STP Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

June 17, 2008
ABR-AE-08000045

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project Units 3 & 4
Docket No. 52-012 and 52-~~102~~ 013
Final Aquatic Ecology Report

Reference: Letter, G.T. Gibson to W.F. Burton, "Environmental Report Acceptance Review: Outstanding Issues," dated November 8, 2007 (ABR-AE-07000010)

In the reference listed above, STP Nuclear Operating Company (STPNOC) made a commitment (Commitment #6) to perform a 12-month aquatic ecology monitoring study to provide current data on the ecological communities in the Colorado River at and near the Unit 1 & 2 facilities, specifically the permitted Reservoir Makeup Pumping Facility and Main Cooling Reservoir (MCR) discharge ports. These same facilities will continue to service the water intake and discharge requirements for the MCR. This commitment was scheduled to be completed by June 30, 2008.

This letter transmits a copy of the final report prepared by ENSR Corporation dated June, 2008 entitled Aquatic Ecology – Colorado River Monitoring Report. Importantly, we would like to note that our assessment of the year-long aquatic study, confirms our original belief that the species diversity and levels are consistent with all the earlier studies conducted (i.e., there have been no significant changes in the ecosystem).

Please feel free to call me at (361) 972-4626 or Russell W. Kiesling at (361) 972-4716 should you have any questions regarding this submittal.

D079
NRO

STI: 32327840

There are no Commitments in this letter.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on June 17, 2008

Gregory T. Gibson
Manager, Regulatory Affairs

sad

Attachment: Aquatic Ecology – Colorado River Monitoring Report cc: w/o attachment except*

(paper copy)

Director, Office of New Reactors
U. S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Regional Administrator, Region IV
U. S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, Texas 76011-8064

Richard A. Ratliff
Bureau of Radiation Control
Texas Department of State Health Services
1100 West 49th Street
Austin, TX 78756-3189

C. M. Canady
City of Austin
Electric Utility Department
721 Barton Springs Road
Austin, TX 787014

*Steven P. Frantz, Esquire
Morgan, Lewis & Bockius LLP
1111 Pennsylvania Ave. NW
Washington, DC 20004

*George F. Wunder
Two White Flint North
11455 Rockville Pike Mail Stop 7 F31
Rockville, MD 20852-2738

*Paul Kallan
Chief, Environmental Projects Branch
U.S. Nuclear Regulatory Commission
Mail Drop O10-H2
11555 Rockville Pike
Rockville, MD 20852

(electronic copy)

A. H. Gutterman, Esquire
Steve Frantz, Esquire
Morgan, Lewis & Bockius LLP

George Wunder
Paul Kallan
U. S. Nuclear Regulatory Commission

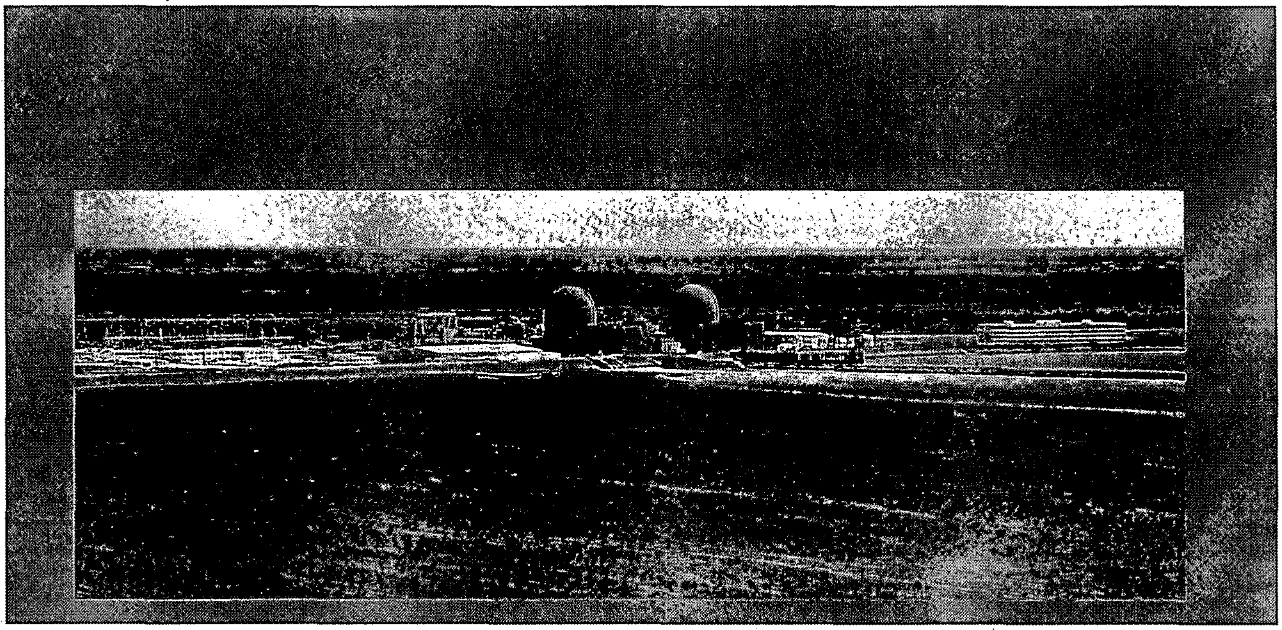
Thad Hill
Marty Ryan
Harry Holloway
Steve Winn
Eddy Daniels
NRG South Texas 3/4 LLC

Jon C. Wood, Esquire
Cox Smith Matthews

C. Kirksey
City of Austin

J. J. Nesrsta
R. K. Temple
Kevin Pollo
L. D. Blaylock
CPS Energy

Prepared for:
STP Nuclear Operating Company
Wadsworth, Texas



Aquatic Ecology - Colorado River Monitoring Report
Unit 3 and 4 Licensing Project

ENSR Corporation
June 2008

ENSR | AECOM

Prepared for:
STP Nuclear Operating Company
Wadsworth Texas

Aquatic Ecology - Colorado River Monitoring Report

Unit 3 and 4 Licensing Project

Prepared By Kurtis K. Schlicht

Reviewed By Robert D. Carpenter

Frederick S. Scharf
Assoc. Professor of Fisheries
Dept. of Biology and Marine Biology
University of North Carolina Wilmington

ENSR | AECOM

Contents

List of Tables

List of Figures

List of Figures (cont.)

List of Figures (cont.)

Executive Summary

STP Nuclear Operating Company (STPNOC) is currently proposing to expand the South Texas Project Electric Generating Station (STPEGS) located in Matagorda County, Texas. STPNOC submitted a combined operating license (COL) application to the Nuclear Regulatory Commission (NRC) for the addition of Units 3 and 4 and is currently in the process of addressing specific components of the Environmental Standard Review Plan (ESRP) NUREG 1555 as it relates to the aquatic ecology of the lower Colorado River. The primary objective of the aquatic assessment was to collect current data for one continuous year on the lower Colorado River in the vicinity of the STPEGS facility that would provide sufficient information for addressing NUREG 1555 objectives. The goals of this study were to:

- Determine current species richness and relative abundances for fishes and macroinvertebrates in the lower Colorado River and subsequent river reaches associated with the study area;
- Determine the current distribution of species associated with STPEGS facilities including the Reservoir Make-up Pumping Facility (RMPF) and the blowdown facility;
- Compare current data to historical data to determine if the composition of aquatic organisms has changed considerably since the initial STPEGS Units 1 and 2 licensing; and
- Document current salinity patterns in the lower Colorado River and its effects on species assemblages in the river.

The Colorado River is one of the largest river systems within the state of Texas, extending approximately 862 miles from the high plains to the coastal marshes in Matagorda County. The section of the river between Bay City and the Intracoastal waterway (ICWW) is a diverse, fluvial system that meanders through the coastal plain providing sediments and nutrients to Matagorda Bay.

The lower Colorado River has been studied on a very limited basis with specific studies associated with the STPNOC facility being conducted in 1974, 1976, 1983, and 1984. Data from 1974 and 1976 were collected during the initial licensing phase for Units 1 and 2 to predict impacts associated with construction and operation of the facility. Data from 1983 and 1984 were collected to demonstrate that numbers of organisms projected to be impacted were representative of the original impact assessments from 1974 and 1976.

The study area associated with this aquatic assessment consisted of an approximately 9 mile stretch of the lower Colorado River extending from the ICWW north to the FM 521 bridge, which is approximately 1.5 miles east of the STPEGS facility. The river stretch was divided into three reaches, each 3 miles in length, using the navigation mile markers (NMM) currently in place along the river. The reaches were identified as Segment A which extended from the ICWW to NMM 3, Segment B which extended from NMM 3 to NMM 6, and Segment C which extended from NMM 6 to NMM 9. Sampling was conducted monthly for a period of one year (June 2007 – May 2008) using gill nets, hoop nets, trawls, and bag seines to collect fish and invertebrate species within the different reaches of the river. Hydrological data including salinity, dissolved oxygen, and temperature were collected during each sampling event. In addition, hydrological data were collected at navigational mile markers located at one mile intervals on the river to help define where and how these influences affect the species community within the river.

Biological and environmental data were used to characterize spatial and temporal patterns of species richness and diversity, relative abundance, and fish and macroinvertebrate size relationships. Species richness, diversity, and relative abundance were estimated by gear type for the entire study area as well as within each river reach. Simpson's Index, Shannon-Wiener diversity indices, evenness, and the Jaccard Coefficient of Community Similarity were analyses used to evaluate and characterize the aquatic community.

A total of 186 samples were collected over the year-long assessment using four sampling gears (65 trawls, 55 seines, 33 gill nets, and 33 hoop nets) within the approximate nine mile study area of the lower Colorado River. Catch rates for each of the gears were variable from month to month with slight tendencies for seasonal trends being evident. Percent composition of organisms collected by each gear during the study indicated that all gears were represented by more than 8 species each comprising greater than 1% of the total catch and species composition captured by each of the gears varied considerably among seasons. Species richness, diversity, and evenness by river segment and gear indicated that species collected with trawls and seines had a greater species richness (44 total species versus 18-20 species collected in gill nets and hoop nets); however other diversity metrics were not considerably different among the sampling gears. Segment A had the highest value of species richness for all gears except hoop nets. Species diversity in trawl catches varied moderately among the three river segments, with both the Simpson's and Shannon-Wiener Index values indicating that segment B had slightly higher diversity than segments A and C.

Surface water temperatures during the study ranged from a low of 11.6°C during the month of January to a high of 31.0°C during the month of August and bottom water temperatures ranged from 11.1°C during the month of January to a high of 30.8°C during the month of August. Surface temperatures were an average of 0.4°C warmer than bottom temperatures throughout the study period, reflecting the general shallow depths in the system. Temporal trends in salinity demonstrated seasonal lows during winter and highs during spring. Salinity readings at the surface were fairly stable ranging from 0.0 ppt to about 7 ppt, with the highest salinities occurring downstream, below NMM 2, and the lowest occurring above NMM 8. Salinities at mid-water depths were the most variable of all three depths recorded. Bottom salinities were generally highest, ranging from 0.0 ppt to a high of 25 ppt, and declined toward upstream stations in nearly all months. Comparison of flow rates and catch rates for all four gears indicates an inverse relationship between flow rate and catch rate. Relationships between catch rate and DO or salinity were variable and did not show any strong trends; however, bag seine catch rates did appear to show a slight positive trend with salinity.

Overall species richness, diversity and evenness for the 1974 trawl data indicated a moderately diverse species community for the lower river during that period. All three measures were slightly lower than current estimates, suggesting greater diversity in the present period. The current data also showed higher species richness in segment A, but the difference was not as large. Data collected during 1974 examining specific segments also indicated a diverse species community for all three segments. The 1983-84 trawl and seine data indicated overall lower species richness, diversity, and evenness relative to the present data.

Using Jaccard coefficients of similarity, comparison of applicable months and gears from the 2007-08 data with samples collected during 1974 resulted in a value of 0.44 suggesting reasonable similarity between these two communities. Comparison of applicable months from the 2007-08 data to the 1983-84 samples resulted in a coefficient value of 0.19, suggesting a relatively low similarity for these communities. Comparison of data from river segment C in 2008 with 1974 and 1983-84 trawl data for a similar river segment resulted in values of 0.36 and 0.37, respectively, suggesting a moderate level of similarity between historical and present communities. Comparison of data for bag seine samples from applicable months during 2007-08 with 1983-84 seine data resulted in coefficient values of only 0.07 and 0.11, suggesting low similarity between historic and present day communities in shallow waters accessible to seines. When 2007-08 bag seine data for segment C was compared to 1983-84 data from the same segment, Jaccard coefficient values increased to 0.31 and 0.33, suggesting moderate community similarity. Overall, present data indicate a more diverse faunal community than that represented by historic data in the lower Colorado River

The number and assortment of organisms collected during this study indicate that this portion of the lower Colorado River supports a diverse assemblage of fauna. The regular occurrence of both fresh and saltwater species, the range of macroinvertebrate and finfish fauna, and the sheer number of species captured among various sampling gears and river reaches provide evidence of a dynamic ecosystem. There was a moderate level of similarity between the current 2007-08 faunal communities and the historic communities (1974 and 1983-84).

Based on the moderate levels of similarity between historical and current faunal communities and the increase in species richness and diversity observed at present, it is reasonable to conclude that the current data provides a sufficient framework for evaluating the potential for any new impacts resulting from the operation of additional facilities in the lower Colorado River.

1.0 Introduction

1.1 Project Goals

This report summarizes the results of ENSR's aquatic assessment of the lower Colorado River conducted in conjunction with the STP Nuclear Operating Company's (STPNOC) Unit 3 and Unit 4 Combined Operating License (COL) application. A proposed expansion project is located proximal to the South Texas Project Electric Generating Station (STPEGS) in Matagorda County, Texas (Figure 1). The extent of the study area included the portion of the lower Colorado River extending from the FM 521 bridge south to the Intracoastal Waterway (ICWW), and covered approximately 9 river miles.

STPNOC has submitted a COL application to the NRC for the construction and operation of two new nuclear reactor units at the STPEGS facility. In accordance with the Environmental Standard Review Plan (ESRP) NUREG 1555 application process, STPNOC completed the required environmental reports necessary to "...describe the aquatic environment and biota at and in the vicinity of the site and other areas to be impacted by the construction, maintenance, or operation of the proposed project". The aquatic assessment conducted by ENSR was designed to provide information on the spatial and temporal distribution, relative abundance, and other structural and functional attributes of biotic assemblages upon which the proposed action could have impact. Data collected in this study will be used to address these specific aquatic ecology objectives of NUREG 1555 and will also be used in conjunction with the historical data collected during the initial construction and operating licensing process completed in the early 1980's to evaluate any long term changes.

The primary objective of the aquatic assessment was to collect current data for one continuous year on the lower Colorado River in the vicinity of the STPEGS facility that would provide sufficient information for addressing NUREG 1555 objectives. In an effort to provide a more complete characterization of the existing conditions in the river, the following goals were established for this study:

- Determine current species richness and relative abundances for fishes and macroinvertebrates in the lower Colorado River and subsequent river reaches associated with the study area;
- Determine the current distribution of species associated with STPEGS facilities including the Reservoir Make-up Pumping Facility (RMPF) and the blowdown facility;
- Compare current data to historical data to determine if the composition of aquatic organisms has changed considerably since the initial STPEGS licensing; and
- Document current salinity patterns in the lower Colorado River and its affects on species assemblages in the river.

1.2 Study system and historical information

The Colorado River is one of the largest river systems within the state of Texas, extending approximately 862 miles from the high plains to the coastal marshes in Matagorda County. The watershed for the Colorado River covers approximately 42,000 square miles and includes five major tributaries and numerous minor tributaries. The flow of water from the Colorado River distributes nutrients and detrital matter to shallow estuarine habitats that make up the Matagorda Bay system. In addition, the Colorado River is tidally influenced as far as 32 miles upstream of Matagorda Bay, with salinities in the vicinity of the STPEGS facility reaching as high as 20 parts per thousand (ppt) during low flow periods. The section of the lower Colorado River between Bay City and the ICWW is a fluvial system that meanders through the coastal plain providing sediments to the marine coastal system. The margins of the river consist of steep, heavily eroded banks or bluffs along nearly the entire stretch from the STPEGS facility to Matagorda Bay. There are several developed residential areas along the eastern shore associated with low lying reaches of the river. The steep banks along the shore restrict most vegetation growth; however, bottomland forested communities and fringing shoreline wetlands do occur throughout the study area.

Flows from the lower Colorado River historically emptied into Matagorda Bay prior to the 1930's. Between 1930-1950, flows were directed directly to the Gulf of Mexico due to the development of a delta and the construction of a channel through the Matagorda peninsula. In the 1950's, a new channel was cut between Matagorda Bay and the river to reconnect flows between the bay and the river through the west side of the delta. The river was then diverted directly into Matagorda Bay in 1992. The extent of this area was not evaluated during this current study. However, it is important to note that the tidal influence through Matagorda Bay plays an important role in the distribution of fish and invertebrate species occurring in lower Colorado River.

The lower Colorado River has been studied on a very limited basis compared to the adjacent Matagorda Bay system, in which the Texas Parks and Wildlife Department (TPWD) has been conducting long-term monitoring for over 25 years. Data for the lower Colorado River suggests that the system is very diverse, sustaining both freshwater and saltwater species that depend on river flows and the extent of upstream movement of the saltwater wedge. Data specific to the STPEGS facility was originally collected during 1973-74 as part of preoperational monitoring of the lower Colorado River by STPNOC. However, this data was collected during an extremely wet period and regulatory authorities required the completion of additional surveys of the river during more representative conditions. The additional studies conducted in 1975-76 characterized the river during more typical environmental conditions and were used to predict estimated impacts associated with impingement and entrainment. During 1983-84, additional data were collected at the reservoir make-up pumping facility (RMPF) intake area to verify operational impacts associated with impingement and entrainment. There have been no additional studies completed subsequent to 1983-84 to document faunal community composition in this region of the lower Colorado River. Only data associated with river portion of the 1983-84 study were reviewed and analyzed as part of this study. This current aquatic assessment will provide the most comprehensive data set collected since 1975.

2.0 Materials and Methods

2.1 Extent of study area and field sampling design

The study area consisted of an approximately 9 mile stretch of the lower Colorado River extending from the ICWW north to the FM 521 bridge. The river stretch was divided into three reaches, each 3 miles in length, using the navigation mile markers (NMM) currently in place along the river. The reaches were established by dividing the 9 mile stretch of the river into roughly equal segments in order to include each of the STPEGS facilities entirely within one of the reaches. The reaches were identified as Segment A which extended from the ICWW to NMM 3, Segment B which extended from NMM 3 to NMM 6, and Segment C which extended from NMM 6 to NMM 9. The STPEGS facilities included the RMPF located adjacent to NMM 8 and the blowdown structure located adjacent to NMM 6, both located in Segment C. Within each reach, sampling locations were chosen randomly. The stratified-random sampling design ensured that the distribution of samples collected provided sufficient spatial coverage to document species richness and catch rates of fauna inhabiting the waters in the vicinity of the STPEGS facilities. The broad spatial coverage also allowed for a general characterization of the dynamics of fish and macroinvertebrate assemblages related to flow rates and the mixing of fresh and saltwater in the lower part of the river. Sampling was conducted monthly for a period of one year (June 2007–May 2008). Monthly sampling ensured that seasonal variation in species richness and catch rates could be detected. Within each month, samples were collected during a two day period randomly selected each month. To reduce variability in sampling conditions among months and to ensure that river conditions were conducive to sampling, a maximum flow level of 5,000 cubic feet per second (cfs) was established. If river conditions exceeded this flow rate samples were not collected until the flow rate returned to a level below this value.

The assessment of fish and macroinvertebrate populations was conducted following techniques described in Murphy and Willis (1996) that are widely applied in fisheries sampling programs. Four gears including gill nets, hoop nets, trawls, and bag seines were used to collect fish and invertebrate species within the different reaches of the river. Multiple sampling gears were necessary to allow sampling in several habitat types and for several life stages of fauna common to the lower Colorado River and Matagorda Bay ecosystems. Gill net sampling was designed to characterize the utilization of shoreline habitats by adult fishes. Gill nets measured 33.3 m long × 1.2 m deep and consisted of 10.2 cm stretched monofilament mesh. During each month, one gill net was set at a randomly selected location within each river reach. Gill nets were set perpendicular to the shoreline within one hour of sunset and were retrieved at sunrise the following morning. Hoop net sampling was also designed to characterize the use of shoreline habitats, but was intended to more effectively target sub-adult fishes compared to gill nets. Each hoop net consisted of a multi-chambered conical net measuring 3.6 m in length with a hoop diameter of 1 m at the opening followed by smaller hoops that were covered with 2.5 cm stretched mesh netting. Each hoop net included 7.5 m long × 1.8 m deep wings comprised of 5 cm stretched mesh that extended from the opening of the net and were anchored to the river bottom. During each month, one hoop net was set at a randomly selected location within each river reach with the net opening facing downstream. Hoop nets were set within one hour of sunset and were retrieved at sunrise the following morning. Bag seine sampling was designed to effectively capture juvenile and sub-adult fishes and macroinvertebrates occupying shoreline habitats. The bag seine measured 18.3 m long × 1.8 m deep, with a 1.8 m × 1.8 m × 1.8 m bag positioned in the center. The seine was constructed of 19 mm stretched mesh in the wings and 13 mm stretched mesh in the bag. Seines were hauled parallel to the shoreline for a distance of 15.2 m defined by a measured length of rope placed on the shoreline. A 12.2 m rope was attached to each bridle pole to maintain equal distance in net spread and, thus the amount of bottom habitat sampled during each seine haul. Six seine samples, two from each reach were collected per month. Trawl sampling was designed to sample fishes and macroinvertebrates using benthic or demersal habitats in deeper areas of the river. During each monthly sampling period, two trawl samples were collected at random locations within each of the river reaches using a 6.1 m otter trawl constructed entirely of 3.5 cm stretched mesh. The trawl was fitted with doors (i.e., otter boards) measuring 46 cm × 91 cm attached to each wing of the net. The doors and net were fastened to a 30.5 m long bridle attached to the stern of the towing vessel, which was a 7.3 m center console boat equipped with a 250 hp outboard engine. Each trawl sample consisted of a ten minute tow in the main river channel in either the upstream or downstream direction at a speed of approximately 3 knots.

Upon retrieval of each sample gear, all fishes and macroinvertebrates were identified to the lowest taxonomic level and enumerated. Up to 30 individuals of each species were measured (total length or carapace width) to the nearest millimeter. Fish total length was measured from the tip of the snout to the tip of the tail, shrimp total length was measured from the tip of the rostrum to the end of the telson, and crab carapace width was measured as the distance between the lateral spine tips.

2.2 Hydrological data collection

Hydrological data was recorded at each station using a YSI™ Model 80 water quality meter and included water temperature (°C), dissolved oxygen (DO in mg/l), and salinity (ppt). Hydrological data were measured at 0.1 m below the surface during bag seine and hoop net sampling, and at both 0.1 m below the surface and 0.3 m above the bottom during gill net and trawl sampling. Gill net and hoop net hydrological data were collected both at the time of net deployment and at the start of net retrieval the following day. In addition to the data collected during each sampling event, hydrological data at surface, middle, and bottom depths were collected monthly at each NMM to more fully document the movement of the saltwater wedge in the lower Colorado River. Water depths, sample locations, latitude and longitude (hddd°mm'ss.s) were recorded using a Garmin GPS/depth finder (Table 1). River flow rates were obtained for each sampling event on an hourly basis from US Geological Survey Real-Time Water Data (USGS 08162500) for the Colorado River near Bay City, Texas. Meteorological data was also recorded and included air temperature, percent cloud cover, precipitation, and tidal stage. Meteorological data was recorded based on observations made in the field at the time of each sample collection. The sampled habitats within each reach were characterized with regards to bank slope, extent and type of shoreline vegetation, river bathymetry, and extent of shoreline development.

2.3 Data analysis

Biological and environmental data were used to characterize spatial and temporal patterns of species richness and diversity, relative abundance, and fish and macroinvertebrate size relationships. Specifically, these metrics were evaluated for seasonal variation and spatial differences related to flow rates and the inland intrusion of saltwater in the lower Colorado River system. We also performed a comparative assessment between the present data and historical data collected during 1983-84 in the vicinity of the RMPF.

Species richness, diversity, and relative abundance were estimated within each river reach by gear type. Species richness (S) was calculated as the total number of different species present. However, richness does not account for differences in the relative proportion and distribution of each species within the community. Therefore, species diversity was calculated using both Simpson's and Shannon-Wiener diversity indices. Simpson's Index (D) accounts for both richness and proportion of each species and is calculated as:

$$D = \mathrm{sum}(p_i^2),$$

where p_i is the number of a given species divided by the total number of individuals of all species observed. The index (D) is usually subtracted from 1 to represent the probability that two randomly selected individuals will represent two distinct species.

The Shannon-Wiener Index (H') specifically measures the order (or disorder) observed within a particular system. The index (H') is defined as:

$$H' = -\mathrm{sum}(p_i * \ln[p_i]),$$

where p_i is the number of a given species divided by the total number of individuals of all species observed and ln is the natural logarithm. The Shannon-Wiener Index measures the average degree of diversity as it relates to predicting the species of a given individual picked at random from the community. The index values vary from zero for communities with only a single species to high values for communities having many species, each with a few individuals. Furthermore, by combining species richness (S) and the Shannon-Wiener Index (H') one can calculate a measure of evenness, which is a measure of how similar the abundance of different species are. Evenness values range from 0 to 1; the closer the value is to 1, the more similarity or evenness in species within the community. Evenness is defined as:

$$E = H'/\ln(S)$$

The Jaccard Coefficient of Community Similarity was used to determine similarities between the samples collected within each reach based on the presence or absence of taxa. The greater the number of taxa shared between communities, the greater the similarity. The value of the coefficient ranges from 0 to 1, with higher coefficients indicating greater similarity between samples. The Jaccard Coefficient is defined as:

$$CCj = 100 * S_c/S_t,$$

where **Sc** = number of species common to both samples and S_t = total number of species in both samples.

Catch per unit of effort (CPUE) was used to estimate the relative abundance of each species captured during the study. CPUE was calculated separately for three different levels of spatial resolution: the entire study area, within each river reach, and for sample locations associated with the RMPF and the blowdown facility. For a given species, CPUE was calculated by dividing the total number of individuals captured by the number of samples completed for each gear used:

$$CPUE = Ni/Ns$$

where **Ni** = number of organisms captured and **Ns** = number of samples completed per gear.

Comparison of data from this study to historical data collected during 1974 and 1983-84 studies included comparing each of the aforementioned metrics for the entire study area across studies. We then compared data collected only within Segment C, which included samples associated with the RMPF and the blowdown facilities. These comparisons enabled determination of whether present assemblages of aquatic organisms were similar or different from historical assemblages, and whether any considerable changes to fish and macroinvertebrate communities associated with the STPEGS facility have occurred.

3.0 Results

3.1 Spatial and temporal patterns variability in catch rates and species composition

A total of 186 samples were collected using four sampling gears (65 trawls, 55 seines, 33 gill nets, and 33 hoop nets) within the approximate nine mile study area of the lower Colorado River (Figure 2). Eleven monthly sample events were completed between June 2007 and May 2008; no samples were collected during July 2007 due to elevated river flows greater than 5,000 cfs. A total of 17,762 organisms comprising 69 species (11 invertebrates and 58 fish species) were captured (Table 2). Bag seine samples collected the highest number of organisms, with a total of 8,797 individuals, followed by trawl samples with 8,760 organisms. Gill nets and hoop nets captured 106 and 99 organisms, respectively. River segment A yielded the highest number of organisms, followed by segment B, and then segment C (Table 3). Among the taxa collected, 18 are considered freshwater species and 51 are considered estuarine species (Hoese and Moore, 1977) Six of the eighteen freshwater species are typically associated with almost entirely freshwater, whereas twelve are commonly found in brackish water systems (Chilton, 1997).

Catch rates for each of the gears were variable from month to month with slight tendencies for seasonal trends being evident (Figures 3 thru 6). Briefly, trawl catches peaked in fall months, seine catches peaked in spring (April), and gill net and hoop net catches were moderately higher during both fall and spring. Trawl catch rates ranged from 11.7 to 439.3 organisms per trawl with two months, October and November, representing the highest catch rates. Bag seine catch rates ranged from 2.2 to 588.4 organisms per seine with the highest capture rate occurring during April. Gill net catch rates ranged from 1.0 to 5.3 organisms per gill net with seven of the months having catch rates above 3.5 organisms per gill net. Hoop net catch rates ranged from 1.0 to 5.7 organisms per hoop net with high catch rates occurring during the months of October, November, and May. Trawl catch rates showed the highest catches in river segment A, with each segment demonstrating higher catches during fall months (Figure 7). Similarly, bag seine catch rates showed consistent seasonal trends across river segments, demonstrating a gradual increase from fall through spring with the highest catches in river segment B (Figure 8). Seasonal trends of higher catches during fall and spring in both gill nets and hoop nets were also consistent across river segments (Figure 9 and 10). Overall, seasonal trends in catch rates varied among gears, but were consistent across river segments within each gear type.

Percent composition of organisms collected by each gear during the study indicated that all gears were represented by more than 8 species each comprising greater than 1% of the total catch. Twelve species each made up >1% for trawls with white shrimp, black drum, and Gulf menhaden comprising 66% of the total catch (Figure 11). Eight species each made up >1% for bag seines with 79% of the catch being comprised by Gulf menhaden, grass shrimp, and striped mullet (Figure 12). Gill nets had 13 species each comprising >1% with smallmouth buffalo and blue catfish representing 53% of the catch (Figure 13). Hoop nets had the largest number of species, 19, that each comprised >1% of the total catch (Figure 14). Red drum, alligator gar, and spotted gar comprised 62% of the hoop net total catch.

Species composition captured by each of the gears varied considerably among seasons. Trawl samples in the fall were comprised predominantly (76%) of white shrimp, Gulf menhaden, and black drum, whereas in the winter 88% of trawl-caught organisms were black drum, Atlantic croaker, or blue catfish. During spring, 68% of trawl catches were bay anchovy, brown shrimp, Atlantic croaker, and sand trout, and during summer, 88% of the catch consisted of blue catfish, white shrimp, and Gulf menhaden (Figure 15). Overall, trawl samples during spring and fall seasons displayed the greatest diversity of organisms. Bag seine samples in the fall were comprised of 71% white shrimp and sailfin molly, with winter catches shifting to grass shrimp, striped mullet, and Atlantic croaker (93% of total). During spring, 87% of organisms captured in seines were Gulf menhaden, striped mullet, and grass shrimp, while in the summer 47% were inland silverside, gizzard shad and striped mullet (Figure 16). Gill net catch composition also changed seasonally, but not as dramatically as observed in trawls and seines (Figure 17). Red drum and alligator gar were two species that were caught consistently in gill nets, regardless of season. Similarly, catfish, smallmouth buffalo, and to a lesser extent, red drum were captured in hoop net samples across seasons (Figure 18). The contribution of sharks and other fish species to hoop nets varied seasonally to a greater extent. Overall, the catch composition of gill nets and hoop nets was more consistent among seasons compared to trawl and seine catches.

3.2 Species richness, diversity, evenness, and similarity

Species richness, diversity, and evenness by river segment and gear are presented in Table 4. Overall, trawls and seines demonstrated greater species richness (44 total species versus 18-20 species in gill nets and hoop nets), however other diversity metrics were not considerably different among the sampling gears. A spatial comparison of diversity metrics for trawls indicated that river segment A had the highest species richness followed by segments B and C, further upriver. Species diversity in trawl catches varied moderately among the three river segments, with both the Simpson's and Shannon-Wiener Index indicating that segment B had slightly higher diversity than segments A and C. Evenness values were also slightly higher in segment B compared to segments A and C. Bag seine data indicated that segment A had the highest species richness followed by segment B and then segment C. Simpson's and Shannon-Wiener indices of diversity were each highest in segment A, followed by segment C and then segment B. Evenness values indicated that segment C had the most even distribution of species in the bag seine samples. The gill net data were more similar across river segments, but did indicate that segment A had the highest species richness, highest species diversity for both Simpson's Index and the Shannon-Wiener Index, and the highest evenness values. The hoop net data showed the least variability among river segments, indicating slightly higher diversity in segment B relative to the other segments.

Calculated values of the Jaccard coefficient of similarity comparing river segments across gear types suggested that good levels of similarity were present among faunal communities. Jaccard coefficients ranged between 0.35 and 0.71, with most values between 0.44-0.58 (Table 5). Bag seine samples were the most consistently similar across river segments, and hoop nets generally showed the lowest similarity among river segments.

