SEASONAL DIVERSITY AND ABUNDANCE OF LARVAL AND JUVENILE FISHES IN THE UPPER BARATARIA ESTUARY

A Thesis

Submitted to the Graduate Faculty of
Nicholls State University
in Partial Fulfillment of the Requirements for the Degree
Master of Science
in
Marine and Environmental Biology

By

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CERTIFICATE

This is to certify that the thesis entitled "Seasonal Diversity and Abundance of Larval and Juvenile Fishes in The Upper Barataria Estuary" submitted for the award of Master of Science to the Nicholls State University is a record of authentic, original research conducted by Mr. Sean Jackson under our supervision and guidance and that no part of this thesis has been submitted for the award of any other degree diploma, fellowship, or other similar titles.

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ABSTRACT

The upper Barataria Estuary is located in southeastern Louisiana, and primarily composed of forested wetlands and agricultural lands. The bayous and canals that drain in the upper Barataria Estuary are surrounded by cypress - tupelo swamps. The upper Barataria Estuary once had a historical connection to the Mississippi River, but this connection was lost with the construction of flood control levees and the closing of distributaries. Since the channelization of the Mississippi River, the only source of water in the upper Barataria Estuary is rainfall. The lack of a natural, predictable flood pulse from the Mississippi River has altered the hydrology of the upper Barataria Estuary.

Numerous aquatic species rely on the annual flood pulse for reproductive cues and access to floodplain habitat. Many species of fish, especially nest builders such as *Lepomis* spp. and *Amia calva*, use the inundated floodplain as a spawning and nursery ground (Pezold 1998; Ross 2001; Fontenot et al. 2001; Hoover and Killgore 2002). The flood pulse concept (FPC) states that some fish species take advantage of the phytoplankton bloom augmented by floodplain derived nutrients and rising temperature to produce the highest growth rate and survival for their larvae (Junk et al. 1989).

Not all large river floodplain ecosystems receive a predictable flood pulse as water temperatures increase (Humphries et al. 1999). In these systems life history strategies may on low flow conditions during high temperature periods for successful reproduction. Some fish species will use the floodplain habitat for reproduction, but can also successfully reproduce in main channel habitats (Humphries et al., 1999). The low flow recruitment hypothesis (LFR) was developed to describe fish reproduction in these systems (Humphries et al., 1999). Fish recruitment in the Brazos River floodplain,

Texas, may conform to the LFR in that recruitment of seven species did not differ between wet and dry years (Zeug and Winemiller 2008b).

Larval fish and water quality data were collected weekly from seven fixed sites in the upper Barataria Estuary from February through September 2007. Larval fish were collected using light trap sampling. Three sites were located in dredged canal habitats characterized by steep dredge spoil banks and little floodplain access. The four remaining sites were located in bayou habitats characterized by low banks and floodplain access during periods of high water.

There were three main goals of this study. First, describe fish reproduction in the upper Barataria Estuary for one season to create a baseline for further research. Second, compare canal and bayou habitats for differences in water quality and fish reproduction. Third, examine the health of the upper Barataria Estuary as a Mississippi River floodplain ecosystem through the use of fish reproduction as an environmental indicator.

A total of 4,110 larval and juvenile fish representing 11 families and 15 genera were collected from 9 February 2007 until 25 September 2007. Larval *Dorosoma* spp., *Ictiobus* spp., and *Lepomis* spp. were more abundant in the dredged canal habitat than the bayou habitat. Only *Heterandria formosa* juveniles were more abundant in the bayou habitat than the canal habitat.

Canal sites had higher specific conductance and dissolved oxygen than bayou sites. Bayou sites were hypoxic (DO < 2.0 mg/L) during 62% of sample trips. Hypoxic conditions were seen in the bayou habitats every sample trip from 30 June 2007 to 22 August 2007, a period of 54 days. The altered hydrology, specifically, the lack of river water flushing may contribute to chronic hypoxia in the bayou habitats of the upper Barataria Estuary thus negatively impacting fish reproduction.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Floodplain ecosystems and their associated swamps and marshes average a net primary production (NPP) of 2,000 $g/m^2/yr$ compared to an average NPP of 250 $g/m^2/yr$ for lake and stream ecosystems (Begon et al. 1996). Hydrology is the driving force behind most ecological processes in large river floodplains (Junk et al 1989). Swamps and marshes linked to large river floodplains depend on a predictable annual flood pulse to support their high production. The unregulated and predictable advance and retreat of flood waters onto the floodplain is described by the flood-pulse concept (Junk et al. 1989). Periods of low water, historically occurring in fall in the upper Barataria Estuary, allow for plant growth on the land between the bayous and canals of the floodplain (Sklar and Conner 1979). When the spring flood pulse arrives, the newly submerged above ground production becomes the base for a detrital food web. Stable isotope analysis suggests that backwater pond food webs are driven by detritus-feeding macroinvertebrates (Herwig et al. 2004).

Not all large river floodplain ecosystems receive a predictable flood pulse as water temperatures increase (Humphries et al. 1999). In these systems some life history strategies depend on low flow conditions during high temperature periods for successful reproduction. The low flow recruitment (LFR) hypothesis was developed in the Murray-Darling River system, Australia, to describe fish recruitment in (Humphries et al. 1999). The Murray-Darling River system is characterized by highly variable hydrology where high flows and floodplain inundation may occur during periods of low temperatures. Some fish species in the Murray-Darling River system successfully spawn when water temperature and water level is decreasing, which allows their larvae to take advantage of food that is concentrated by low water levels (Humphries et al., 1999). The LFR postulates that some fish species will use the floodplain habitat for reproduction, but can also successfully reproduce in main channel habitats (Humphries et al., 1999). King et al. (2003) found that larval abundance of native fishes were not different between non-flood and flood years for the Ovens River floodplain, Australia. Fish recruitment in the Brazos River floodplain, Texas may conform to the LFR in that recruitment of seven species did not differ between wet and dry years (Zeug and Winemiller 2008b). In this case oxbow lakes were important spawning and nursery areas.

Although algal carbon is the widely accepted food base for lotic communities (Thorp et al. 1998; Bunn et al. 2003), and may be an important source of carbon for small bodied consumers (i.e. *Gambusia affinis*) in floodplain lakes (Zeug and Winemiller 2008a), it does not appear to be the base for the food web of large river floodplains (Herwig et al. 2004). When the floodplain is inundated, organic matter is transferred from the terrestrial floodplain to the water column, and supports heavy bacterial growth. At high temperatures, the rate of bacterial respiration can exceed the rate of primary production and dissolved oxygen (DO) can become depleted to a hypoxic level (DO $\leq$ 2.0 mg/L; Sabo et al. 1999a). As the waters recedes, floodplain-derived nutrients be concentrated within the water column and stimulate primary production, DO increases and the water returns to normoxic conditions (DO >2.0 mg/L oxygen, Fontenot et al. 2001). Backwater areas that are not flushed by the river may remain hypoxic for extended periods of time (Sabo et al. 1999a, 1999b).

A healthy ecosystems has been defined as an ecological system that is stable and sustainable over time (Costanza et al. 1992). The concept of ecosystem health was refined by Costanza and Mageau (1999) to include three main components: vigor, organization, and resilience (V-O-R model). In the V-O-R model, vigor (V) measures the production or throughput of the ecosystem. Organization (O) accounts for the biodiversity and structure of the ecosystem, and resilience (R) represents the ecosystem's ability to maintain or rebuild its structure and production potential after exposure to stress (Costanza and Mageau 1999). Boesch and Paul (2001) suggest that the V-O-R model is good in theory, but hard to measure, and list several measurable environmental indicators that can be used to examine the health of a coastal ecosystem. The indicators include contaminant levels, water quality, fisheries catch, extent of certain habitats, and community structure (Boesch and Paul 2001).

In active large river floodplains, such as the Atchafalaya River Basin (ARB), Louisiana, there are three main types of water described by their color. Brown water is usually found in main river channels, canals, and bayous and is characterized by high flow, high sediment load, and normoxic conditions. Green water is stratified with normoxic conditions on the surface and hypoxic conditions near the bottom, and is common in floodplain lakes and gets its green color from increased phytoplankton concentration. Black water is most commonly found in swamps, backwaters, or canals, and is characterized by lower flows than riverine waters, hypoxic DO, and lower productivity than other water colors. Low primary production and low flow of black water results in low turbidity. During high water periods, all three types of water may be seen in one day in the ARB. Any site in the ARB may experience all three types of water as the flood pulse moves throughout the floodplain (Sabo et al 1999a, 1999b.).

The Barataria-Terrebonne National Estuary covers 1.7 million hectares of southeastern Louisiana, and is composed of the Terrebonne Estuary in the west and the Barataria Estuary in the east. The Barataria Estuary is bounded by the Mississippi River to the northeast. Bayou Lafourche and the Gulf of Mexico border the estuary to the west and south (Figure 1). The Barataria Estuary is composed of a diverse array of habitats that transform from freshwater swamps in the upper estuary to salt marshes in the lower estuary along a salinity and elevation gradient. The upper Barataria Estuary consists mostly of cypress - tupelo swamps (Kemp et al. 1985; Braud et al. 2006) surrounded by forested, agricultural, and urban lands (Braud et al. 2006). The major water bodies of the upper Barataria Estuary are Bayou Citamon, Bayou Chevreuil, the St. James Canal, Grand Bayou and Bayou Boeuf, which drain the upper Barataria Estuary into Lac des Allemands. The upper Barataria Estuary is 41.5% forested wetlands, 38.0% agricultural lands, 5.2% urban land, and 1.4% freshwater marsh (Braud et al. 2006).

The upper Barataria Estuary had a historical connection to the Mississippi River, which was lost with the construction of flood control levees and the closing of distributaries (USACE 2004). The annual flood pulse that once supplied the estuary with nutrients and sediments, now flows directly into the Gulf of Mexico from the Mississippi River channel. Since the channelization of the Mississippi River, the only outside source of water in the upper Barataria Estuary is rainfall. Loss of the natural flood pulse from the Mississippi River has altered the hydrology of the upper Barataria Estuary and contributed to the loss of coastal wetlands in south Louisiana (Sklar and Conner 1979; Barras et al. 1994). The St. James Canal and sections of Bayou Chevreuil have been dredged for drainage and navigation purposes. The height of the shoreline along dredged habitats is elevated, causing further alteration to the hydrology of the upper Barataria

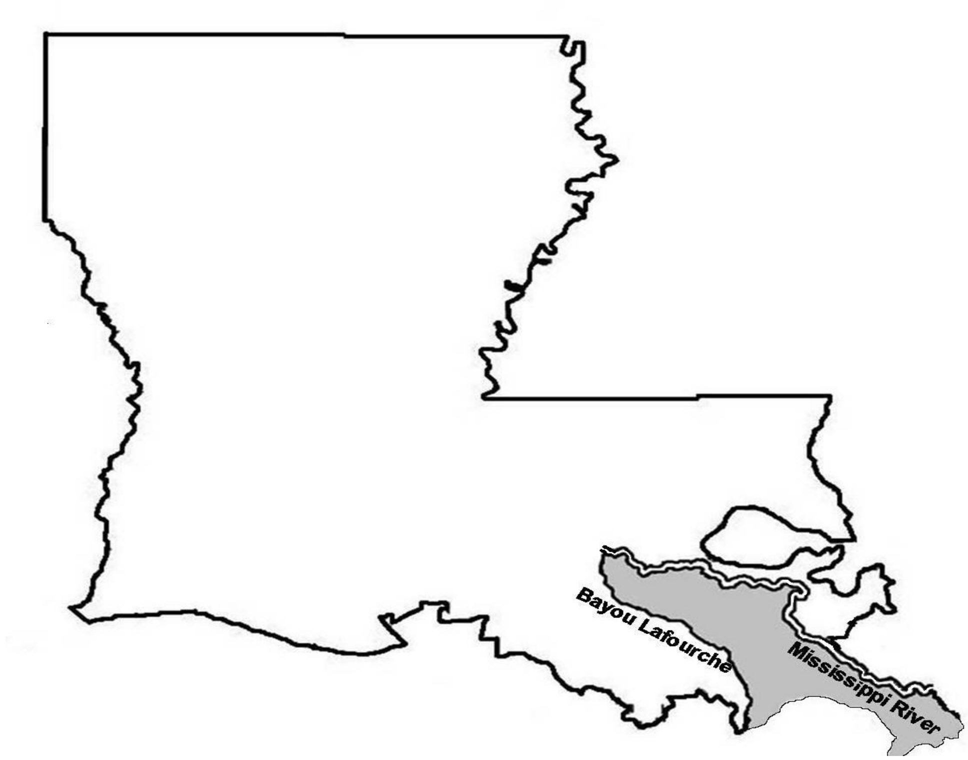

Figure 1. The Barataria Estuary (gray shaded are) located in southeast Louisiana.

Estuary (Sklar and Conner 1983). Bayou Chevreuil and Bayou Citamon have natural sections (i.e., not dredged) where the shoreline is physically unchanged by anthropogenic activities. Natural bayou areas have low banks that allow for overbank flooding during periods of high water, and allow the floodplain to be continuous with the adjacent bayou.

Brown, green, and black water types can be expected in the upper Barataria Estuary along with tea-colored water. Tea-colored water has many of the characteristics of black water, but suspended flocculated matter decreases its clarity. Sites in the upper Barataria Estuary characterized by tea-colored water average Secchi disc depths of less than 45 cm (Fontenot 2006), whereas black water sites in the ARB had a mean of 82.9 cm according to Rutherford et al. (2001).

The altered hydrology of the upper Barataria Estuary (disconnection from the main river) may lead to the unpredictable or "flashy" or nature of the water level in the system (Sklar and Conner 1979). The only source of water in the system is rainfall runoff from swamps and agricultural fields surrounding the waterways. Water levels in the upper Barataria Estuary can fluctuate on a daily basis, thus only allowing floodplain access for aquatic organisms during periods of heavy rainfall (Davis 2006; Fontenot 2006; Estay 2007). During high water events, organic matter flushed into the bayous can fuel high rates of bacterial respiration. With no regular input of outside water to flush hypoxic waterways, extended periods of hypoxia can occur (Davis 2006; Fontenot 2006). Some of the waterways in the upper Barataria Estuary, such as Bayou Chevreuil and Bayou Citamon, have been listed as impaired by the U.S. Environmental Protection agency due to nuisance exotic species, organic enrichment/low dissolved oxygen, and toxic inorganic minerals (USEPA 2005).

Lac des Allemands and the surrounding waterways form the headwaters of the Barataria Estuary and represent the only hydrologic connection between the floodplain swamps of the upper estuary and the lower estuary. During low water events tidal influences, such as reversal in the direction of water flow, may be seen in Bayou Chevreuil (Estay 2007). The Lac des Allemands connection allows for the exchange of nutrients and organisms between the upper and lower estuary. Coastal species that have been collected in the upper estuary include penaeid shrimp, blue crab *Callinectes sapidus*, Gulf menhaden *Brevoortia patronus*, bay anchovy *Anchoa mitchill,* and Atlantic croaker *Micropogonias undulaues* (Dantin 2007; personal observation 2007). Coastal species may use the upper estuary as a feeding or nursery area. Because estuarine species may be fed upon by freshwater fish, they may represent an important pathway for energy movement both up and down the estuary.

Fish commonly found in the upper Barataria Estuary may be grouped based on their pattern of movement between aquatic habitats. Species such as gizzard shad *Dorosoma cepedianum,* buffalo *Ictiobus* spp., and yellow bass *Morone mississippiensis* may make seasonal spawning migrations from Lac des Allemands into and up Bayou Chevreuil (Ross 2001; Fontenot 2006). Gizzard shad relative abundance in the upper Barataria Estuary typically increases in January and remains high through the end of April, with spawning occurring from late March through July (Fontenot 2006). Yellow bass make spring spawning runs into tributaries when water temperature reach 16-22 °C (Burnham 1910; Holland-Bartles et al. 1990; Ross 2001). Buffalo *Ictiobus* spp. have been reported to congregate in large schools to spawn around the margins of cypress-tupelo swamps on the floodplain of the Yazoo River in Mississippi in April (Yeager 1936; Ross 2001).

Fish of the families Centrarchidae (sunfish) and Ictaluridae (catfish) are found in the bayous of the upper estuary throughout the year (Davis 2006; Fontenot 2006). Sunfish such as some members of the genus *Lepomis* and some catfish from the genus *Ictalurus* have the ability to tolerate low dissolved oxygen, but they avoid areas of hypoxic water (Odum and Caldwell 1955; Moss and Scott 1961; Killgore and Hoover 2001). Spotted gar *Lepisosteus oculatus* and bowfin *Amia calva* are found in areas of hypoxic and normoxic waters, but are more common in areas adjacent to shallow vegetated habitat (Davis 2006; Fontenot 2006). Members of the family Poeciliidae have a flattened head and upturned mouth that allow them to utilize the high oxygen concentration at the air-water interface during periods of hypoxia (Lewis 1970; Ross 2001), several species such as mosquitofish *Gambusia affinis,* least killifish *Heterandria formosa*, and sailfin molly *Poecilia latipinna* are ubiquitous in the upper Barataria Estuary (personal observation 2007).

