Corporation (formerly Ebasco Environmental) was contracted by Texas Utilities Electric Services to perform this 316(b) Demonstration for the CP Unit No. 2. Foster Wheeler Environmental assembled a team of experienced fisheries professionals and power plant engineers to design and perform the studies.

The team was led by Dr. Glenn Piehler, a Certified Fisheries Scientist (American Fisheries Society), and an active participant in 316(b) projects from the time of their genesis in 1972. Dr, Piehler joined Ebasco in 1974, and is currently manager of Foster Wheeler Environmental's Lyndhurst, NJ (headquarters) office.

To support the field effort, Foster Wheeler Environmental retained the services of the University of North Texas Institute of Applied sciences (IAS) in Denton, Texas. Dr. Kenneth Dickson, also a noted aquatic biologist with eminent qualifications and credentials, knowledge of local fisheries, experience with 316(b) demonstrations, and involvement in statewide environmental policy assessment, directs the IAS. On this project, he was assisted by Mr. Robert Killam, who is Administrative Services Officer for the UNT Department of Biological Sciences, and an experienced 316(b)/fisheries scientist. Mr. Killam and Dr. Piehler were contemporaries at the University of Massachusetts in 1971, and again (for two years) in 1976-77 when they collaborated in performance of fisheries and 316(b) studies for Niagara Mohawk's proposed Lake Erie Generating Station (LEGS).

Ebasco/Comanche Peak (Ebasco/CP) engineers on-site collaborated with environmental staff to share facilities, and provide personnel support for liaison with CPSES operating staff; equipment fabrication and testing (e.g., impingement collection devices, entrainment collection systems); and actual collection of samples with UNT research assistants. Ebasco/CP staff were expert, detail-oriented engineers; they knew the plant; and were skilled at handling boats and equipment, including fabrication, handling and maintenance.

The following sections briefly summarize the responsibilities and credentials of the CP 316(b) team members.

H-1. PROJECT MANAGER

Name: Dr. Glenn Piehler, Foster Wheeler Environmental

Responsibilities: Design project; serve as point of contact with TU Services project manager; manage contracts, costs, schedule, and resources; prepare/submit monthly invoices and progress reports; attend progress meetings; supervise data analysis, interpret results, and prepare technical reports; represent TU Services in meetings (if any).

Education: Ph.D., 1972 (Fisheries Science w/Statistics minor)
M.S., 1967 (Fisheries Biology w/Zoology minor)
B.S., 1965 (Biology w/Chemistry minor)

Years Experience: 24 (started full-time professional employment May, 1971; completed dissertation/Ph.D. one year later)

Relevant Experience: (Power plants, 316(b)s, project management)

- Management of EIS/316s throughout the U.S. and Pacific Rim Countries.
- 30 utilities worldwide
- 2 Texas utilities; 4 projects - all CWS related
- 5 EISs for nuclear generating stations (NGS)
- 316(b)s or related work for 8 NGS, and 7 fossil-fueled SES
- ASLB expert testimony for Seabrook NGS (former PSNH) and Douglas Point NGS (PEPCO)

H-2. LEAD PERSONNEL

Name: Dr. Kenneth Dickson, Director, UNT/IAS

Responsibilities: Subconsultant to Foster Wheeler Environmental and director of services under IAS subcontract; supervise and QA work of IAS graduate research students assigned to CP 316(b) field and lab work; consult with Foster Wheeler Environmental during performance of the project.

Education: Ph.D., 1971 (Aquatic Biology)
M.S., 1968 (Biology)
B.S., 1968 (Science Education)

Years Experience: 24

Relevant Experience: (Power plants, 316(b)s, Texas)

- Educated at UNT; with the IAS since 1978
- Member of numerous state- and national-level environmental councils and advisory groups
- Author of over 100 books and journal publications
- Performed 316(b)s for two Appalachian Power Co. power plants

Name: Robert (Bob) Killam, UNT

Responsibilities: Subconsultant to Foster Wheeler Environmental to provide mobilization and startup training for UNT students and other field support staff; provide field assistance in the entrainment sampling program and QC of impingement sampling, ID, and reporting, and QC laboratory processing of ichthyoplankton.

Education: B.S., 1973 (Fisheries Biology)

Years Experience: 22

Relevant Experience: (Power plants, 316(b)s, Texas)

- Eight years' experience as a consultant to utility companies in performance of EIS, 316(a), and 316(b) studies
- Ten years on staff of UNT Biological Sciences Department
- Aquatic biology lab supervisor (six years, including ichthyoplankton processing)
- Field biologist and site manager for power plant EIS and 316s (three years)
- 316(a) & (b) studies for Niagara Mohawk at Dunkirk and Buffalo, New York

H-3. KEY SUPPORT PERSONNEL

Name: John Schaffer

Responsibilities: Data entry; assisted in report preparation and data analysis; technical review and preparation of 316(b)

Education: M.S., 1989. (Biology)
B.S., 1987. (Biology)

Years Experience: 10

Relevant Experience:

- Developed and implemented a predictive 316(b) Demonstration field program for a proposed power plant on the Delaware River.

- Provided oversite and technical review of entrainment and impingement compliance monitoring reports for a major NE utility.

Name: Al DiSanto, Foster Wheeler Environmental

Responsibilities: Equipment design and fabrication; intake velocity measurements; field sampling assistance on-site; primary point of contact with CP operating staff.

Education: B.S., 1980 (Civil Engineering)

Years Experience: 23

Relevant Experience: (CPSES design/operating experience; knowledge of the intake and SCR)

- Conducted diving/underwater assessments, and feasibility studies of circulating water intake structure modification to migrate impingement, at Waterford #3 and St. Lucie #1 NGS
- Nine years at CPSES with extensive experience in site engineering, procedures, specifications, and facilities

Name: George Bauml, UNT Graduate Research Assistant

Responsibilities: Field operations for entrainment and impingement sampling, field operations, lead for fisheries surveys of SCR. Equipment maintenance and coordination of sample collection.

Education: M.S., UNT (Pending)
B.S., 1991 (Wildlife & Fisheries Science)

Years Experience: 2

Relevant Experience:

- Graduate Student Assistant at IAS
- Assists in fisheries surveys for IAS

Name: Brynne Bryan, UNT Graduate Research Assistant

Responsibilities: Responsible for ichthyoplankton laboratory analysis. Duties included the identification and enumeration of ichthyoplankton samples collected as part of the CPSES entrainment study.

Education: M.S., 1994 (Environmental Science)
B.S., (Biology)

Years Experience: 3

Relevant Experience:

- Experienced in the identification of fish eggs and larvae from inland waters.
- Practiced in laboratory techniques for evaluating/documenting biological data
- Assists in fisheries surveys for IAS

Name: Dr. Stephan Cairns, UNT

Responsibilities: Functioned as overall field coordinator/supervisor for UNT in conducting entrainment, impingement and SCR surveys. Coordinated field sample collections was laboratory staff for timely processing of ichthyoplankton samples. Provided technical assistance for all elements of the 316(b) field study. Provided oversite of QA/QC of all samples by UNT staff.

Education: Ph.D., 1993. (Biology)
M.S., 1988. (Biology)
B.S., 1977. (Botany)

Years Experience: 7

Relevant Experience:

- Responsible for coordination of field activities and equipment for fisheries/ecological investigations conducted by UNT/IAS biologists

- Participated in numerous surveys/studies investigating fisheries resources of inland waters.

- Practiced in the identification of North American fish species.

- Coordinator of laboratory staff/resources for fisheries surveys

Agencies Consulted: Texas Parks and Wildlife Department.