3.3 Hydrological data

Hydrological data including water temperature, salinity, and dissolved oxygen collected for each gear and sample location are presented in Tables 6 thru 9. Surface water temperatures during the study ranged from a low of 11.6°C during the month of January to a high of 31.0°C during the month of August and bottom water temperatures ranged from 11.1°C during the month of January to a high of 30.8°C during the month of August. Average water temperatures during the study period were 23.3°C. Surface temperatures were an average of 0.4°C warmer than bottom temperatures throughout the study period, reflecting the general shallow depths in the system. Temporal trends in salinity demonstrated seasonal lows during winter and highs during spring (Figure 19). Surface salinities during the study ranged from a low of 0.2 ppt to a high of 8.0 ppt for all gears. Bottom salinities measured during trawling ranged from 0.2 to 22.0 ppt. There were no clear seasonal trends in DO (Figure 20). With the exception of some bottom DO measurements taken during trawling, all measurements were greater than 5.0 mg/l. Bottom DO readings were lowest in November and April.

Additional hydrological data were collected at each NMM from September 2007 through May 2008. Monthly temperature, salinity, and dissolved oxygen readings for surface, mid-water, and bottom depths are presented in Figures 21 thru 46. Salinity readings at the surface were fairly stable ranging from 0.0 ppt to about 7 ppt, with the highest salinities occurring downstream, below NMM 2, and the lowest occurring above NMM 8. Salinities at mid-water depths were the most variable of all three depths recorded. Bottom salinities were generally highest, ranging from 0.0 ppt to a high of 25 ppt, and declined toward upstream stations in nearly all months. Salinity levels in the river were highly dependent on both the influx of freshwater from upstream as well as on tidal exchange with Matagorda Bay. Figures 47 and 48 clearly illustrate the potential influence of river flows on both surface and bottom salinities. DO measurements ranged from 5 - 12 mg/l and were an average of 5.3 mg/l higher at the surface compared to bottom depths.

Temporal trends in river flow demonstrated a significant increase in flow beginning in late June and ending in early August due to a prolonged rainfall event that recorded more than 10 inches of rain during the month of June and 24 inches of rain during July. Mean flow rates reached a high of 15,590 cfs during the month of July, while the maximum flow rate recorded reached 37,900 cfs. Low flow rates, at or below 1000 cfs, were documented during the months of October thru December and then again from March thru May. Comparison of flow rates and catch rates for all four gears indicates an inverse relationship between flow rate and catch rate. Periods of high flow generally resulted in low catch rates that could be due to reduced gear efficiency or movement of fauna to low flow microhabitats. Relationships between catch rate and DO or salinity were variable and did not show any strong trends, however, bag seine catch rates did appear to show a slight positive trend with salinity.

3.4 Historic communities and comparison with current data

Overall species richness, diversity and evenness for the 1974 trawl data indicated a moderately diverse species community for the lower river during that period (Table 12). All three measures were slightly lower than current estimates, suggesting greater diversity in the present period. Data collected during 1974 examining specific segments also indicated a diverse species community for all three segments; however, species richness numbers for sampling areas T2 and T3 (segment B) and T4 (segment C) had much lower species richness compared to area T5 (segment A). The current data also showed higher species richness in segment A, but the difference was not as large. The 1983-84 trawl and seine data indicated overall lower species richness, diversity, and evenness relative to the present data. Species richness was in the mid-20's and the Simpson's diversity indices were each 0.66 or below during the 1983-84 sampling period. In contrast, the present data yielded species richness of 44 and Simpson's diversity indices above 0.80 for trawl and seine samples.

Using Jaccard coefficients of similarity, comparison of applicable months and gears from the 2007-08 data with samples collected during 1974 resulted in a value of 0.44 suggesting reasonable similarity between these two communities. Comparison of applicable months from the 2007-08 data to the 1983-84 samples resulted in a coefficient value of 0.19, suggesting a relatively low similarity for these communities. Comparison of data from river segment C in 2008 with 1974 and 1983-84 trawl data for a similar river segment resulted in values of 0.36 and 0.37, respectively, suggesting a moderate level of similarity between historical and present communities. Comparison of data for bag seine samples from applicable months during 2007-08 with 1983-84 seine data resulted in coefficient values of only 0.07 and 0.11, suggesting low similarity between historic and present day communities in shallow waters accessible to seines. When 2007-08 bag seine data for segment C was compared to 1983-84 data from the same segment, Jaccard coefficient values increased to 0.31 and 0.33, suggesting moderate community similarity. Overall, present data indicate a more diverse faunal community than that represented by historic data in the lower Colorado River.

4.0 Conclusions

The number and assortment of organisms collected during this aquatic assessment indicate that this portion of the lower Colorado River supports a diverse assemblage of fauna. The regular occurrence of both fresh and saltwater species, the range of macroinvertebrate and finfish fauna, and the sheer number of species captured among various sampling gears and river reaches provide evidence of a dynamic ecosystem. The trawl and bag seine sampling produced the richest species assemblages, with species richness more than double that observed for hoop net and gill net sampling. The difference in species richness values between the gears may be related to differences in gear size, mesh size, and their active versus passive capture techniques. Both the trawls and seines were large gears with small mesh sizes that actively swept expansive areas of bottom habitat. Another factor that may have influenced the catch rates of the hoop nets and gill nets was the depth and contour of the river where these gears were being used. The gill nets were 33.3 m long, but only 1.2 m deep, while the hoop nets were 18.3 m long and only 1.8 m deep. The bathymetry along the shoreline in many areas results in depths exceeding 3 m within a short distance (10-12m) from shore. Therefore, hoop nets and gill nets were not likely fishing the entire vertical component of the water column allowing fish moving along the shoreline to potentially swim either over or under the nets depending on how they were set. Although catch rates in our passive gears were lower, the catches were distributed relatively evenly among species with multiple species each contributing greater than 1% of the catch, indicating that the majority of the larger bodied fauna were detected by our sampling. Both our trawl and seine sampling detected a rich faunal assemblage utilizing benthic habitats in shallow and deeper parts of the river. These active gears, particularly the seines, were designed to characterize the juvenile life stages of many of the invertebrate and fish species present in the system. An important point to make is that species captured in the seine are typically within the size range of organisms that are most commonly impacted by impingement. Therefore, the seine data collected as part of this study should provide an appropriate resource for evaluating potential impacts associated with the STPNOC facilities, particularly the RMPF.

In most instances, percent species composition was dominated (>60%) by three to four species for each of the sampling gears. Dominant faunal species included Gulf menhaden, blue catfish, red drum, white shrimp, black drum, grass shrimp, striped mullet, gafftopsail catfish, smallmouth buffalo, alligator gar, and spotted gar, and were dependent on gear type. Catfish, gar, and drum species tended to dominate the gill net and hoop net catches, whereas Gulf menhaden, shrimp, mullet species were prevalent in the trawl and seine catches. Despite the fact that most catches were dominated by a few species, a large number of species contributed (> 1%) to the overall faunal composition for each of the gears, an indication that the gears were not overly selective for particular species. Interestingly, despite demonstrating overall lower species richness, more species contributed at the 1% level to the composition of hoop net and gill net catches compared to trawl and seine samples.

Seasonal variation in catch rates and composition were evident for each of the sampling gears. Trawl catches peaked in the fall, seine catches peaked in the spring, and hoop net and gill net catches were higher during both fall and spring. Species composition also varied among seasons, especially for trawl and seine samples, which changed considerably among the four seasonal periods. Gill net and hoop net catch compositions were more consistent across seasons. Seasonal variation within ecological communities is common and can be attributed to a number of abiotic and biotic factors. Abiotic factors include changing environmental conditions, most importantly water temperature, salinity, and dissolved oxygen concentrations within a water body. Biotic factors include behaviorally mediated diel and seasonal migrations, as well as changing predator and prey distributions. All of these factors contribute to determining community structure and the seasonal changes that are typically observed. We measured several potentially important abiotic factors during the course of this study. Water temperature ranged between about 11-30°C throughout the year, and salinity ranged from zero to a high of 22ppt near the bottom at sites closest to the ICWW. Based on the temperature control of physiological rates and the effect of salinity on osmoregulatory costs, much of the seasonal variation in faunal catch rates and composition is often attributed to these environmental factors. Dissolved oxygen levels were mostly above levels (5 mg/l) considered hypoxic to fishes, but did drop below those levels in some of the deeper habitats. The appearance of hypoxic zones in deeper habitats during warmer months when the system may be highly stratified could constrain organisms into the shallow habitats toward the river banks, at least during some parts of the day. Downstream flow rates in the river had a demonstrated effect on salinity throughout the water column. Seasonal changes in flow rate could cause some organisms to relocate to avoid high flows or lower salinity water. Periods of high flow generally resulted in low catch rates. It is important to note that sampling during low flow periods does not necessarily reflect the conditions when make-up water is pumped to the reservoir. Therefore, species represented during low flow periods may not reflect those that would be present at the RMPF during high flow periods when the pumps are operating.

The variance of species richness and diversity within the lower Colorado River also had a spatial component. River segment A, which was closest to the ICWW and had the highest salinities, had the highest value of species richness for both the trawl and bag seine samples. Bag seine diversity, based on the Simpson's and Shannon-Wiener indices, was also higher in the river reach closest to the ICWW, while the trawl samples were more diverse in the middle river reach. Gill net samples demonstrated a similar pattern, with higher species richness, diversity, and evenness in the lowest reach sampled. By and large, faunal diversity decreased with greater distance from the ICWW. The observed pattern is most likely due to the large diversity of species associated with the Matagorda Bay ecosystem that continuously immigrate into and emigrate from the lower Colorado River with tidal flushing. The extent of this movement is limited by the upstream location of the salt front at any given time. The moderate to high values of the Jaccard coefficients of similarity that we calculated for the three river segments by gear type suggest that the faunal communities sampled during this study were relatively similar in space. Much of the non-similarity among gear types could be attributed to differences in gear selectivity, efficiency, and the microhabitats (e.g., depth) sampled.

There was a moderate level of similarity between the current 2007-08 faunal communities and the historic communities (1974 and 1983-84). Generally, when samples collected in the same river segments were compared, the data indicated greater similarity between the current and historic communities. Overall, the current faunal communities demonstrate greater species richness and diversity relative to the historic communities. There are several possible reasons for the observed differences in species richness and diversity between current and historic faunal communities. First, sampling gears and protocols may not be identical, resulting in potential biases in catch rates and gear efficiency. Second, the sampling completed for this study was completed over a more extensive spatial area and with greater temporal frequency than historical data collections. Sampling across three river segments each month using four different sampling gears may have allowed us to more fully characterize the faunal community in the current time period. Reduced sampling effort and spatial extent may have contributed to the lower richness and diversity during the historical sampling period. Lastly, the faunal community may simply have changed during the past two decades, particularly given changes in the bottom topography and channelization that have occurred in that time. The fact that the faunal community has become richer and more diverse in the past twenty-five years supports the contention that STPNOC facilities are having minimal negative impact, at least on the population dynamic of aquatic organisms. Based on the moderate levels of similarity between historical and current faunal communities and the increase in species richness and diversity observed at present, it is reasonable to conclude that the current data should provide a sufficient framework for evaluating the potential for any new impacts resulting from the operation of additional facilities in the lower Colorado River.

REFERENCES

Alder, H. L. and E. B. Roessler. 1977. Introduction to Probability and Statistics. W.H. Freeman and Company. QA273.A43

Chilton, Earl. W., Inland Fisheries Division. 1997. *Freshwater Fishes of Texas*. Texas Parks and Wildlife Press. Austin Texas.

Hoese, H.D. and R.H. Moore. 1977. Fishes of the Gulf of Mexico: Texas, Louisiana, and Adjacent Waters. First Edition. Texas A&M University Press, College Station, Texas

Houston Lighting and Power Company, South Texas Project, Units 1 and 2, Environmental Report, U.S. AEC Docket Nos. 50-498 and 50-499, 1974, as amended.

Kohler, C. C. and W. A. Hubert, editors. 1993. Inland Fisheries Management in North America. American Fisheries Society, Bethesda, Maryland

Krebs, C.J. 1989. Ecological Methodology. Harper and Row, Publishers. New York. 654p

McAden, D.C., G.N. Greene, and W.B. Baker Jr. 1984. Report #1: Colorado River Entrainment and Impingement Monitoring Program Phase II Studies July 1983 – June 1984. Submitted by, Ecology Division, Environmental Protection Department, Houston Lighting and Power.

McAden, D.C., G.N. Greene, and W.B. Baker Jr. 1985. Report #2: Colorado River Entrainment and Impingement Monitoring Program Phase II Studies July – December 1984. Submitted by, Ecology Division, Environmental Protection Department, Houston Lighting and Power.

Nielsen, L. A. and D. L. Johnson, editors. 1983. Fisheries Techniques. American Fisheries Society, Bethesda, Maryland.

Wilber, D.H. and R. Bass.1998. Effect of the Colorado River Diversion on Matagorda Bay Epifauna. Estuarine, Coastal and Shelf Science. 47, 309-318. Article No. ec980356.

TABLES

Table 1. Latitude and Longitude Coordinates for Samples Lower Colorado River 2007 to 2008

Location	Latitude	Longitude
Trawl	29 41 04.1	95 58 35.2
Segment 1	28 41 21.0	95 58 35.4
	28 40 59.3	95 58 36.8
	28 41 20.7	95 58 36.4
	28 41 57.7	95 58 35.1
	28 41 50.2	95 58 37.5
	28 41 54.0	95 58 81.6
	28 41 30.8	95 58 46.7
	28 41 31.7	95 58 48.0
	28 41 65.0	95 58 81.5
	28 42 25.0	95 58 38.3
	28 42 07.1	95 58 35.1
	28 43 00.1	95 58 34.6
	28 42 27.9	95 58 39.1
	28 43 02.2	95 58 31.7
	28 43 06.1	95 58 25.5
	28 42 45.7	95 58 85.0
	28 43 42.9	95 58 97.7
	28 42 54.8	95 58 36.0
	28 43 05.2	95 58 55.2
	28 41 31.6	95 58 48.2
	28 42 46.0	95 58 33.5
Trawl		
Segment 2	28 43 28.4	95 58 19.0
	28 43 30.4	95 58 18.9
	28 43 58.4	95 58 16.7
	28 44 06.0	95 58 19.8
	28 44 11.7	95 58 20.6
	28 44 01.1	95 58 18.2
	28 44 01.0	95 58 30.5
	28 43 43.5	95 58 16.5
	28 44 04.5	95 58 18.6
	28 44 37.4	95 58 52.9
	28 44 26.0	95 58 42.5
	28 44 28.8	95 59 32.0
	28 44 27.6	45 59 31.6
	28 44 26.9	95 59 19.2
	28 44 32.4	95 59 41.6
	28 44 26.3	95 59 15.7
	28 44 46.2	95 58 12.3
	28 44 26.3	95 59 21.1
	28 44 26.2	95 56 16.0
	28 44 43.5	95 59 25.5
	28 44 07.1	95 58 19.3
	28 44 42.7	95 59 58.1

Table 1. continued

Location	Latitude	Longitude
Trawl		
Segment 3	28 46 35.2	95 59 42.6
	28 46.22.4	95 59 55.7
	28 45 59.6	96 00 10.0
	28 46 30.1	95 59 48.1
	28 46 23.8	95 59 53.5
	28 45 51.5	96 00 08.5
	28 45 19.2	96 00 11.1
	28 42 54.9	95 58 34.3
	28 45 28.9	95 59 54.1
	28 45 57.8	96 59 99.8
	28 46 56.1	95 59 24.1
	28 47 12.3	95 59 39.3
	28 47 18.4	95 59 45.4
	28 47 12.4	95 59 39.6
	28 46 55.1	95 59 26.6
	28 46 57.2	95 59 25.3
	28 47 18.2	95 59 60.2
	28 46 57.9	95 59 24.5
	28 46 55.9	95 59 25.4
	28 47 02.9	95 59 41.2
	28 45 29.2	95 59 55.0
	28 46 35.3	95 59 43.5
Bag Seine		
Segment 1	28 42 59.7	95 58 37.9
	28 42 58.8	95 58 38.1
	28 41 38.9	95 58 48.9
	28 42 58.3	95 58 37.9
	28 41 38.3	95 58 49.0
	28 41 38.0	95 58 49.4
	28 41 54.0	95 58 81.6
	28 41 65.2	95 58 81.1
	28 41 39.0	95 58 48.6
	28 41 65.0	95 58 81.5
	28 42 59.0	95 58 37.8
	28 43 02.2	95 58 34.3
	28 42 58.2	95 58 37.7
	28 43 02.9	95 58 58.1
	28 42 97.7	95 58 63.4
	28 42 58.7	95 58 38.0
	28 42 94.3	95 58 63.7
	28 41 39.2	95 58 48.6
	28 43 06.4	95 58 27.7

Table 1. continued

Location	Latitude	Longitude
Bag Seine		
Segment 2	28 44 58.0	95 59 58.6
	28 43 08.8	95 58 19.3
	28 44 28.4	95 58 23.7
	28 43 44.8	95 58 19.0
	28 44 27.9	95 59 24.1
	28 44 52.2	95 58 95.2
	28 44 47.3	95 58 41.5
	28 44 29.5	95 59 05.6
	28 43 71.1	95 58 32.2
	28 44 31.3	95 58 55.7
	28 44 31.4	95 58 55.4
	28 44 41.5	95 59 55.0
	28 44 46.8	95 59 39.4
	28 44 02.3	95 58 20.7
	28 44 31.4	95 58 53.1
	28 44 52.6	95 58 89:1
	28 44 31.4	95 58 55.7
	28 44 28.1	95 59 23.2
Bag Seine		
Segment 3	28 45 55.7	96 00 67.6
	28 44 28.4	95 59 23.7
	28 45 56.4	96 00 07.5
	28 45 33.1	95 59 56.6
	28 45 33.1	95 59 56.6
	28 45 55.1	95 59 93.9
	28 45 32.7	95 59 56.4
	28 45 32.8	95 59 56.9
	28 45 25.3	95 59 88.4
	28 45 56.8	96 00 07.8
	28 46 02.0	96 00 07.0
	28 45 57.6	96 00 07.6
	28 46 00.2	96 00 08.0
	28 46 00.9	96 00 08.1
	28 46 01.2	96 00 13.0
	28 46 01.0	96 00 13.2
	28 45 33.0	95 59 56.3
	28 46 00.7	96 00 08.0

Table 1. continued

Location	Latitute	Longitude
Gill Net		
Segment 1	28 42 42.6	95 58 35.0
	28 42 40.6	95 58 35.7
	28 42 41.4	95 58 35.5
	28 41 38.6	95 58 48.4
	28 43 00.3	95 58 36.2
	28 42 57.1	95 58 37.4
	28 41 69.9	95 58 76.3
	28 42 56.8	95 58 34.2
	28 42 52.0	95 58 35.1
	28 42 87.5	95 58 56.3
	28 41 29.5	95 58 44.8
Gill Net		
Segment 2	28 44 20.7	95 58 33.5
	28 44 28.8	95 59 18.1
	28 44 26.7	95 58 47.8
	28 44 27.1	95 58 42.5
	28 44 28.7	95 58 53.6
	28 44 28.1	95 58 49.2
	28 44 45.8	95 58 78.6
	28 44 28.3	95 59 01.1
	28 44 31.4	95 58 55.4
	28 44 38.9	95 58 63.9
	28 44 27.3	95 58 45.7
Gill Net		
Segment 3	28 46 48.0	95 59 34.6
	28 46 20.9	95 59 59.5
	28 46 19.7	96 00 01.0
	28 46 44.7	95 59 34.3
	28 46 23.9	95 59 55.0
	28 46 18.9	96 00 00.0
	28 46 33.8	95 59 99.9
	28 46 21.1	96 00 00.0
	28 46 19.6	96 00 00.0
	28 46 31.0	96 00 00.8
	28 46 20.4	96 00 00.0

Table 1. continued

Location	Latitute	Longitude
Hoop Net		
Segment 1	28 41 01.1	95 58 33.2
	28 42 27.5	95 58 37.3
	28 42 51.5	95 58 32.6
	28 41 21.7	95 58 34.0
	28 42 41.8	95 59 35.1
	28 42 45.1	95 58 50.7
	28 41 39.9	95 58 59.9
	28 42 58.8	95 59 38.1
	28 42 30.8	95 58 37.4
	28 43 04.1	95 58 57.0
	28 41 25.3	95 58 37.7
Hoop Net		
Segment 2	28 44 28.1	95 58 56.3
	28 44 31.2	95 58 57.4
	28 44 31.5	95 58 56.8
	28 44 27.6	95 58 51.5
	28 44 29.9	95 59 04.5
	28 44 30.3	95 59 02.2
	28 44 52.2	95 58 95.2
	28 44 30.8	95 59 58.2
	28 44 27.2	95 58 49.4
	28 44 44.2	95 58 78.4
	28 44 27.6	95 58 51.1
Hoop Net		
Segment 3	28 46 44.5	95 59 33.1
	28 45 59.8	96 00 07.8
	28 47 01.5	95 59 26.7
	28 46 52.5	95 59 30.0
	28 46 28.8	95 59 49.2
	28 46 27.2	95 59 49.8
	28 46 40.8	95 59 92.4
	28 46 24.0	95 59 55.3
	28 46 25.3	95 59 53.9
	29 46 39.7	95 59 92.5
	28 46 24.1	95 59 55.4

Table 2: Cumulative Catch by Gear for the lower Colorado River Study 2008.

Common Name	Scientific Name	Sampling Gear Utilized: Bag Seine	Gill Net	Hoop Net	Trawl	Total
Finfish						
Alligator Gar	*Lepisosteus spatula*	2	2	13		17
Atlantic Croaker	*Micropogonias undulatus*	562	1		482	1045
Atlantic Cutlassfish	*Trichiurus lepturus*				6	6
Atlantic Threadfin	*Polydactylus octonemus*				6	6
Bay Anchovy	*Anchoa mitchilli*	24			264	288
Bay Whiff	*Citharichthys spilopterus*	15			2	17
Bayou Killifish	*Fundulus pulvereus*	3				3
Black Drum	*Pogonias cromis*	1	1	1	1360	1363
Blue Catfish	*Ictalurus furcatus*	51	22	3	677	753
Bluegill	*Lepomis macrochirus*	3				3
Bull Shark	*Carcharhinus leucas*		6			6
Channel Catfish	*Ictalurus punctatus*	22		2	6	30
Cichlid	*Lethrinops brevis*				16	16
Crevalle Jack	*Caranx hippos*	2				2
Cyprinid Spp.	*Cyprinid spp.*	1				1
Diamond Killifish	*Adinia xenica*	11				11
Flathead Catfish	*Polydictis olivaris*			2		2
Freshwater Goby	*Ctenogobius shufeldti*	9				9
Gafftopsail Catfish	*Bagre marinus*		9		183	192
Gizzard Shad	*Dorosoma cepedianum*	8		2	52	62
Grass Carp	*Ctenopharyngodon idella*		2	1		3
Gulf Killifish	*Fundulus grandis*	20				20
Gulf Menhaden	*Brevoortia patronus*	2960	5	2	1076	4043
Hardhead Catfish	*Ariopsis felis*		1	1	252	254
Inland Silverside	*Menidia beryllina*	6				6
Ladyfish	*Elops saurus*		2		1	3
Lined Sole	*Achirus lineatus*				3	3
Longnose Gar	*Lepisosteus osseus*			1		1
Mangrove Snapper	*Lutjanus griseus*				1	1
Mosquitofish	*Gambusia affinis*	1				1
Naked Goby	*Gobiosoma bosci*	3				3
Pigfish	*Orthopristis chrysoptera*				1	1
Pinfish	*Lagodon rhomboides*				11	11
Rainwater Killifish	*Lucania parva*	2				2
Red Drum	*Sciaenops ocellatus*	8	8	38	25	79
Rough Silverside	*Membras martinica*	17				17
Sailfin Molly	*Poecilia latipinna*	150				150
Sand Trout	*Cynoscion arenarius*	22	5		294	321
Sharptail Goby	*Oligolepis acutipennis*	39				39
Sheepshead	*Archosargus probatocephalus*	14	1	6	48	69
Sheepshead Minnow	*Cyprinodon variegatus*	79			7	86
Shiner	*Shiner Spp.*	2				2
Silver Jenny	*Eucinostomus gula*				2	2
Silver Perch	*Bairdiella chrysoura*				350	350
Smallmouth Buffalo	*Ictiobus bubalus*		32	5		37
Southern Flounder	*Paralichthys lethostigma*	2	2	3	12	19
Southern Stingray	*Dasyatis americana*				1	1
Spadefish	*Chaetodipterus faber*			4		4
Speckled Trout	*Cynoscion nebulosus*		4		53	57
Spot croaker	*Leiostomus xanthurus*	88		1	156	245
Spotfin mojarra	*Eucinostomus argenteus*	3			5	8
Spotted Gar	*Lepisosteus oculatus*	1	1	10	1	13
Star Drum	*Stellifer lanceolatus*				86	86
Striped Mullet	*Mugil cephalus*	1671		1	1	1673
Threadfin Shad	*Dorosoma petenense*	3			7	10
Tonguefish	*Symphurus plaguisa*				3	
Violet Goby	*Gobioides broussonnetii*	1				1
White Mullet	*Mugil curema*	180			2	182

Table 2 continued.

Common Name	Scientific Name	Sampling Gear Utilized Bag Seine	Gill Net	Hoop Net	Trawl	Total
Invertebrates						
Atlantic Brief squid	*Lolliguncula brevis*	1			30	31
Blue Crab	*Callinectes sapidus*	189	2	3	77	216
Brown Shrimp	*Farfantepenaeus aztecus*	264			192	272
Crawfish	*Procamburus spp.*				1	1
Grass Shrimp	*Palaemonetes pugio*	1762				1763
Lesser Blue Crab	*Callinectes similis*	1			5	3
Mud Crab	*Rhithropanopeus harrisii*				1	
River Shrimp	*Macrobrachium ohione*	10			5	15
Roughback Shrimp	*Trachypenaeus similis*					1
Seabob	*Xiphopenaeus kroyeri*				127	
White Shrimp	*Litopenaeus setiferus*	584			2870	3454
	Total	8797	106	99	8760	**17762**

Table 3. Abundance and distribution of species collected in three reaches of the lower Colorado River, 2007-2008.

Common Name	Scientific Name	Segment A	Segment B	Segment C	Total
Alligator Gar	*Atractosteus spatula*	4	7	6	17
Atlantic Croaker	*Micropogonias undulatus*	559	287	199	1045
Atlantic Cutlassfish	*Trichiurus lepturus*	2	3	1	6
Atlantic Threadfin	*Polydactylus octonemus*	6	0	0	6
Bay Anchovy	*Anchoa mitchilli*	135	119	34	288
Bay Whiff	*Citharichthys spilopterus*	11	6	0	17
Bayou killifish	*Fundulus pulvereus*	1	1	1	3
Black Drum	*Pogonias cromis*	662	632	69	1363
Blue Catfish	*Ictalurus furcatus*	39	180	534	753
Blue Crab	*Callinectus sapidus*	136	48	85	269
Bluegill	*Lepomis machrochirus*	1	2	0	3
Brown Shrimp	*Penaeus aztecus*	236	119	101	456
Bull Shark	*Carcharhinus leucas*	5	1	0	6
Channel Catfish	*Ictalurus punctatus*	2	11	17	30
Cichlid	*Lethrinops brevis*	16	0	0	16
Crawfish	*Procamburus spp.*	1	0	0	1
Crevalle Jack	*Caranx hippos*	1	0	1	2
Cyprinid Spp.	*Cyprinid spp.*	1	0	0	1
Diamond killifish	*Adinia xenica*	5	3	3	11
Flathead Catfish	*Polydictis olivaris*	0	0	2	2
Freshwater Goby	*Ctenogobius shufeldti*	7	2	0	9
Gafftop Catfish	*Bagre marinus*	148	24	20	192
Gizzard Shad	*Dorosoma cepedianum*	21	14	27	62
Grass carp	*Ctenopharyngodon idella*	1	1	1	3
Grass Shrimp	*Palaemonetes pugio*	385	1211	166	1762
Gulf Killifish	*Fundulus grandis*	1	16	3	20
Hardhead Catfish	*Ariopis felis*	182	61	11	254
Inland Silverside	*Menidia beryllina*	3	1	2	6
Ladyfish	*Elops saurus*	0	1	0	1
Ladyfish	*Elops lacerta*	1	1	0	2
Lesser Blue Crab	*Callinectes similis*	6	2	0	8
Lined Sole	*Achirus lineatus*	1	2	0	3
Longnose Gar	*Lepisosteus osseus*	0	0	1	1
Mangrove Snapper	*Lutjanus griseus*	1	0	0	1
Menhaden	*Brevoortia patronus*	452	2665	926	4043
Mosquitofish	*Gambusia affinis*	0	1	0	1
Mud Crab	*Rhithropanopeus harrisii*	1	0	0	1
Naked Goby	*Gobiosoma bosci*	3	0	0	3
Pigfish	*Orthopristis chrysoptera*	0	1	0	1
Pinfish	*Lagodon rhomboides*	11	0	0	11
Rainwater killifish	*Lucania parva*	1	1	0	2
Red Drum	*Sciaenops ocellatus*	26	25	28	79
Red Eared Slider	*Trachemys scripta elegans*	0	1	0	1
River Shrimp	*Macrobrachium ohione*	1	11	3	15
Sailfin Molly	*Poecilia latipinna*	32	110	8	150
Sand Trout	*Cynoscion arenarius*	245	46	30	321

Table 3. Continued.

Common Name	Scientific Name	Segment A	Segment B	Segment C	Total
Seabob	*Xiphopenaeus kroyeri*	24	5	98	127
Sharptail Goby	*Oligolepis acutipennis*	19	15	5	39
Sheepshead	*Archosargus probatocephalus*	13	45	11	69
Sheepshead Minnow	*Cyprinodon variegatus*	36	0	13	49
Shiner	*Shiner spp.*	0	2	0	2
Silver Jenny	*Eucinostomus gula*	0	1	1	2
Silver perch	*Bairdiella chrysoura*	330	8	12	350
Silverside	*Membras martinica*	17	0	0	17
Smallmouth Buffalo	*Ictiobus bubalus*	5	17	15	37
Southern flounder	*Paralichthys lethostigma*	14	3	2	19
Southern Stingray	*Dasyatis americana*	1	0	0	1
Spadefish	*Chaetodipterus faber*	2	1	0	3
Speckled Trout	*Cynoscion nebulosus*	48	45	1	94
Spot	*Leiostomus xanthurus*	150	64	31	245
Spotfin mojarra	*Eucinostomus argenteus*	7	1	0	8
Spotted Gar	*Lepisosteus oculatus*	2	6	5	13
Squid	*Lolliguncula brevis*	21	9	1	31
Star Drum	*Stellifer lanceolatus*	86	0	0	86
Striped Mullet	*Mugil cephalus*	795	343	535	1673
Threadfin Shad	*Dorosoma petenense*	2	2	6	10
Tonguefish	*Symphurus plagiusa*	3	0	0	3
Violet Goby	*Gobioides broussonnetii*	1	0	0	1
White Mullet	*Mugil curema*	138	32	12	182
White Shrimp	*Penaeus setiferus*	2768	513	173	3454
		7834	6728	3200	17762

Table 4. Species richness and species diversity values calculated for data collected from various sampling gears in three reaches of the lower Colorado River, 2007-2008.

Trawls		Segment A	Segment B	Segment C	Overall
Species Richness	S	37	29	24	44
Simpson's Index	D	0.25	0.18	0.24	0.16
Index Diversity	1-D	0.75	0.82	0.76	0.84
Reciprocal Index	1/D	3.99	5.66	4.18	6.18
Shannon-Wiener	H	2.04	2.13	1.90	2.32
Evenness	E	0.56	0.63	0.60	0.61

Seines		Segment A	Segment B	Segment C	Overall
Species Richness	S	38	35	22	44
Simpson's Index	D	0.16	0.33	0.21	0.20
Index Diversity	1-D	0.84	0.67	0.79	0.80
Reciprocal Index	1/D	6.34	3.02	4.77	4.99
Shannon-Wiener	H	2.21	1.57	1.95	2.00
Evenness	E	0.61	0.44	0.63	0.53

Hoop Nets		Segment A	Segment B	Segment C	Overall
Species Richness	S	11	12	12	20
Simpson's Index	D	0.24	0.15	0.22	0.19
Index Diversity	1-D	0.76	0.85	0.78	0.81
Reciprocal Index	1/D	4.18	13.43	4.52	5.35
Shannon-Wiener	H	1.89	2.15	1.97	2.25
Evenness	E	0.79	0.87	0.79	0.75

Gill Nets		Segment A	Segment B	Segment C	Overall
Species Richness	S	14	12	9	18
Simpson's Index	D	0.12	0.22	0.25	0.16
Index Diversity	1-D	0.88	0.78	0.75	0.84
Reciprocal Index	1/D	8.62	4.49	3.98	6.31
Shannon-Wiener	H	2.36	1.91	1.73	2.26
Evenness	E	0.89	0.77	0.79	0.78

Table 5. Jaccard coefficients of similarity between reaches of the lower Colorado River calculated for data collected from various sampling gears, 2007-2008.