The fishes of the upper Barataria Estuary can also be grouped based on their life history and reproductive strategies. Winemiller and Rose (1992) proposed that the majority of life history/ reproductive strategies of North American fishes could be split into three categories: opportunistic strategists, periodic strategists, and equilibrium strategists. Strategies can be arranged on a trilateral continuum (Figure 2), allowing for intermediates among the three along a gradient based on life history trade-offs (Winemiller 1992). Opportunistic strategists are small bodied, rapidly maturing fish with low fecundity, high reproductive investment and long spawning periods (Winemiller

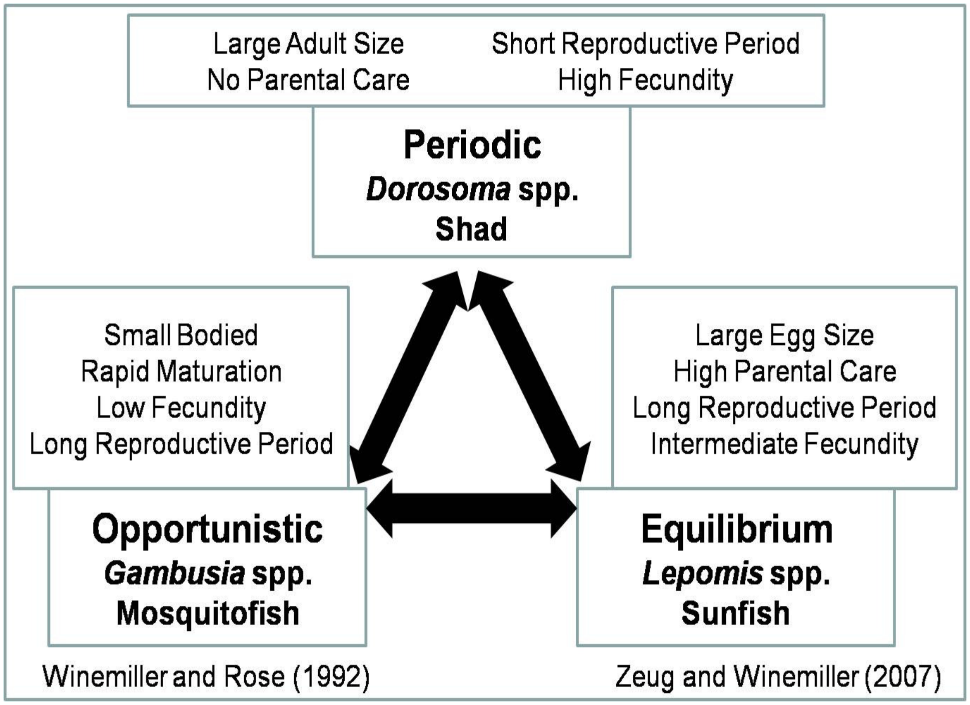

Figure 2. Reproductive strategies arranged on a trilateral continuum based on Winemiller and Rose (1992) and Zeug and Winemiller (2007).

1992; Winemiller and Rose 1992). Livebearers (poeciliidae), with their large offspring, short brood times, and adaptations to extreme habitats, are good examples of opportunistic strategists found in the upper Barataria Estuary. Periodic strategists take advantage of predictable environmental changes that provide optimal, but patchy, conditions for larval growth and survival with short spawning seasons, high fecundity, and no parental care (Winemiller 1992; Winemiller and Rose 1992). In the upper Barataria Estuary shad *Dorosoma* spp. and buffalo *Ictiobus* spp. are good representatives of periodic strategists. Equilibrium strategists use large egg size, long spawning seasons, and high parental care to maximize larval and juvenile and survival (Winemiller 1992; Winemiller and Rose 1992). Pipefishes (Syngnathidae) provide high levels of parental care and make good examples of equilibrium strategists.

Not all fish have reproductive strategies that fit wholly into one category, they exhibit trade-offs in life history parameters that place them in intermediate positions along the trilateral continuum (Winemiller and Rose 1992). Bowfin *Amia calva,* sunfishes Centrarchidae, and bullhead *Ameiurus* spp. invest high amounts of parental care through nest building and brood guarding, exhibit some spawning seasonality, and moderately high fecundity, placing each at intermediate positions between periodic and equilibrium strategists (Winemiller 1992; Davis 2006). Zeug and Winemiller (2007) studied the life history strategies of fish the Brazos River floodplain in Texas and classified *Gambusia affinis* as opportunistic, *Dorosoma cepedianum* as periodic, and *Lepomis macrochirus* and *Pomoxis annularis* as equilibrium strategists. For a successful spawn, environmental conditions should be optimal for larval survival. The two primary environmental factors that influence the timing of fish reproduction most are temperature and light (Moyle and Cech 2000). Many species of marine fish use the lunar cycle as a spawning cue (Moyle and Cech 2000). Each fish species has distinct environmental and nutritional requirements for spawning and larval survival. Therefore each species spawning period should be the time of year that spawning success will be optimized (Helfman et al. 1997). Because little fisheries research has been conducted in the upper Barataria Estuary, the spawning period for common fish in the area is not documented. A 2005-2006 study on bowfin *Amia calva* concluded that lack of access to the floodplain may have led to little reproduction, with only 5 of 123 females with fully developed eggs having spawned, possibly leading to a weak year class (Davis 2006). Spotted gar *Lepisosteus oculatus* research in the upper Barataria Estuary has shown their spawning period was March through May in 2007 (Smith 2008). Gizzard shad *Dorosoma cepedianum* had a spawning period from late March through July in the upper Barataria Estuary for 2006 (Fontenot 2006). In the Atchafalaya River Basin *Lepomis* spp. were found to have a spawning period from April through September, so we should be able to expect a similar spawning period in the upper Barataria Estuary (Fontenot 2001).

Numerous aquatic species rely on the annual flood pulse for reproductive cues and access to floodplain habitat (Junk et al 1989). Many species of fish, especially nest builders such as *Lepomis* spp. and *Amia calva*, use the inundated flood plain as a spawning and nursery ground (Pezold 1998; Ross 2001; Fontenot et al. 2001; Hoover and Killgore 2002), and when water levels recede the larval fish are flushed into the channel. If larval fish are swept into a hypoxic area, it may affect their survival or growth, which may alter species diversity and relative abundance of larval fish. Studies from the Atchafalaya River Basin show that hypoxic areas are poor nursery grounds for larval fish, where larval *Dorosoma spp.* and *Lepomis* spp. were rare in areas of low DO (Sabo et al. 1991; Fontenot et al. 2001). However not all fish rely on floodplain access to spawn. Backwater channels and their edges are important spawning habitats for some species of shad Clupeidae, minnows Cyprinidae, and suckers Catostomidae; Ross 2001). To date, there have been no published larval fish studies conducted in the upper Barataria Estuary.

This study was undertaken to characterize fish reproduction in the upper Barataria estuary and determine if natural bayou sites provide better spawning/nursery habitats than dredged canal sites. We predict that larval fish relative abundances will be greater in natural bayou habitats than dredged canal habitats. There were three main goals of this study. First, describe fish reproduction in the upper Barataria Estuary for one season to create a baseline for further research. Second, compare canal and bayou habitats for differences in water quality and fish reproduction. Third, examine the health of the upper Barataria Estuary as a Mississippi River floodplain ecosystem through the use of fish reproduction as an environmental indicator. Specific objectives for this study were to:

1. determine spawning period for each taxonomic group of fish collected in the upper Barataria Estuary;
2. compare relative abundance between canal and bayou habitats for all species and for each taxonomic group during their spawning period;
3. compare water quality data between canal and bayou habitats, and;
4. determine the relationship between larval fish abundance and water quality.

METHODS

Study sites

St. James Canal and Bayou Chevreuil drain mostly cypress-tupelo swamps of the upper Barataria Estuary. Bayou Citamon is the local name of the northwest extension of Bayou Chevreuil. Seven fixed sites were established in the St. James Canal, Bayou Chevreuil, and Bayou Citamon (Figure 3). Sites 1 and 2 are located in the St. James Canal. Site three is located at the confluence of the St. James Canal and Bayou Chevreuil (dredged portion of Bayou Chevreuil). Site 4 is located in Bayou Chevreuil. Site 5 is located at the confluence of Bayous Chevreuil and Citamon. Sites 6 and 7 are located in Bayou Citamon. Sites 1, 2, and 3 are dredged canal habitats (canal) and sites 4, 5, 6, and 7 are natural bayou habitats (bayou).

Water quality and vegetation

For each sampling trip dissolved oxygen (mg/L), temperature (°C), and specific conductance (µs) was measured with a handheld oxygen-conductivity-salinity-temperature meter (Yellow Springs Instruments, Yellow Springs, Ohio) at each site before larval fish sampling began. Water quality parameters were collected 0.5 m below the surface. Water color was recorded (black, green, brown, or tea-colored) at each site for each sample trip. The presence or absence of aquatic vegetation within 1m of each light trap was recorded for each site for each sampling trip. Water level (m) was recorded from USGS station #073804751 on the St. James canal near Donalsonville, LA, for the duration of the study.

Light trap construction

Light traps were constructed of clear acrylic and the design was modified (30 cm

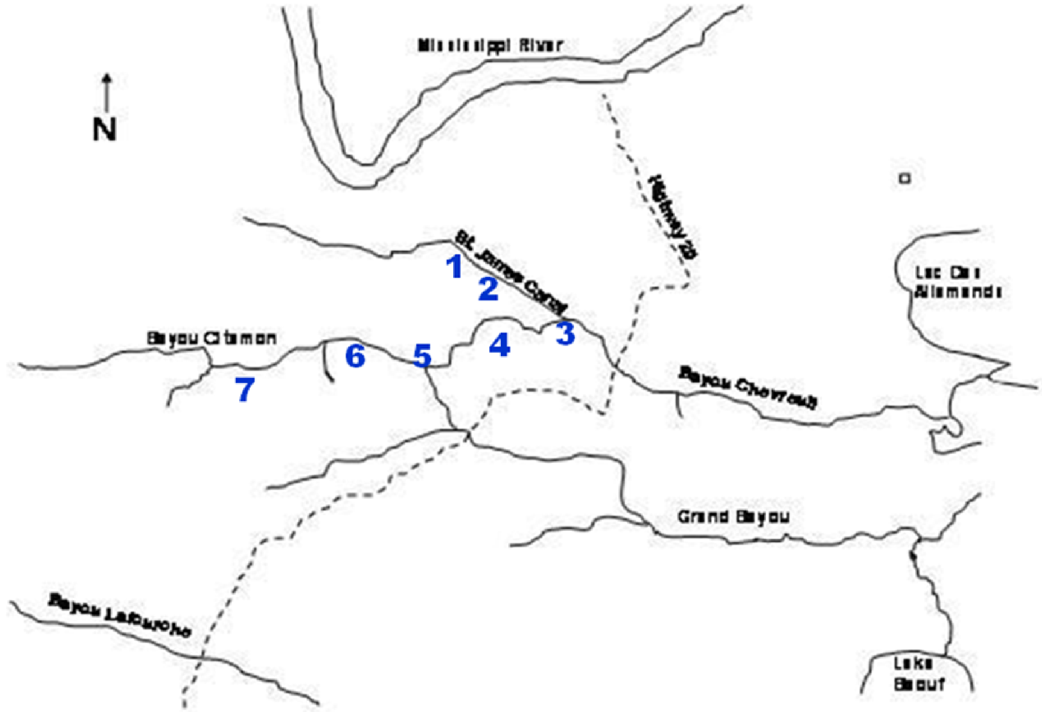

Figure 3. Seven light trap sampling sites in the major waterways of upper Barataria Estuary. Sites 1-3 represent dredged habitat and sites 4-7 represent natural habitat (not dredged). GPS coordinates for each site: Site 1; 29°57'26.27"N, 90°47'21.51"W: Site 2; 29°56'43.11"N, 90°46'15.05"W: Site 3; 29°55'47.07"N, 90°44'49.66"W: Site 4 29°55'50.35"N, 90°46'33.82"W: Site 5; 29°54'50.92"N, 90°47'58.01"W: Site 6 29°55'11.19"N, 90°48'41.07"W: Site 7; 29°55'31.34"N, 90°49'48.81"W.

wide by 15 cm tall) from Byrd (1994; Figure 4). The quatrefoil design uses a cloverleaf arrangement of four 15 cm x 9 cm acrylic pipes to funnel the fish into the trap and a small 13.5 cm x 4 cm acrylic tube in the middle to hold the light stick. This arrangement also makes it difficult for fish to escape the trap. The trap entrance gaps have an average opening of is 3.23 ± 0.48 mm wide by 15 cm tall and a range of 2.0 mm to 5.0 mm. The collection assembly uses a 500 µm Nitex® mesh screen to sieve out the catch. Two 30 cm x 13 cm pieces of foam insulation were attached to the top to provide floatation. The light source was a 13 cm green chemical light stick. Many teleost species are able to detect green light with cone cells in their retina (Moyle and Cech 2000). Light traps baited with green light sticks outperformed all other colors tested according to Marchetti et al. (2004).

Light trap sampling

Weekly collections were made from 9 February 2007 through 25 September 2007. Three light traps were placed at each site 2 hours before sunset and were retrieved approximately 2.5 hours after official sunset. The exact time each trap was deployed was recorded from official sunset to retrieval time. The percentage of lunar illumination was recorded for each sampling date, with 100% lunar illumination on the full moon and 0% lunar illumination on the new moon. The contents of each trap were washed into a 500 mL labeled sample bottle and placed on ice until processed. In the laboratory fish were identified to lowest taxa possible and counted. After the larvae were identified, they were preserved in 70% ethyl alcohol.

Catch per unit effort

Catch per unit effort (CPUE) was calculated for each site for each week as a

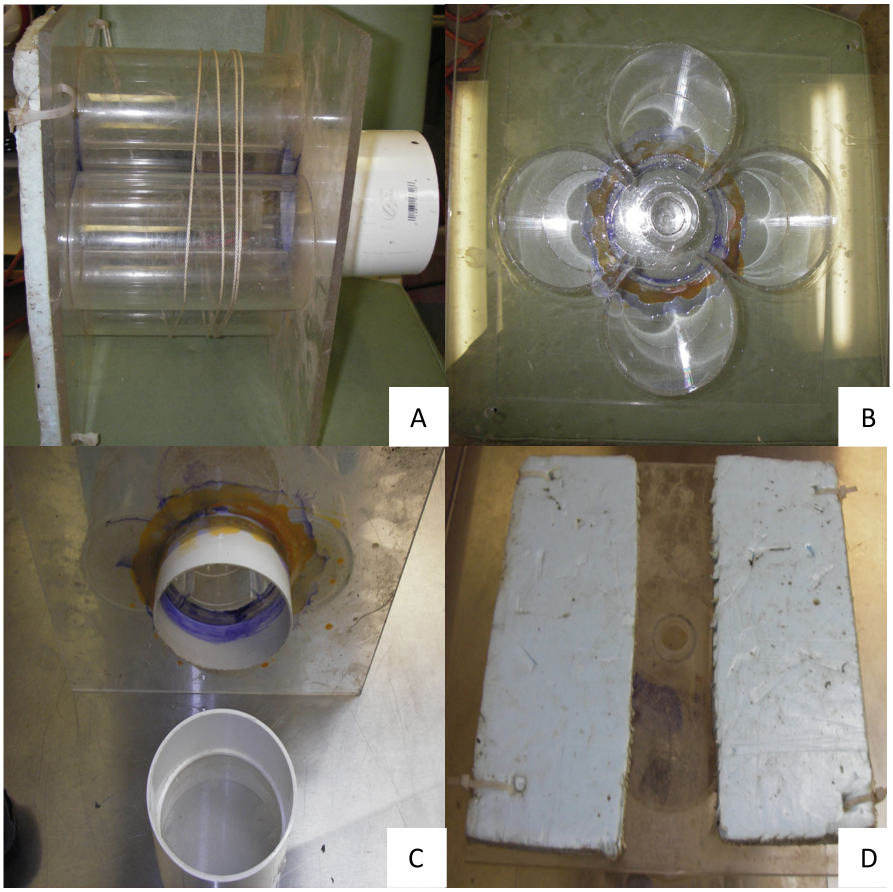

Figure 4. Light trap design modified from Byrd (1994) showing side view (A), cloverleaf arrangement of the pipes (B), the collection assembly (C), and top view (D).

measure of relative abundance. CPUE was calculated by dividing the total number of each taxonomic group collected in each trap by the number of hours past sunset the trap was deployed. The CPUE for all three traps at each site were averaged to compute the average CPUE for each site for each week. Mean values for each habitat were used to compare bayou habitat (N=4 sites) to canal habitat (N=3).

Data analysis

Fish were identified to species when possible, but all analyses were performed at genus level. Fish collection period was determined for each taxonomic group as the period between first and last collection, and provided a period that each taxonomic group could be expected to be collected.

Analysis of variance (ANOVA) was used to compare CPUE, temperature, dissolved oxygen, and specific conductance between canal and bayou habitats (SAS 2003). Regression analysis was used to determine the relationship between CPUE and dissolved oxygen, temperature, specific conductance, and percent lunar illumination (SAS 2003). The effects of lunar illumination were analyzed through the use of ANOVA to compare CPUEs between samples collected with ≥75% lunar illumination and samples collected with <75% lunar illumination (SAS 2003).

Principal components analysis (PCA) was used to analyze general relationships between water quality variables and habitat types. PCA was conducted on normalized Log_{10} (x +1) transformed data with Primer software (Primer v.6). Site loadings generated on principal component one (PC1) and PC2 was plotted. Correlations between each PC and each of the water quality variables were superimposed on this plot as vectors extending from the origin to the point where the correlation coefficients for each variable intersect. Each line represents the magnitude of the water quality variable's association to the PCs, and an imaginary line extended in the opposite direction shows the corresponding negative trend.

Principal components analysis (PCA) was used to analyze general relationships between habitat types and CPUE for each fish genera and developmental stage. PCA was conducted on normalized Log_{10} (x +1) transformed data with Primer software (Primer v.6). Site loadings generated on principal component one PC1 and PC2 were plotted. Correlations between each PC and each of the genera were superimposed on this plot as vectors extending from the origin to the point where the correlation coefficients for each variable intersect. Each line represents the magnitude of the generas association to the PCs, and an imaginary line extended in the opposite direction shows the corresponding negative trend.

RESULTS

Fish

A total of 4,110 fish representing 11 families and 15 genera were collected from 9 February 2007 until 25 September 2007 (Figure 5). A total 1,936 juvenile and 2,164 larvae were collected. Poeciliids made up 44% of total fish collected. The most abundant fish collected was juvenile *Gambusia affinis* making up 88% of juvenile fish collected and 41% of the total fish collected. Sunfishes Centrarchidae made up 52% (49% *Lepomis* spp. and 3% *Pomoxis* spp.) of the total larvae collected. *Lepomis* spp. accounted for 4% of juvenile fish collected and 28% of the total fish collected. *Ictiobus* spp. made up 45% of larval fish collect and 24% of total fish collected.

Vegetation

Bayou sites had both submerged and floating vegetation for 82% of sample trips and only submerged vegetation for 18% of sample trips. Canal sites had both submerged aquatic and floating vegetation for 18.7% of sample trips, only submerged vegetation for 5.3% of sample trips, only floating vegetation for 6.7% of sample trips, and no vegetation for 69.3% of sample trips. No vegetation was found at sites 1 and 2 in the canal habitat. The most common species of submerged aquatic vegetation were coontail *Ceratophyllum demersum* and hydrilla *Hydrilla verticillata*, which were found at all bayou sites and site 3 in the canal habitat. Other species of submerged aquatic vegetation indentified included: Fanwort *Cabomba carolinian,* pondweed *Potamogeton* spp., parrot feather watermilfoil *Myriophyllum aquaticum*, and waternymph *Najas* spp. The most common species of floating aquatic vegetation was common salvinia *Salvinia minima*, which was found at all bayou sites and site 3 in the canal habitat. Other species of submerged aquatic

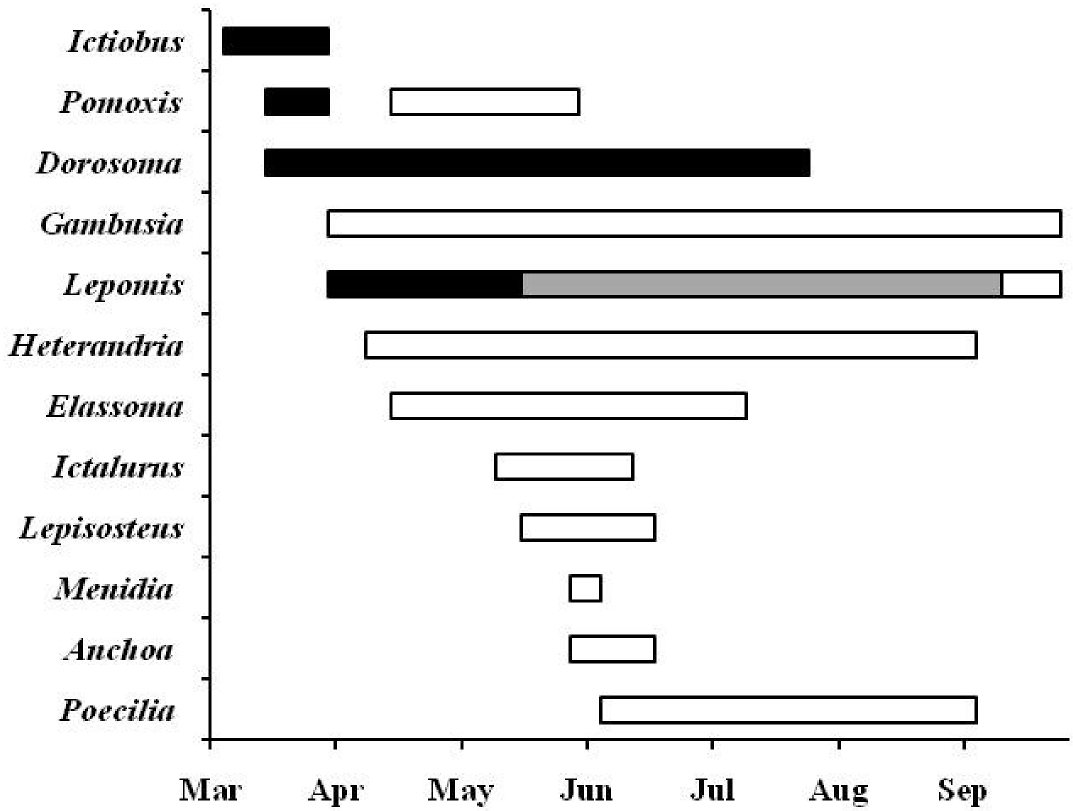

Figure 5. Collection periods for larval (black), larval/juvenile overlap (gray), and juvenile (open) fish collected from 3 February 2007 to 25 September 2007. The area between *Pomoxis* larval and juvenile collection periods denotes no larval/juvenile overlap.

vegetation indentified included: common duckweed *Lemna minor*, water hyacinth *Eichhoria crassipes*, and water lettuce *Pistia stratiotes*.

Water quality

The mean (±SD) water temperature (ºC) did not differ between canal (25.93 ± 5.34) and bayou (25.32 ± 4.97) habitats for all sample dates combined. The mean dissolved oxygen and specific conductance for all sample dates combined were higher in the canal than bayou (Figures 6 and 7). Canal mean dissolved oxygen was hypoxic for 15% of samples and bayou mean dissolved oxygen was hypoxic for 62% of the samples with the longest period of hypoxic conditions lasting 54 days (Figure 8). Water color varied from brown sediment laden water to tea colored water to a mix of both. I never observed green water. Canal habitats were sediment laden in 70% of sample trips, mixed in 17% of sample trips, and tea colored in 13% of sample trips (Figure 9). Bayou habitats were sediment laden in 30% of sample trips, mixed in 14% of sample trips, and tea colored in 56% of sample trips (Figure 9). The mean daily (±SE) water level collected from USGS station #073804751 on the St. James Canal near Donalsonville LA. was 1.79 ± 0.01 m (Figure 10). The floodplain was only inundated three times during the sampling period, each time lasting less than a day.

LARVAE

***Dorosoma* spp. larvae**

A total of 76 *Dorosoma* spp. larvae were collected between 17 March 2007 to 21 July 2007 (*Dorosoma* spp. collection period; Table 1, Figure 5, Figure 11). The greatest overall mean CPUE for *Dorosoma* spp. larvae occurred on 17 March 2007 (Figure 12). The

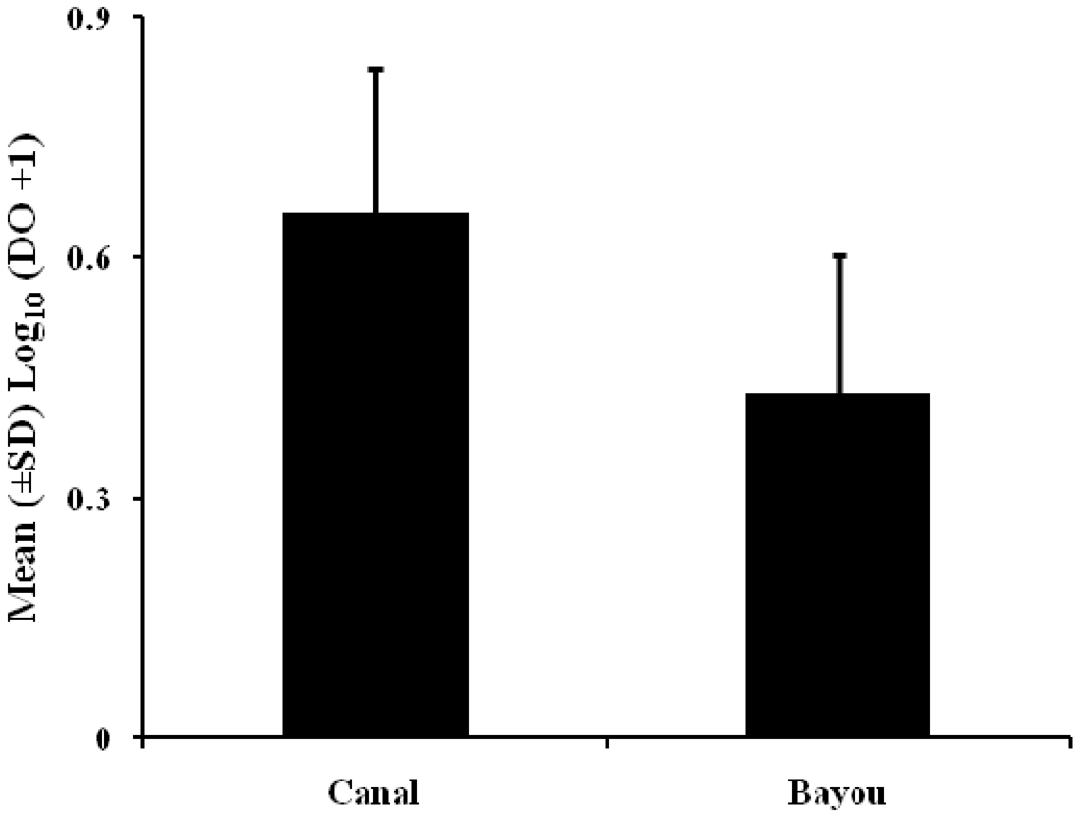

Figure 6. Log_{10} transformed mean (±SD) dissolved oxygen (mg/L) for canal (N=81) and bayou (N=108) habitats for 15 February 2007 to 25 September 2007. Mean values are not similar (P = <0.0001 α = 0.05)

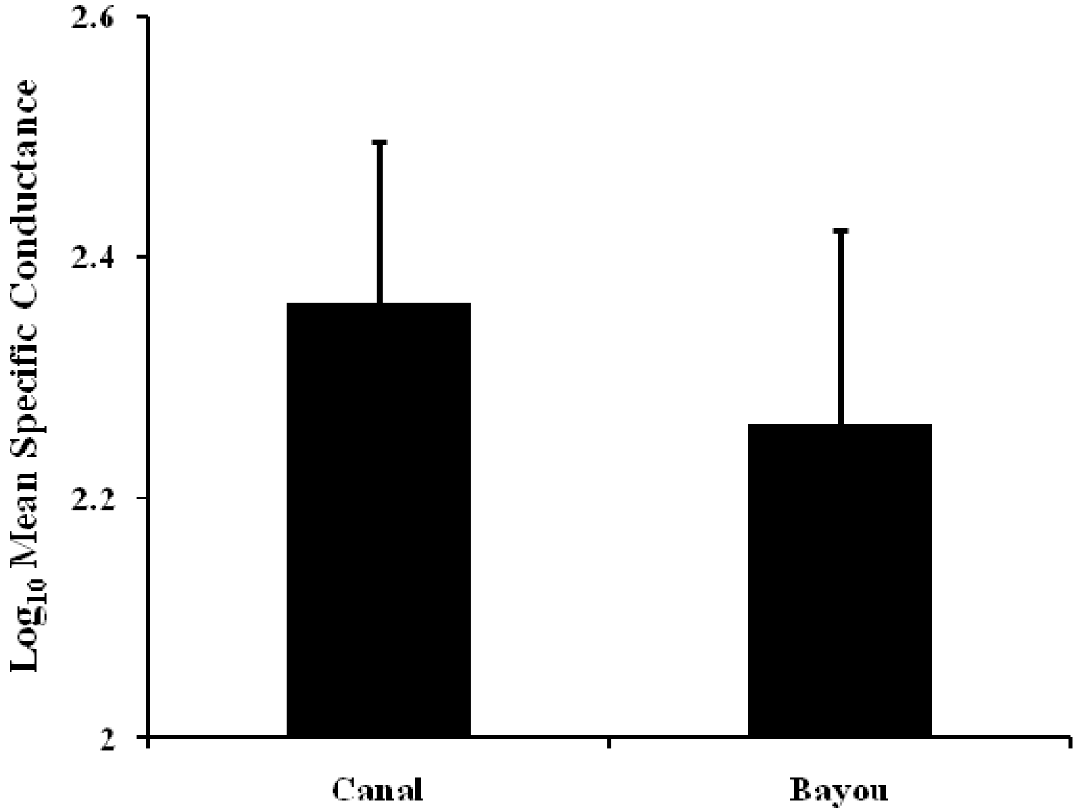

Figure 7. Log_{10} transformed mean (±SD) Specific Conductance (µS) for canal (N=81) and bayou (N=108) habitats for 15 February 2007 to 25 September 2007. Mean values are not similar ($P = <0.0001$, $\alpha = 0.05$)

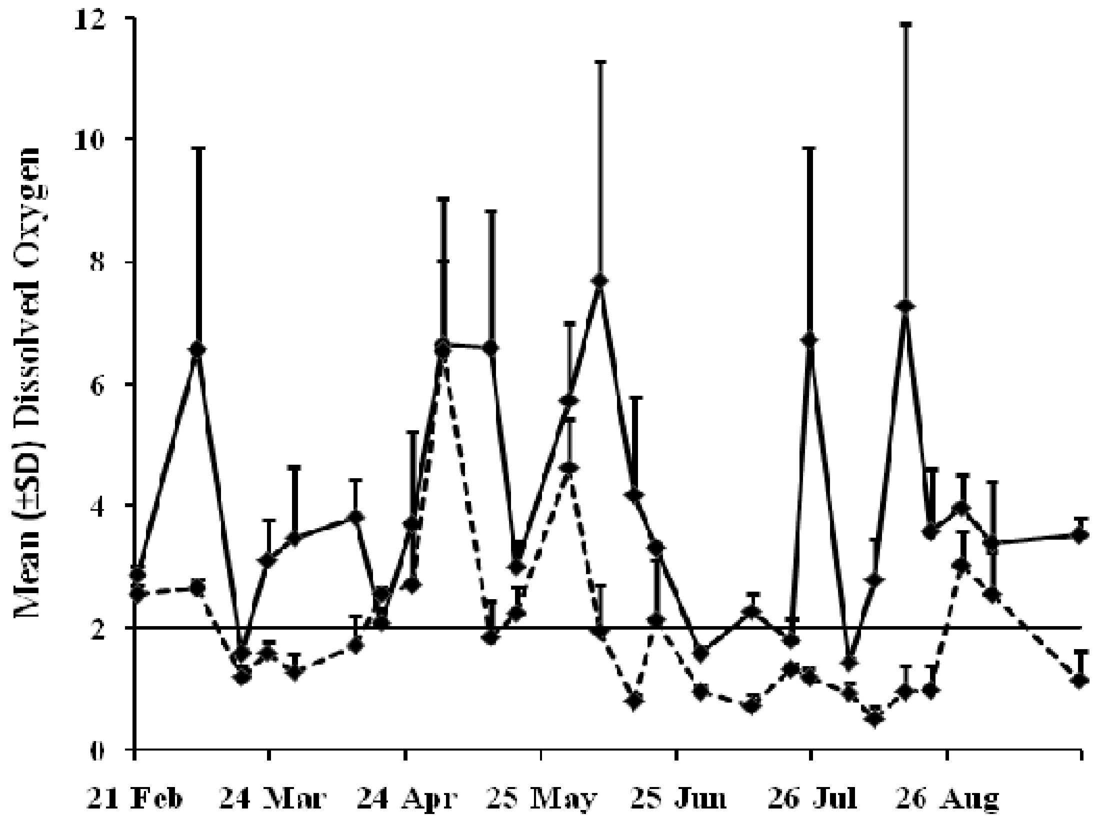

Figure 8. Mean (±SD) dissolved oxygen (mg/L) for canal (N=81, solid line) and bayou habitats (N=108, dashed line) for 21 February 2007 to 25 September 2007.