Gear Utilized	**Segment Sampled**		
	Segment A vs Segment B	Segment A vs Segment C	Segment B vs Segment C
Trawl	0.53	0.45	0.71
Bag Seine	0.66	0.55	0.58
Hoop Net	0.35	0.44	0.41
Gill Net	0.53	0.44	0.40

Table 6. Hydrological data collected during trawl sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Surface Water Temp. (°C)	Bottom Water Temp. (°C)	Surface Salinity (ppt)	Bottom Salinity (ppt)	Surface Oxygen (mg/l)	Bottom Oxygen (mg/l)
6/11/2007	1037	A	1	29.6	29.7	29.3	0.5	0.3	7.6	7.5
6/11/2007	1108	A	2	29.8	29.6	29.2	0.2	0.4	7.8	7.8
6/11/2007	1152	B	3	30.4	29.9	29.2	0.2	0.2	7.6	7.9
6/11/2007	1222	B	4	30.4	29.4	29.0	0.2	0.2	7.8	7.4
6/11/2007	1353	C	5	35.8	30.6	29.9	0.2	0.2	6.9	7.6
6/11/2007	**	C	6							
8/28/2007	1316	A	1	28.2	30.7	30.6	0.2	0.3	7.1	6.6
8/28/2007	1415	A	2	31.2	30.7	30.5	0.2	0.2	6.9	6.6
8/28/2007	1445	B	3	30.8	30.6	30.5	0.2	0.2	6.7	6.6
8/28/2007	1517	B	4	32.4	31.0	30.8	0.2	0.2	6.8	6.7
8/28/2007	1549	C	5	32.5	30.8	30.8	0.2	0.2	6.8	6.8
8/28/2007	1642	C	6	31.1	30.9	30.8	0.2	0.2	6.9	6.8
9/26/2007	1314	A	1	32.1	29.7	29.5	0.9	12.6	6.4	5.3
9/26/2007	1411	A	2	30.3	29.1	29.4	0.3	14.4	6.7	3.4
9/26/2007	1435	B	3	28.9	29.1	28.9	0.2	8.4	6.7	3.9
9/26/2007	1505	B	4	28.1	29.4	28.6	0.2	0.2	7.4	6.7
9/26/2007	1608	C	5	30.5	29.6	28.8	0.2	0.2	7.5	7.5
9/26/2007	1653	C	6	28.9	29.1	28.6	0.2	0.2	7.3	6.5
10/31/2007	855	A	1	18.2	19.4	20.4	2.9	22.4	9.2	6.3
10/31/2007	1029	A	2	21.2	19.9	20.8	2.3	20.8	10.3	0.1
10/31/2007	1518	B	3	22.3	21.1	20.7	1.4	21.6	15.9	4.0
10/31/2007	1449	B	4	24.2	20.1	20.5	1.2	20.4	11.1	3.9
10/31/2007	1259	C	5	23.3	25.2	19.8	2.4	0.8	18.1	11.3
10/31/2007	1212	C	6	25.3	19.6	21.0	0.5	13.0	10.1	0.8

Table 6. Hydrological data collected during trawl sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Surface Water Temp. (°C)	Bottom Water Temp. (°C)	Surface Salinity (ppt)	Bottom Salinity (ppt)	Surface Oxygen (mg/l)	Bottom Oxygen (mg/l)
11/14/2007	1246	A	1	19.2	22.1	23.3	4.2	19.1	5.2	1.9
11/14/2007	1214	A	2	16.6	22.1	23.6	3.9	17.5	4.8	3.9
11/14/2007	1138	B	3	15.2	21.9	22.6	2.2	17.6	3.8	0.9
11/14/2007	1108	B	4	14.8	22.1	22.4	1.9	4.2	4.4	2.7
11/14/2007	1253	C	5	22.4	22.9	22.8	1.3	17.4	5.7	0.0
11/14/2007	907	C	6	15.1	22.2	22.8	1.2	11.4	4.8	0.0
12/12/2007	1116	A	1	12.6	20.0	20.9	2.9	21.1	9.8	6.3
12/12/2007	1054	A	2	13.0	19.5	21.2	2.9	20.1	9.9	4.8
12/12/2007	1027	B	3	11.8	19.7	21.2	2.5	17.3	9.4	5.0
12/12/2007	1006	B	4	13.1	19.6	20.6	1.8	15.9	9.5	3.6
12/12/2007	943	C	5	11.5	19.5	19.4	1.5	18.9	9.0	2.9
12/12/2007	922	C	6	11.0	19.5	18.4	1.0	18.3	8.4	1.6
1/24/2008	**	A	1							
1/24/2008	1132	A	2	8.9	12.3	12.3	1.1	19.0	9.9	0.3
1/24/2008	1101	B	3	9.0	12.7	11.1	0.7	19.5	10.0	7.7
1/24/2008	1036	B	4	8.2	12.8	11.6	0.6	14.0	9.9	9.9
1/24/2008	953	C	5	8.5	12.8	12.3	0.2	0.3	10.4	9.7
1/24/2008	928	C	6	7.4	12.9	13.1	0.2	0.2	10.2	9.9
2/21/2008	1058	A	1	19.9	17.3	17.0	1.0*	18.0*	9.8	8.3
2/21/2008	1128	A	2	20.8	17.2	17.0	1.0*	18.0*	10.3	10.0
2/21/2008	1022	B	3	19.6	17.3	17.2	0.8*	8.0*	10.0	9.8
2/21/2008	1004	B	4	19.8	17.2	17.2	0.8*	8.0*	10.1	9.2
2/21/2008	1040	C	5	20.2	17.4	17.4	0.8*	0.5*	9.9	2.5
2/21/2008	908	C	6	20.5	16.9	17.0	0.8*	0.5*	10.5	9.5

Table 6. Hydrological data collected during trawl sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Surface Water Temp. (°C)	Bottom Water Temp. (°C)	Surface Salinity (ppt)	Bottom Salinity (ppt)	Surface Oxygen (mg/l)	Bottom Oxygen (mg/l)
3/19/2008	1607	A	1	20.6	21.7	20.6	**	**	8.3	5.3
3/19/2008	1638	A	2	20.7	21.7	21.2	**	**	8.4	5.0
3/19/2008	1701	B	3	19.8	21.8	20.9	**	**	9.1	5.0
3/20/2008	1237	B	4	17.7	21.0	20.8	**	**	8.5	4.8
3/20/2008	1204	C	5	18.6	22.4	21.4	**	**	9.0	8.3
3/20/2008	1116	C	6	17.2	21.3	20.7	**	**	8.3	5.1
4/9/2008	1502	A	1	26.5	25.5	23.7	4.8	21.9	10.3	3.6
4/9/2008	1534	A	2	26.5	26.4	23.2	4.1	22.4	10.1	3.4
4/9/2008	1602	B	3	25.1	25.6		2.8	19.7	8.9	3.8
4/9/2008	1726	B	4	25.6	25.6	23.6	2.7	21.1	9.0	3.2
4/9/2008	1755	C	5	24.0	24.9	23.5	1.8	13.1	8.2	1.9
4/9/2008	1821	C	6	23.7	24.6	23.5	1.2	11.2	7.5	2.9
5/12/2008	1600	A	1	24.4	26.8	26.4	8.2	23.0	10.1	4.1
5/12/2008	1655	A	2	24.4	27.1	26.5	6.7	22.0	11.1	4.3
5/12/2008	1724	B	3	24.7	26.8	26.9	6.2	22.2	9.3	3.2
5/12/2008	1750	B	4	24.6	26.4	26.6	5.3	20.7	9.4	2.9
5/12/2008	1814	C	5	24.2	26.4	26.0	4.1	18.8	9.9	2.0
5/12/2008	1835	C	6	23.9	26.5	25.1	3.5	19.3	10.1	1.5

* Salinity readings were calculated from a percentage reading collected using a different water quality meter.
** Salinity readings could not be calculated from percentage readings from different water quality meter.

Table 7. Hydrological data collected during bag seine sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Water Temp. (°C)	Salinity (ppt)	Oxygen (mg/l)
6/11/2007	1136	A	1	32.7	30.1	0.2	6.5
6/11/2007	*	A	2				
6/11/2007	1247	B	3	30.8	29.9	0.2	6.5
6/11/2007	*	B	4				
6/11/2007	*	C	5				
6/11/2007	*	C	6				
8/28/2007	1808	A	1	29.3	30.6	0.2	6.3
8/28/2007	*	A	2				
8/28/2007	1755	B	3	29.4	30.7	0.2	5.9
8/28/2007	1731	B	4	30.8	31.0	0.2	5.9
8/28/2007	1710	C	5	30.0	30.9	0.2	6.3
8/28/2007	*	C	6				
9/26/2007	1345	A	1	29.1	30.2	0.8	6.4
9/26/2007	1400	A	2	29.6	29.4	0.4	6.5
9/26/2007	1530	B	3	28.3	29.5	0.2	6.9
9/26/2007	*	B	4				
9/26/2007	1545	C	5	29.7	29.4	0.2	7.2
9/26/2007	1555	C	6	29.5	29.9	0.2	7.6
10/30/2007	1614	A	1	22.4	21.8	1.7	12.9
10/30/2007	*	A	2				
10/30/2007	*	B	3				
10/30/2007	*	B	4				
10/30/2007	1347	C	5	24.9	20.6	1.3	10.6
10/30/2007	*	C	6				

Table 7. Hydrological data collected during bag seine sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Water Temp. (°C)	Salinity (ppt)	Oxygen (mg/l)
11/14/2007	1400	A	1	24.4	24.2	3.5	9.1
11/14/2007	1422	A	2	25.6	24.1	2.0	8.7
11/14/2007	1353	B	3	26.2	24.4	1.7	8.3
11/14/2007	1330	B	4	25.6	24.3	1.4	7.2
11/14/2007	1305	C	5	25.5	24.7	1.0	6.6
11/14/2007	1234	C	6	31.5	25.0	1.0	7.1
12/12/2007	1522	A	1	19.9	21.9	2.3	11.1
12/12/2007	1500	A	2	20.0	21.8	1.8	11.2
12/12/2007	1435	B	3	22.8	22.4	1.2	11.8
12/12/2007	1405	B	4	21.5	22.2	1.1	12.0
12/12/2007	1355	C	5	21.9	22.3	0.9	11.6
12/12/2007	1320	C	6	21.5	22.2	0.8	11.6
1/23/2008	1542	A	1	11.2	11.6	1.7	10.2
1/23/2008	1525	A	2	11.3	11.7	1.1	10.5
1/23/2008	1458	B	3	11.6	12.3	0.9	10.6
1/23/2008	1425	B	4	11.4	12.3	0.8	10.8
1/23/2008	1508	C	5	11.6	12.4	0.4	11.5
1/23/2008	1441	C	6	11.6	12.6	0.4	9.3
2/20/2008	1549	A	1	18.5	17.9	1.0	9.9
2/20/2008	1520	A	2	18.4	18.0	0.9	10.3
2/20/2008	1621	B	3	19.5	17.3	0.8	10.1
2/20/2008	1453	B	4	18.2	18.1	0.4	10.1
2/20/2008	1422	C	5	17.9	17.4	0.4	10.0
2/20/2008	1406	C	6	18.0	17.2	0.3	10.6

Table 7. Hydrological data collected during bag seine sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Water Temp. (°C)	Salinity (ppt)	Oxygen (mg/l)
3/19/2008	1545	A	1	20.4	21.6	1.6	8.5
3/19/2008	1505	A	2	19.0	22.0	4.0	8.7
3/19/2008	1735	B	3	19.9	22.0	3.0	8.8
3/19/2008	1435	B	4	20.8	22.1	3.0	8.7
3/19/2008	1407	C	5	20.8	22.4	2.0	8.9
3/19/2008	1340	C	6	18.5	22.3	1.0	8.6
4/9/2008	1551	A	1	24.7	26.6	4.9	8.8
4/9/2008	1520	A	2	25.4	25.7	4.1	8.0
4/9/2008	1442	B	3	26.2	26.5	3.7	7.9
4/9/2008	1420	B	4	26.5	25.7	2.8	8.1
4/9/2008	1340	C	5	25.6	25.5	2.5	7.2
4/9/2008	1314	C	6	25.9	25.4	1.8	7.3
5/12/2008	1545	A	1	23.9	26.7	6.4	9.3
5/12/2008	1515	A	2	24.7	26.9	5.5	8.3
5/12/2008	1435	B	3	26.9	26.1	4.5	7.2
5/12/2008	1410	B	4	24.7	26.1	3.7	8.3
5/12/2008	1323	C	5	25.6	26.3	2.8	7.4
5/12/2008	1240	C	6	24.8	26.7	2.9	7.6

* Seine samples were not collected due to unsampleable shorelinen and high water flows in the river.

Table 8. Hydrological data collected during gill net sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Surface Water Temp. (°C)	Bottom Water Temp. (°C)	Surface Salinity (ppt)	Bottom Salinity (ppt)	Surface Oxygen (mg/l)	Bottom Oxygen (mg/l)
6/11/2007	1758	A	1	29.1	29.2	29.5	0.2	0.7	7.8	7.4
6/12/2007	817				29.7	29.8	0.3	0.3	7.2	7.3
6/11/2007	1725	B	2	28.4	29.9	29.9	0.2	0.2	6.9	7.3
6/12/2007	801			27.4	29.7	29.7	0.2	0.2	7.6	7.2
6/11/2007	1716	C	3	25.7	30.1	30.2	0.2	0.2	7.1	7.2
6/12/2007	730			27.2	29	29.1	0.2	0.2	7.8	7.5
8/28/2007	1927	A	1	29.2	30.7	*	0.2	*	6.5	*
8/29/2007	716			26.6	30	*	0.2	*	6.3	*
8/28/2007	1951	B	2	28.8	32.6	*	0.2	*	6.8	*
8/29/2007	743			26.5	29.6	*	0.2	*	6.1	*
8/28/2007	2002	C	3	28.2	30.4	*	0.2	*	6.4	*
8/29/2007	758			25.4	29.6	*	0.2	*	6.2	*
9/26/2007	1828	A	1	27.3	29.2	29.2	0.5	16.5	7.6	4.3
9/27/2007	805			26	28.6	29.0	0.5	16.5	7.3	4.2
9/26/2007	1817	B	2	26.8	28.6	28.4	0.2	8.7	7.8	2.5
9/27/2007	754			25.4	28.9	28.5	0.2	8.5	5.8	2.5
9/26/2007	1755	C	3	27.3	28.9	28.9	0.2	1.9	7.8	5.6
9/27/2007	726			24.9	28.3	28.3	0.2	1.9	6.3	5.6

Table 8. Hydrological data collected during gill net sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Surface Water Temp. (°C)	Bottom Water Temp. (°C)	Surface Salinity (ppt)	Bottom Salinity (ppt)	Surface Oxygen (mg/l)	Bottom Oxygen (mg/l)
10/30/2007	1758	A	1	19.5	20.7	20.3	1.9	22.3	12.9	5.2
10/31/2007	817			16.1	18.9	20.4	2.9	23.0	9.1	5.8
10/30/2007	1725	B	2	20.9	20.6	20.4	1.4	21.5	12.0	3.8
10/31/2007	801			17.3	19.4	19.7	2.2	22.8	8.2	6.6
10/30/2007	1716	C	3	22.5	20.4	20.5	0.7	17.5	13.3	2.7
10/31/2007	730			15.7	19.4	20.3	0.9	18.7	9.7	2.4
11/14/2007	1715	A	1	22.9	23.7	23.0	2.1	15.0	7.6	2.3
11/15/2007	805			14.1	22.0	23.0	2.9	19.4	4.3	1.8
11/14/2007	1655	B	2	22.5	23.7	22.9	1.4	7.1	6.2	1.8
11/15/2007	741			14.9	21.8	22.6	2.0	13.5	3.8	0.2
11/14/2007	1625	C	3	23.6	24.1	22.9	0.9	17.5	5.8	0.1
11/15/2007	713			14.9	22.5	22.6	1.3	17.0	4.7	0.1
12/12/2007	1708	A	1	18.6	21.8	20.4	1.7	21.8	11.5	4.7
12/13/2007	820			12.1	19.6	21.1	2.4	15.0	8.9	5.4
12/12/2007	1643	B	2	18.4	21.8	21.9	1.1	2.1	12.2	9.6
12/13/2007	745				19.9	20.8	1.8	6.2	9.5	4.6
12/12/2007	1624	C	3	18.1	21.5	18.9	0.8	17.9	11.3	2.5
12/13/2007	710			10.8	20.0	20.1	1.4	17.5	9.5	9.0

Table 8. Hydrological data collected during gill net sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Surface Water Temp. (°C)	Bottom Water Temp. (°C)	Surface Salinity (ppt)	Bottom Salinity (ppt)	Surface Oxygen (mg/l)	Bottom Oxygen (mg/l)
1/23/2008	1715	A	1	12.3	11.7	12.5	1.4	19.0	11.7	9.8
1/24/2008	828			8.3	11.7	12.1	1.6	18.0	10.3	10.1
1/23/2008	1656	B	2	12.3	12.4	12.3	0.7	1.3	11.8	11.1
1/24/2008	755			9.9	12.6	12.6	0.5	1.2	10.1	9.7
1/23/2008	1632	C	3	11.6	12.3	12.3	0.3	0.4	10.2	9.9
1/24/2008	729			9.8	12.9	12.3	0.2	0.2	10.4	10.1
2/20/2008	1809	A	1	19.3	17.4	17.2	0.0	2.0	10.4	9.9
2/21/2008	830			19.5	17.3	17.2	0.0	2.0	10.0	9.5
2/20/2008	1736	B	2	19.5	17.2	17.2	0.0	0.0	10.4	9.8
2/21/2008	738			19.5	17.2	17.2	0.0	0.0	9.9	9.8
2/20/2008	1705	C	3	19.5	17.1	17.1	0.0	0.0	10.5	9.9
2/21/2008	715			9.9	17.1	17.3	0.0	1.0	10.6	8.1
3/19/2008	1940	A	1	14.1	21.3	21.5	2.0	4.0	8.2	8.2
3/20/2008	1000			15.2	20.5	21.0	2.0	40.0	8.5	5.4
3/19/2008	1900	B	2	15.3	21.6	21.3	2.0	17.0	8.0	7.5
3/20/2008	940			15.2	20.8	20.8	1.0	40.0	8.4	6.2
3/19/2008	1850	C	3	18.4	21.8	21.7	1.0	3.0	9.1	8.9
3/20/2008	925			17.2	21.2	21.2	1.0	1.0	8.2	8.5

Table 8. Hydrological data collected during gill net sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Surface Water Temp. (°C)	Bottom Water Temp. (°C)	Surface Salinity (ppt)	Bottom Salinity (ppt)	Surface Oxygen (mg/l)	Bottom Oxygen (mg/l)
4/8/2008	1957	A	1	23.2	23.3	23.9	3.3	20.3	5.2	3.7
4/9/2008	811			22.8	24.4	24.3	2.2	2.4	6.3	5.8
4/8/2008	1938	B	2	23.2	25.1	23.9	2.6	15.5	8.5	3.1
4/9/2008	755			22.4	25.2	24.3	1.5	1.5	6.6	6.8
4/8/2008	1914	C	3	24.2	24.8	23.6	1.2	11.3	7.7	2.9
4/9/2008	732			22.6	23.7	23.7	1	1	6.1	1.1
5/12/2008	1956	A	1	23.7	26.2	26.2	12.1	23.3	8.7	3.5
5/13/2008	855			25.9	26.6	26.1	13.9	20.6	5.3	0.02
5/12/2008	1930	B	2	23.4	26.5	26.6	8.1	21.1	8.7	3.1
5/13/2008	800			24.7	25.6	26.7	7.1	21.8	7.2	1
5/12/2008	1912	C	3	23.7	26.3	25	3.3	19.4	10.7	1.5
5/13/2008	725			24.9	25.7	25.4	4.1	19.2	7.8	1.7

*Unable to get bottom readings do to meter cable.

Table 9. Hydrological data collected during hoop net sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Surface Water Temp. (°C)	Surface Salinity (ppt)	Surface Oxygen (mg/l)
6/11/2007	1854	A	1	32.2	30.0	0.4	8.1
6/12/2007	638			24.8	29.4	0.4	7.1
6/11/2007	1937	B	2	28.0	30.0	0.2	7.6
6/12/2007	722			27.7	29.5	0.2	7.2
6/11/2007	2004	C	3	27.5	30.1	0.2	7.5
6/12/2007	802			27.2	29.0	0.2	7.2
8/28/2007	1915	A	1	29.9	30.7	0.2	6.5
8/29/2007	701			24.6	29.9	0.2	5.9
8/28/2007	1940	B	2	27.8	30.7	0.2	6.7
8/29/2007	723			26.3	29.7	0.2	6.0
8/28/2007	1957	C	3	27.0	30.4	0.2	6.5
8/29/2007	2000			27.1	29.5	0.2	6.2
9/26/2007	1828	A	1	27.7	28.7	0.5	7.1
9/27/2007	810			25.6	28.2	0.7	6.1
9/26/2007	1808	B	2	27.8	29.1	0.2	7.3
9/27/2007	745			24.9	28.1	0.3	6.0
9/26/2007	1740	C	3	28.6	29.2	0.2	7.3
9/27/2007	723			23.1	28.0	0.2	6.2

Table 9. Hydrological data collected during hoop net sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Surface Water Temp. (°C)	Surface Salinity (ppt)	Surface Oxygen (mg/l)
10/30/2007	1809	A	1	19.5	20.6	2.3	11.8
10/31/2007	834			17.8	19.2	2.8	9.0
10/30/2007	1733	B	2	20.9	20.7	1.5	12.5
10/31/2007	748			17.0	19.5	1.9	8.8
10/30/2007	1706	C	3	22.5	20.2	1.0	12.8
10/31/2007	720			15.7	19.1	0.9	8.8
11/14/2007	1709	A	1	22.9	23.7	2.0	7.4
11/15/2007	825			15.2	22.0	3.0	4.3
11/14/2007	1640	B	2	22.5	23.8	1.7	5.6
11/15/2007	748			14.9	22.1	2.1	3.5
11/14/2007	1620	C	3	23.6	24.1	1.0	5.9
11/15/2007	655			14.9	22.2	1.4	3.9
12/12/2007	1656	A	1	17.7	21.8	1.8	11.4
12/13/2007	809			12.1	19.7	1.8	9.2
12/12/2007	1638	B	2	17.6	21.8	1.1	11.9
12/13/2007	727			12.5	19.8	1.8	9.2
12/12/2007	1619	C	3	20.4	21.8	0.9	10.7
12/13/2007	700			10.8	19.7	1.4	9.5

Table 9. Hydrological data collected during hoop net sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Surface Water Temp. (°C)	Surface Salinity (ppt)	Surface Oxygen (mg/l)
1/23/2008	1706	A	1	12.3	11.7	1.9	12.5
1/24/2008	812			9.9	11.9	2.2	11.3
1/23/2008	1643	B	2	12.3	12.3	0.8	9.9
1/24/2008	750			9.9	12.3	0.6	9.6
1/23/2008	1630	C	3	12.3	12.3	0.2	12.3
1/24/2008	720			9.8	12.8	0.2	9.8
2/20/2008	1815	A	1	19.2	17.8	0.0	10.4
2/21/2008	815			19.7	17.3	0.0	9.8
2/20/2008	1747	B	2	19.5	17.7	0.0	10.4
2/21/2008	730			20.1	17.3	0.0	9.8
2/20/2008	1716	C	3	19.5	17.1	0.0	10.2
2/21/2008	705			20.3	17.1	0.0	10.6
3/19/2008	1930	A	1	14.6	21.4	4.0	7.9
3/20/2008	1015			17.0	20.3	2.0	8.6
3/19/2008	1915	B	2	16.6	21.4	2.0	8.4
3/20/2008	950			18.2	20.7	1.0	8.6
3/19/2008	1845	C	3	20.6	22.2	1.0	9.1
3/20/2008	915			12.5	21.0	1.0	7.5

Table 9. Hydrological data collected during hoop net sampling on the lower Colorado River, 2007 to 2008.

Date	Central Standard Time	Segment	Station	Air Temp. (°C)	Surface Water Temp. (°C)	Surface Salinity (ppt)	Surface Oxygen (mg/l)
4/8/2008	1949	A	1	23.2	25.4	3.3	9.3
4/9/2008	804			23.2	24.3	2.1	6.6
4/8/2008	1930	B	2	23.2	24.7	2.6	8.3
4/9/2008	745			22.7	24.2	1.4	6.4
4/8/2008	1906	C	3	23.6	24.8	1.2	7.8
4/9/2008	721			22.7	24.3	1.2	6.4
5/12/2008	1947	A	1	23.5	26.3	11.9	8.4
5/13/2008	841			25.1	25.9	14.5	5.4
5/12/2008	1926	B	2	23.6	26.4	8.8	8.5
5/13/2008	747			24.6	25.7	7.0	7.1
5/12/2008	1911	C	3	24.0	26.5	3.2	9.4
5/13/2008	719			24.5	25.6	4.0	7.2

Table 10. Monthly mean flow rates for the lower Colorado River calculated using hourly rates during each sample period, 2007-2008 (USGS 08162500 Colorado Rv NR Bay City, Tx).

Month (Dates)	Mean Flow (cfs)
June (11 & 12)	3583.1
July*	15310.0
August (28 & 29)	5545.0
September (26 & 27)	1914.4
October (30 & 31)	1045.6
November (14 & 15)	840.3
December (12 & 13)	856.8
January (23 & 24)	2860.0
February (19 & 20)	2900.0
March (19 & 20)	942.5
April (8 & 9)	898.6
May (12 & 13)	219.5

* No samples collected in July due to high river flow rates (>5,000 cfs). Flow data were averaged based on monthly time period that would have been sampled.

Table 11. Cumulative Catch by Gear for the lower Colorado River 1983, 1984, and 2008

		Trawls			Seines			
Common Name	**Scientific Name**	**1983[a]**	**1984[b]**	**2008[c]**	**1983[d]**	**1984[e]**	**2008[f]**	**Totals**
Alligator Gar	*Lepisosteus spatula*						2	2
Atlantic Brief Squid	*Lolliguncula brevis*			30			1	31
Atlantic Croaker	*Micropogonias undulatus*	37		482			562	1081
Atlantic Cutlassfish	*Trichiurus lepturus*			6				6
Atlantic Threadfin	*Polydactylus octonemus*			6				6
Bay Anchovy	*Anchoa mitchilli*	3617		264	73	170	24	4148
Bay Whiff	*Citharichthys spilopterus*	15		2	67	1	15	100
Bayou Killifish	*Fundulus pulvereus*						3	3
Black Drum	*Pogonias cromis*			1360			1	1361
Blue Catfish	*Ictalurus furcatus*	15		677			51	743
Blue Crab	*Callinectes sapidus*	264		77	110	9	189	649
Bluegill	*Lepomis macrochirus*						3	3
Bluntnose Jack	*Hemicaranx amblyrhynchus*					5		5
Brown Shrimp	*Farfantepenaeus aztecus*			192	1	5	264	462
Bull Shark	*Carcharhinus leucas*							0
Channel Catfish	*Ictalurus punctatus*			6			22	28
Cichlid	*Lethrinops brevis*			16				16
Crawfish	*Procamburus spp.*			1	1			2
Crevalle Jack	*Caranx hippos*				13		2	15
Cyprinid Spp.	*Cyprinid spp.*						1	1
Darter Goby	*Gobionellus boleosoma*	10			42	10		62
Diamond Killifish	*Adinia xenica*						11	11
Fat Sleeper	*Dormitator maculatus*				20			20
Flathead Catfish	*Polydictis olivaris*							0
Freshwater Goby	*Ctenogobius shufeldti*				2		9	11
Gafftopsail Catfish	*Bagre marinus*	9		183				192
Gizzard Shad	*Dorosoma cepedianum*	2		52			8	62
Grass Carp	*Ctenopharyngodon idella*				2			2
Grass Shrimp	*Palaemonetes pugio*	2				65	1762	1829
Gulf Killifish	*Fundulus grandis*					2	20	22
Gulf Menhaden	*Brevoortia patronus*	3		1076	29	24	2960	4092
Hardhead Catfish	*Ariopsis felis*	40		252				292
Inland Silverside	*Menidia beryllina*				9	3	6	18
Ladyfish	*Elops saurus*			1		1		2
Leatherjacket	*Oligoplites saurus*					1		1
Lesser Blue Crab	*Callinectes similis*			5			1	6
Lined Sole	*Achirus lineatus*	3		3				6
Longnose Gar	*Lepisosteus osseus*							0
Lyre Goby	*Evorthodus lyricus*				2	1		3
Mangrove Snapper	*Lutjanus griseus*			1				1
Mosquitofish	*Gambusia affinis*				1		1	2
Mottled Mojarra	*Eucinostomus lefroyi*				2			2
Mud Crab	*Rhithropanopeus harrisii*	1		1				2
Naked Goby	*Gobiosoma bosci*	2					3	5
Pigfish	*Orthopristis chrysoptera*			1				1
Pinfish	*Lagodon rhomboides*	2		11		9		22
Rainwater Killifish	*Lucania parva*						2	2
Red Drum	*Sciaenops ocellatus*			25			8	33
River Shrimp	*Macrobrachium ohione*	747		5	52	1	10	815
Rough Silverside	*Membras martinica*						17	17
Roughback Shrimp	*Trachypenaeus similis*							0
Roughneck Shrimp	*Trachypenaeus constrictus*	1				1		2
Sailfin Molly	*Poecilia latipinna*				2	1	150	153
Sand Trout	*Cynoscion arenarius*	29		294	9	3	22	357
Seabob	*Xiphopenaeus kroyeri*			127				127
Sharptail Goby	*Oligolepis acutipennis*						39	39
Sheepshead	*Archosargus probatocephalus*			48	1		14	63
Sheepshead Minnow	*Cyprinodon variegatus*			7			79	86
Shiner	*Shiner spp.*						2	2
Silver Jenny	*Eucinostomus gula*			2				2
Silver Perch	*Bairdiella chrysoura*	1		350				351
Skipjack Herring	*Alosa chysochloris*					1		1

Table 11. continued.

Common Name	Scientific Name	Trawls 1983[a]	Trawls 1984[b]	Trawls 2007[c]	Seines 1983[d]	Seines 1984[e]	Seines 2007[f]	Totals
Smallmouth Buffalo	*Ictiobus bubalus*							0
Southern Flounder	*Paralichthys lethostigma*	4		12	2	1	2	21
Southern Stingray	*Dasyatis americana*			1				1
Spadefish	*Chaetodipterus faber*							0
Speckled Trout	*Cynoscion nebulosus*			53				53
Spot Croaker	*Leiostomus xanthurus*	18		156	1	9	88	272
Spotfin mojarra	*Eucinostomus argenteus*			5	2	9	3	19
Spotted Gar	*Lepisosteus oculatus*	2		1	4	1	1	9
Star Drum	*Stellifer lanceolatus*			86				86
Striped Anchovy	*Anchoa hepsetus*					1		1
Striped Mullet	*Mugil cephalus*			1			1671	1672
Threadfin Shad	*Dorosoma petenense*			7			3	10
Tonguefish	*Symphurus plaguisa*			3				3
Violet Goby	*Gobioides broussonnetii*	1					1	2
White Mullet	*Mugil curema*			2	68	10	180	260
White Shrimp	*Litopenaeus setiferus*	115		2870	652	643	584	4864
	Totals	4940	0	8760	1167	987	8797	24651

a - 14 trawls were conducted
b - No trawls were conducted
c - 65 trawls were conducted
d - 10 seines were conducted
e - 4 seines were conducted
f - 55 seines were conducted

Table 12. Species richness and species diversity values calculated for data collected using trawls and seines on the lower Colorado River, 1974, 1983, and 1984.

1974 Trawl		T5*	T4*	T2 and T3*	Overall
Species Richness	S	22	11	12	40
Simpson's Index	D	0.27	0.22	0.43	0.20
Index Diversity	1-D	0.73	0.78	0.57	0.80
Reciprocal Index	1/D	3.75	4.47	2.31	5.01
Shannon-Wiener	H	1.73	1.75	1.29	2.01
Evenness	E	0.56	0.73	0.52	0.55

1983 Trawl (July-Sep)		Overall**
Species Richness	S	24
Simpson's Index	D	0.56
Index Diversity	1-D	0.44
Reciprocal Index	1/D	1.78
Shannon-Wiener	H	0.98
Evenness	E	0.31

1983 Seine (July-Sep)		Overall**
Species Richness	S	25
Simpson's Index	D	0.34
Index Diversity	1-D	0.66
Reciprocal Index	1/D	2.98
Shannon-Wiener	H	1.72
Evenness	E	0.54

1984 Seine (Sep)		Overall**
Species Richness	S	26
Simpson's Index	D	0.46
Index Diversity	1-D	0.54
Reciprocal Index	1/D	2.18
Shannon-Wiener	H	1.29
Evenness	E	0.40

*The data from T5 corresponds to the current Segment A, T4 corresponds to Segment B, and T2 and T3 were collected within what is currently referred to as Segment C.

**The 1983 and 1984 data was all collected within what is now referred to as Segment C.

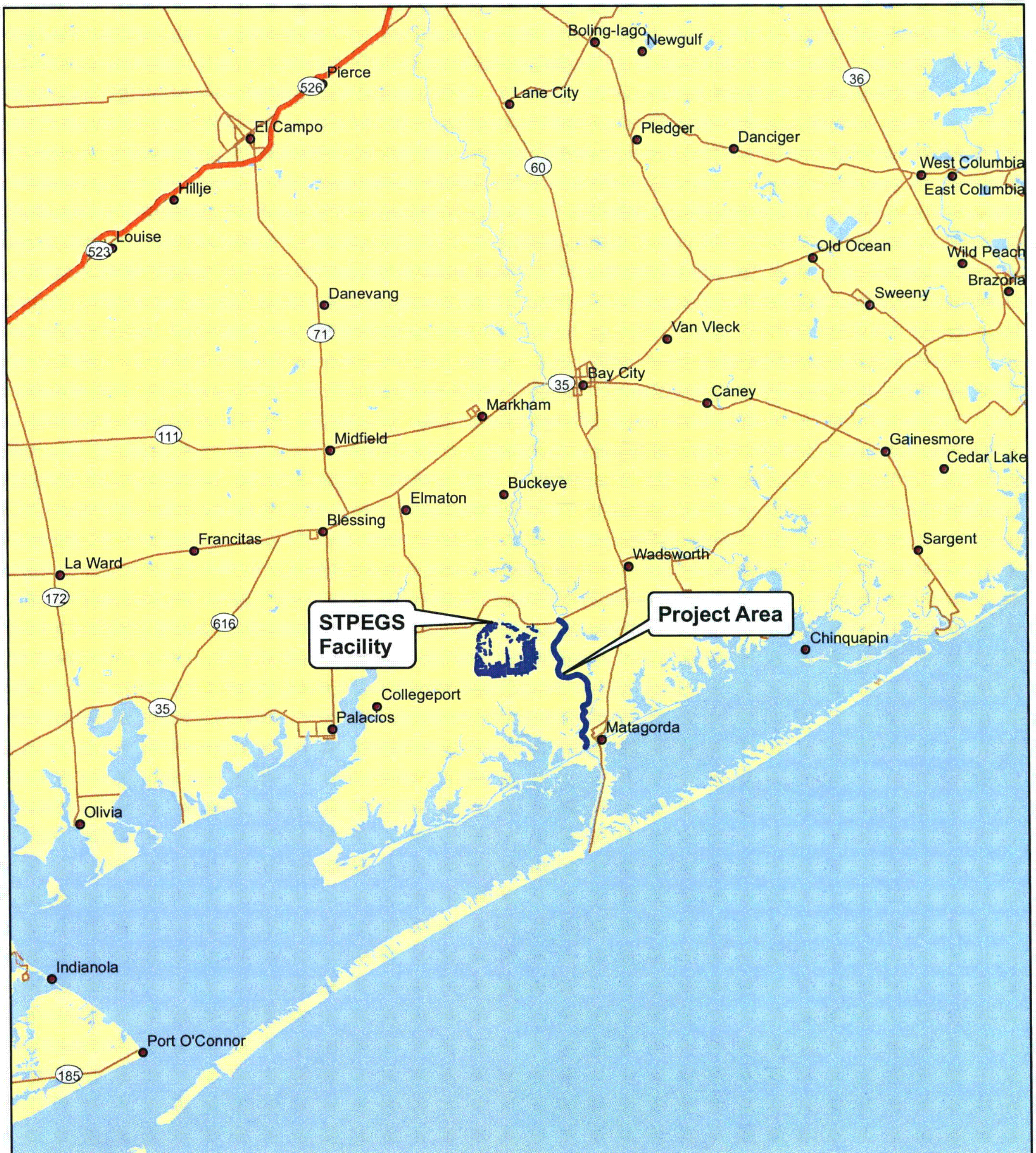
Table 13. Jaccard coefficients of similarity between current and historic data calculated for data collected using trawls and seines on the lower Colorado River, 1974, 1983, 1984, and 2007-2008.

Current Data Utilized	Historical Data Utilized				
	1974 Trawl (All Data)	1974 Trawl (Stations T2 and T3)*	1983 Trawl (July-Sep)	1983 Seine (July-Sep)	1984 Seine (Sep)
2007-08 Trawl (All Applicable Months)**	43.9		18.52		
2007-08 Trawl (Segment C)		36.36	37.14		
2007-08 Seine (All Applicable Months)				7.41	11.11
2007-08 Seine (Segment C)				30.56	33.33

*Stations T2 and T3 from the 1974 study were located within what is currently referred to as Segment C.

**Applicable Months refer to the current months corresponding to the available months within the limited historical datasets

FIGURES



Project Location Map
South Texas Project Electric Generation Station
Unit 3 and 4 Licensing Project

Scale: 1:500,000 (1" = 7.9 miles)

Background: ESRI
StreetMap USA

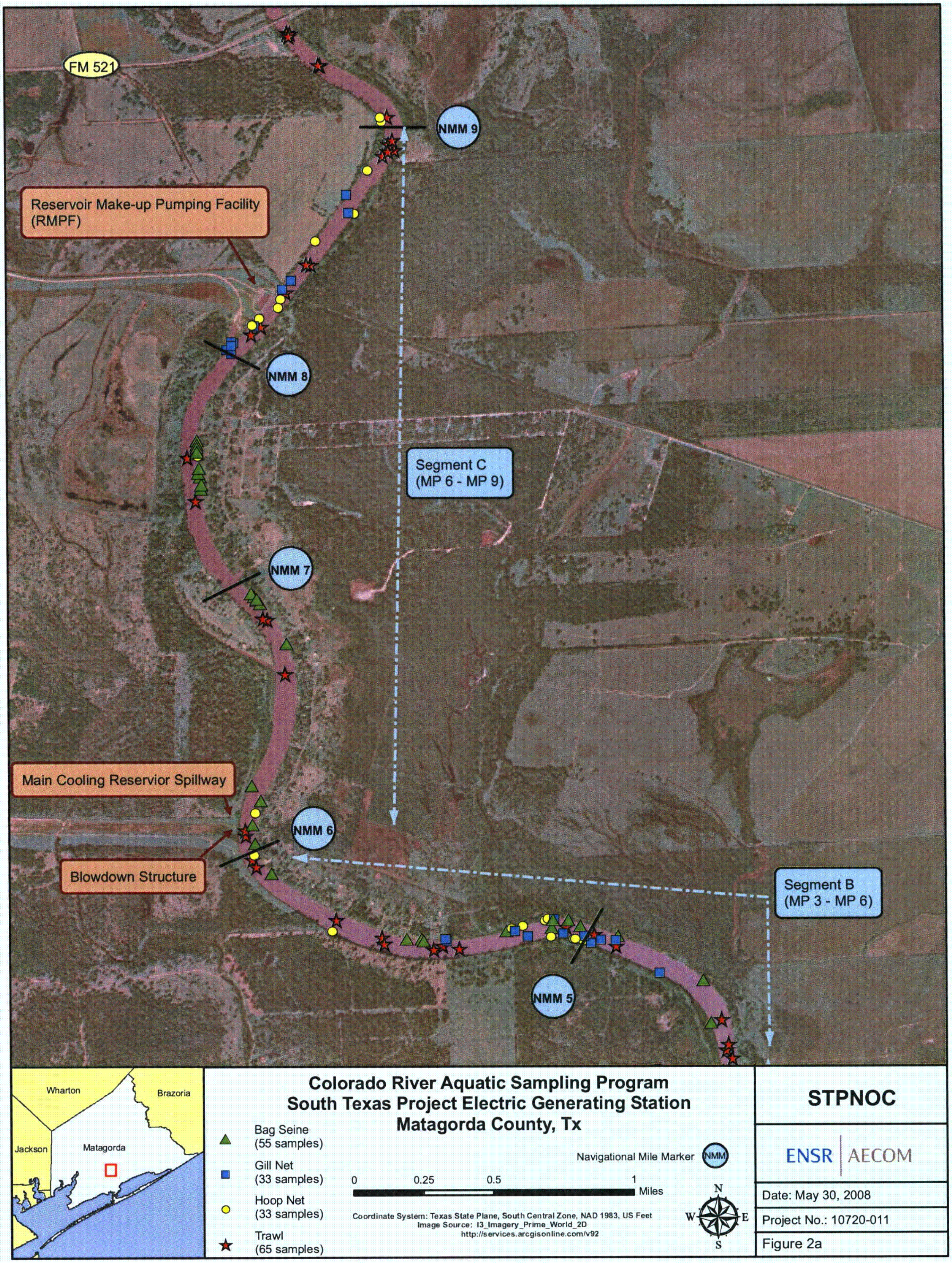
STPNOC

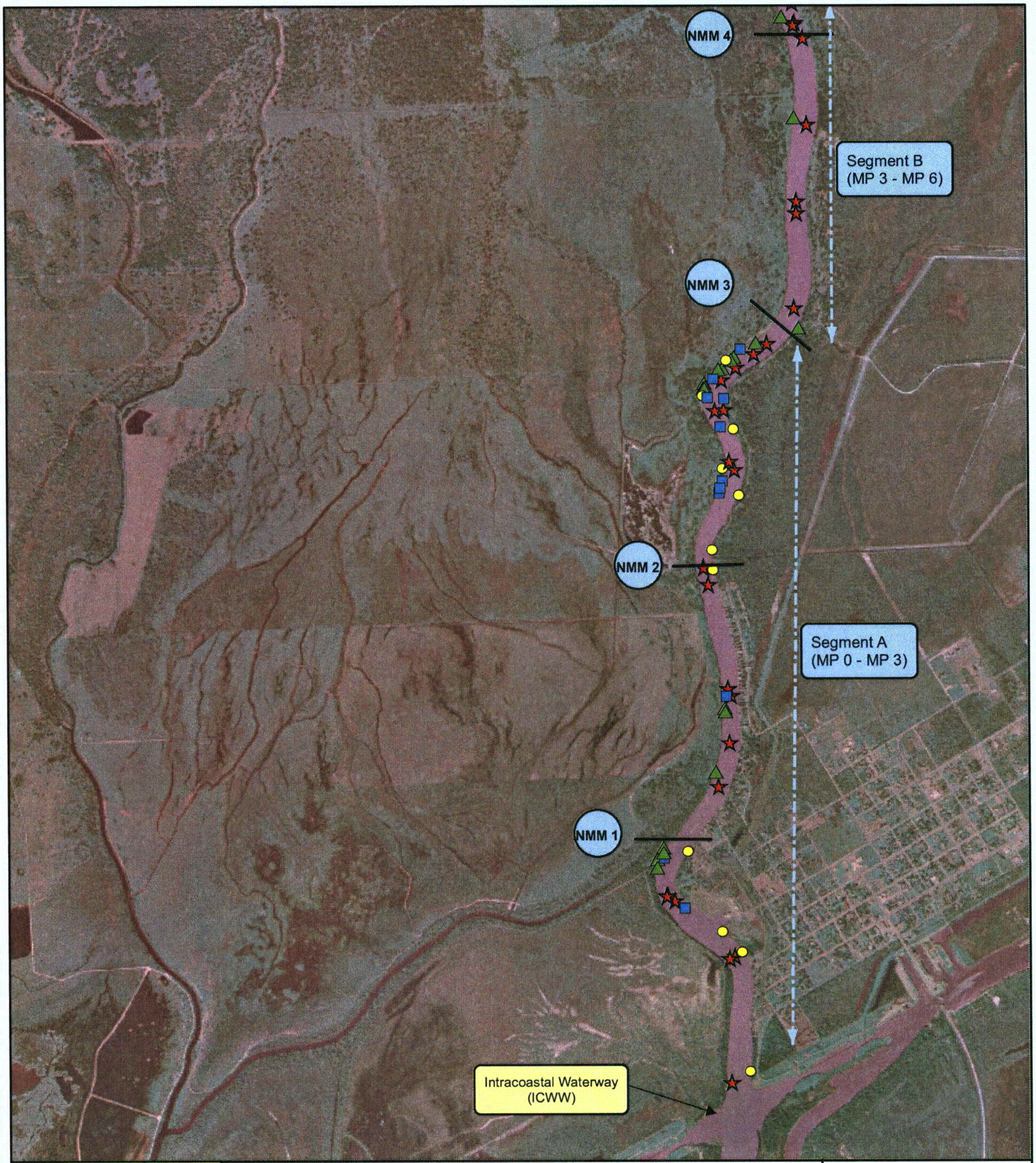
ENSR | AECOM

Date: June 2, 2008

Project No.: 10720-011

Figure 1


FM 521
NMM 9
Reservoir Make-up Pumping Facility (RMPF)
NMM 8
Segment C (MP 6 - MP 9)
NMM 7
Main Cooling Reservior Spillway
NMM 6
Blowdown Structure
Segment B (MP 3 - MP 6)
NMM 5
Wharton
Brazoria
Jackson
Matagorda
Colorado River Aquatic Sampling Program
South Texas Project Electric Generating Station
Matagorda County, Tx
Bag Seine (55 samples)
Gill Net (33 samples)
Hoop Net (33 samples)
Trawl (65 samples)
Navigational Mile Marker
NMM
0
0.25
0.5
1
Miles
Coordinate System: Texas State Plane, South Central Zone, NAD 1983, US Feet
Image Source: I3_Imagery_Prime_World_2D
http://services.arcgisonline.com/v92
N
W
E
S
STPNOC
ENSR
AECOM
Date: May 30, 2008
Project No.: 10720-011
Figure 2a



Colorado River Aquatic Sampling Program
South Texas Project Electric Generating Station
Matagorda County, Tx

- Bag Seine (55 samples)
- Gill Net (33 samples)
- Hoop Net (33 samples)
- Trawl (65 samples)

Navigational Mile Marker (NMM)

0 0.25 0.5 1 Miles

Coordinate System: Texas State Plane, South Central Zone, NAD 1983, US Feet
Image Source: I3_Imagery_Prime_World_2D
http://services.arcgisonline.com/v92

N W E S

STPNOC

ENSR | AECOM

Date: May 30, 2008

Project No.: 10720-011

Figure 2b

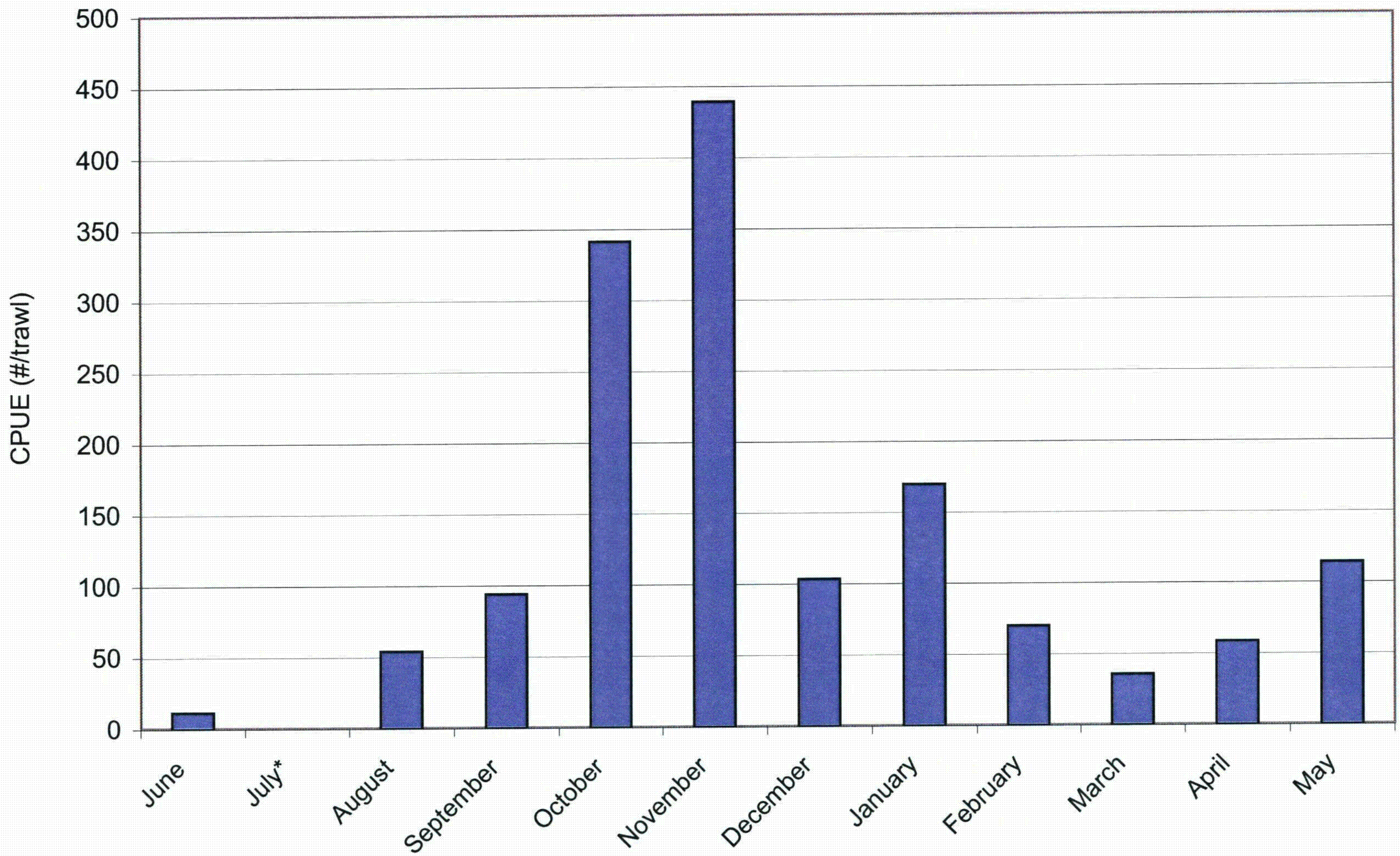


Figure 3. Catch per unit effort (CPUE) for organisms collected from trawl samples in the lower Colorado River, 2007 - 2008.

* No July samples collected due to high river flows (>5000 cfs).

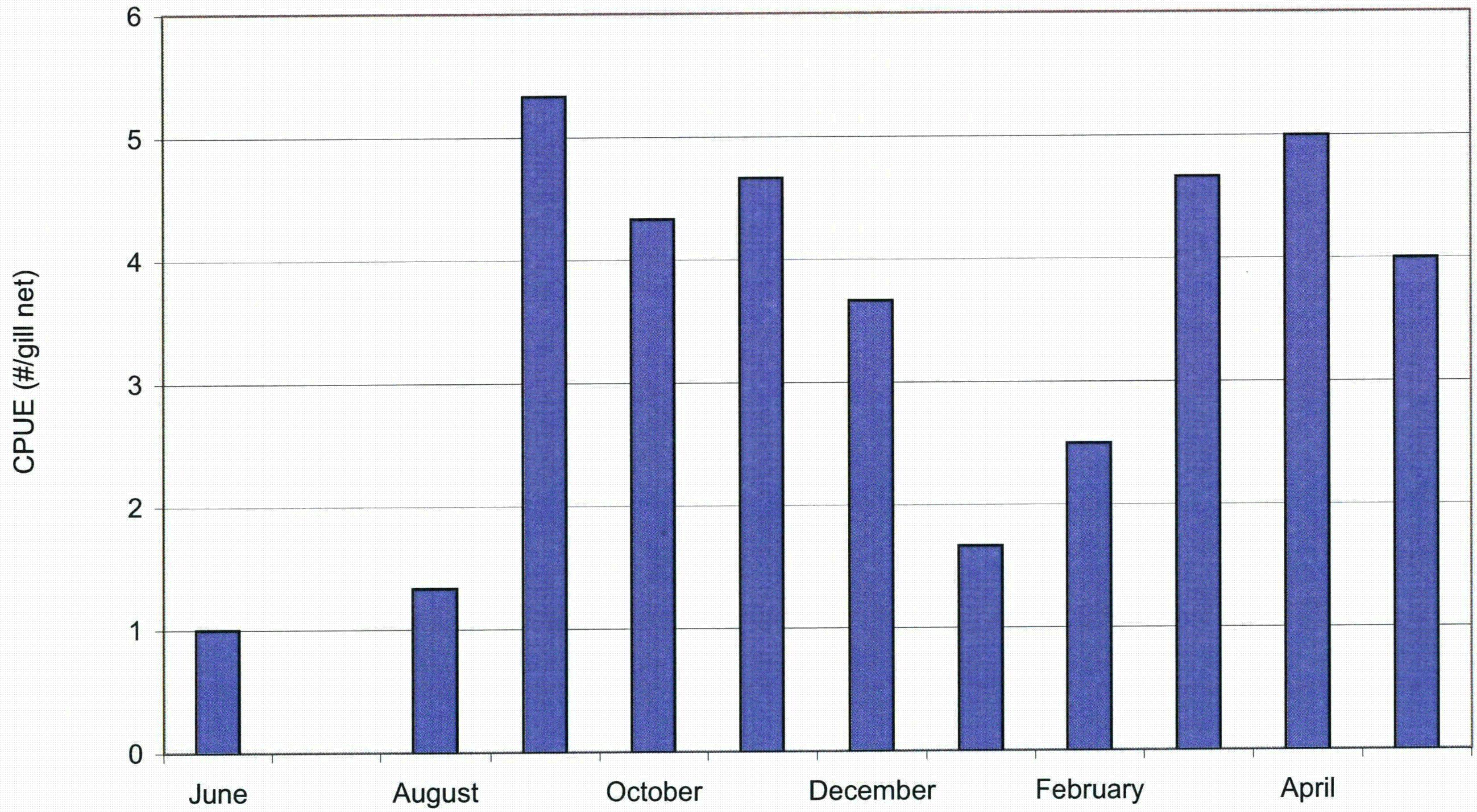


Figure 4. Catch per unit effort (CPUE) for organisms collected from gill net samples in the lower Colorado River, 2007 - 2008.

*No July samples collected due to high river flows (>5000 cfs).

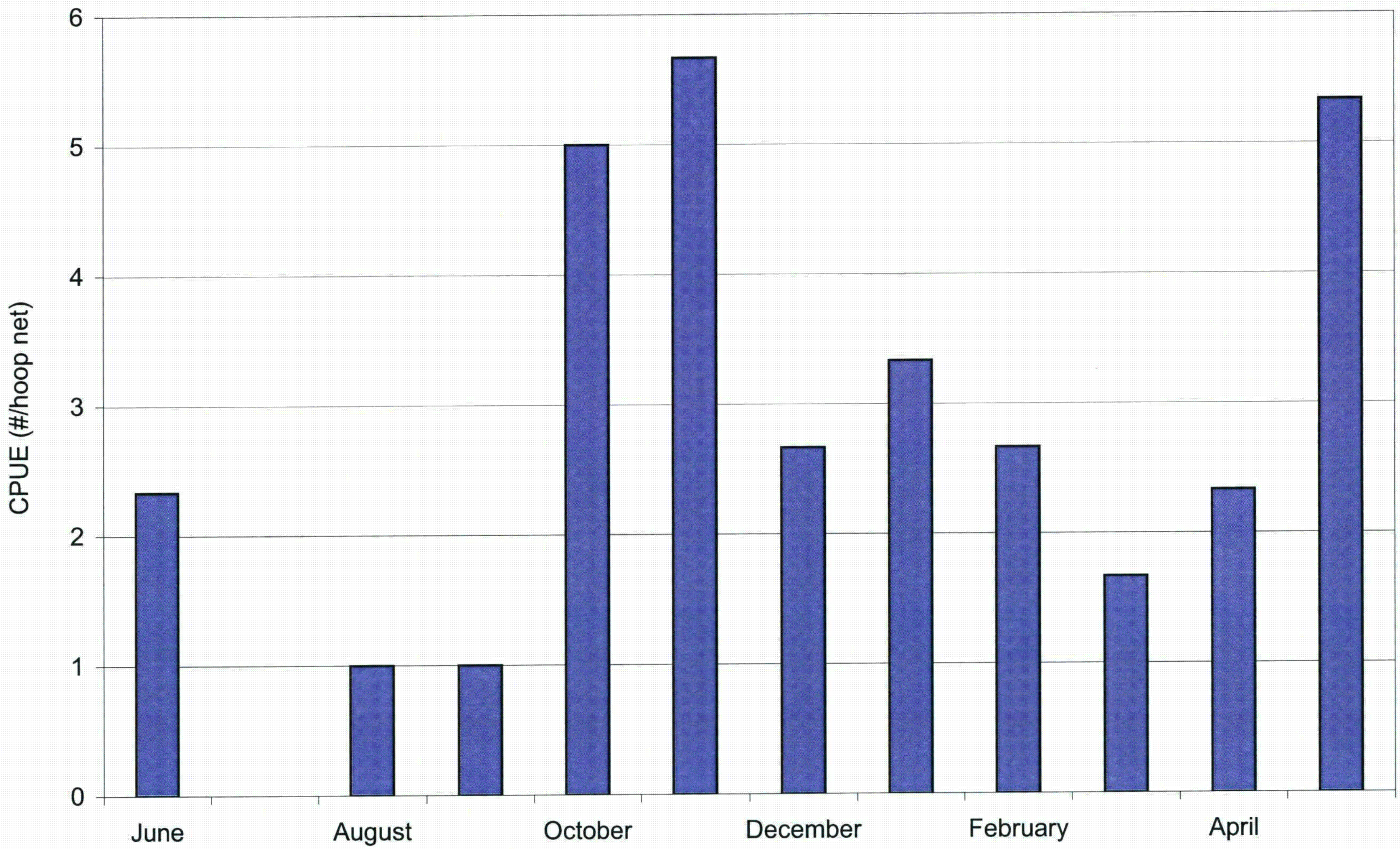


Figure 5. Catch per unit effort (CPUE) for organisms collected from hoop net samples in the lower Colorado River, 2007 - 2008.

*No July samples collected due to high river flows (>5000 cfs).

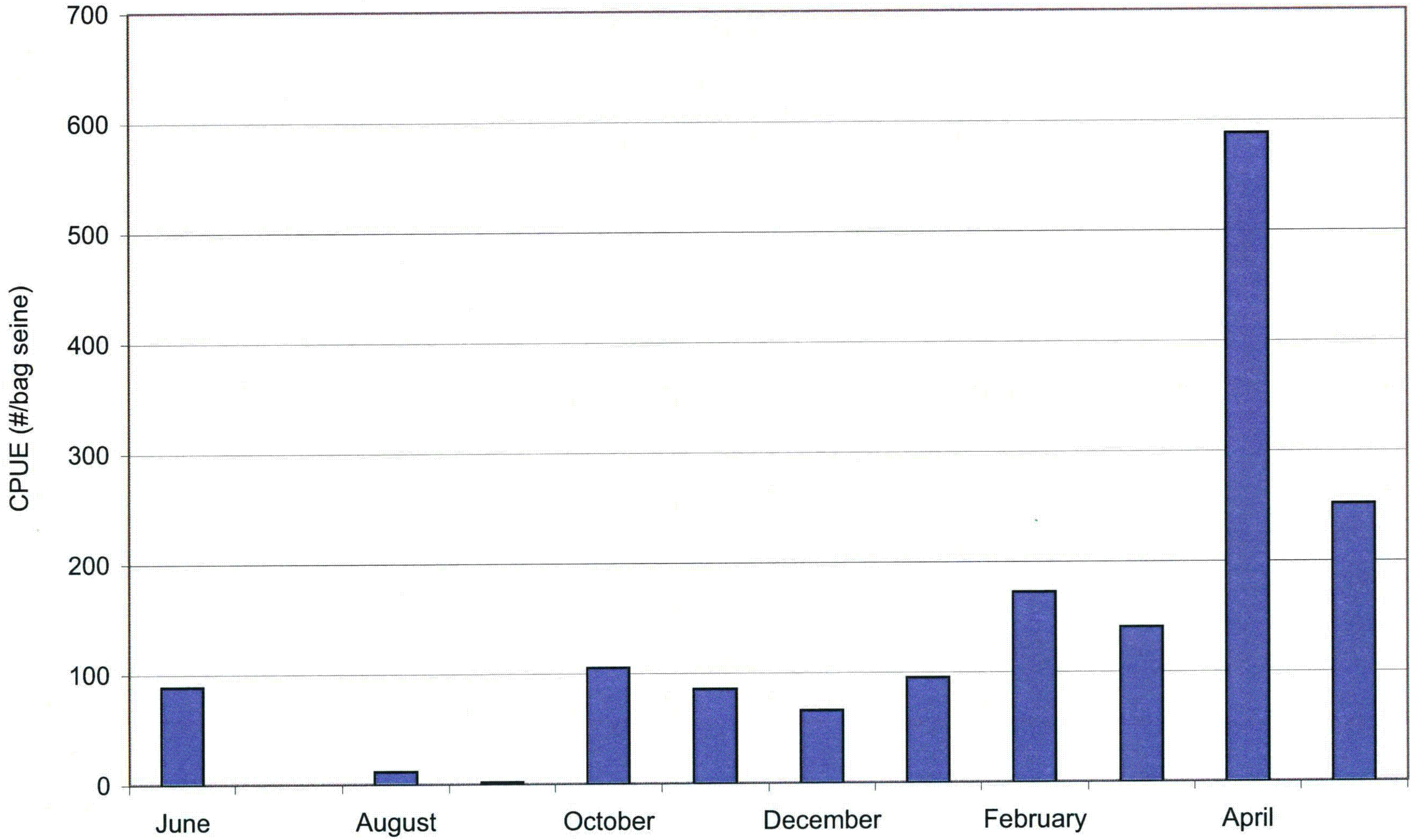


Figure 6. Catch per unit effort (CPUE) for organisms collected from bag seine samples in the lower Colorado River, 2007 - 2008.

*No July samples collected due to high river flows (>5000 cfs).

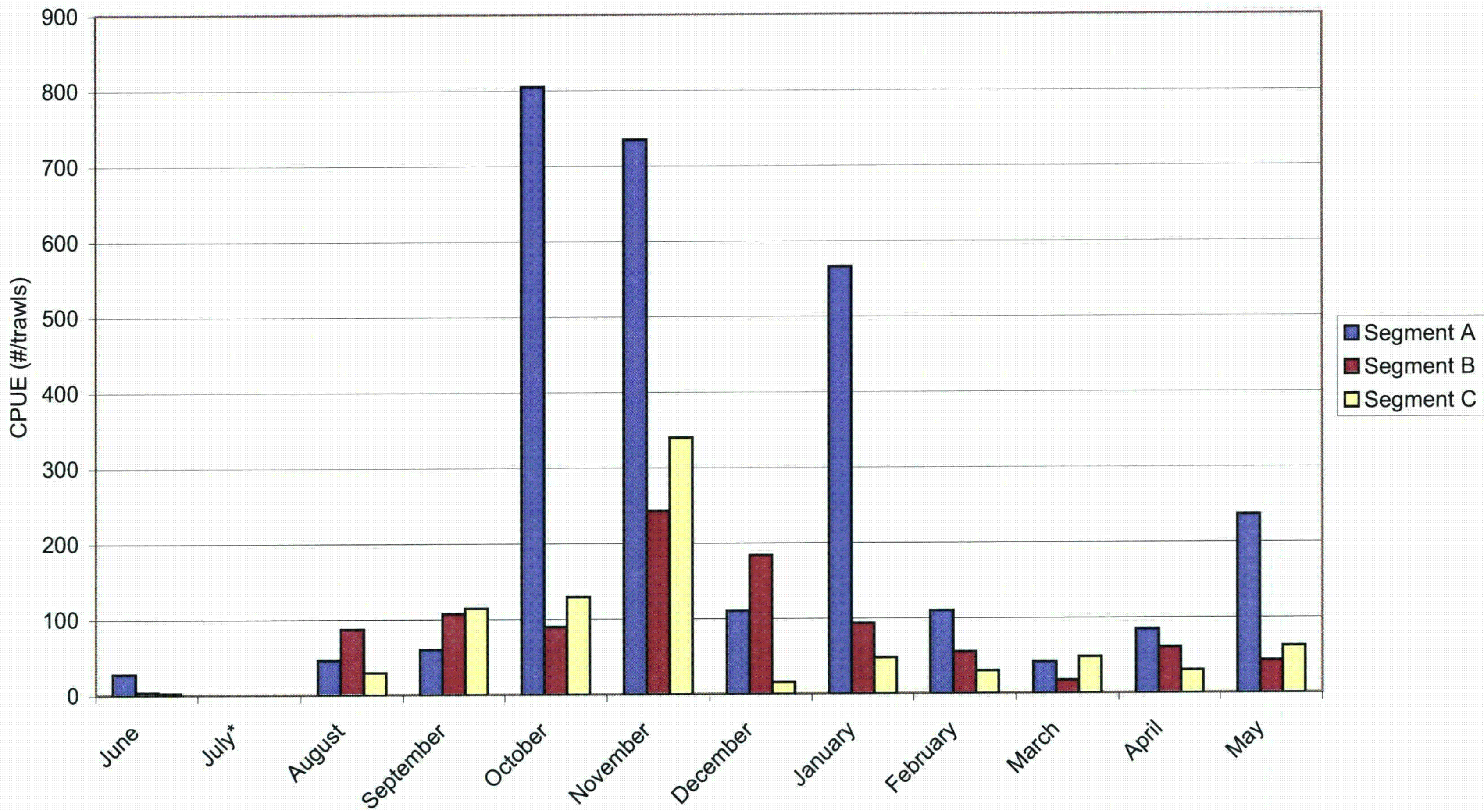


Figure 7. Monthly catch per unit of effort (CPUE) for trawl samples in the lower Colorado River, 2007-2008.