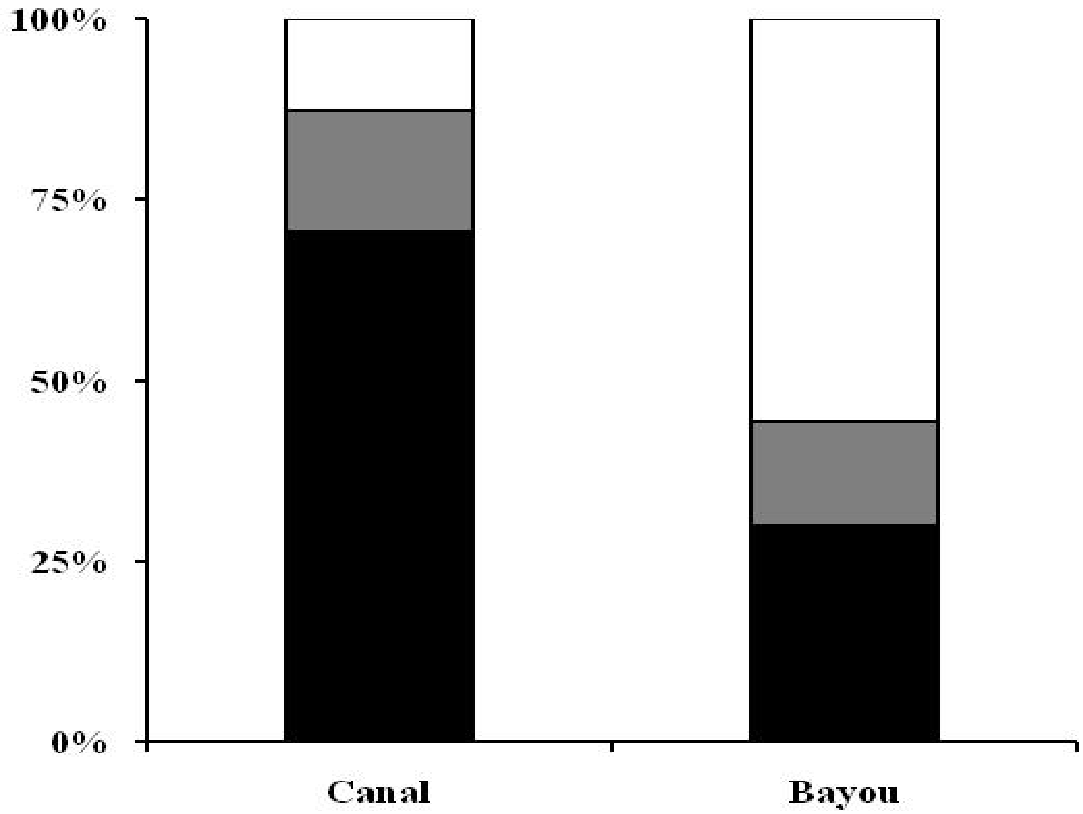

Figure 9. Percentage water type [sediment laden (black), mixed (gray), and tea colored (open)] for all trips combined for canal (N=81) and bayou (N=108) habitats.

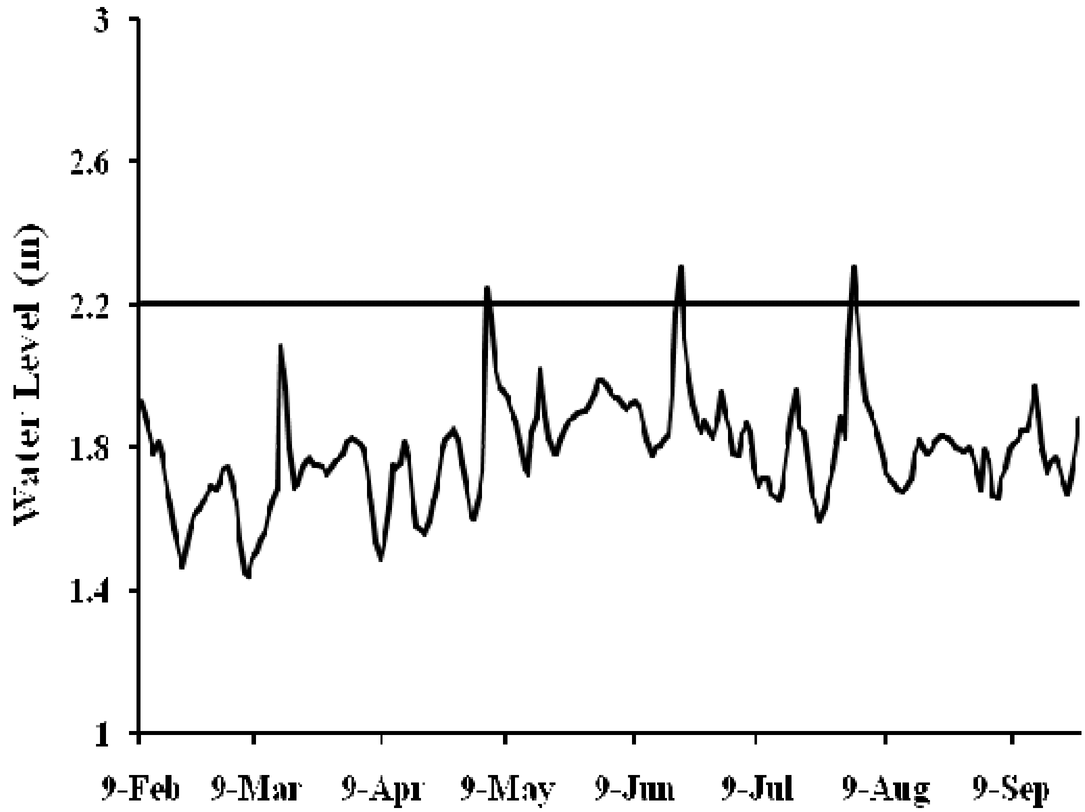

Figure 10. Daily mean water level (m) for the upper Barataria Estuary from 9 February 2007 to 25 September 2007. Solid line at 2.2 meters represents water level of floodplain inundation.

Table 1. Collection period, total number (N), and mean (±SE) temperature (ºC), dissolved oxygen (mg/L), and specific conductance (μs) for each genus of larvae for both habitats. An asterisk indicates there was a difference between habitats for that value based on ANOVA ($P \leq 0.05$, $\alpha = 0.05$).

Species	Collection Period	Habitat	N	Temperature	DO	Specific Conductance
Dorosoma spp.	3/17/07 – 7/21/07	Canal	68*	25.9 ± 0.5	3.8 ± 0.32*	278 ± 10.5*
		Bayou	8	25.6 ± 0.4	2.1 ± 0.20	227 ± 10.1
Ictiobus spp.	3/7/07 – 3/29/07	Canal	894*	21.2 ± 0.9	3.7 ± 0.69	243 ± 9.9*
		Bayou	78	20.6 ± 0.9	1.7 ± 0.16	205 ± 6.2
Lepomis spp.	3/29/07 – 9/5/07	Canal	667*	27.9 ± 0.4	4.1 ± 0.30*	251 ± 9.9*
		Bayou	383	27.3 ± 0.3	1.9 ± 0.17	202 ± 9.1
Pomoxis spp.	3/17/07 – 3/29/07	Canal	3	22.5 ± 0.9	2.7 ± 0.37*	251 ± 11.5*
		Bayou	61	22.1 ± 0.8	1.3 ± 0.08	211 ± 7.7

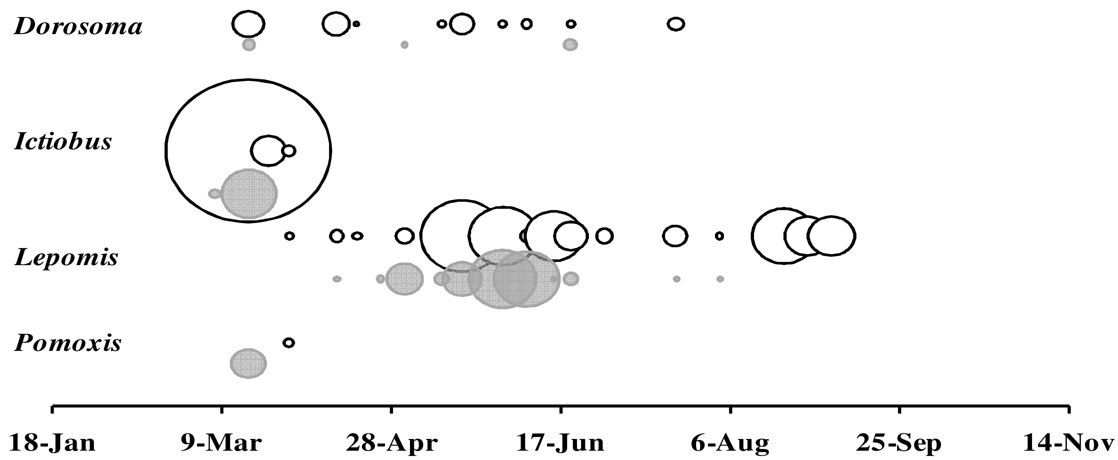

Figure 11. Catch per unit effort for each genera of larvae through their collection periods by habitat. Canal CPUE is represented by open circles and bayou CPUE represented by shaded gray circles. Circle sizes represents size of CPUE for each sample date.

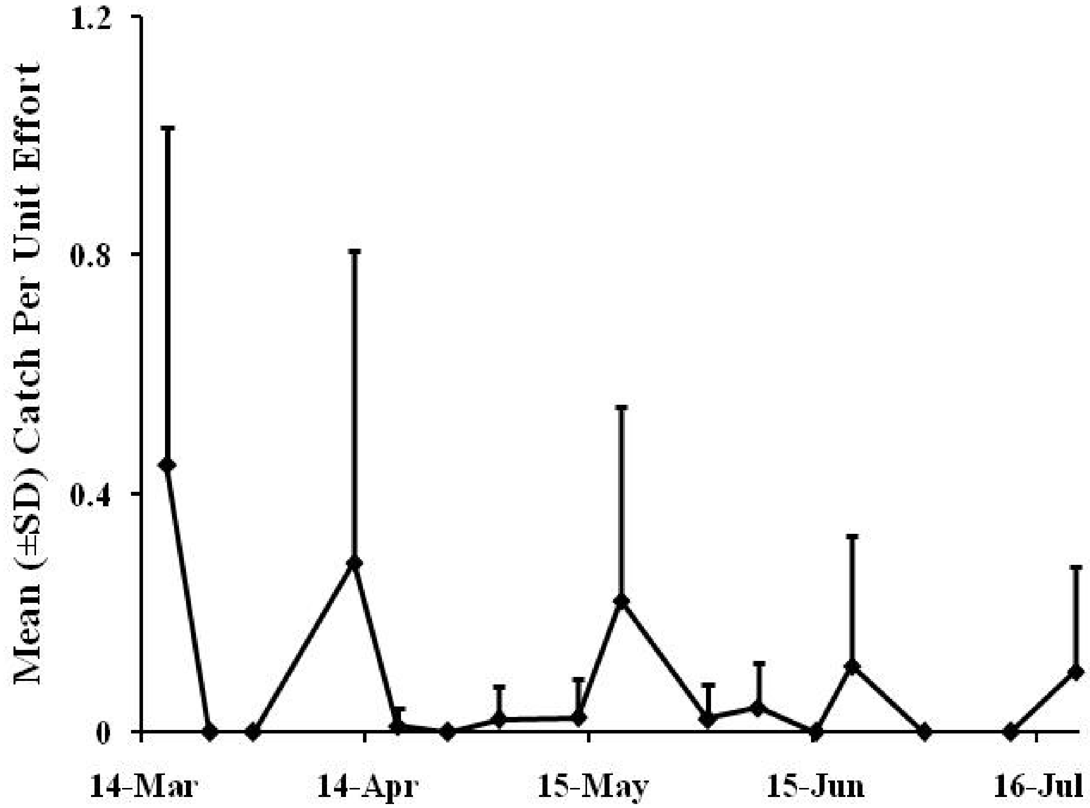

Figure 12. Mean (±SD) larval *Dorosoma spp*. catch per unit effort for 17 March 2007 to 21 July 2007 (*Dorosoma* spp. collection period) for all sites combined.

mean CPUE was greater at canal habitats than bayou habitats (Table 1). Mean water temperature was not different between canal and bayou habitats during the *Dorosoma* spp. collection period (Table 1). Mean dissolved oxygen and mean specific conductance were greater at canal habitats than bayou habitats during the *Dorosoma* spp. collection period (Table 1). Larval *Dorosoma* spp. CPUE was weakly negatively correlated (P=0.0011, R^2=0.089) to temperature (Figure 13) but was not correlated to any other water quality variable. Larval *Dorosoma* spp. CPUE did not differ between normoxic (N=63) and hypoxic (N=49) collections (Figure 14).

***Ictiobus* spp. larvae**

A total of 972 *Ictiobus* spp. larvae were collected between 7 March 2007 and 29 March 2007 (*Ictiobus* spp. collection period; Table 1, Figure 5, Figure 11). The greatest overall mean CPUE for *Ictiobus* spp. larvae occurred on 17 March 2007 (Figure 15). Mean CPUE was greater in canal habitats than bayou habitats (Table 1). Mean water temperature during the *Ictiobus* spp. collection period did not differ between canal and bayou habitats (Table 1). Mean dissolved oxygen, and mean specific conductance were greater at canal than bayou habitats (Table 1). Larval *Ictiobus* spp. CPUE was not correlated to any water quality variable and was not different between normoxic (N=14) and hypoxic (N=15) collections (Figure 14).

***Lepomis* spp. larvae**

A total of 1,050 *Lepomis* spp. larvae were collected between 29 March 2007 to 5 September 2007 (*Lepomis spp*. larvae collection period; Table 1, Figure 5, Figure 11). The greatest overall mean CPUE for *Lepomis spp*. larvae occurred on 31 May 2007 (Figure 16). Mean CPUE, mean dissolved oxygen, and mean specific conductance

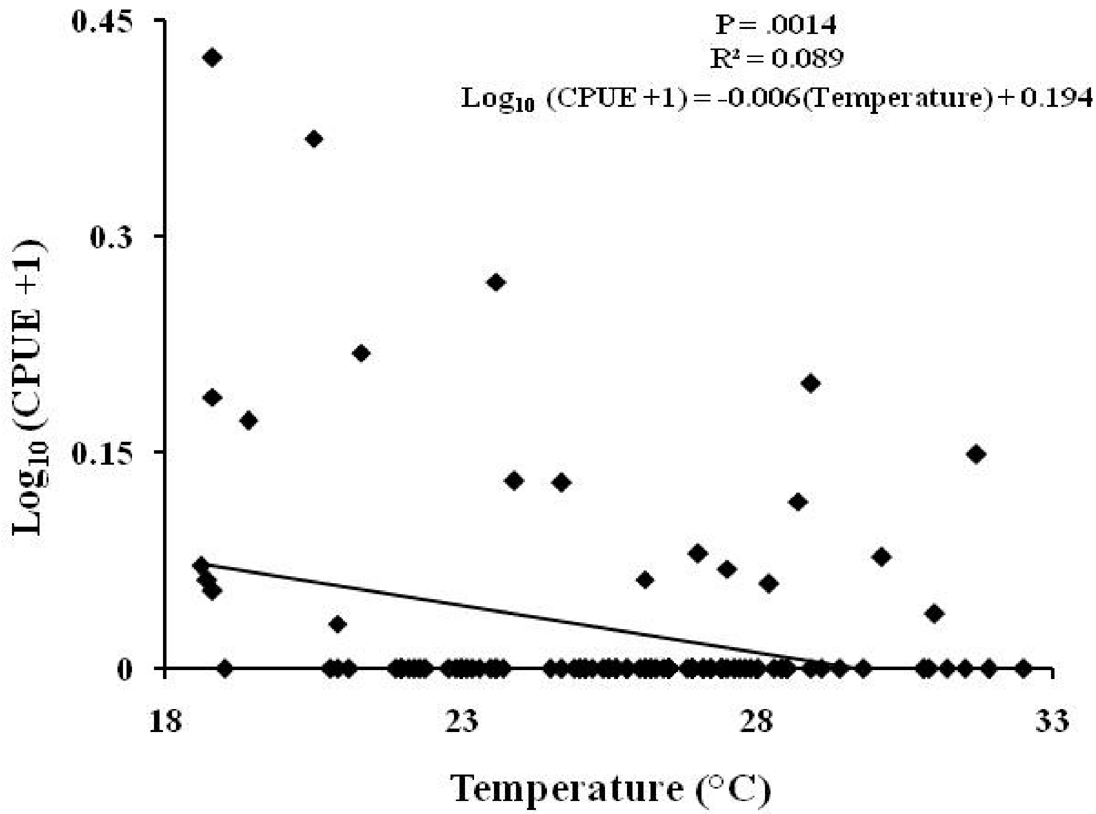

Figure 13. The relationship between $\log_{10}$ (CPUE +1) catch per unit effort and temperature (ºC) for larval *Dorosoma* spp. collected between 17 March 2007 to 21 July 2007 (*Dorosoma* spp. collection period).

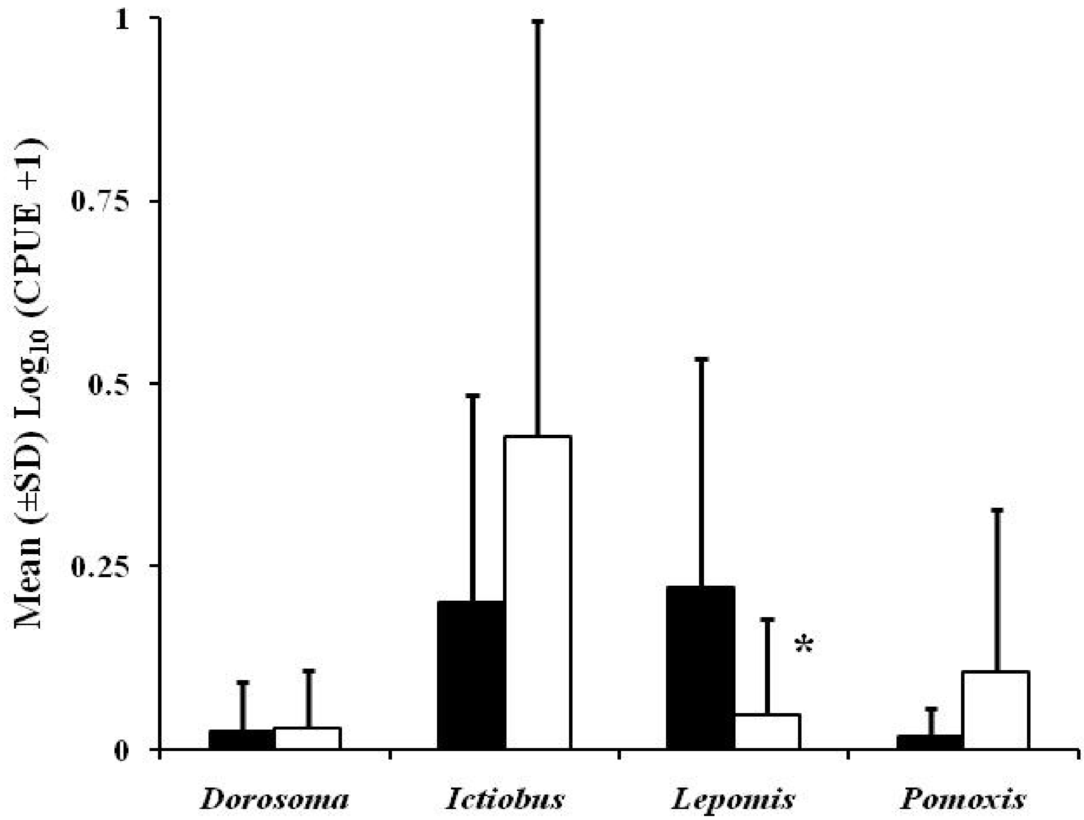

Figure 14. Mean (±SD) $\log_{10}$ transformed (CPUE + 1) catch per unit effort for normoxic (black) and hypoxic (open) samples for each larval taxa during its collection period (Table 1). An asterisk indicates there was a difference value based on ANOVA ($P \leq 0.05$).

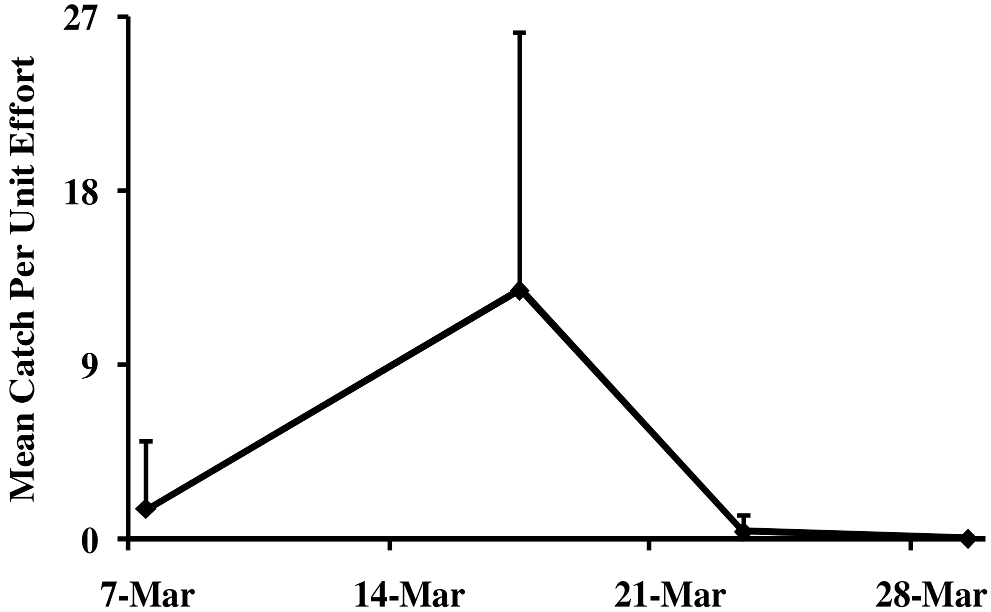

Figure 15. Mean (±SD) larval *Ictiobus spp*. catch per unit effort for 7 March 2007 to 29 March 2007(*Ictiobus* spp. collection period) for all site combined.

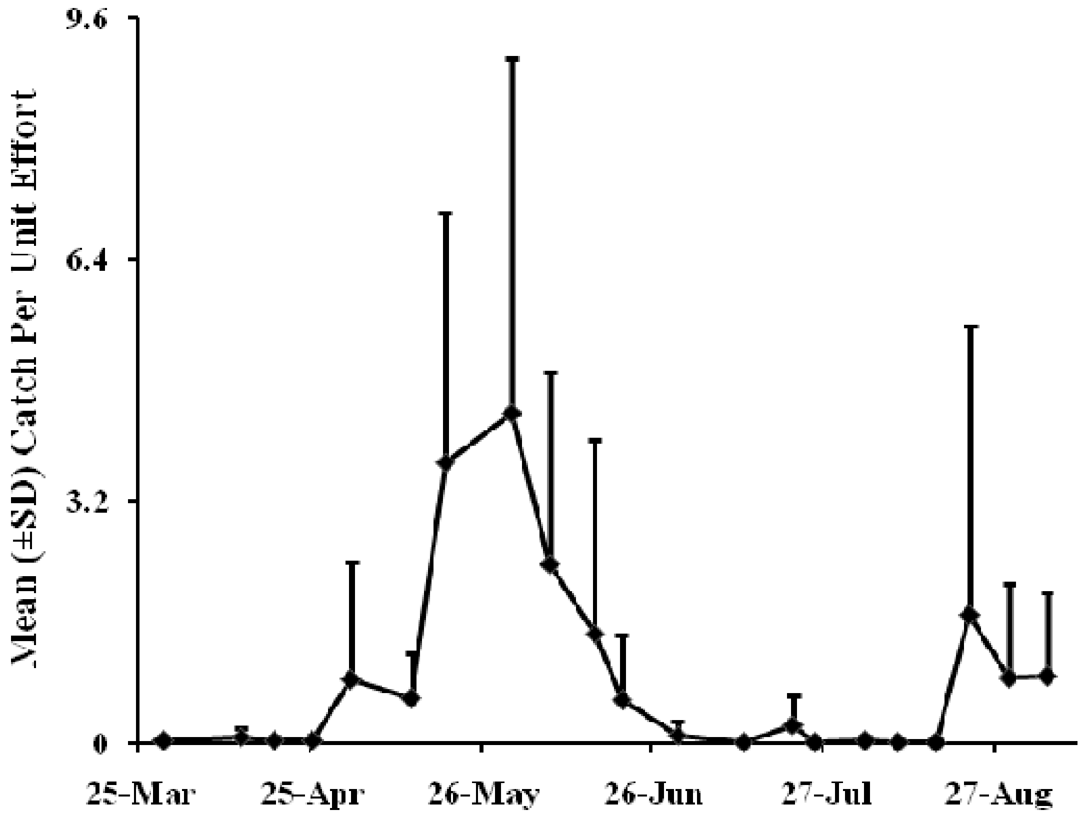

Figure 16. Mean (±SD) larval *Lepomis spp*. catch per unit effort for 29 March 2007 to 5 September 2007 (*Lepomis* spp. larvae collection period) for all sites combined.

were greater at canal habitats than bayou habitats (Table 1). Mean temperature did not vary between canal and bayou sites (Table 1). Mean CPUE for larval *Lepomis* spp. was greater in normoxic (N=83) collections than hypoxic (N=63) collections (Figure 14). Larval *Lepomis* spp. CPUE was weakly positively correlated (P=<0.0001, R^2=0.1264) to dissolved oxygen (Figure 17), and weakly positively correlated (P=0.0005, R^2=0.0813) to specific conductance (Figure 18). Larval *Lepomis* spp. CPUE was not correlated to temperature.

***Pomoxis* spp. larvae**

A total of 64 *Pomoxis* spp. larvae were collected between 17 March 2007 to 29 March 2007 (*Pomoxis* spp. larvae collection period; Table 1, Figure 5, Figure 11). The greatest overall mean CPUE for *Pomoxis spp*. larvae occurred on 17 March 2007 (Figure 19). Mean CPUE did not vary between habitats although no larval *Pomoxis* spp. were collected at sites 1 and 3 (canal habitats). Mean water temperature was not different between canal habitats and bayou habitats for the larval *Pomoxis* spp. collection period (Table 1). Mean dissolved oxygen, and mean specific conductance were greater at canal habitats than bayou habitats during the larval *Pomoxis* spp. collection period (Table 1). The mean CPUE was not different between normoxic (N=6) and hypoxic (N=15) collections (Figure 14). Larval *Pomoxis* spp. CPUE was weakly negatively correlated (P=0.013, R^2=0.282) to specific conductance (Figure 20) but was not correlated to any other water quality variable.

***Cyprinus carpio* larvae**

Larval *Cyprinus carpio* were collected on 23 March 2007 at site 6 and 18 April 2007 at site 7. The small number (N=2) collected of this species collected did not allow for

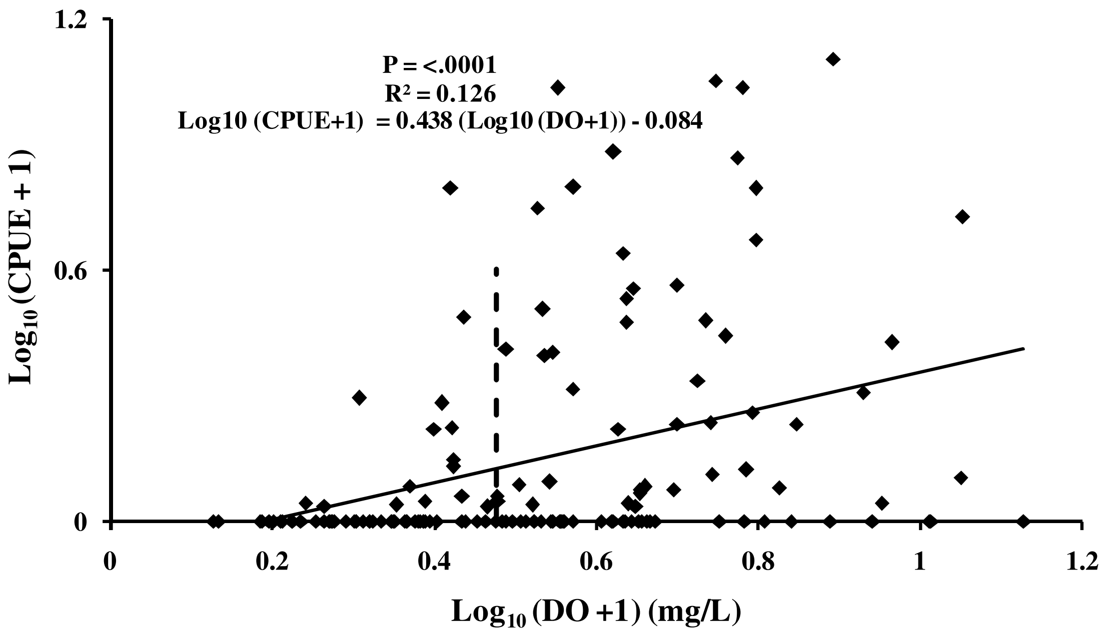

Figure 17. Relationship between $\log_{10}$ transformed (CPUE+1) catch per unit effort and $\log_{10}$ transformed (DO+1) dissolved oxygen (mg/L) for larval *Lepomis* spp. collected between 29 March 2007 and 5 September 2007 (*Lepomis spp*. larvae collection period). Vertical black line represents a dissolved oxygen of 2.0 mg/L.

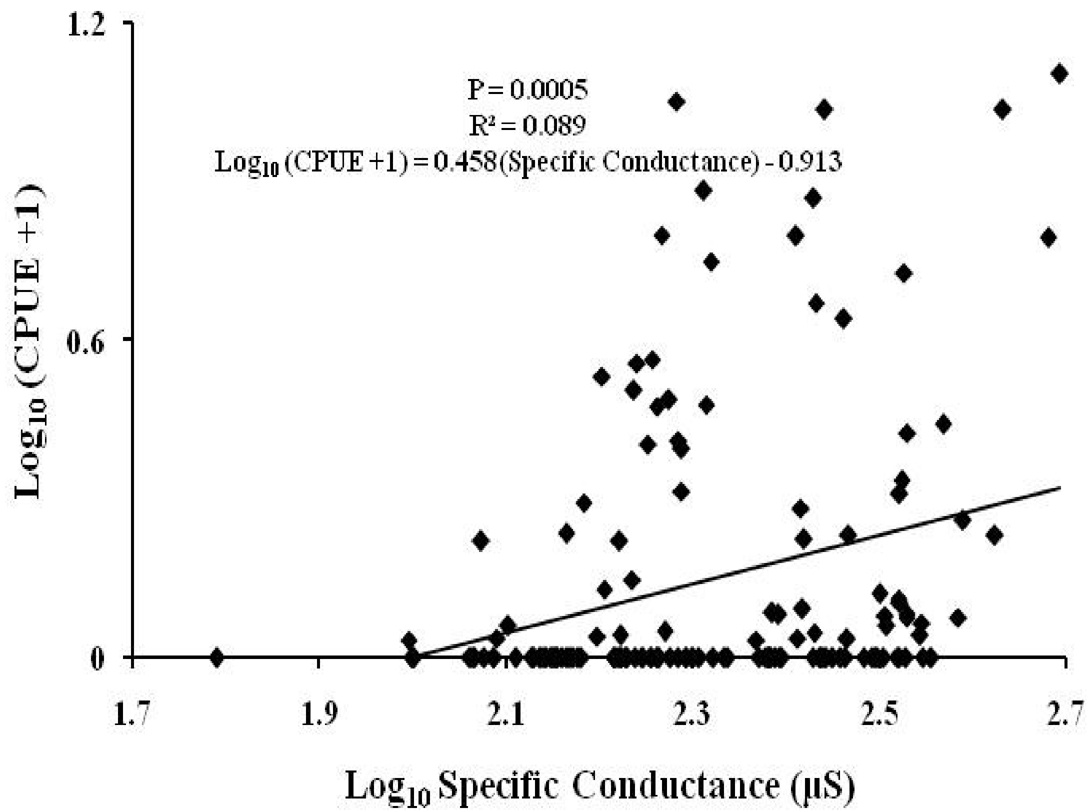

Figure 18. Relationship between $\log_{10}$ transformed (CPUE+1) catch per unit effort and $\log_{10}$ transformed specific conductance (µS) for larval *Lepomis* spp. Collected between 29 March 2007 and 5 September 2007 (*Lepomis* spp. larvae collection period).