* No July samples collected due to high river flows (>5,000cfs).

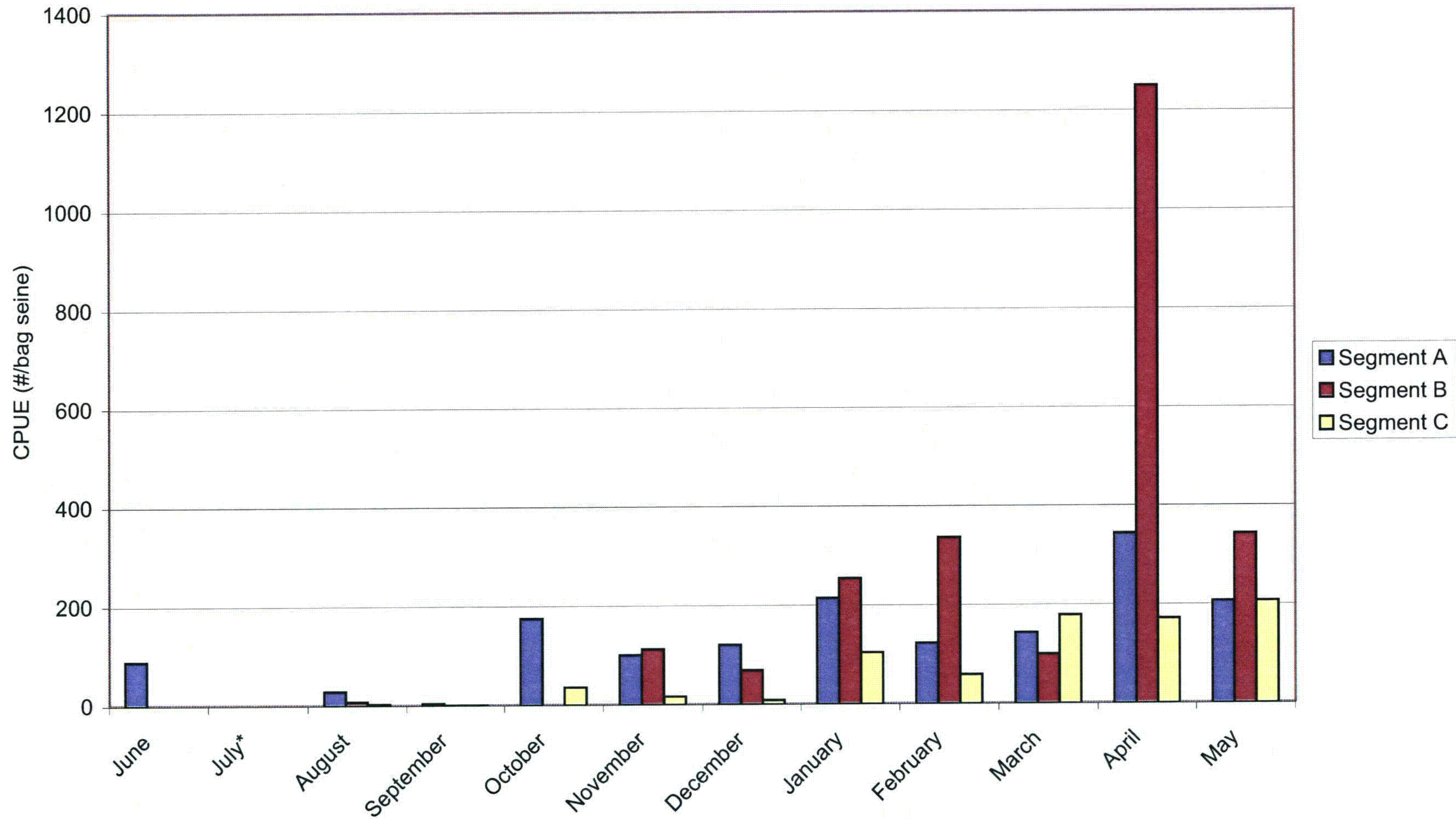


Figure 8. Monthly catch per unit of effort (CPUE) for bag seine samples in the lower Colorado River, 2007-2008.

* No July samples collected due to high river flows (>5,000cfs).

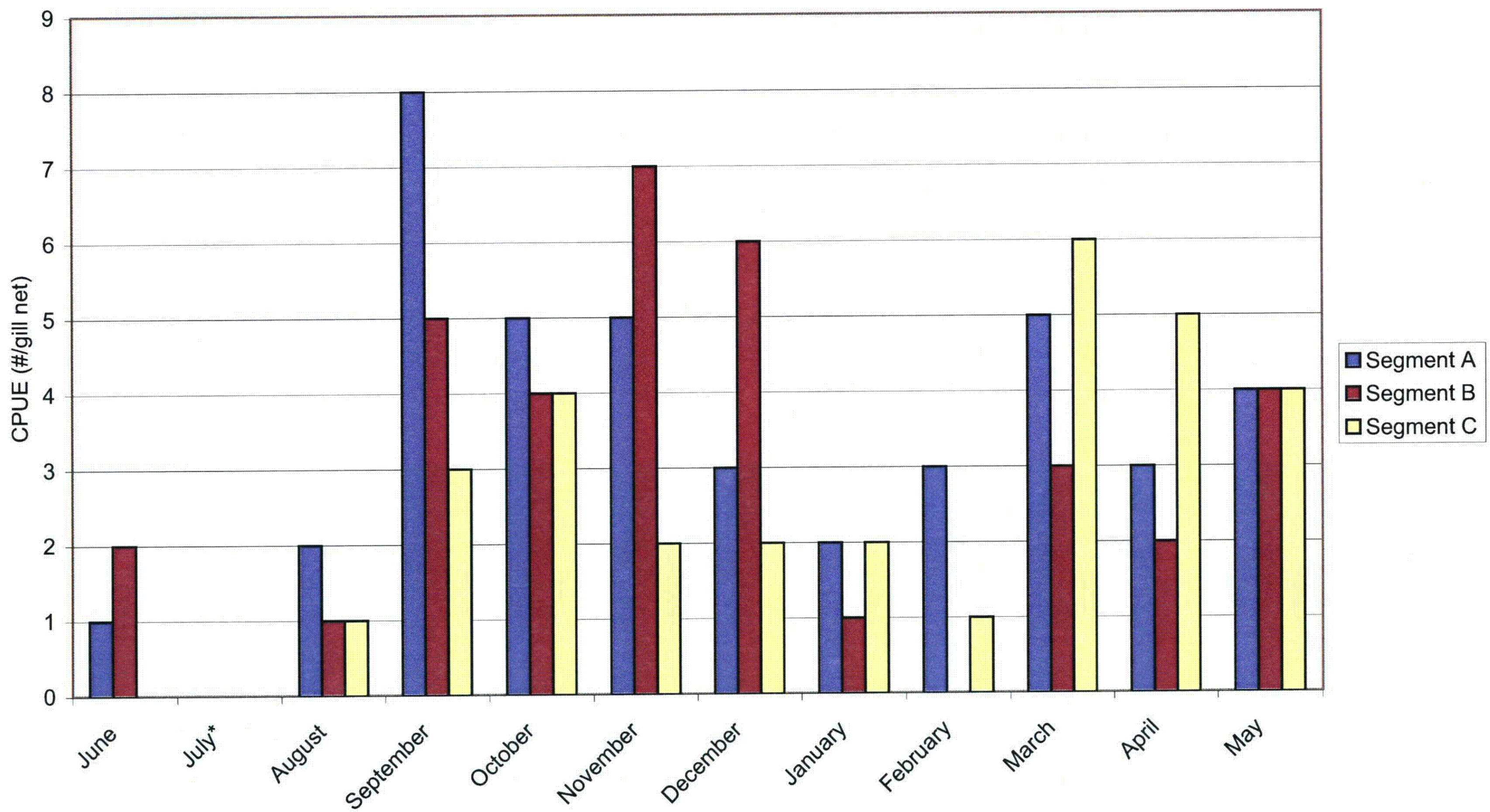


Figure 9. Monthly catch per unit of effort (CPUE) for gill net samples in the lower Colorado River, 2007-2008.

* No July samples collected due to high river flows (>5,000 cfs).

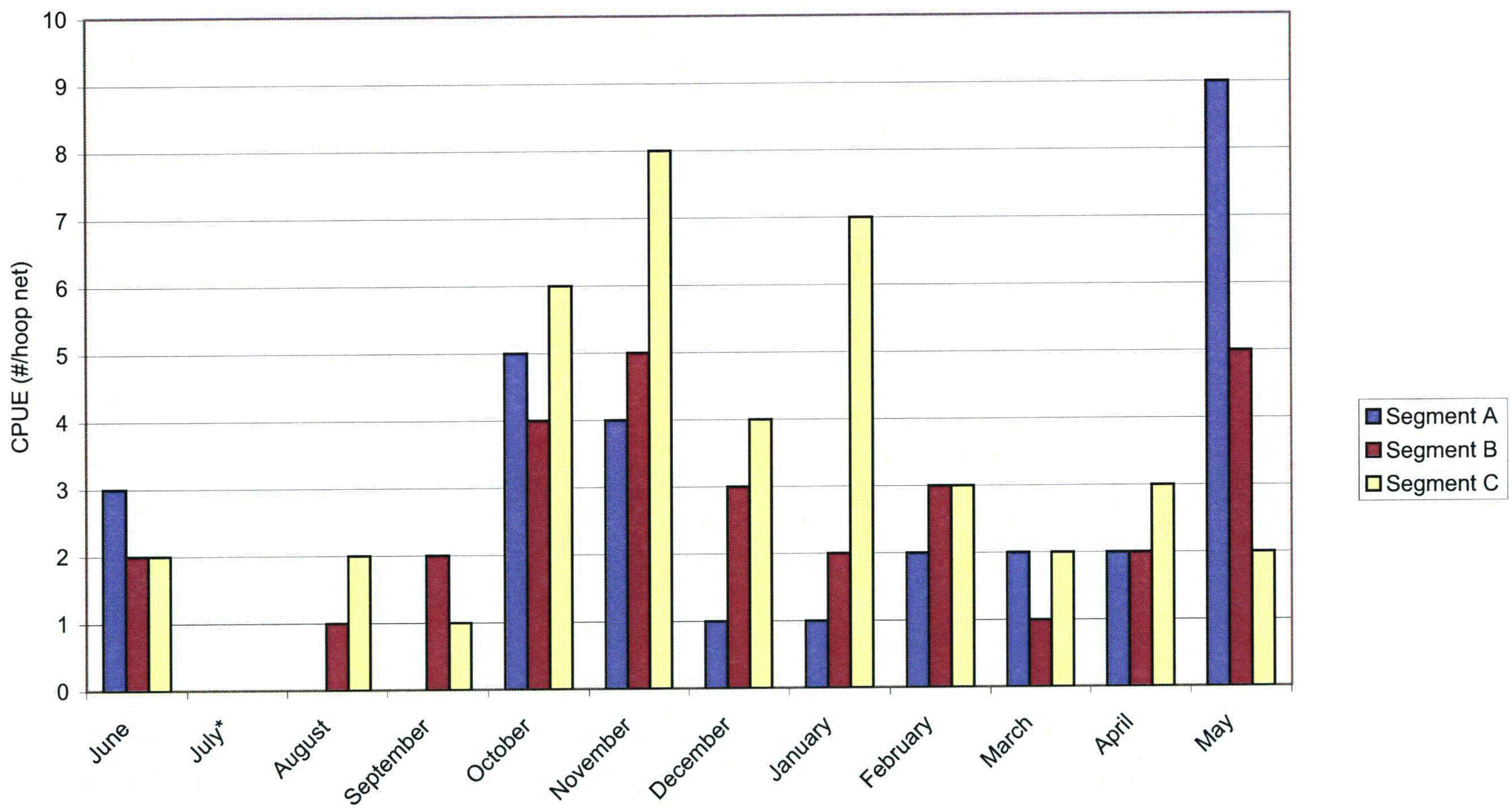


Figure 10. Monthly catch per unit of effort (CPUE) for hoop net samples in the lower Colorado River, 2007-2008.

* No July samples collected due to high river flows (>5,000 cfs).

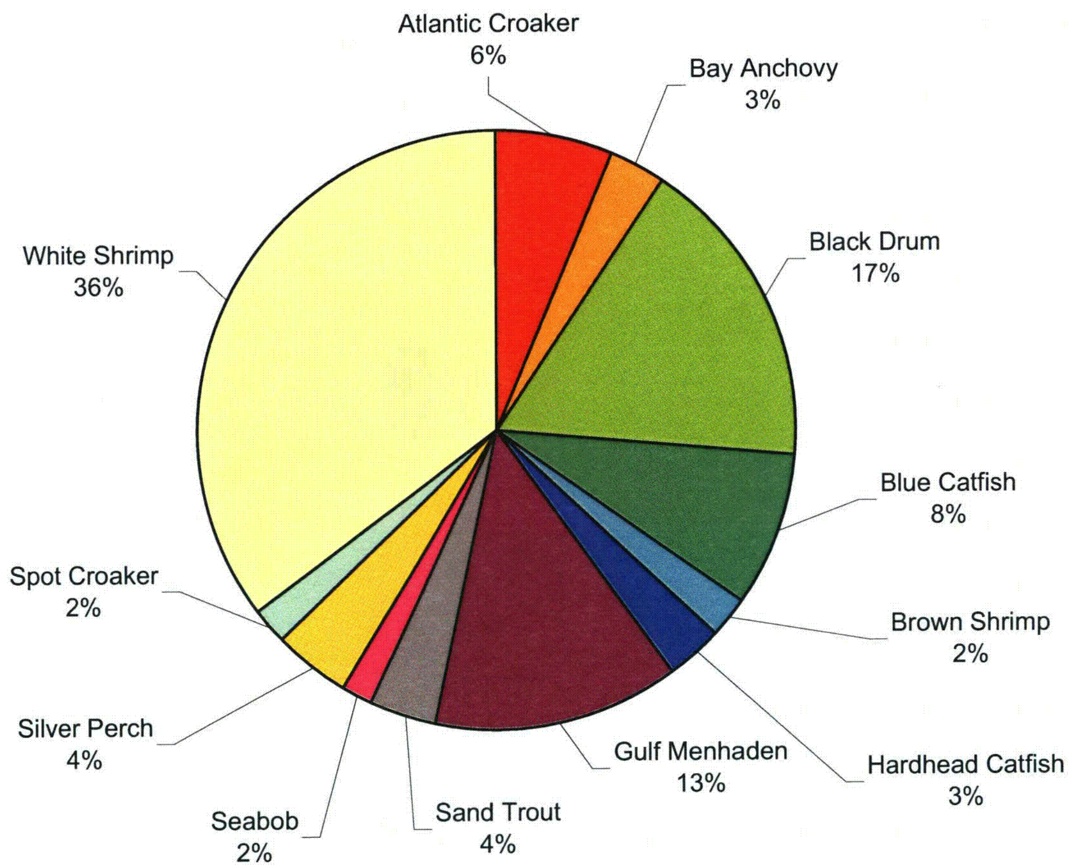


Figure 11. Composition of organisms representing >1% of trawl samples in the lower Colorado River, 2007-2008.

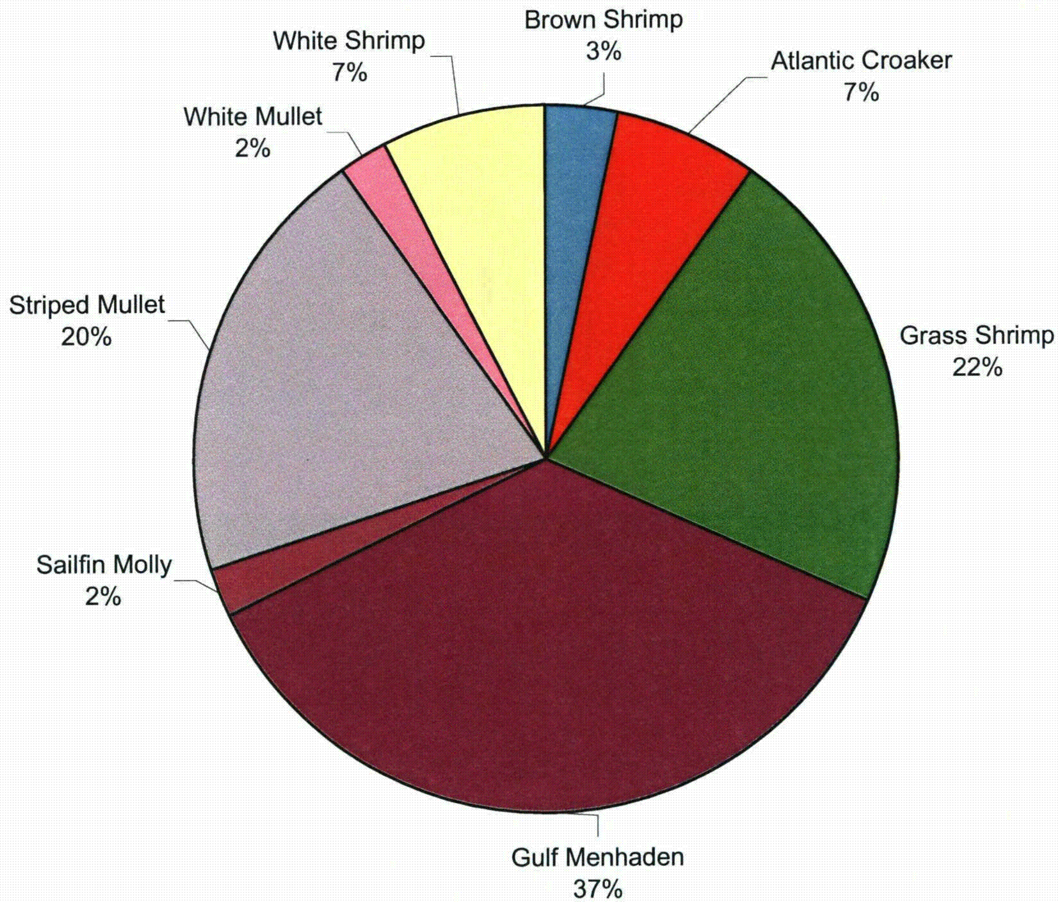


Figure 12. Composition of organisms representing >1% of bag seine samples in the lower Colorado River, 2007-2008.

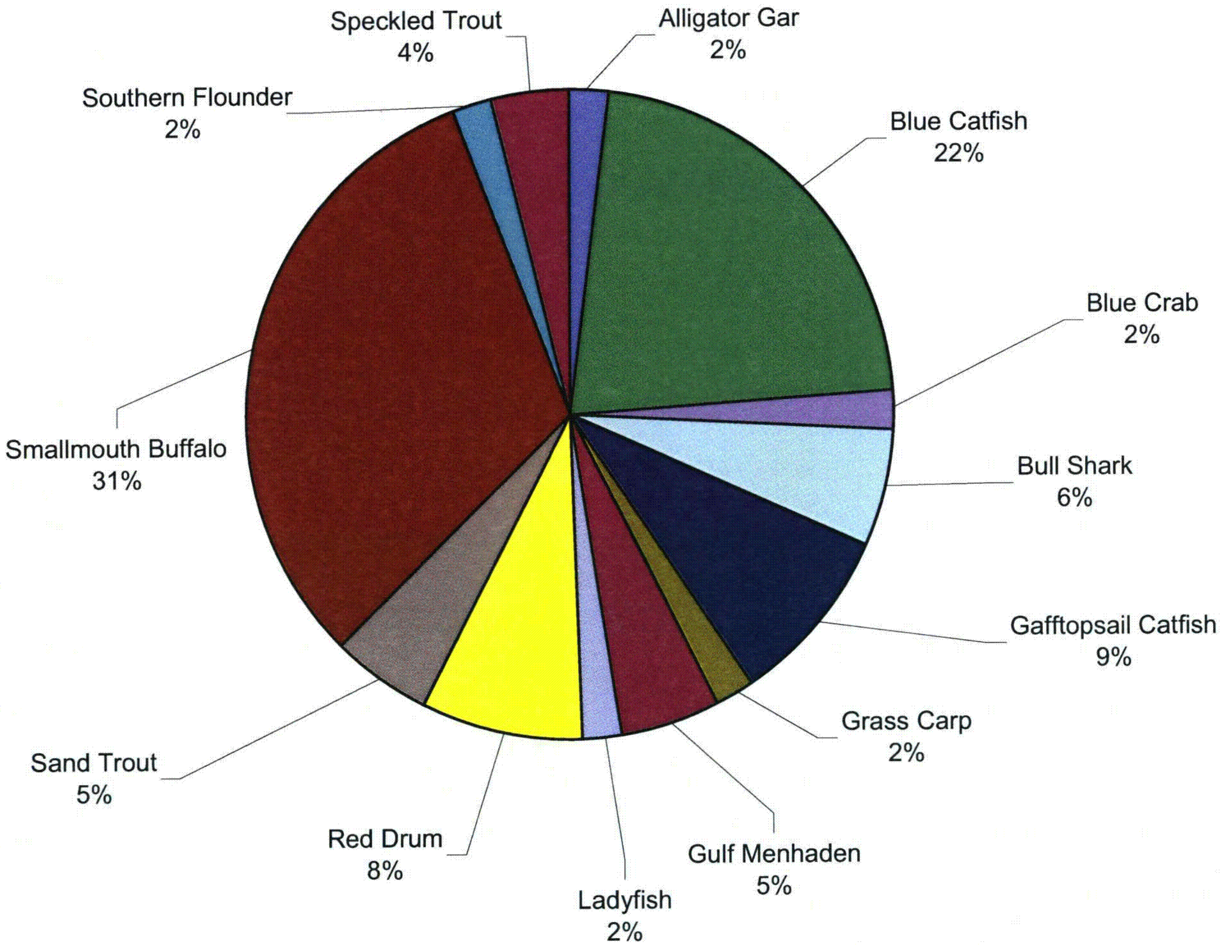


Figure 13. Composition of organisms representing >1% of gill net samples in the lower Colorado River, 2007-2008.

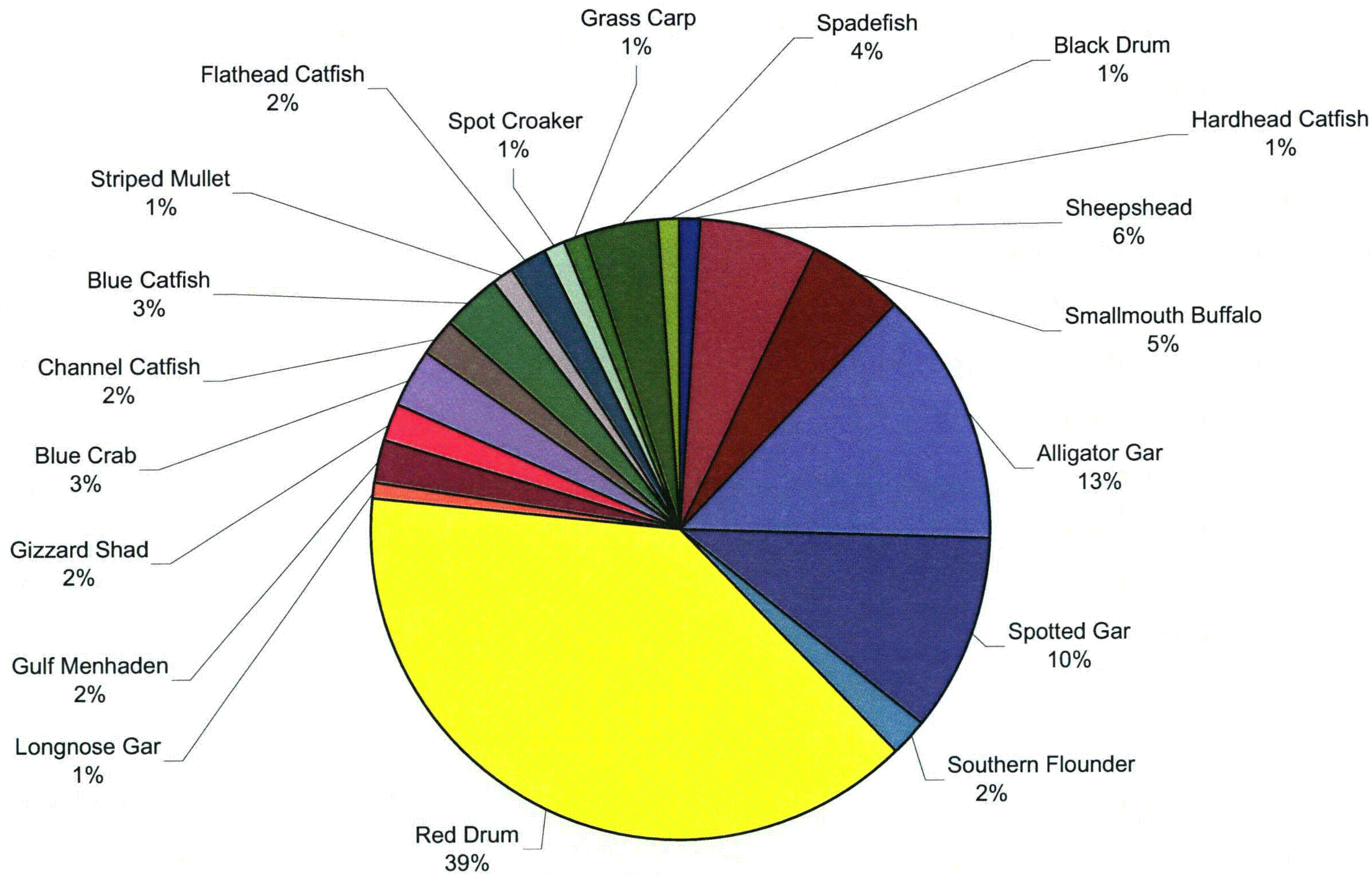


Figure 14. Composition of organisms representing >1% of hoop net samples in the lower Colorado River, 2007-2008.

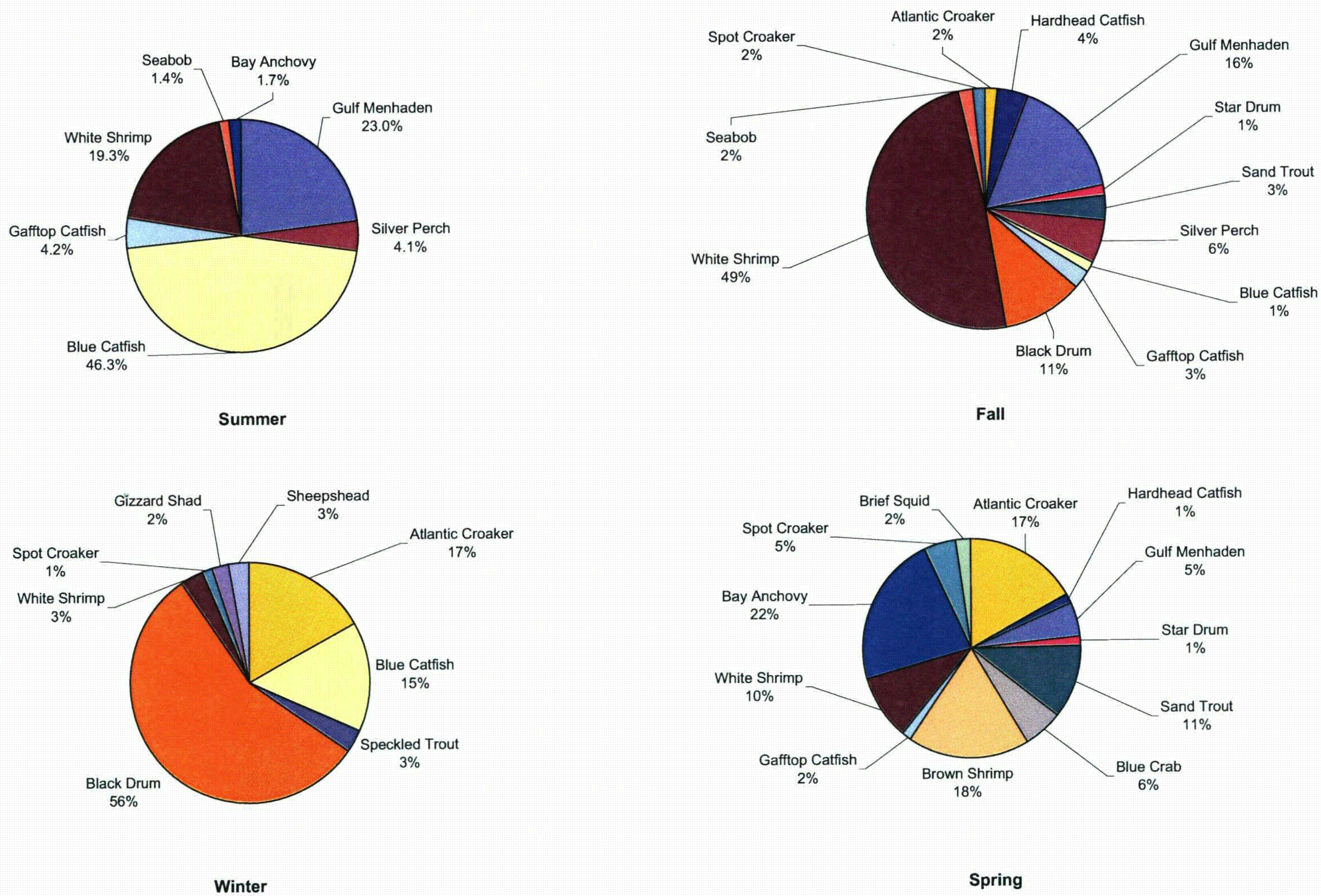


Figure 15. Seasonal composition of aquatic organisms representing >1% of trawl samples in the lower Colorado River, 2007-2008.

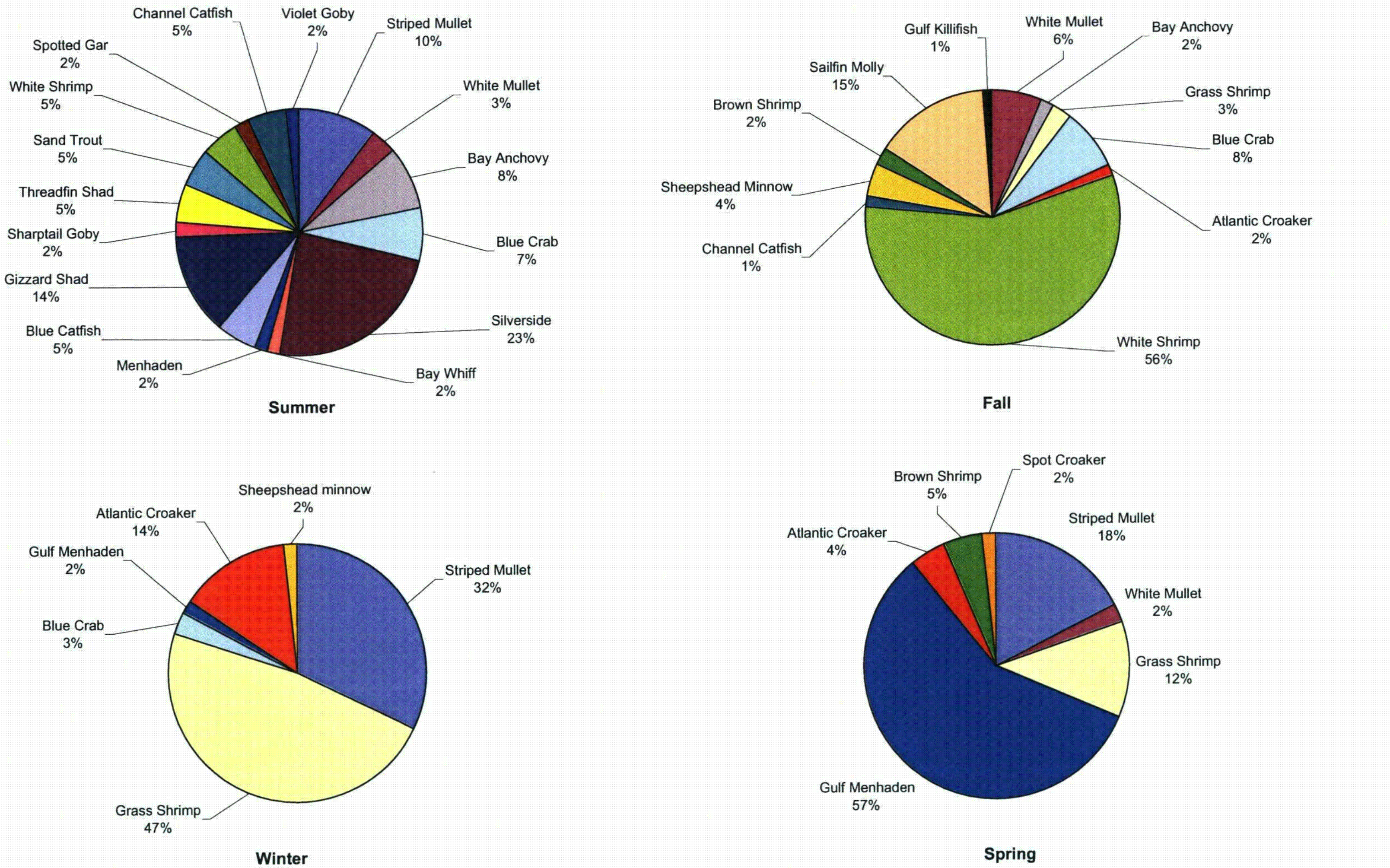


Figure 16. Seasonal composition of aquatic organisms representing >1% of bag seine samples in the lower Colorado River, 2007-2008.

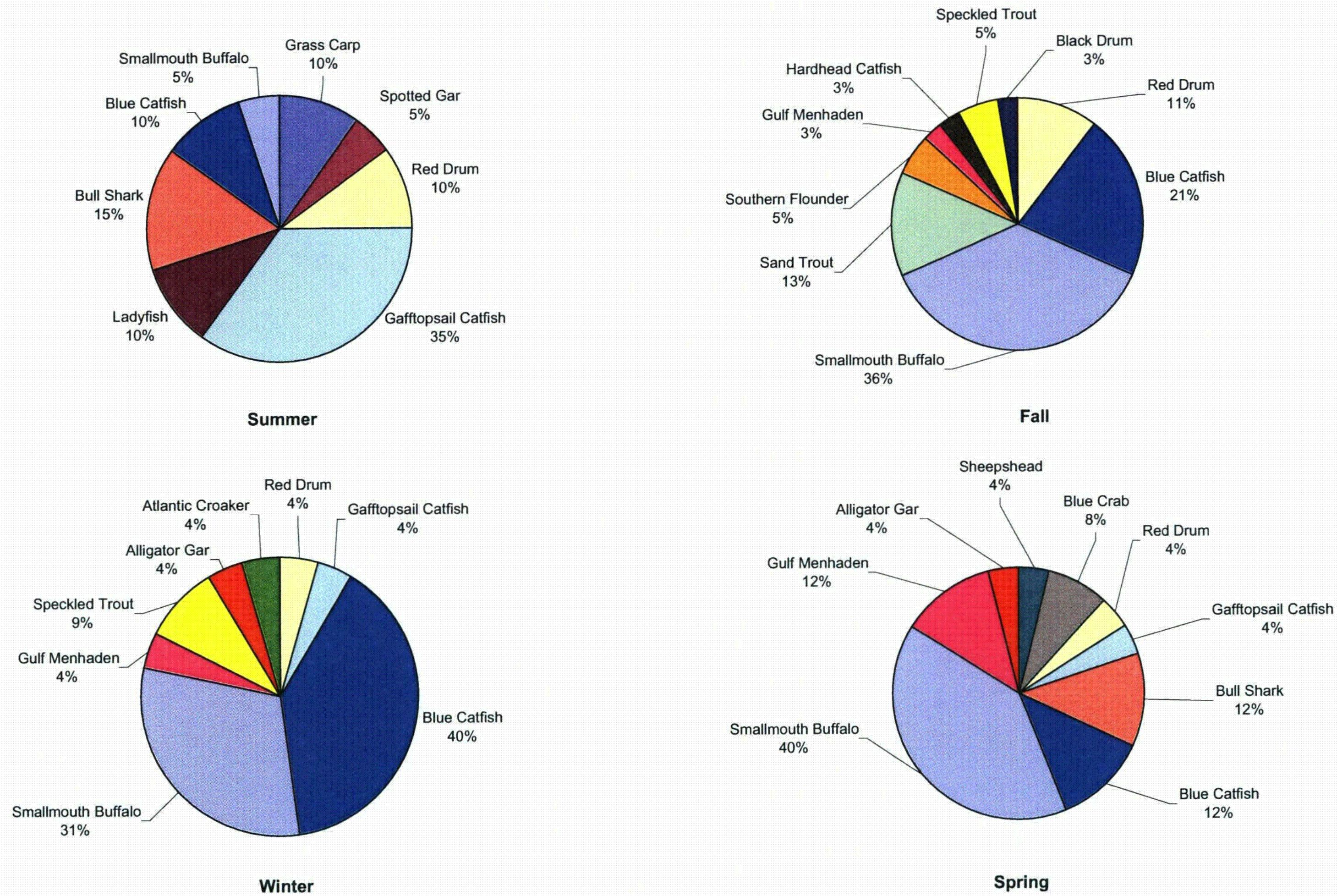


Figure 17. Seasonal composition of aquatic organisms representing >1% of gill net samples in the lower Colorado River, 2007-2008.

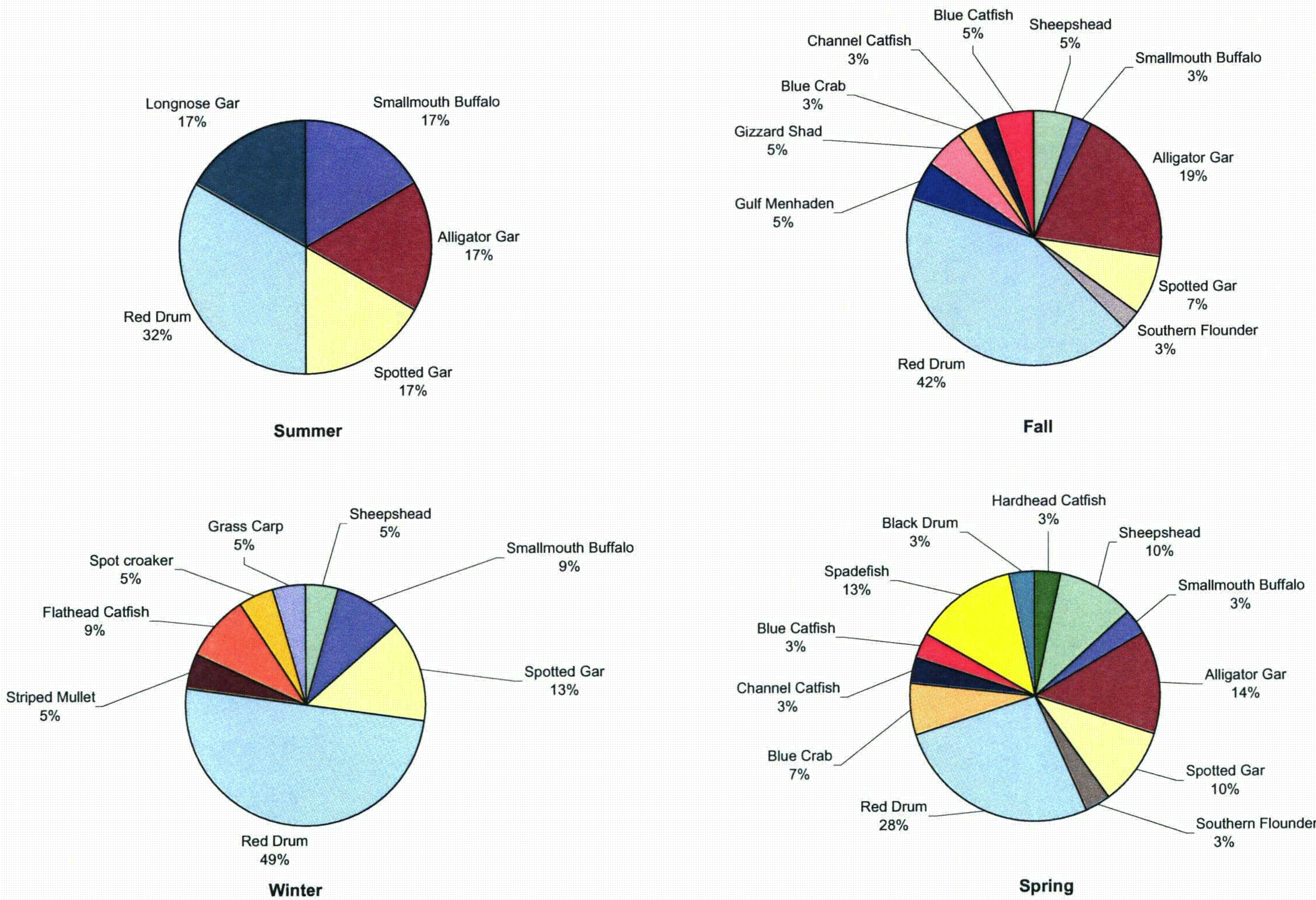
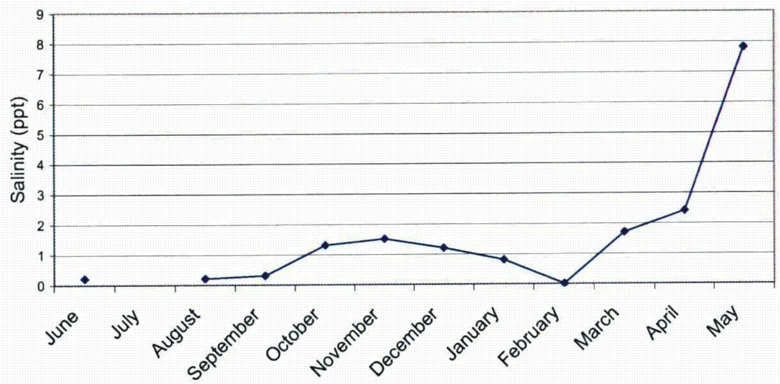
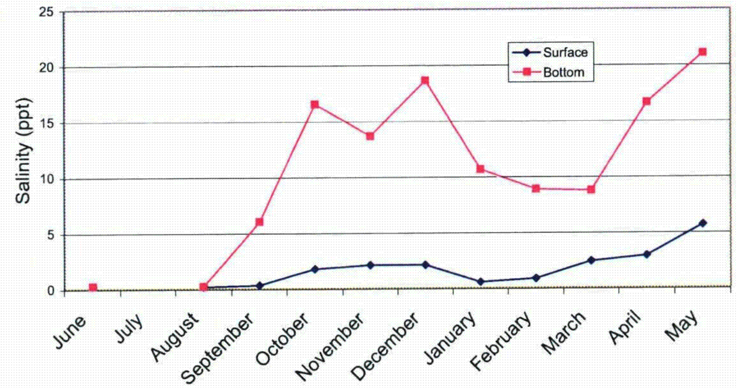


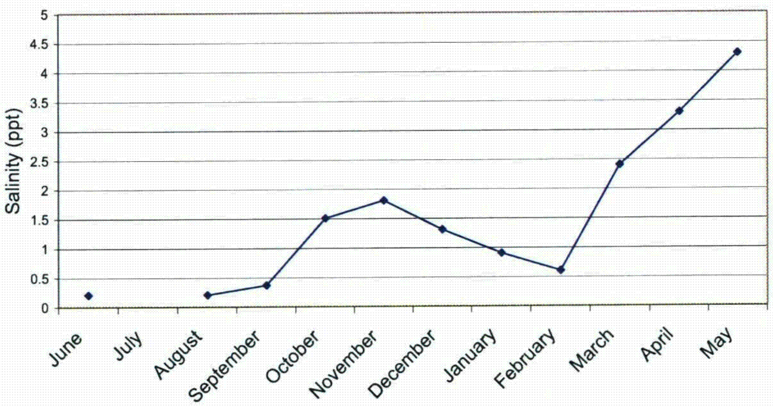
Figure 18. Seasonal composition of aquatic organisms representing >1% of hoop net samples in the lower Colorado River, 2007-2008.



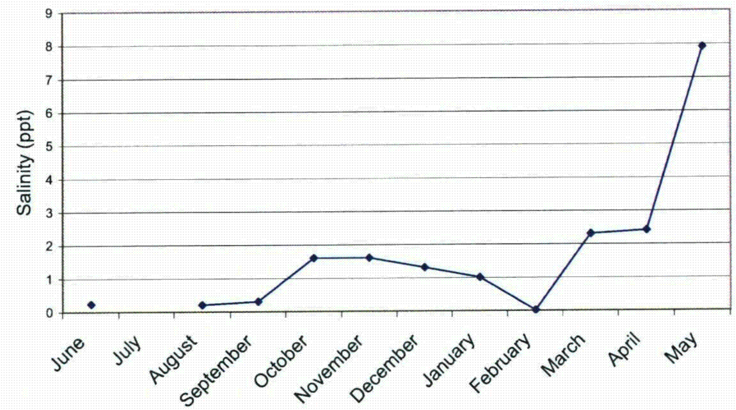
Gill Net



Trawl



Bag Seine



Hoop Net

Figure 19. Average salinity by gear for sample locations on the lower Colorado River, 2007-2008.

* No July samples collected due to high river flows (>5,000 cfs).

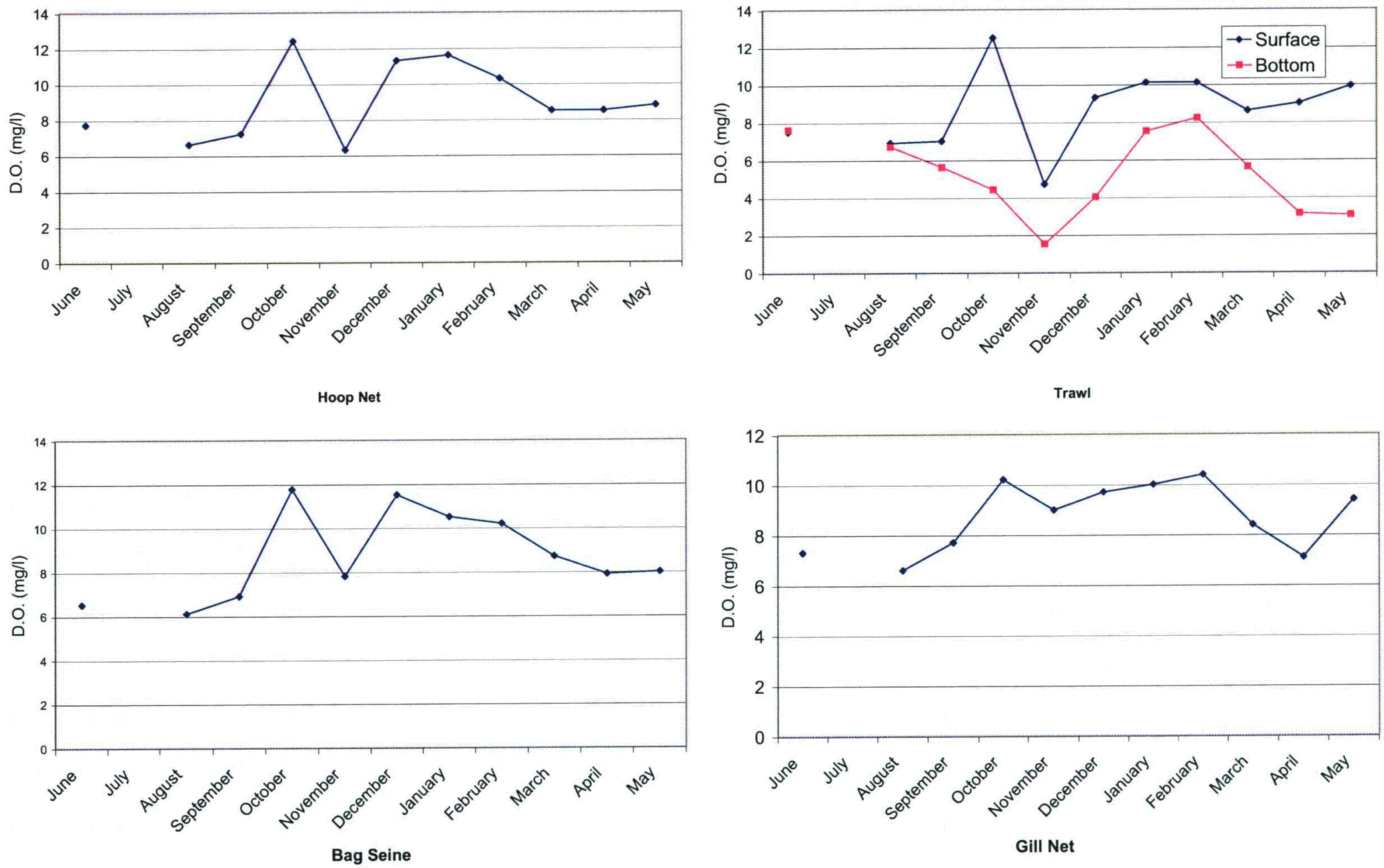


Figure 20. Average dissolved oxygen by gear for sample locations on the lower Colorado River, 2007-2008.

* No July samples collected due to high river flows (>5,000 cfs).

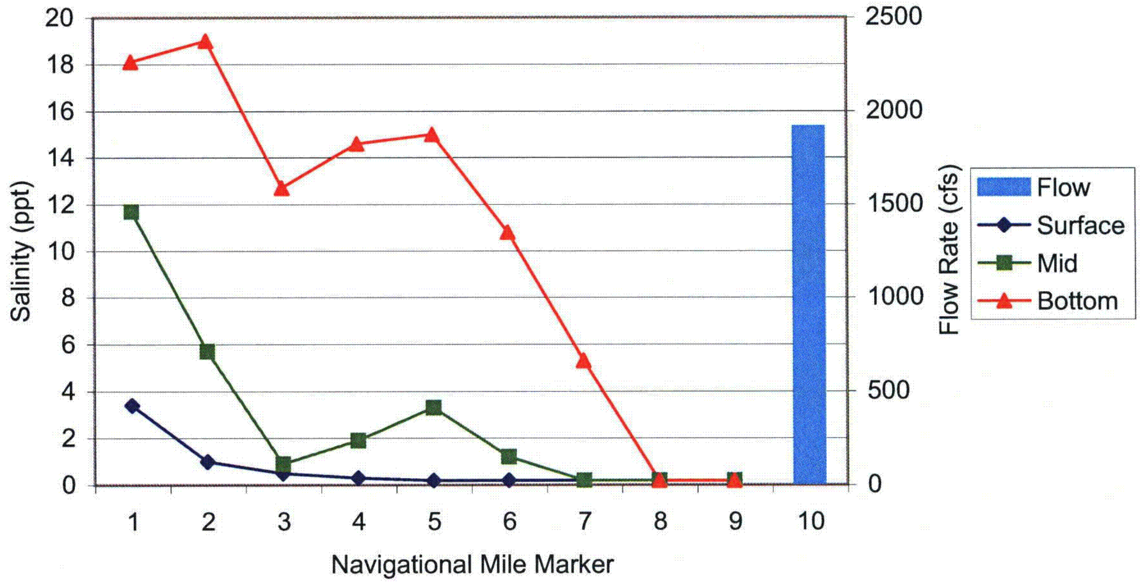


Figure 21. September salinity readings from navigational mile marker locations on the lower Colorado River compared to the mean monthly river flow rate, 2007-2008.

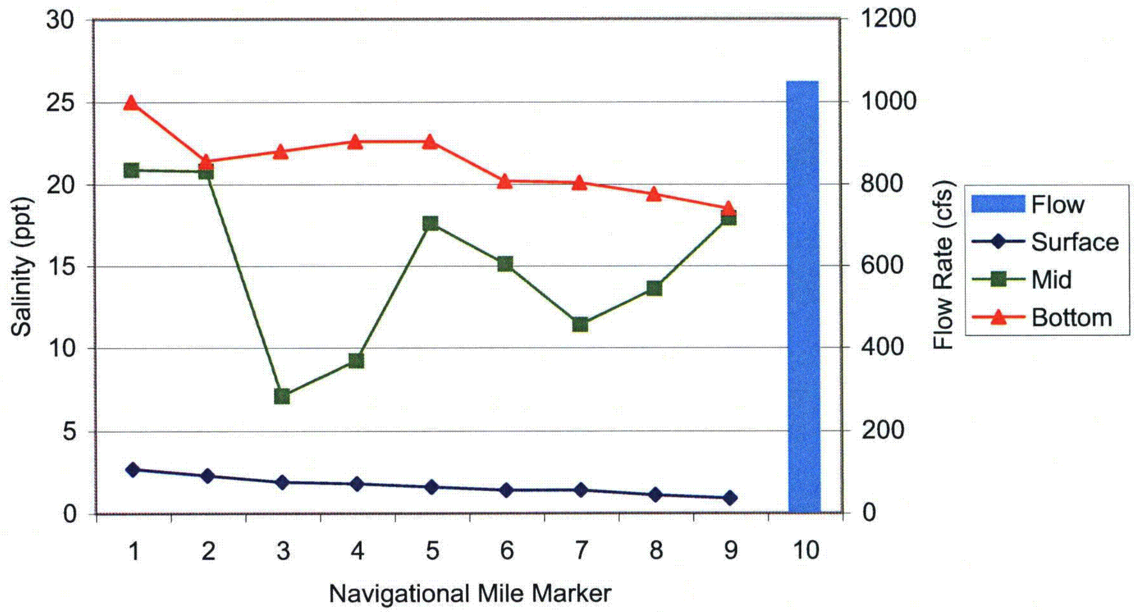


Figure 22. October salinity readings from navigational mile marker locations on the lower Colorado River compared to the mean monthly river flow rate, 2007-2008.

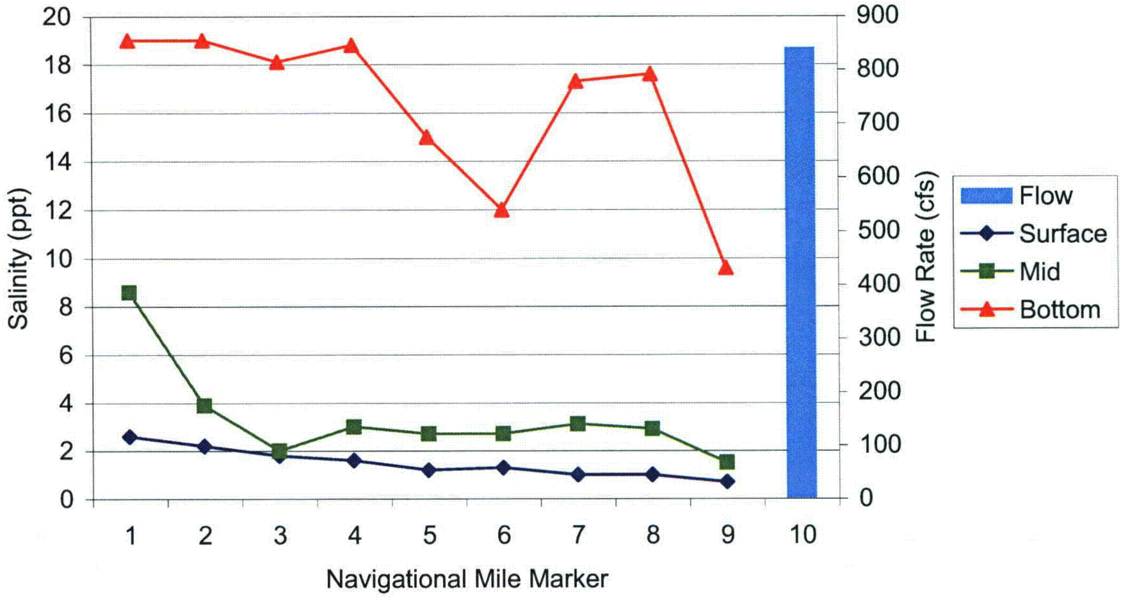


Figure 23. November salinity readings from navigational mile marker locations on the lower Colorado River compared to the mean montly flow rate, 2007-2008.

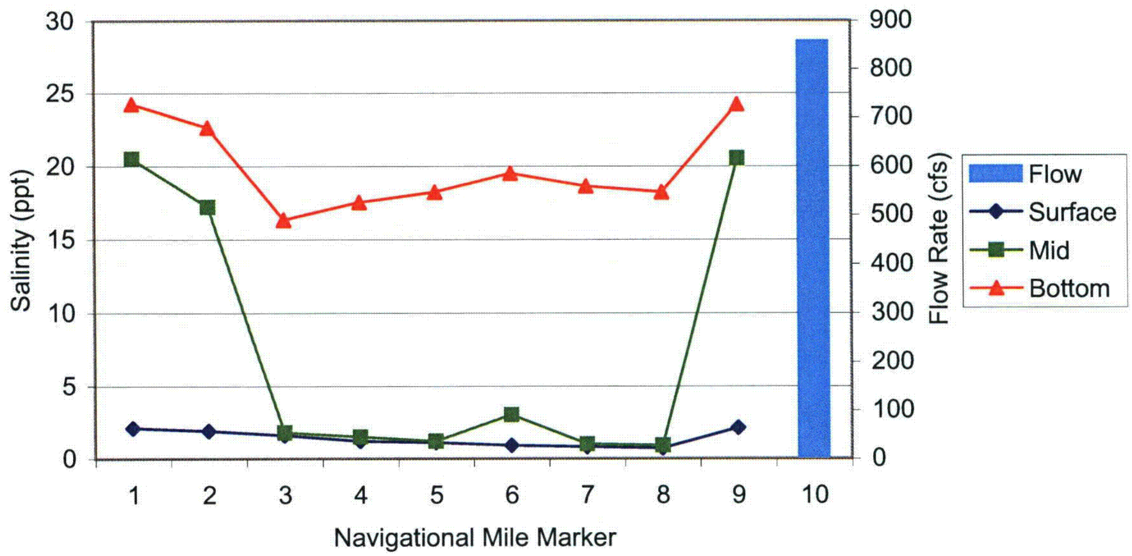


Figure 24. December salinity readings from navigational mile marker locations on the lower Colorado River compared to the mean montly flow rate, 2007-2008.

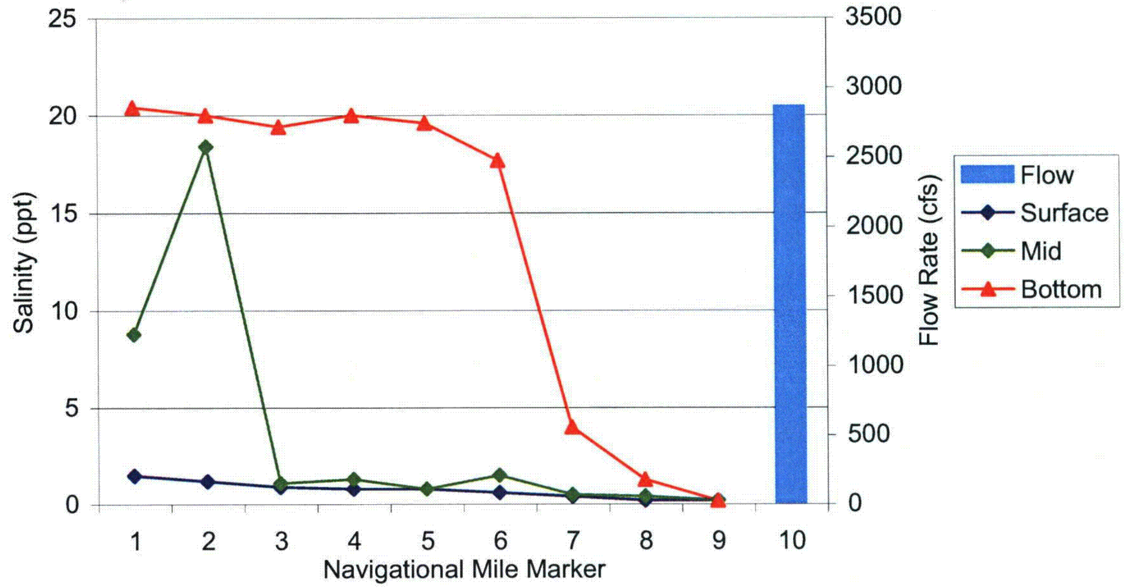


Figure 25. January salinity readings from navigational mile marker locations on the lower Colorado River compared to the mean monthly flow rate, 2007-2008.

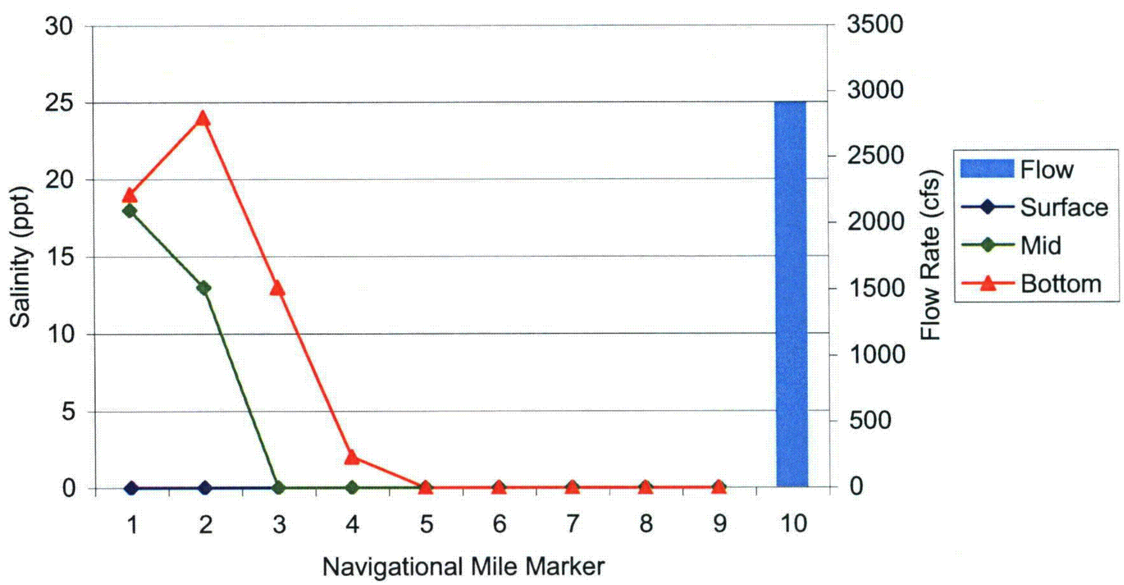


Figure 26. February salinity readings from navigations mile marker locations on the lower Colorado River compared to the mean montly flow rate, 2007-2008.

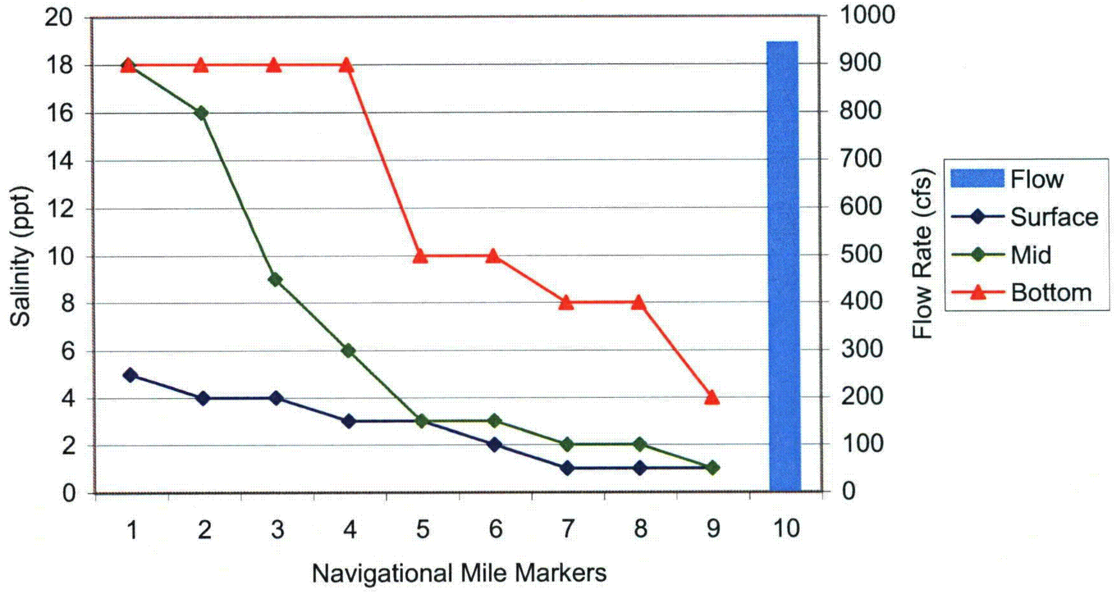


Figure 27. March salinity readings from navigational mile marker locations on the lower Colorado River compared to the mean montly flow rate, 2007-2008.