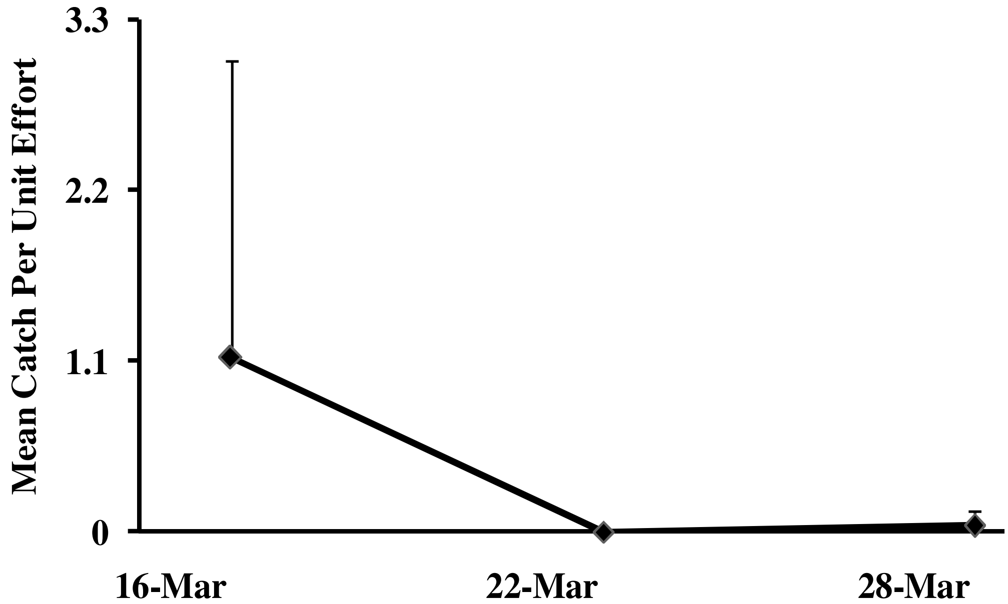

Figure 19. Mean (±SD) larval *Pomoxis* spp. catch per unit effort for all sites combined for 17 March 2007 to 29 March 2007 (*Pomoxis* spp. larvae collection period).

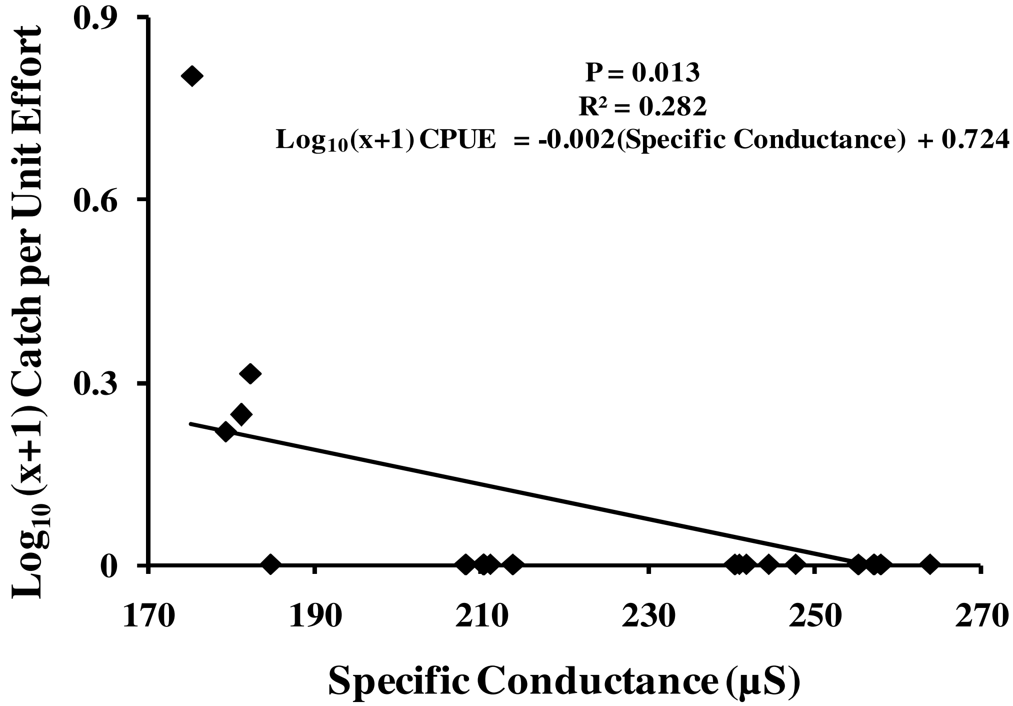

Figure 20. Relationship between mean $\log_{10}$ transformed (CPUE +1) catch per unit effort and mean specific conductance (µS) for larval *Pomoxis* spp. collected between 17 March 2007 and 29 March 2007.

analysis.

JUVENILE

Gambusia affinis juveniles

A total of 1,689 juvenile *Gambusia affinis* were collected between 29 March 2007 to 25 September 2007 (*Gambusia affinis* juvenile collection period; Table 2, Figure 5, Figure 21). The greatest overall mean CPUE for juvenile *Gambusia affinis* occurred on 21 July 2007 and did not differ between habitats or between normoxic (N=87) and hypoxic (N=67) collections (Figures 22 and 23). Mean water temperature did not differ between canal and bayou habitats (Table 2). Mean dissolved oxygen and mean specific conductance were greater at canal habitats than bayou habitats (Table 2). Juvenile *Gambusia affinis* CPUE was weakly positively correlated with temperature ($P = 0.0012$, $R^2 = 0.067$) and weakly negatively correlated with specific conductance ($P = 0.0086$, $R^2 = 0.045$; Figures 24 and 25). *Gambusia affinis* CPUE was not correlated with dissolved oxygen.

Heterandria formosa juveniles

A total of 93 juvenile *Heterandria formosa* were collected between 12 April 2007 to 5 September 2007 (*Heterandria formosa* juvenile collection period; Table 2, Figure 4, Figure 20). The greatest overall mean CPUE for juvenile *Heterandria formosa* occurred on 2 May 2007 (Figure 26). Mean CPUE was greater at bayou habitats than canal habitats, but no difference was detected between normoxic (N=81) and hypoxic (N=59) waters (Table 2, Figure 23). Mean water temperature did not differ between canal habitats and bayou habitats during the juvenile *Heterandria formosa* collection period (Table 2). Mean dissolved oxygen and mean specific conductance were greater at canal

Table 2. Collection period, total number (N), and mean (±SE) temperature (ºC), dissolved oxygen (mg/L), and specific conductance (µs) for each species of juvenile collected for each

habitat. An asterisk indicates there was a difference between habitats for that value based on ANOVA ($P \leq 0.05$).

Species	**Collection Date**	**Habitat**	**N**	**Temperature**	**DO**	**Specific Conductance**
Gambusia affinis	3/29/07 – 9/25/07	Canal	976	27.9 ± 0.38	4.0 ± 0.29*	245 ± 9.9*
		Bayou	713	27.3 ± 0.26	1.9 ± 0.16	198 ± 8.9
Heterandria formosa	4/12/07 – 9/5/07	Canal	10*	28.0 ± 0.42	4.1 ± 0.31*	249 ± 10.4*
		Bayou	83	27.4 ± 0.28	2.0 ± 0.18	200 ± 9.5
Lepomis spp.	5/13/07 – 9/25/07	Canal	43	29.1 ± 0.33	4.1 ± 0.35*	225 ± 11.0*
		Bayou	41	28.1 ± 0.24	1.6 ± 0.14	171 ± 8.9

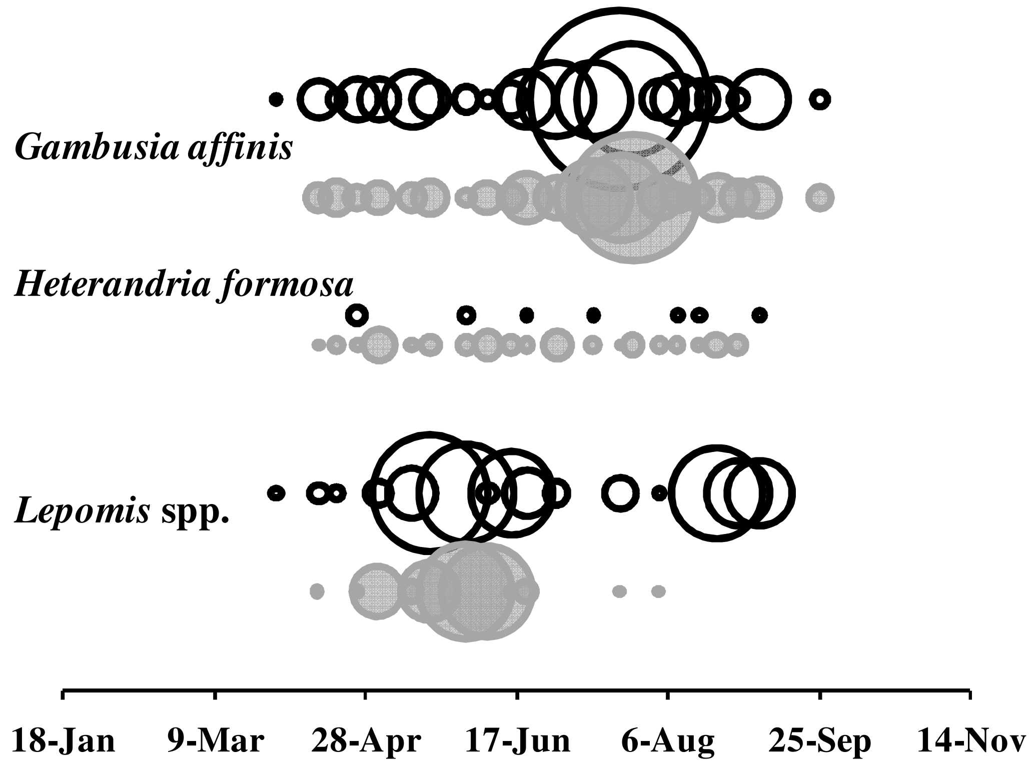

Figure 21. Catch per unit effort for each genera of juvenile fish through their collection periods by habitat. Canal CPUE is represented by open circles and bayou CPUE represented by shaded gray circles. Circle sizes represents size of CPUE for each sample date.

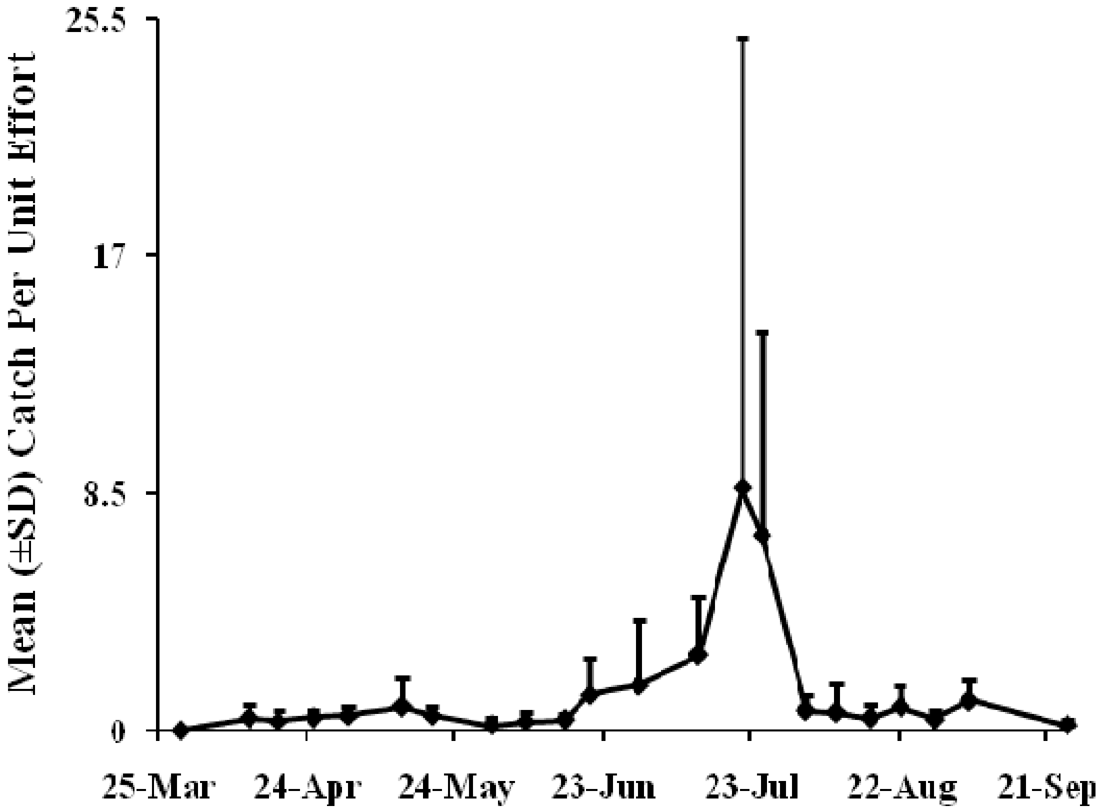

Figure 22. Mean (±SD) juvenile *Gambusia affinis* catch per unit effort for 29 March 2007 to 25 September 2007 (*Gambusia affinis* juvenile collection period) for all sites combined.

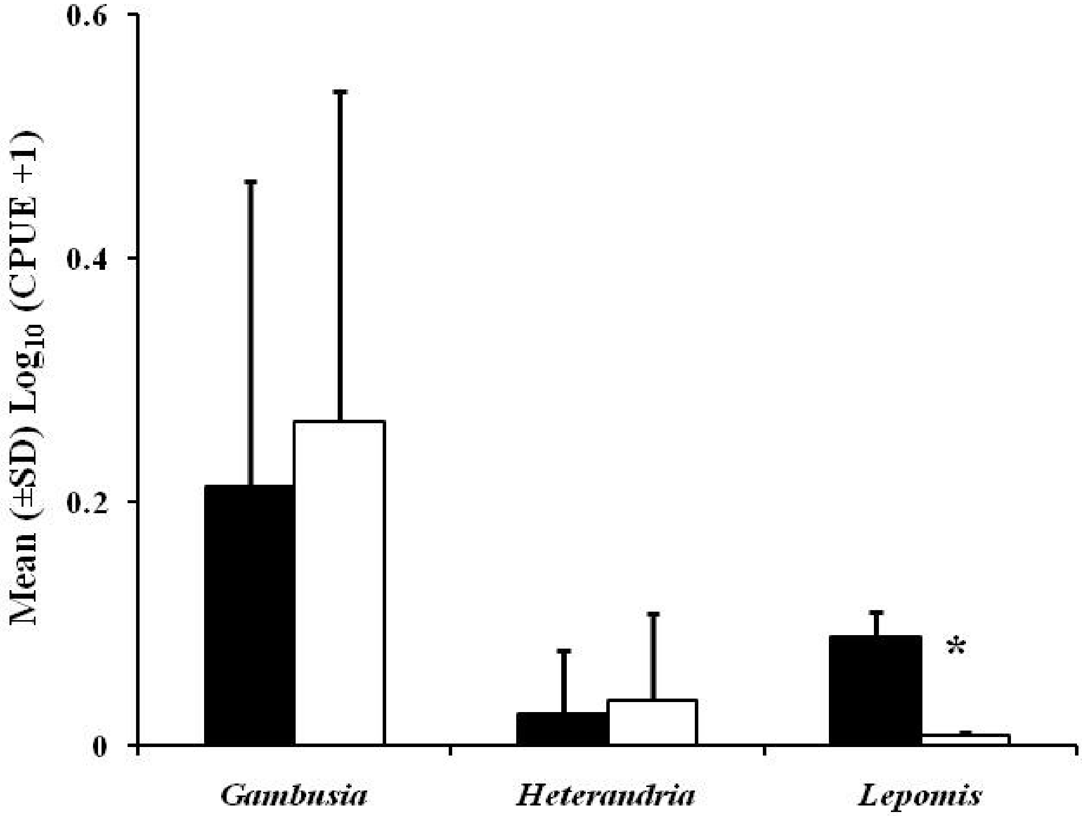

Figure 23. Mean (±SD) $\log_{10}$ transformed (CPUE + 1) catch per unit effort for normoxic (black) and hypoxic (open) samples for each juvenile taxa during its collection period (Table 2). An asterisk indicates there was a difference value based on ANOVA ($P \leq 0.05$).