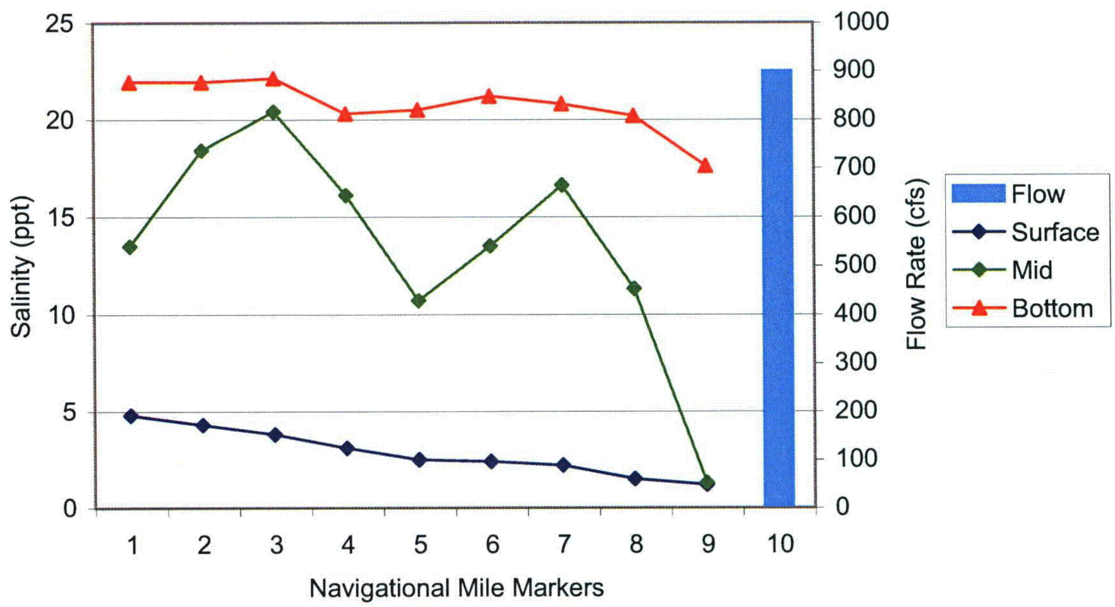


Figure 28. April salinity readings from navigational mile marker locations on the lower Colorado River compared to the mean monthly flow rate, 2007-2008.

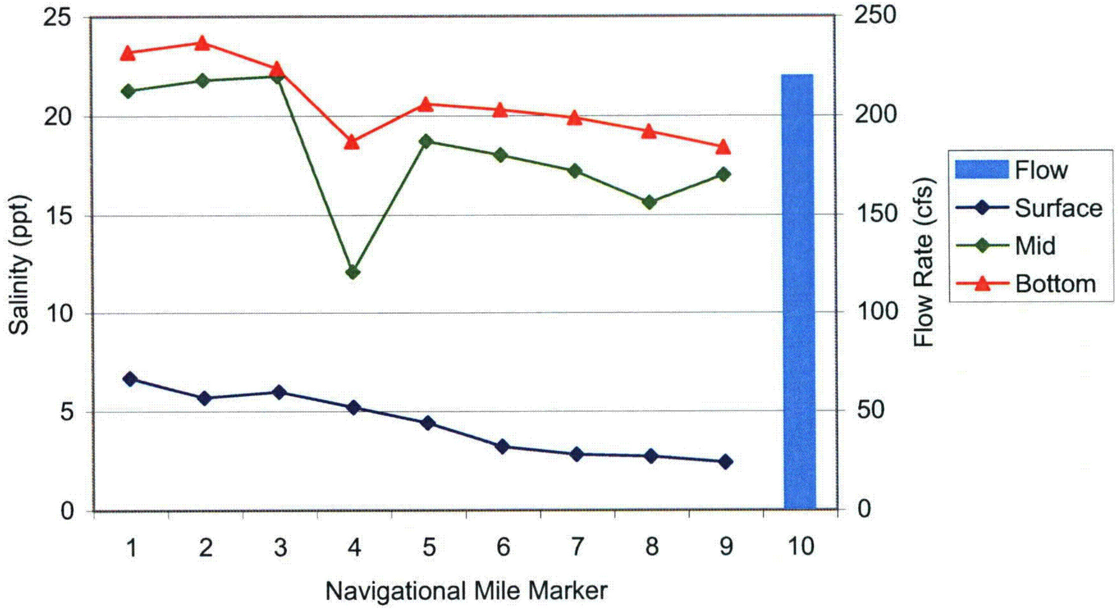


Figure 29. May salinity readings from navigational mile marker locations on the lower Colorado River compared with to mean montly flow rate, 2007-2008.

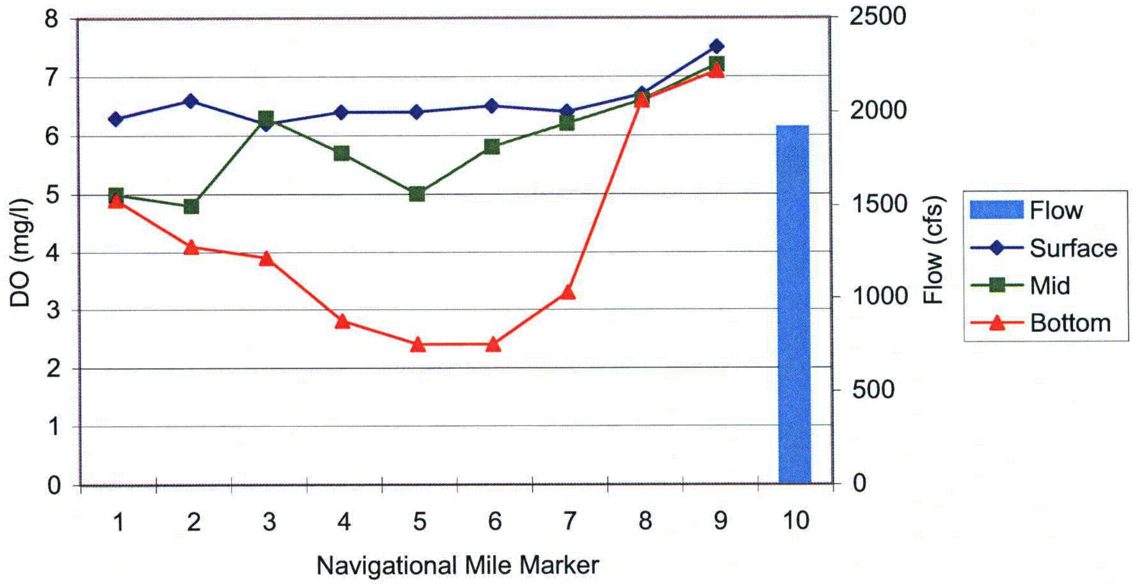


Figure 30. September dissolved oxygen readings from navigational mile marker locations on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

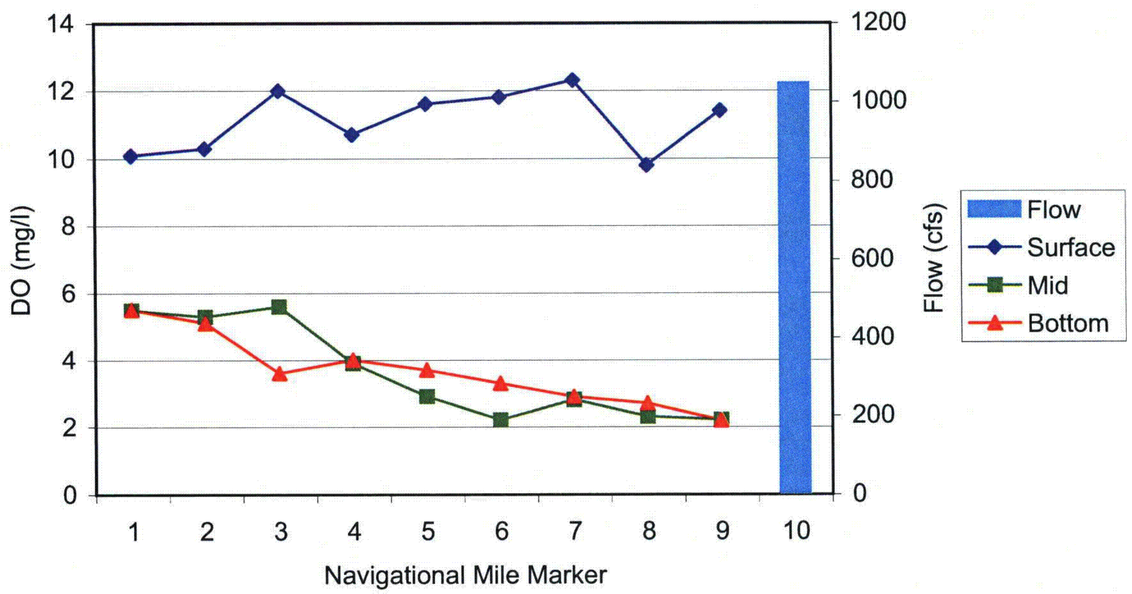


Figure 31. October dissolved oxygen readings from navigational mile marker locations on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

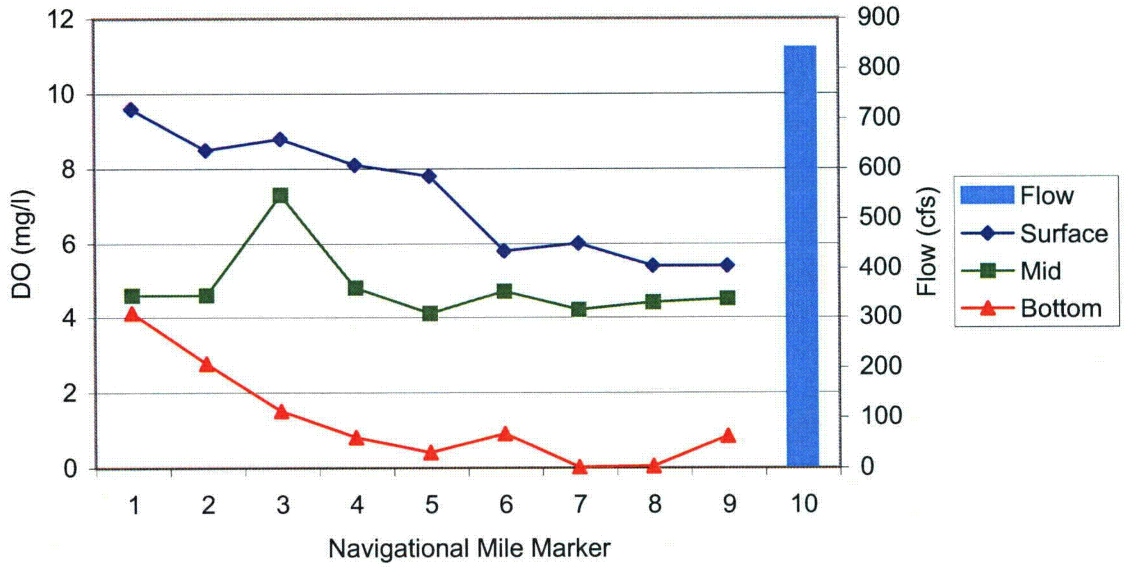


Figure 32. November dissolved oxygen readings from navigational mile marker locations on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

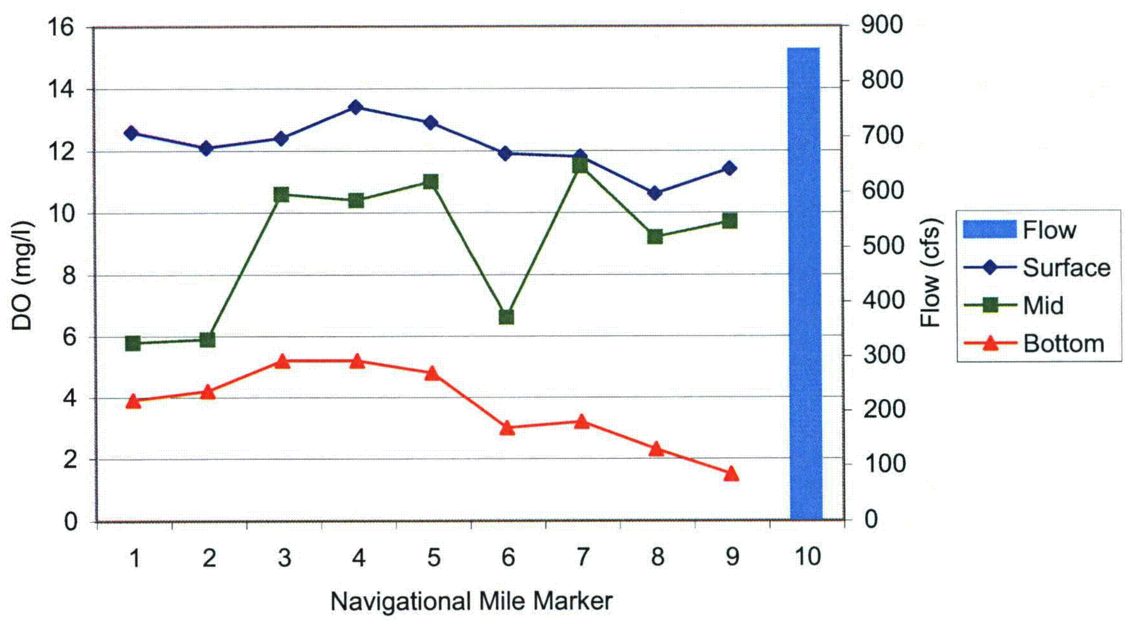


Figure 33. December dissolved oxygen readings from navigational mile marker on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

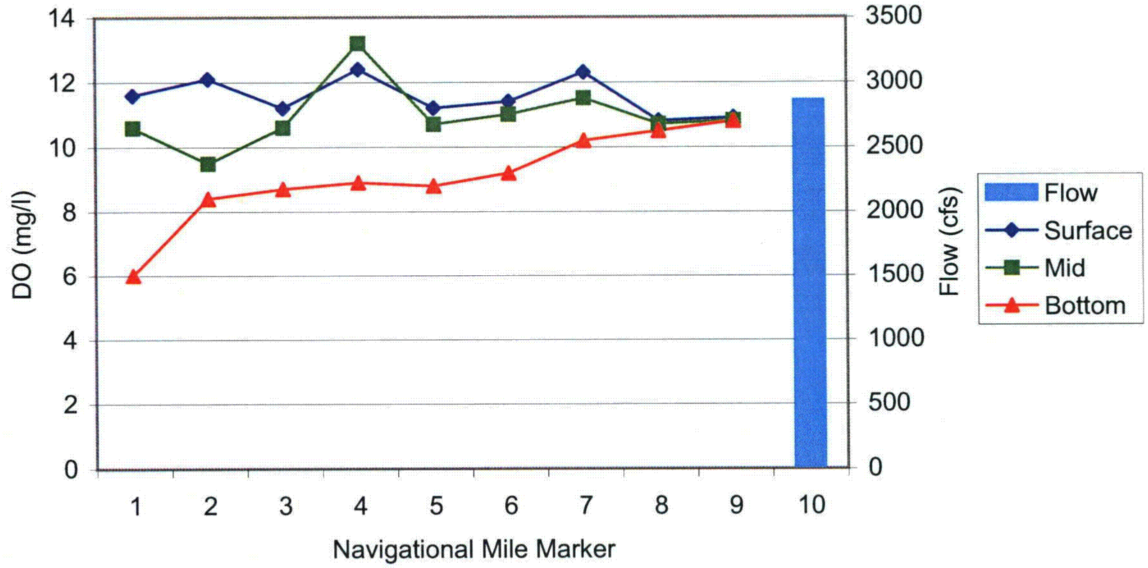


Figure 34. January dissolved oxygen readings from navigational mile marker on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

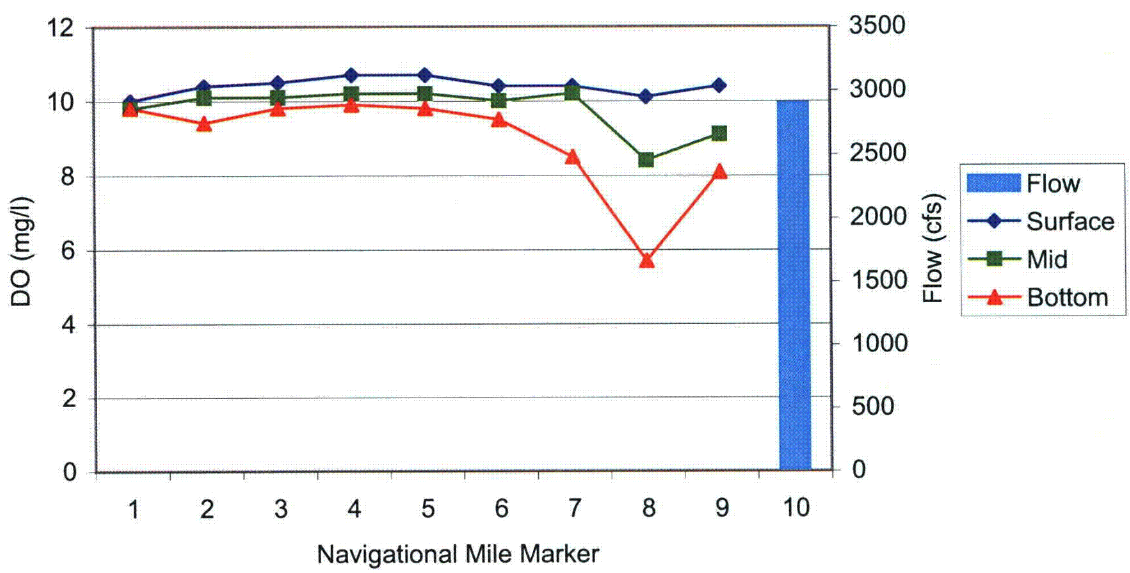


Figure 35. February dissolved oxygen readings from navigational mile marker on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

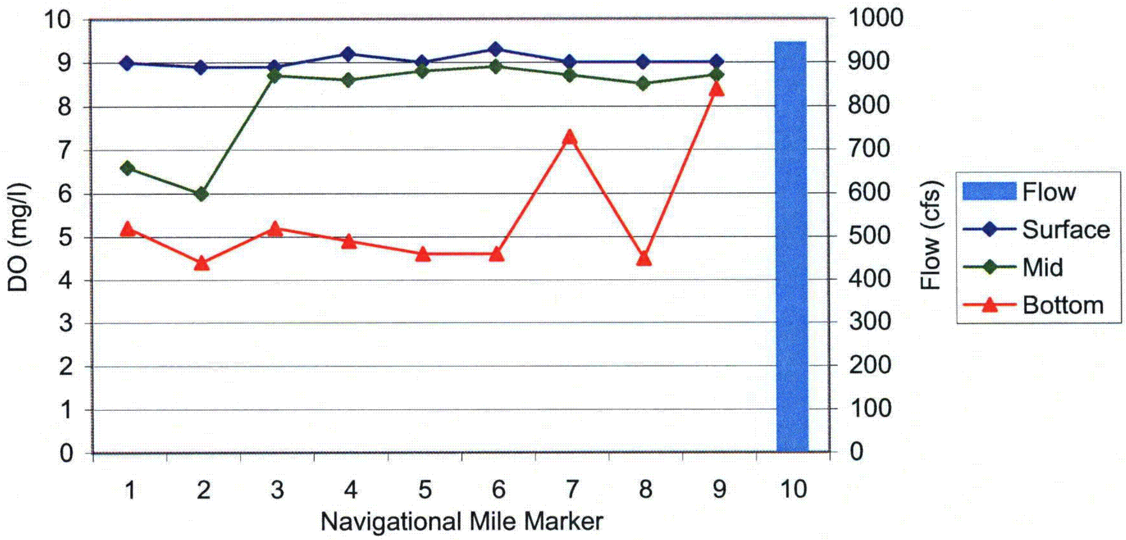


Figure 36. March dissolved oxygen readings from navigational mile marker on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

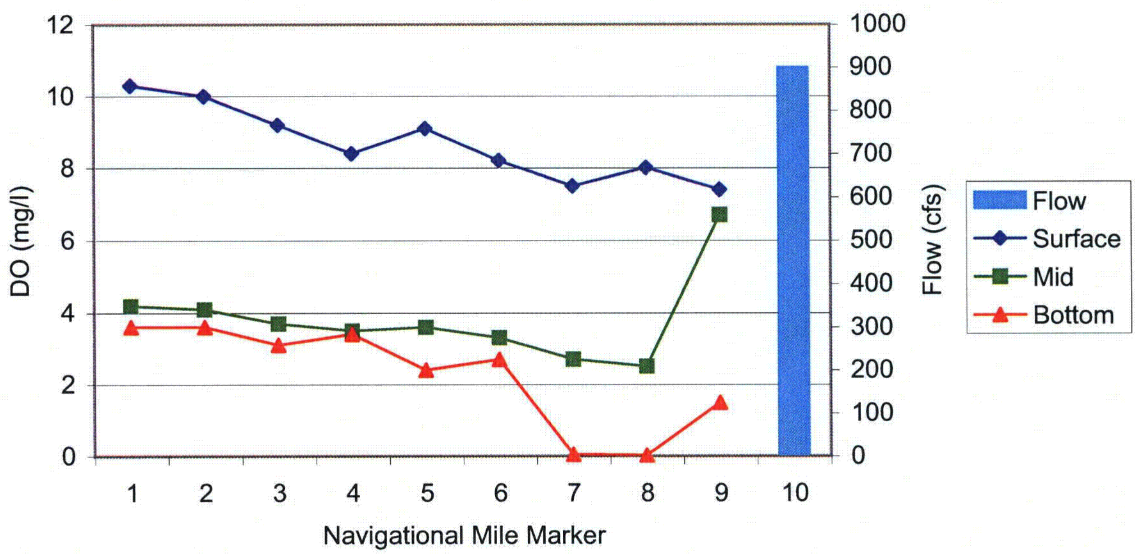


Figure 37. April dissolved oxygen readings from navigational mile marker on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

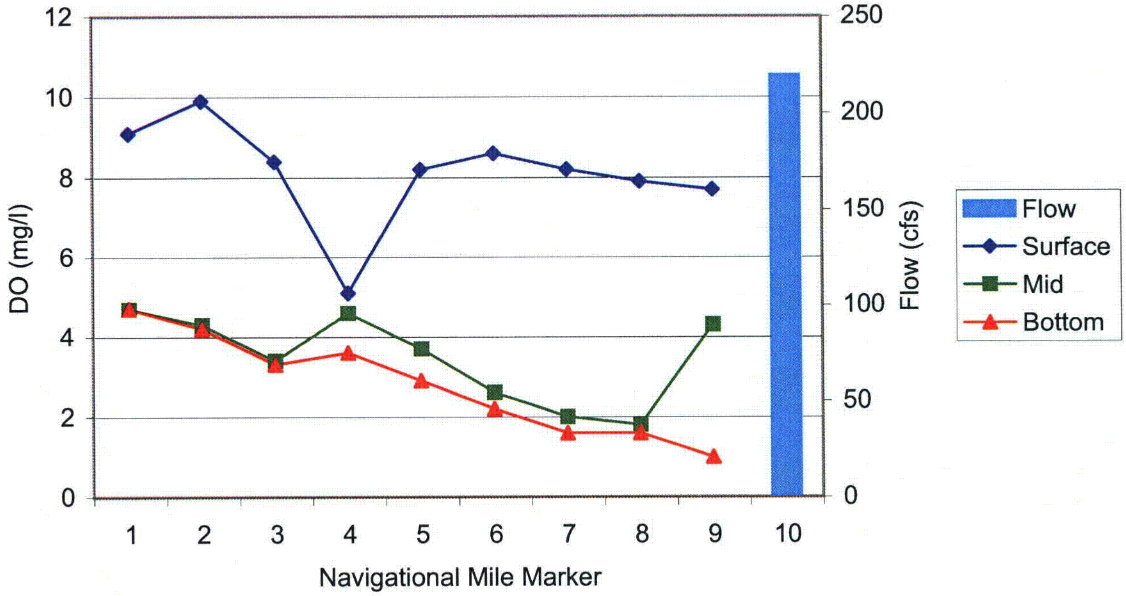


Figure 38. May dissolved oxygen readings from navigational mile marker on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

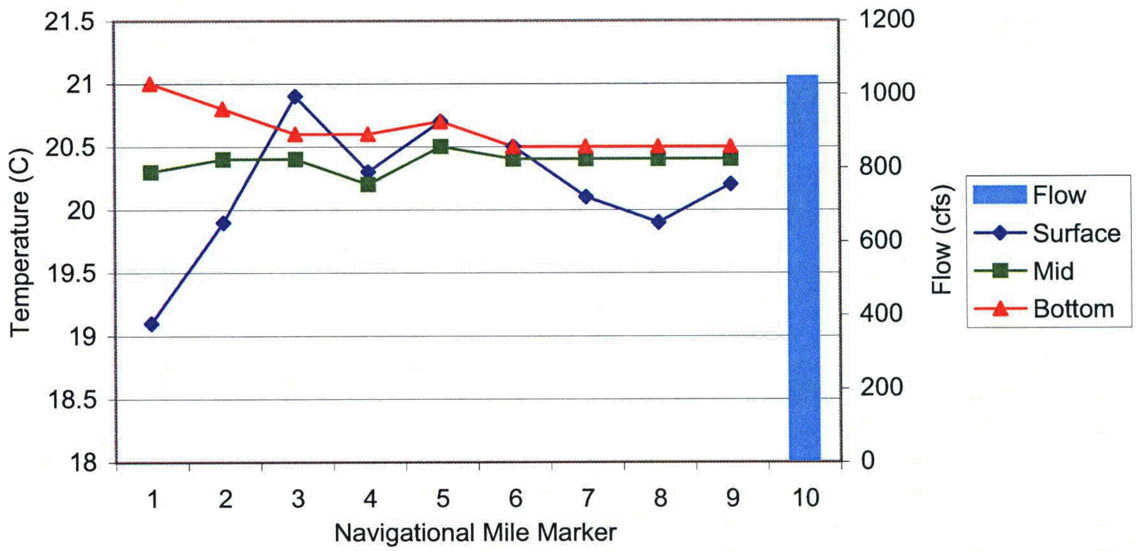


Figure 39. October temperature readings from navigational mile marker locations on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

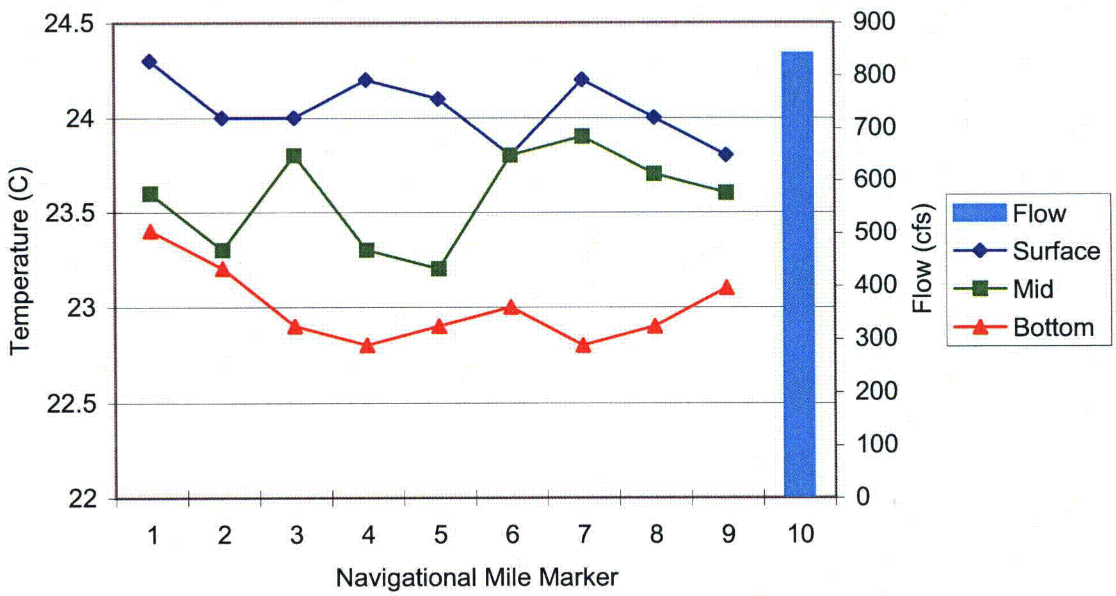


Figure 40. November temperature readings from navigational mile marker locations on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

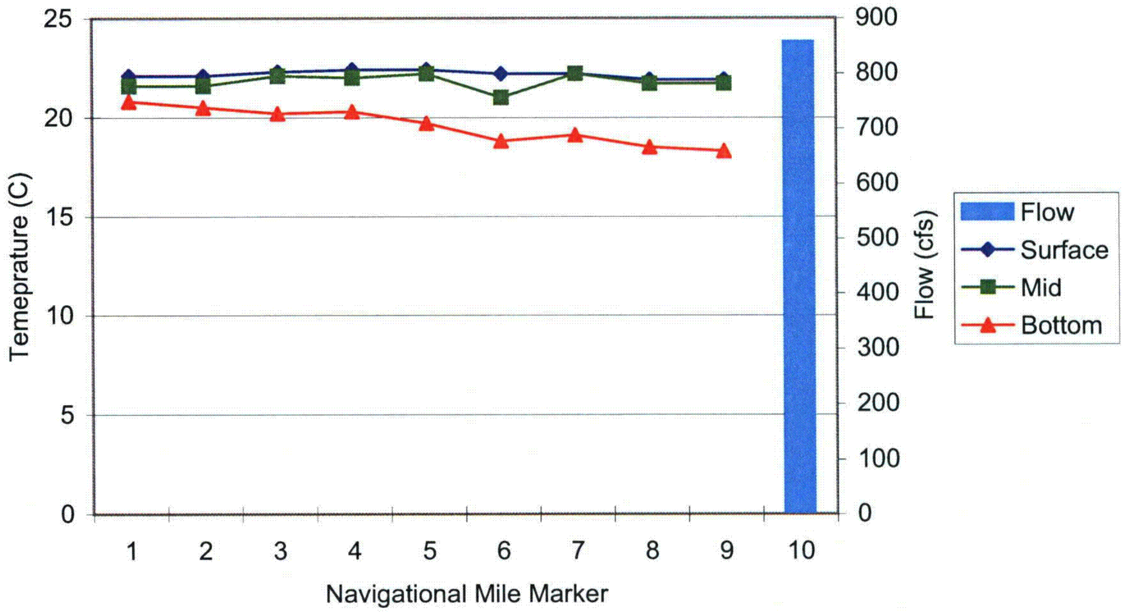


Figure 41. December temperature readings from navigational mile marker locations on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

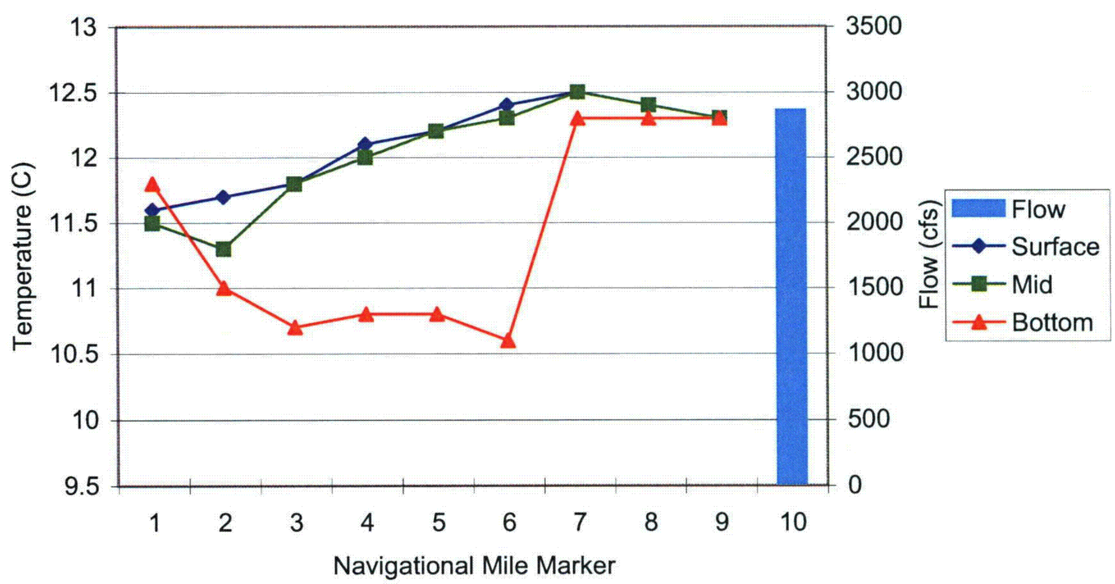


Figure 42. January temperature readings from navigational mile marker locations on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

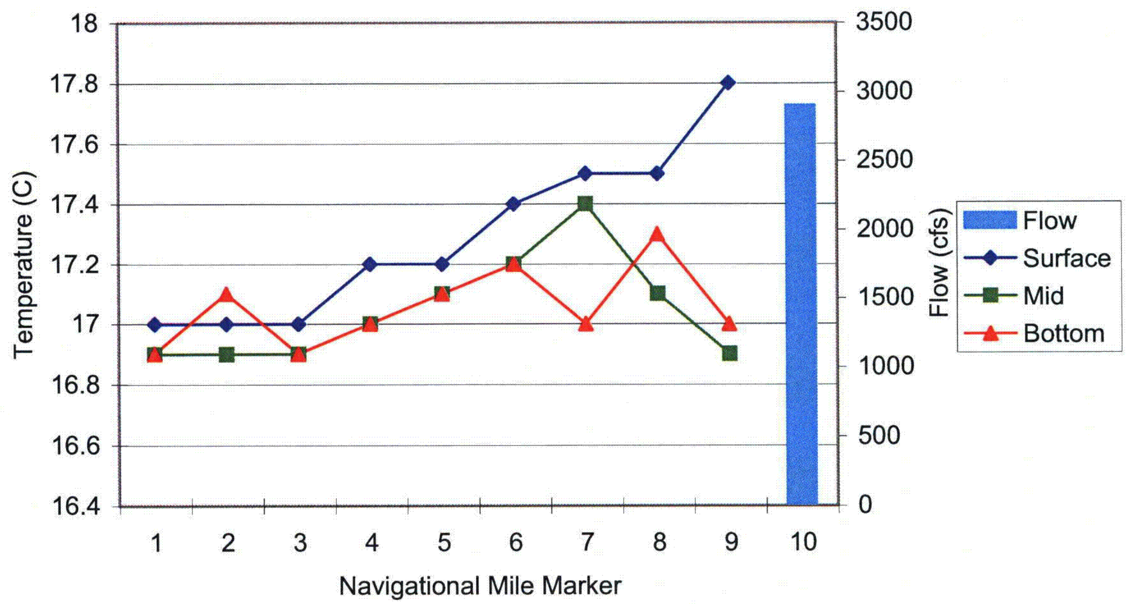


Figure 43. February temperature readings for navigatinal mile marker locations on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

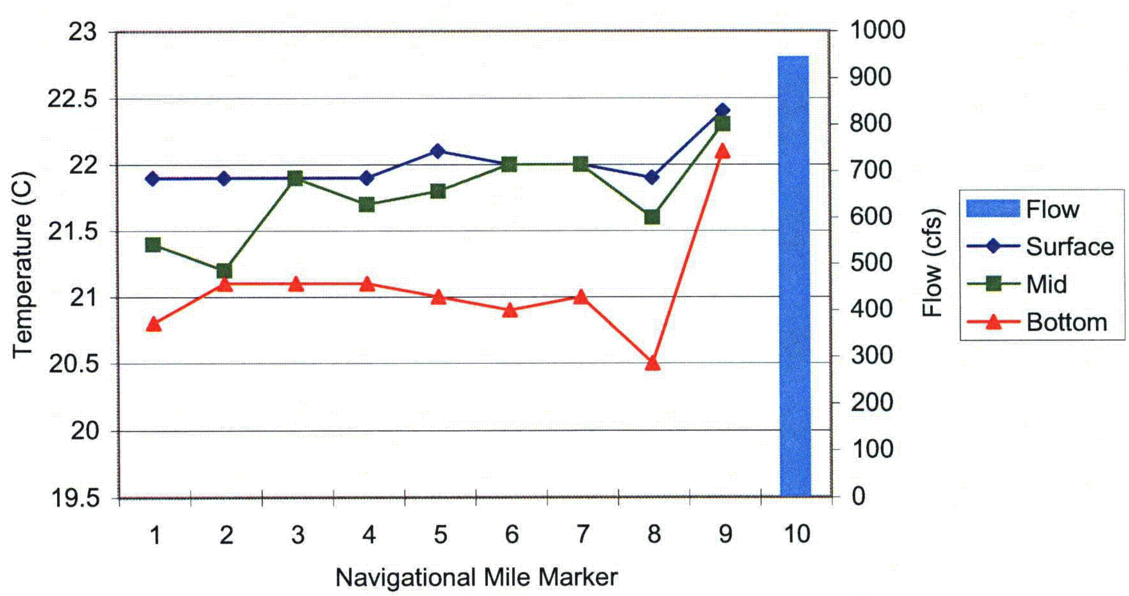


Figure 44. March temperature readings for navigational mile marker locations on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

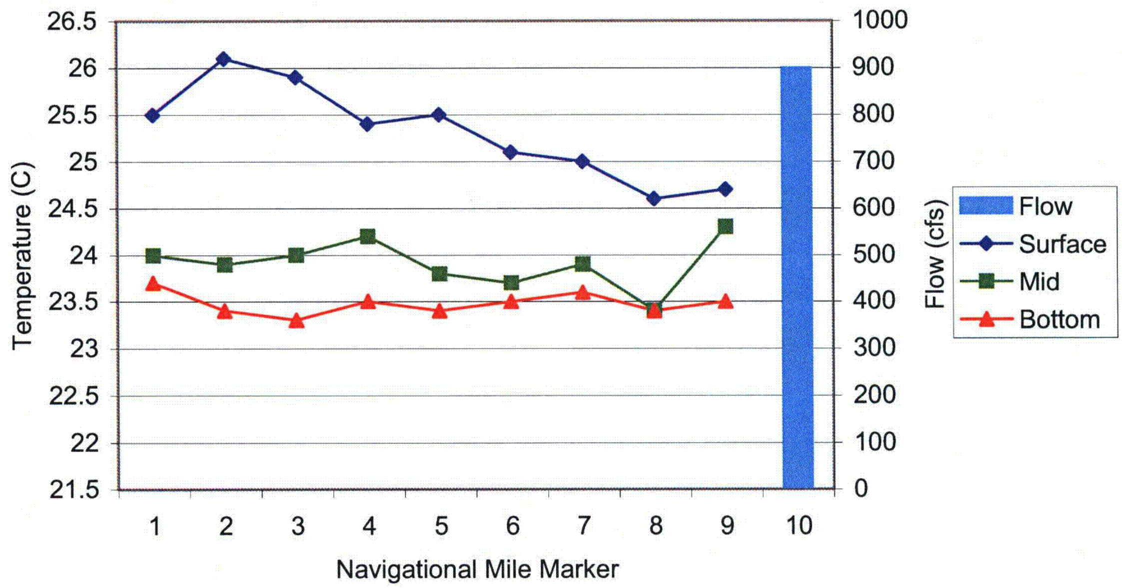


Figure 45. April temperature readings for navigational mile marker locations on the Colorado River compared to mean monthly flow rate, 2007-2008.

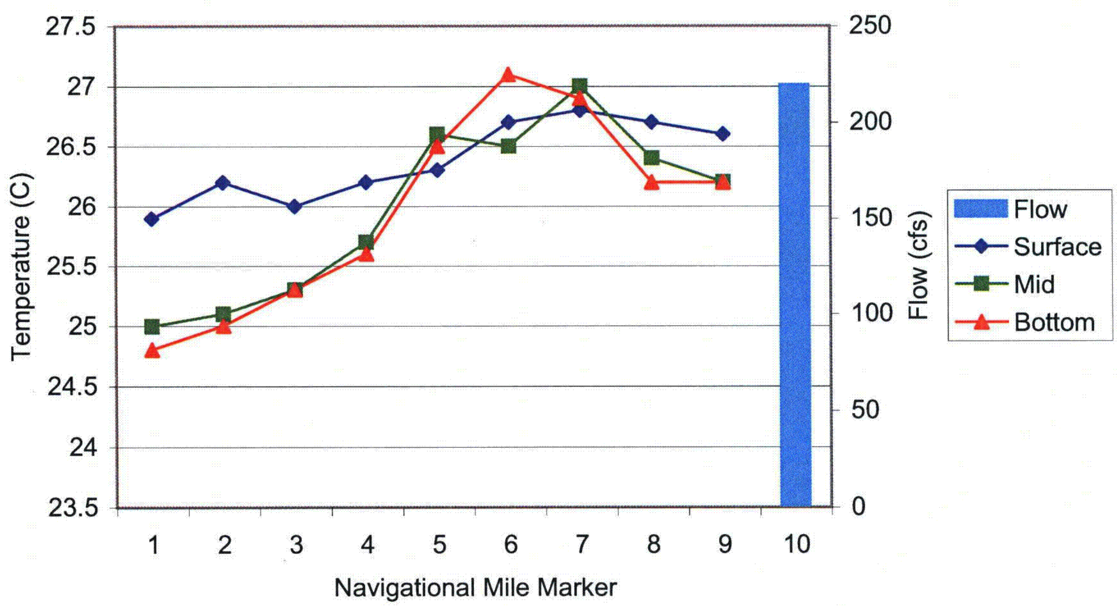


Figure 46. May temperature readings from navigational mile marker locations on the lower Colorado River compared to mean monthly flow rate, 2007-2008.

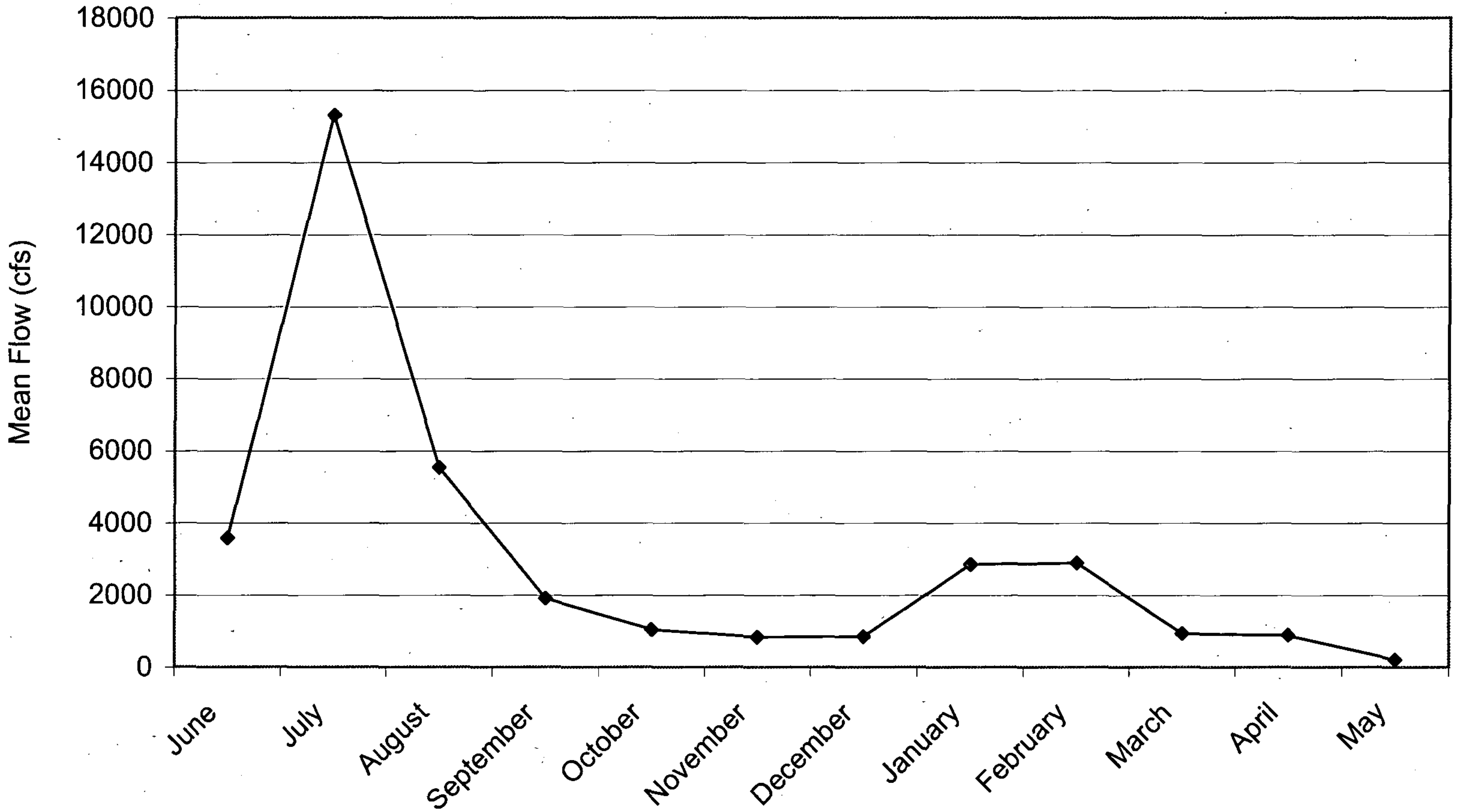


Figure 47. Monthly mean flow rates for the lower Colorado River during each sampling event, 2007 to 2008 (USGS 08162500 Colorado Rv NR Bay City, TX).

* No samples collected during July due to high river flow (>5,000 cfs).
Data point represents time period sample event would have been collected.

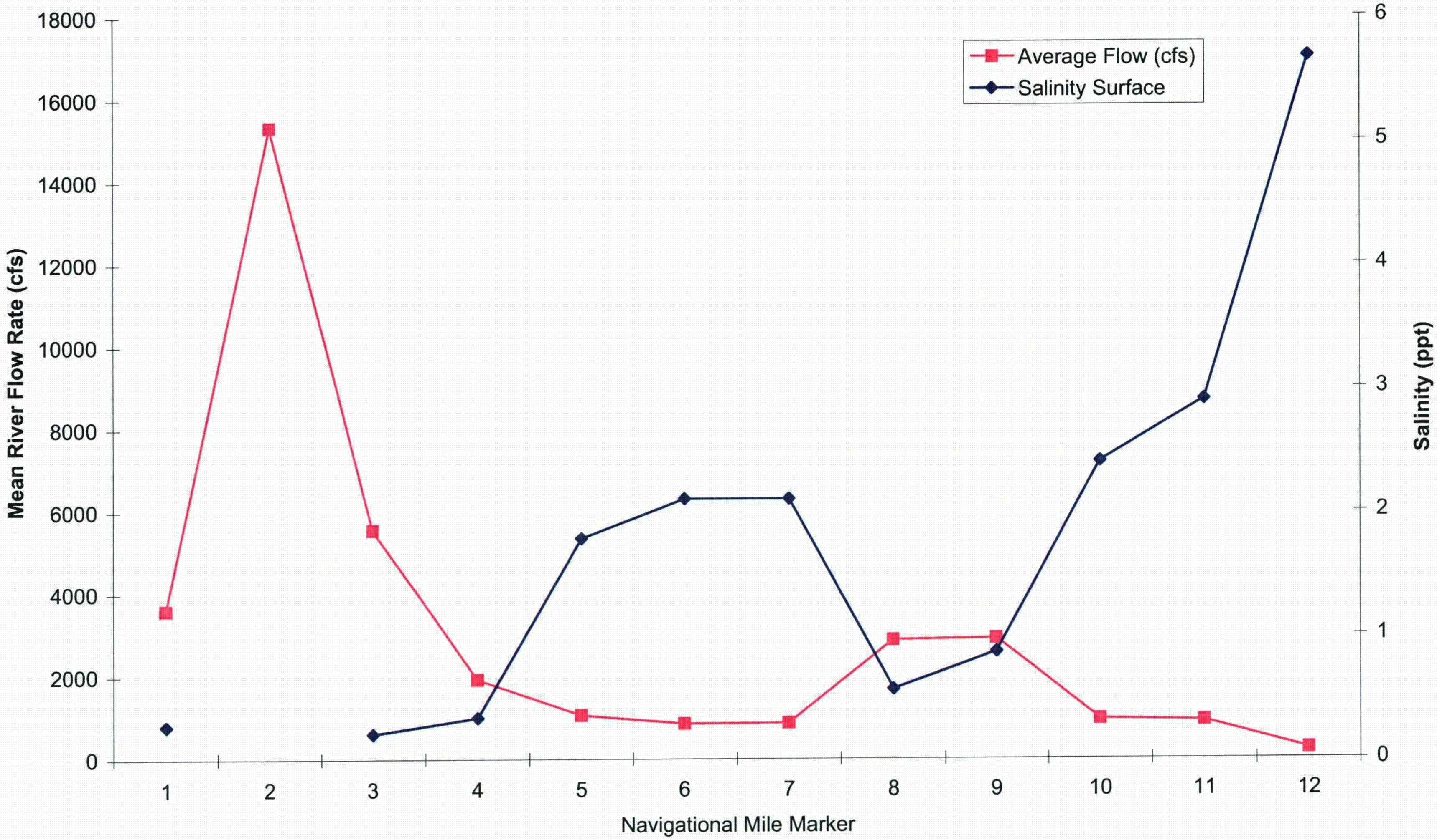


Figure 48. Comparison of monthly mean flow rates (cfs) during sampling to surface salinity readings at navigational mile markers on the lower Colorado River, 2007-2008.

*No July samples collected due to high river flow (>5,000)

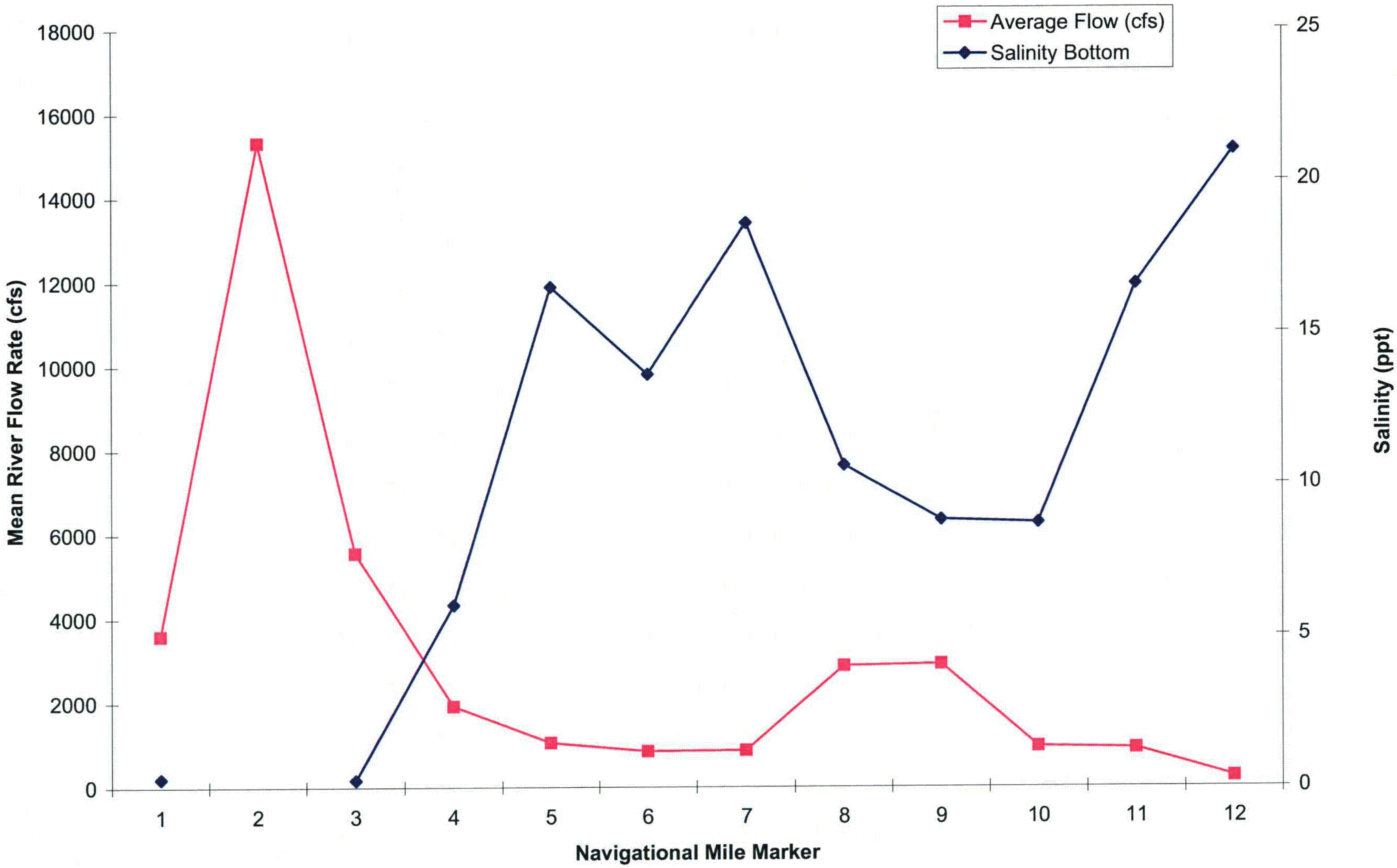


Figure 49. Comparison of montly mean flow rates (cfs) during sampling to bottom salinity readings at navigational mile markers on the lower Colorado River, 2007-2008.

*No July samples were collected due to high river flow (>5,000 cfs)

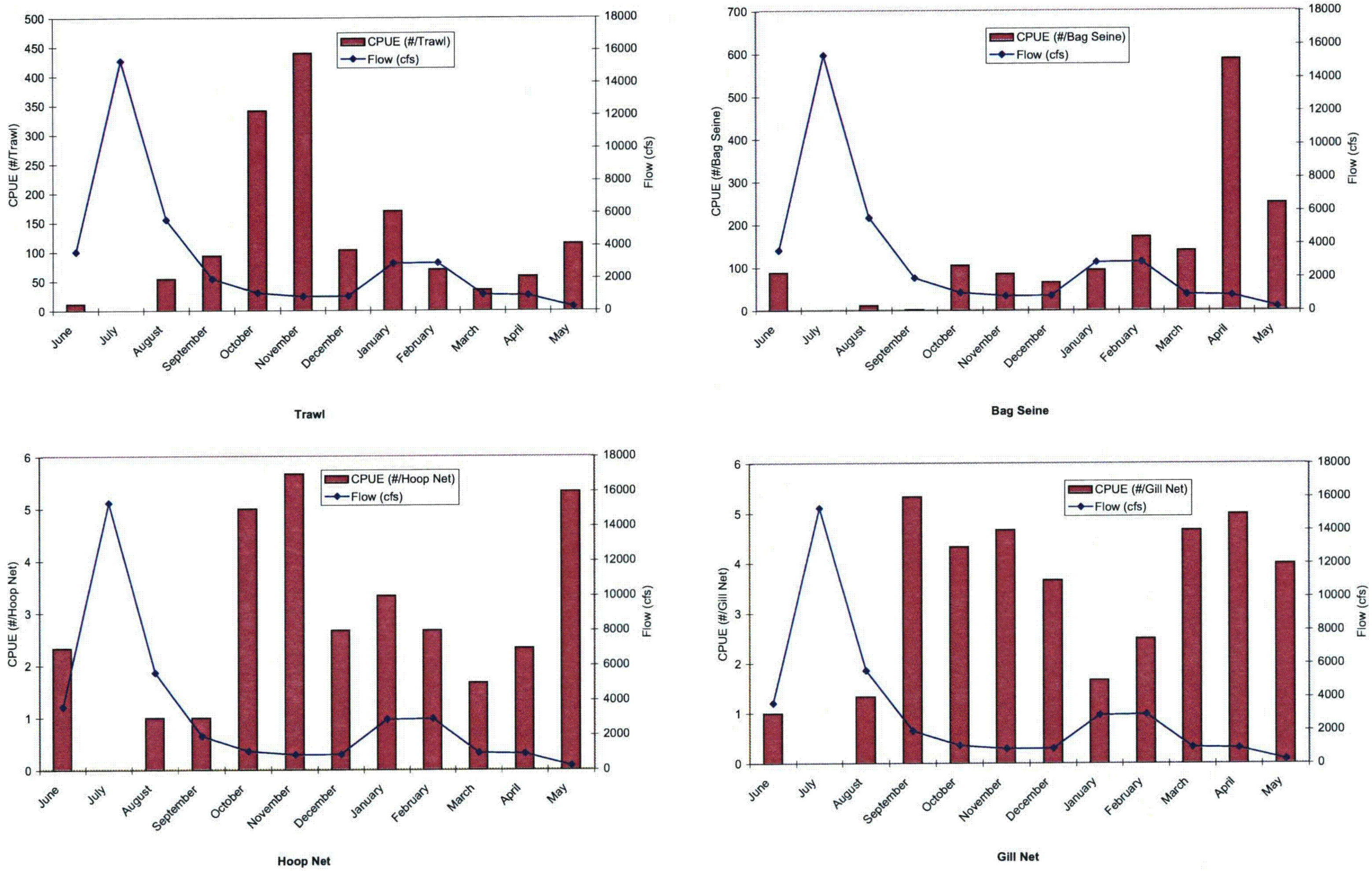


Figure 50. Comparison of catch per unit of effort (CPUE) by gear to mean river flow for the lower Colorado River, 2007-2008.

*No July samples collected due to high river flows (>5000 cfs).

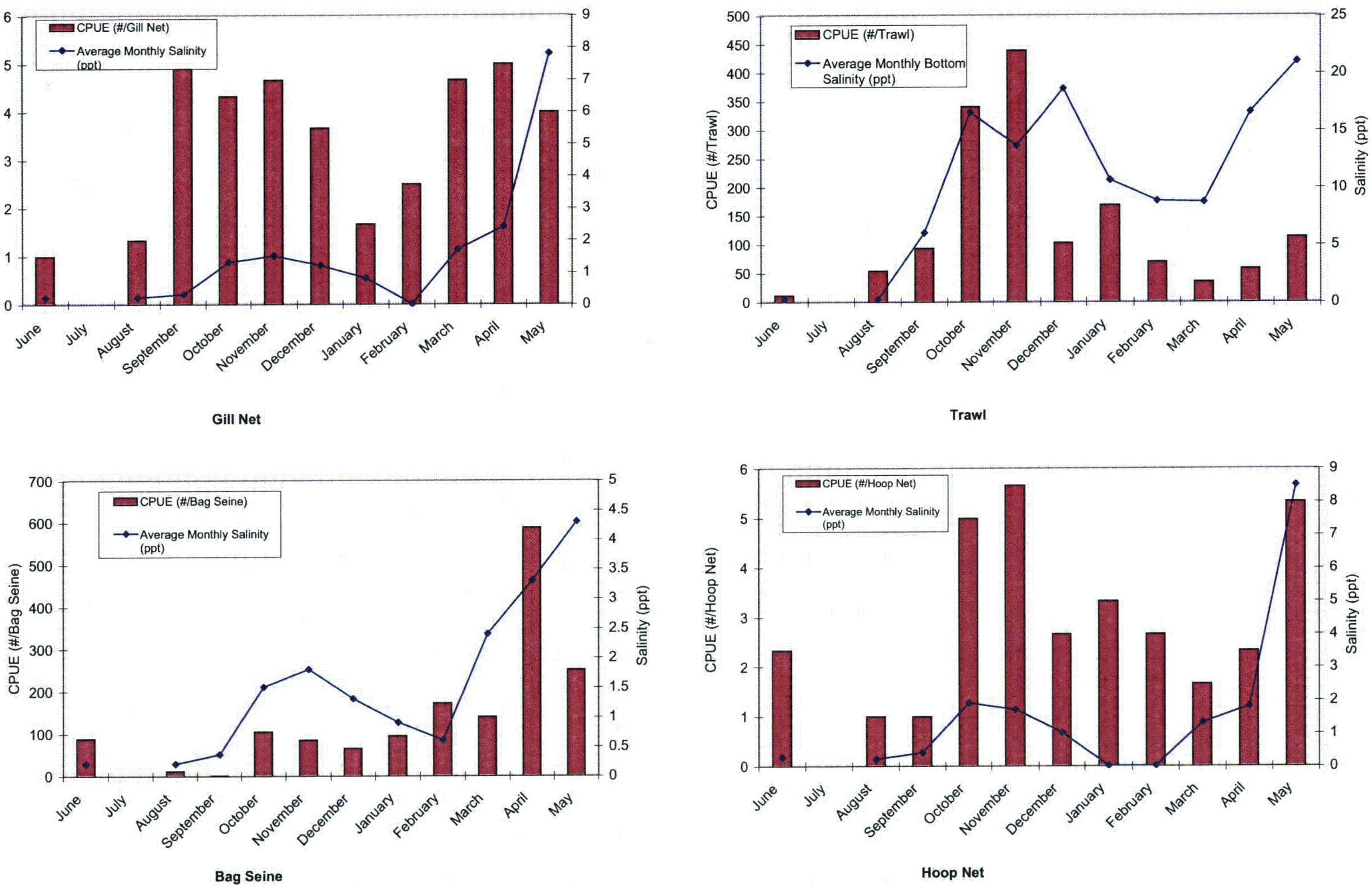


Figure 51. Comparison of catch per unit of effort (CPUE) by gear to average monthly salinity for the lower Colorado River, 2007-2008.

* No July samples collected due to high river flow (>5000 cfs)

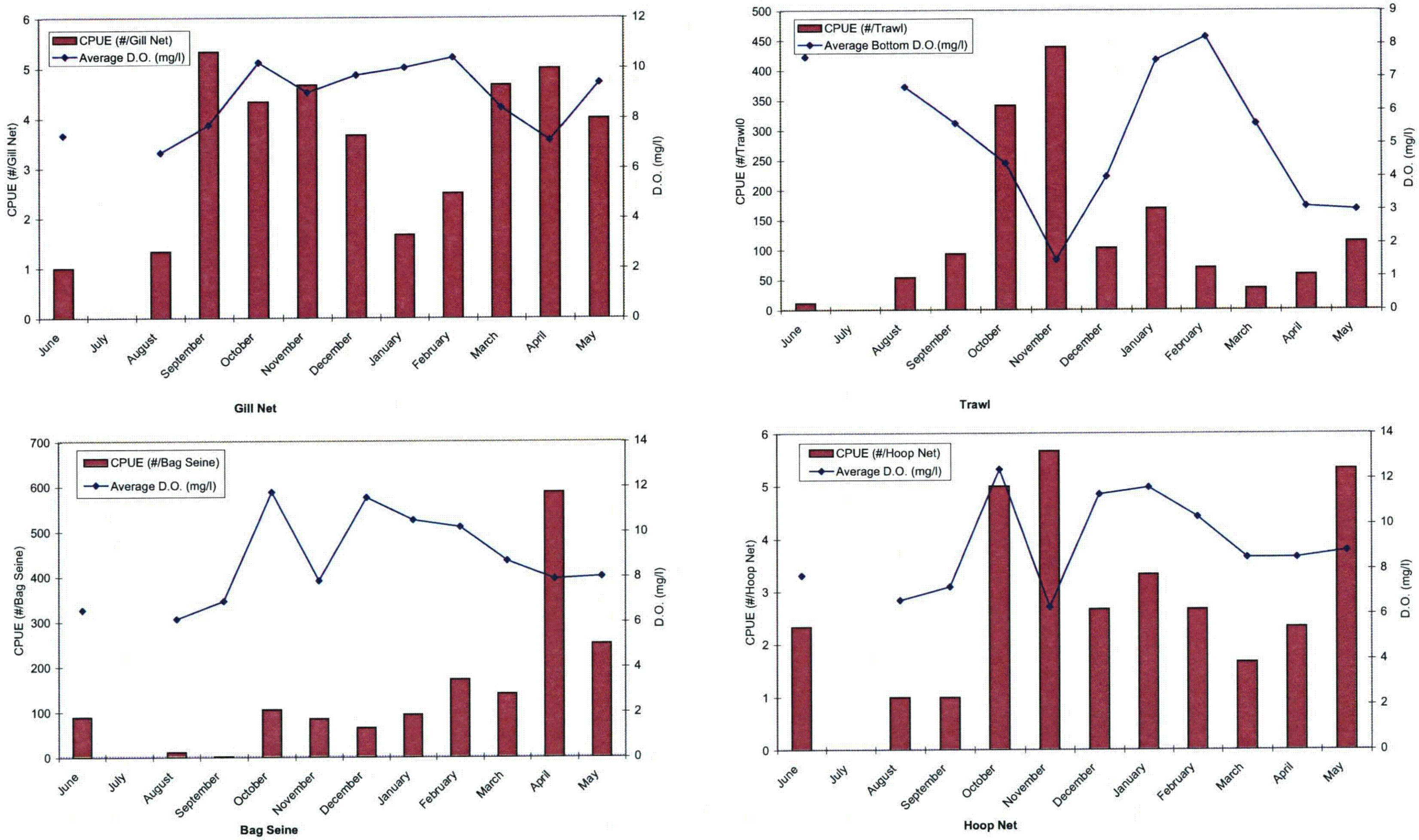


Figure 52. Comparison of catch per unit of effort (CPUE) by gear to average monthly dissolved oxygen for the lower Colorado River, 2007-2008.

*No July samples collected due to high river flows (>5,000 cfs)