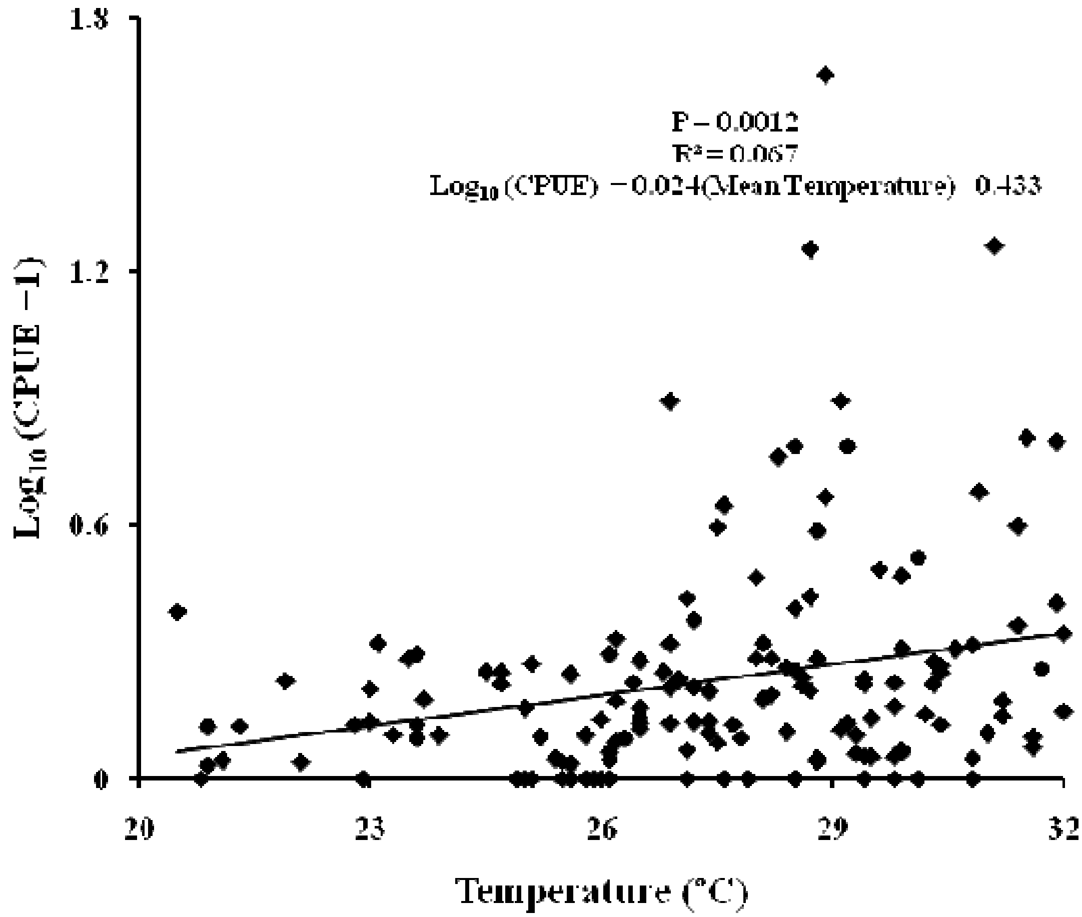

Figure 24. The relationship between $\log_{10}$ transformed (CPUE+1) catch per unit effort and temperature (°C) for juvenile *Gambusia affinis* 17 March 2007 to 25 September 2007 (*Gambusia affinis* juvenile collection period).

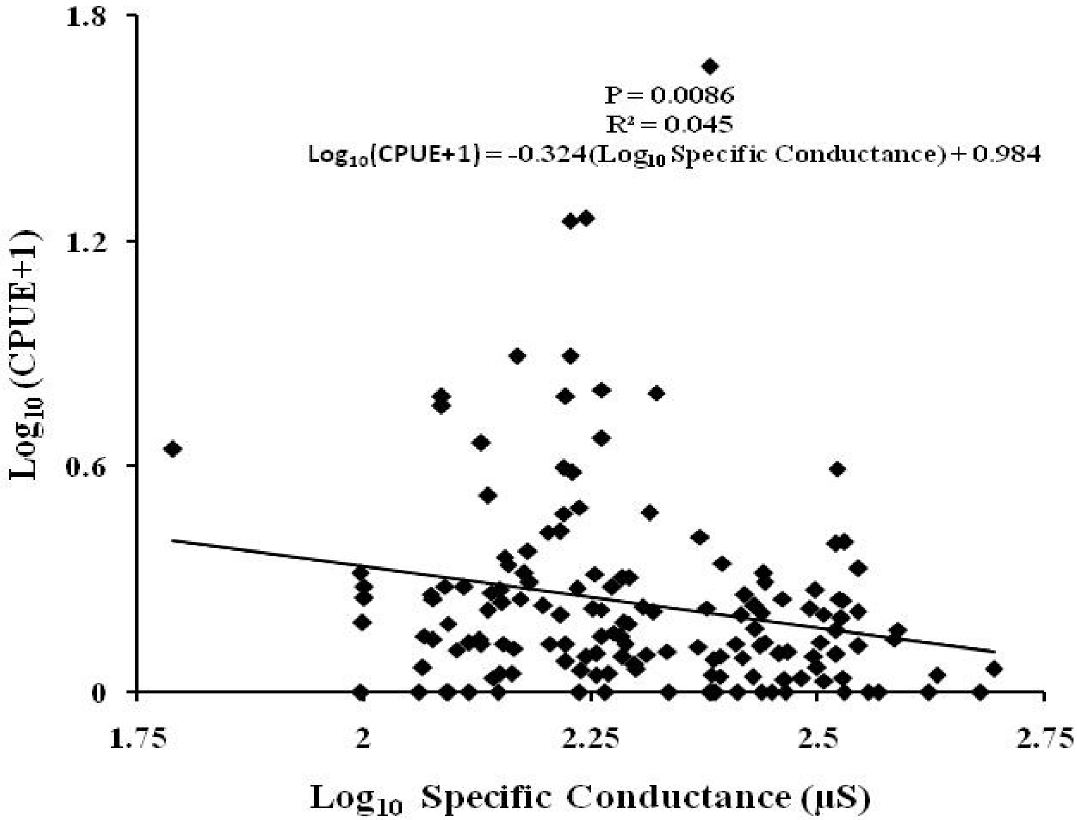

Figure 25. The relationship between $\log_{10}$ transformed (CPUE+1) catch per unit effort and $\log_{10}$ transformed specific conductance (µS) for juvenile *Gambusia affinis* for 17 March 2007 to 25 September 2007 (*Gambusia affinis* juvenile collection period).

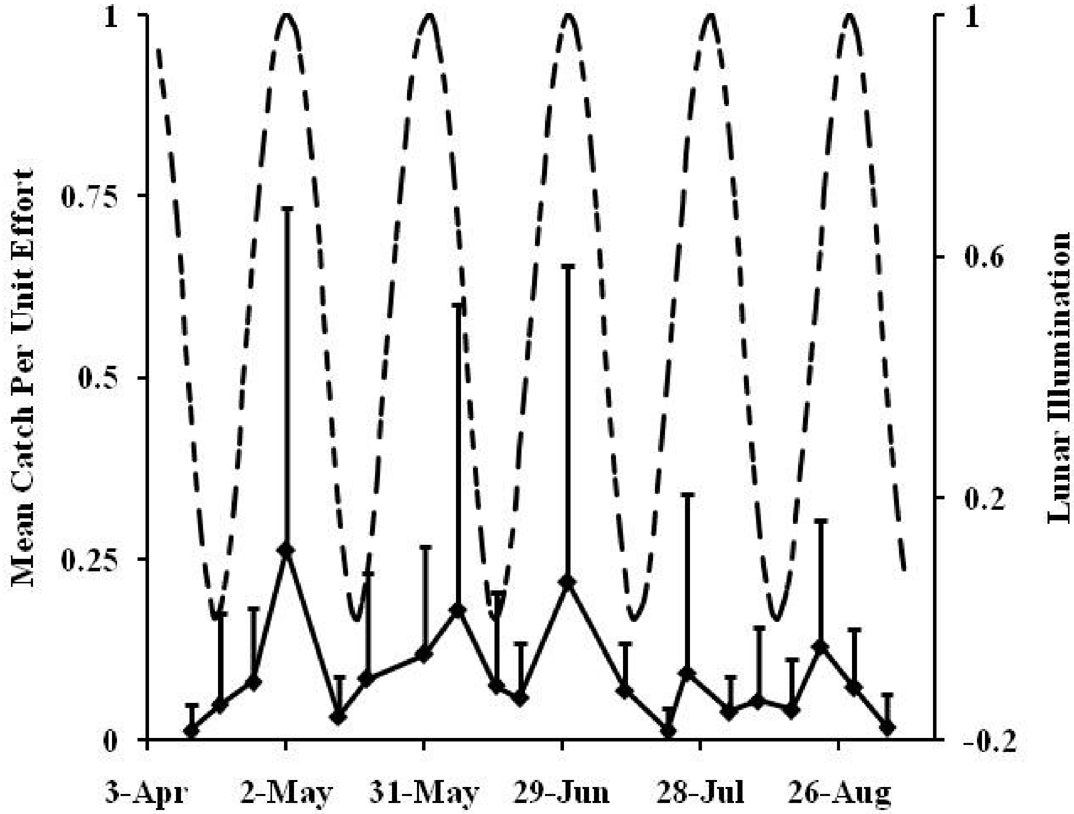

Figure 26. Mean (±SD) juvenile *Heterandria formosa* catch per unit effort for 12 March 2007 to 5 September 2007 (*Heterandria formosa* juvenile collection period) for all sites combined. The dashed represents lunar illumination with a full moon at 1 and a new moon at 0.

Habitats than bayou habitats for the juvenile *Heterandria formosa* collection (Table 2). Juvenile *Heterandria formosa* CPUE was not correlated to any water quality variable. *Heterandria formosa* CPUE was greater at lunar illuminations of ≥75% than lunar illuminations <75% (Figure 27) and weakly positively correlated ($P = 0.0049$, $R^2 = 0.362$) with lunar illumination (Figure 28).

***Lepomis* spp. juveniles**

A total of 84 juvenile *Lepomis* spp. were collected between 13 May 2007 to 25 September 2007 (*Lepomis* spp. juvenile collection period) (Table 2; Figure 5, Figure 21). The greatest overall mean CPUE for juvenile *Lepomis* spp. occurred on 13 May 2007 (Figure 29). The mean overall CPUE was not different between habitats, but was greater in normoxic (N=62) waters than hypoxic (N=57) waters (Figure 23). Overall mean water temperature, mean dissolved oxygen, and mean specific conductance were greater at canal habitats then bayou habitats (Table 2). Juvenile *Lepomis* spp. CPUE was weakly negatively correlated ($P=0.0019$, $R^2=0.08$) to temperature (Figure 30) but was not correlated to any other water quality variable.

Rarely collected juveniles

Nine genera of juveniles were collected in numbers too small to analyze (Table 3). Estuary associated species such as *Anchoa mitchilli* were only collected at canal habitats (Table 3). *Lepisosteus oculatus* was only collected from bayou habitats (Table 3). Some species such as *Elassoma zonatum* and *Poecilia latipinna* were collected from habitats throughout the study area (Table 3).

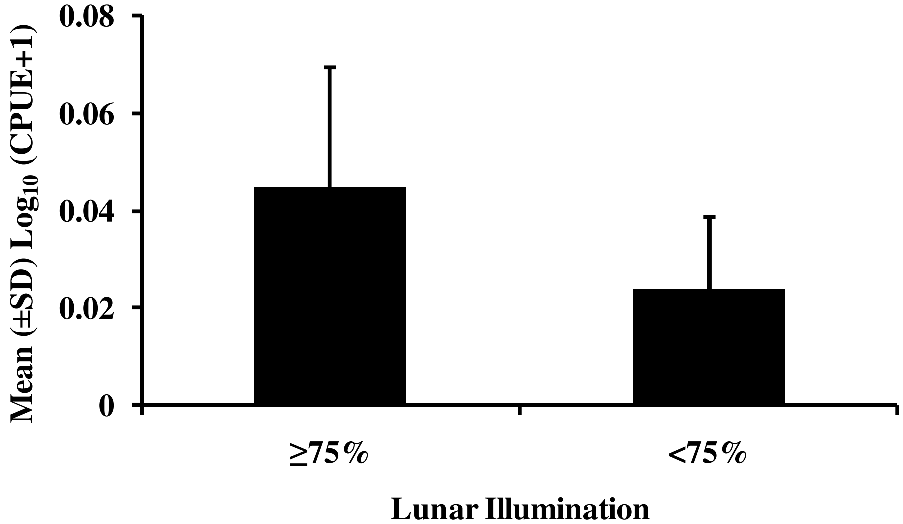

Figure 27. Mean (±SD) juvenile *Heterandria formosa* $\log_{10}$ transformed (CPUE+1) catch per unit effort was greater at ≥75% lunar illumination then <75% lunar illumination. ($P = 0.029$, $\alpha = 0.05$) for 12 March 2007 to 5 September 2007 (*Heterandria formosa* juvenile collection period).

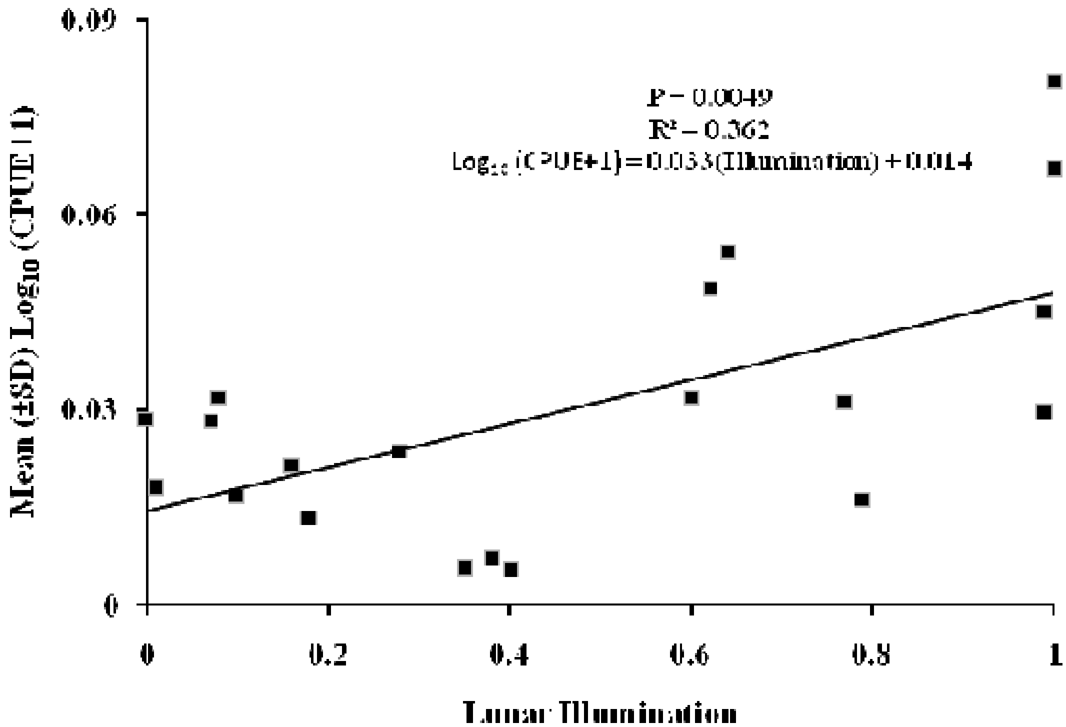

Figure 28. The relationship between $\log_{10}$ transformed (CPUE+1) catch per unit effort and lunar illumination (0 = new moon and 1 = full moon) for 12 March 2007 to 5 September 2007 (*Heterandria formosa* juvenile collection period).

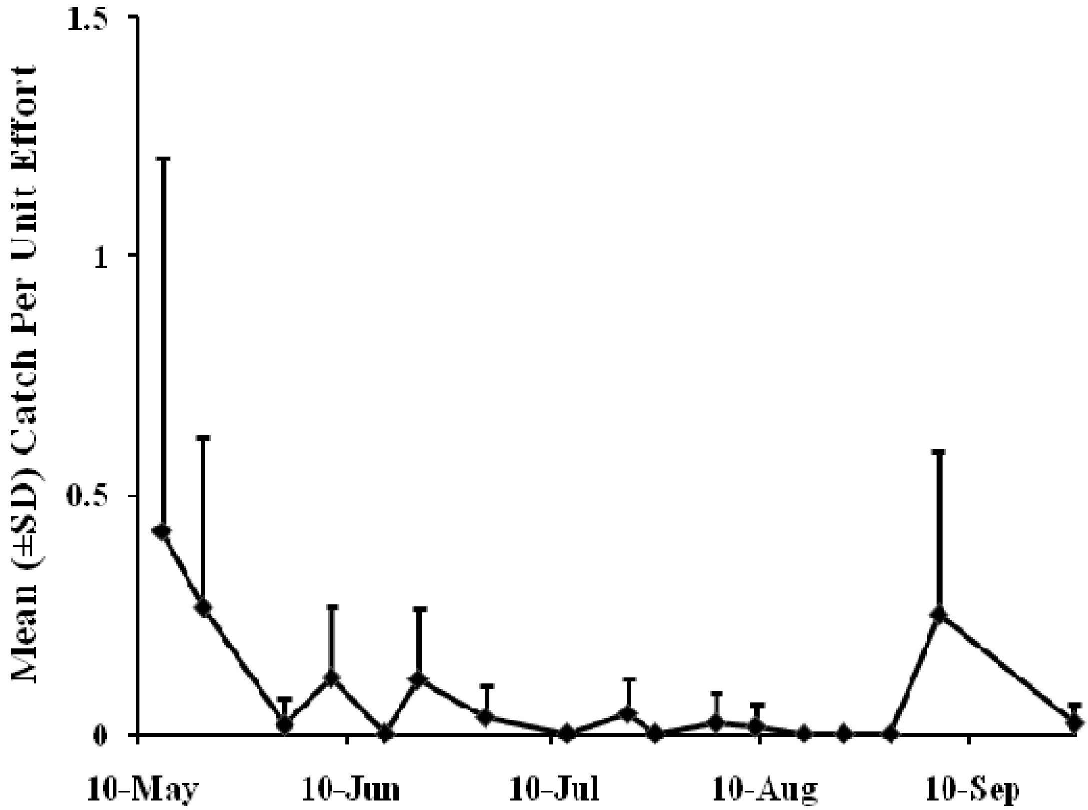

Figure 29. Mean (±SD) juvenile *Lepomis* spp. catch per unit effort for 13 May 2007 to 25 September 2007 (*Lepomis* spp. juvenile collection period) for all sites combined.

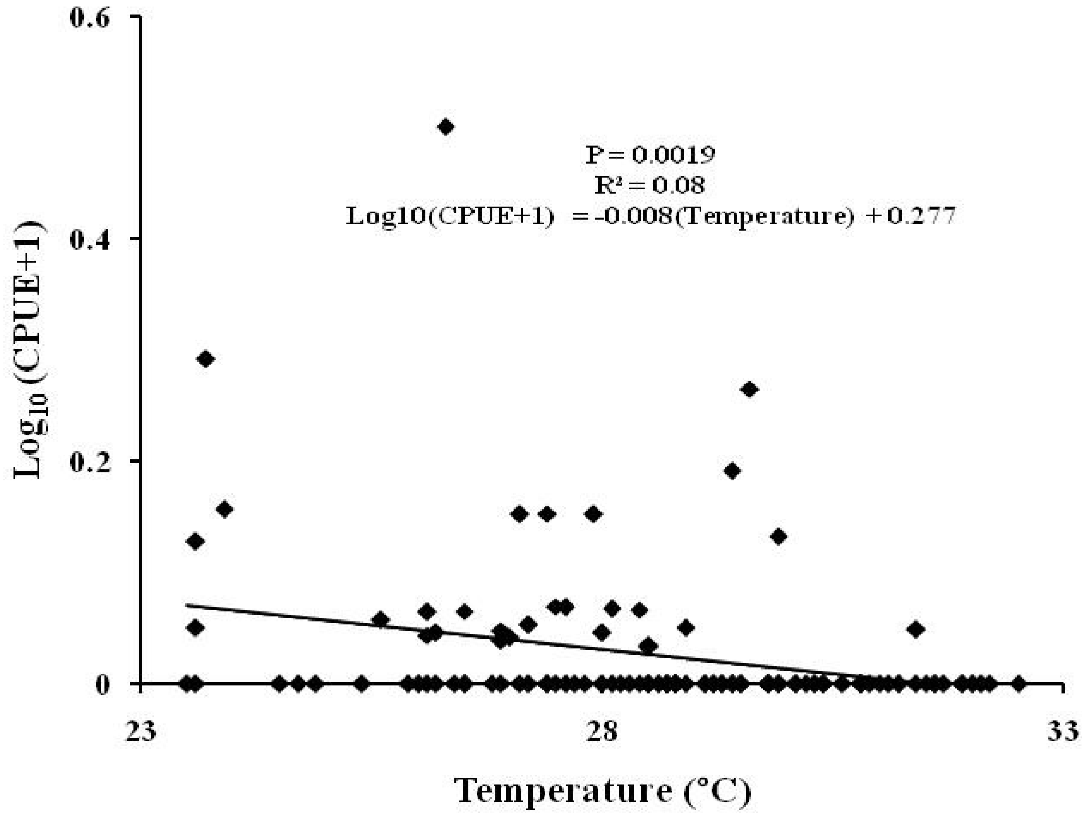

Figure 30. The relationship between $\log_{10}$ transformed (CPUE+1) catch per unit effort and temperature (°C) for juvenile *Lepomis* spp. collected between 13 May 2007 to 25 September 2007.

Table 3. First and last collection date, number (N), and collection sites for rare juveniles collected from sample date 12 April 2007 until 5 September 2007.

Species	Collection date	N	Collection Sites
Lepisosteus oculatus	5/19/2007 – 6/20/2007	8	4, 5, 6, 7
Anchoa mitchilli	5/31/2007 – 6/20/2007	6	1, 2, 3
Notemigonus crysoleucas	8/16/2007	1	7
Ictalurus punctatus	5/13/2007 – 6/15/2007	5	1, 2, 6
Poecilia latipinna	6/7/2007 – 9/5/2007	27	1, 3, 4, 5, 6, 7
Menidia beryllina	5/31/2007 – 6/7/2007	6	2
Syngnathus scovelli	6/7/2007	1	3
Pomoxis spp.	4/12/2007 – 5/19/2007	3	1, 3, 7
Elassoma zonatum	4/18/2007 – 7/12/2007	13	1, 3, 5, 6, 7

PRINCIPAL COMPONENTS ANALYSIS

Water Quality

The PCA yielded two principal components that accounted for 86.4% of variation in the water quality data by habitat (Figure 31). Dissolved oxygen and specific conductance were positively loaded on principal component 1 (PC1) and temperature was positively loaded on principal component 2 (PC2; Table 4). Canal habitats generally exhibited higher dissolved oxygen and specific conductance than bayou habitats.

Fish

The PCA yield two principal components that accounted for 42.1% of variation in the CPUE data by site (Figure 32). *Dorosoma* spp., *Ictiobus* spp. and *Pomoxis* spp. were negatively loaded on PC1. *Lepomis* spp. larvae, *Lepomis* spp. juveniles, and *Dorosoma* spp. were negatively loaded on PC2 (Table 4). *Dorosoma* spp. and *Ictiobus* spp. had the most influence on the larval fish assemblage in canal habitats. *Gambusia affinis* and *Heterandria formosa* dominated the fish assemblage in bayou habitats. *Lepomis* spp. and *Pomoxis* spp. were intermediately positioned between canal and bayou habitats.

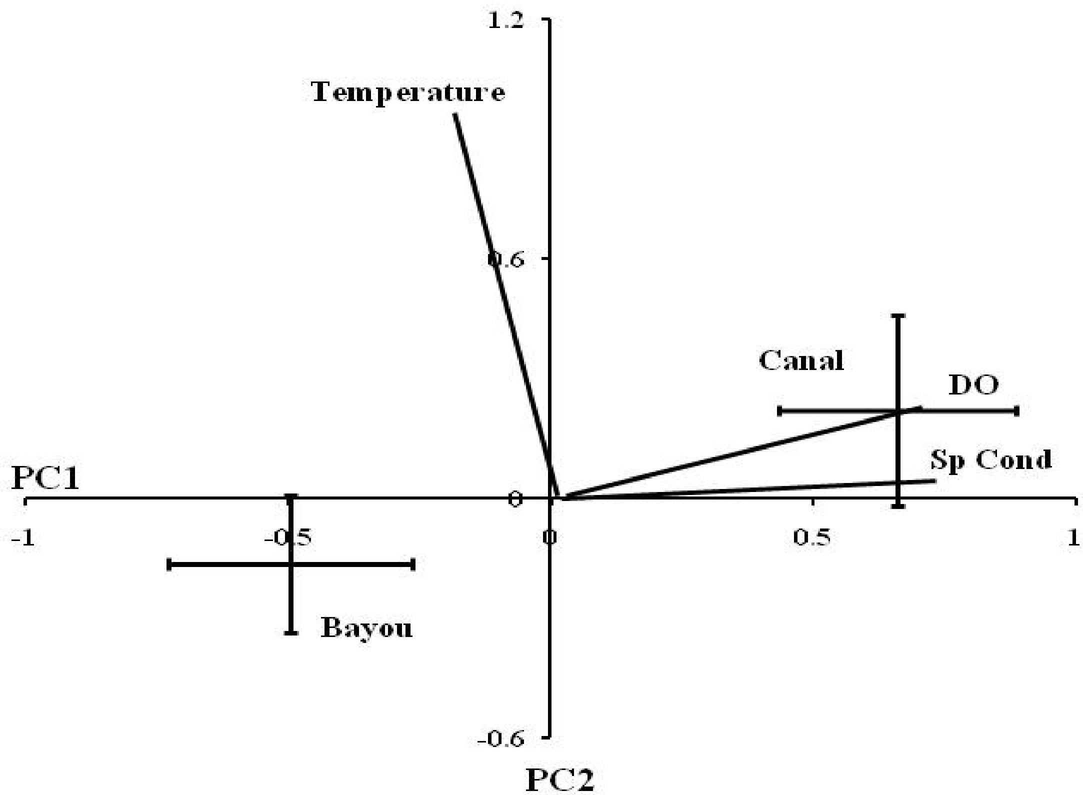

Figure 31. Two-dimensional PCA ordination of water quality data by habitat with PC1 (x-axis) and PC2 (y-axis) accounting for 86.4% of variation. Lines indicate water quality variable loadings on each component. Crossed bars represent ± 95% confidence intervals.

Table 4. Water quality PCA loadings with PC1 explaining 53.1% of the variation and PC2 explaining 32% of the variation.

Variable	PC1	PC2
Temperature (°C)	-0.199	0.971
Dissolved Oxygen (mg/L)	0.684	0.234
Specific Conductance (µS)	0.702	0.048

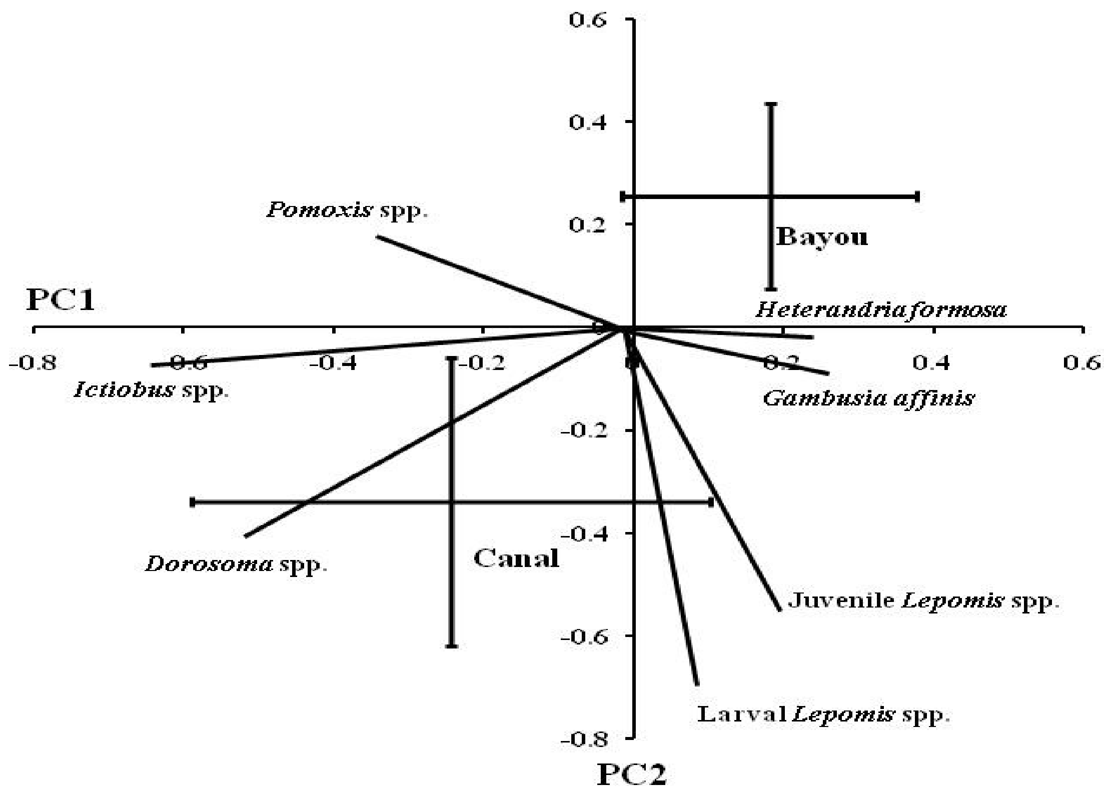

Figure 32. Two-dimensional PCA ordination of CPUE data by habitat with PC I (x-axis) and PC II (y-axis) accounting for 42.1% of the variation. Lines indicate CPUE loadings on each component. Crossed bars represent ± 95% confidence intervals.

Table 5. Fish PCA loadings with PC1 explaining 23.9% of the variation and PC2 explaining 18.2% of the variation.

Species	PC1	PC2
Dorosoma spp.	-0.517	-0.406
Ictiobus spp.	-0.643	-0.074
Gambusia affinis	0.291	-0.087
Heterandria formosa	0.267	-0.017
Lepomis spp. larvae	0.084	-0.693
Lepomis spp. juveniles	0.195	-0.558
Pomoxis spp.	-0.343	0.176

DISCUSSION

Many organisms native to large river floodplain ecosystems have evolved to take advantage of predictable seasonal inundation of floodplain habitat (Sparks 1995). The timing and duration of the flood pulse are important factors for fish species that use the flooded area for spawning and nursery habitat (Fontenot et al. 2001). The flood pulse concept concludes that fish species take advantage of the phytoplankton bloom, augmented by floodplain derived nutrients and rising temperature to produce the highest growth rate and survival for their larvae (Junk et al. 1989). In the ARB many fish species have developed spawning periods that coincide with the predictable flood pulse and concomitant rise in temperature (Hall and Lambou 1990). In southeast Louisiana, Mississippi River floodplains typically reach peak inundation during April, with a pulse of river water that homogenizes water quality among floodplain bayous and backwaters (Sabo et al 1999a, 1999b.; Fontenot et al. 2001).

Some large-river floodplain ecosystems, such as the Brazos River, Texas, and Murray-Darling River system, Australia, do not receive a predictable flood pulse. In the Brazos River and the Murray-Darling River systems, fish recruitment conforms to the low flow recruitment hypothesis, which states that some fish species use floodplain habitat for reproduction when available, but can also use main channel habitats to spawn (Humphries et al. 1999; Zeug and Winemiller 2008b). Because of its altered hydrology, the fish assemblages of the upper Barataria Estuary may shift from species adapted to a flood pulse based life history to species that are better suited to a low flow recruitment based life history. Bayous are typically formed as distributaries or interdistributaries in river floodplain systems. Bayou habitats in the upper Barataria Estuary are characterized by low banks, meandering curves, and heavily vegetated littoral zones. Bayou sites typically exhibited tea-colored water, low dissolved oxygen, and low specific conductance (Estay 2007). Canals are generally straight channel, dredged water bodies created for navigation, drainage, or access. Canal habitats in the upper Barataria Estuary have relatively high banks, straight channels, and little to no aquatic vegetation. Canal habitats were usually characterized by sediment laden water, high specific conductance, and higher dissolved oxygen levels then the bayou habitats.

Abundant aquatic vegetation and meanders may slow water flow in bayou habitats to the point that bayou habitats could be characterized as lower energy lentic environments when compared to canal habitats. Canal habits have few curves to slow water flow and a higher sediment load than bayou habitats, giving canal habitats some characteristics of higher energy lotic environments. Within floodplain habitats, lentic habitats support higher biomasses of bacterioplankton then do lotic habitats and lotic habitats support higher biomasses of phytoplankton than do lentic habitats (Hein et al. 1999). Canal habitats had higher specific conductance and more lotic characteristics then bayou habitats, which may have supported a higher biomass of phytoplankton than bayou habitats, helping to explain the differences in dissolved oxygen between the habitats. Canal habitats experienced shorter and fewer periods of hypoxic conditions than bayou habitats. The tea-colored waters of bayou habitats may have lower phytoplankton biomass than canal habitats. The dissolved organic humic acids in tea colored water reduces the availability of light from the blue-green region of the visible spectrum, to phytoplankton, and may lead to reduced primary production and dissolved oxygen levels (Phlips et al. 2000). In lower energy lentic habitats, rainwater runoff that is not followed by river water flushing can lead to hypoxia. The lack of flushing due to the altered hydrology of the upper Barataria Estuary may prolong the periods of chronic hypoxia in the bayou habits (Sabo et al. 1999b, Ahearn et al. 2006).

As with previous research in the upper Barataria Estuary, no sustained spring flood pulse occurred in 2007 (Davis 2006; Fontenot 2006; Estay 2007). Water levels in the study area were unpredictable and driven by runoff from local precipitation. Heavy rainfall events flush decaying organic matter from the floodplain and nutrient rich agricultural runoff into the bayous. The heavy bacterial load and increased respiration rates supported by the input of organic matter can lead to decreased dissolved oxygen levels. Hypoxic conditions were seen in the bayou habitats every sample trip from 30 June 2007 to 22 August 2007, a period of 54 days. This supports the results of past studies in the area that also showed chronic hypoxia is a problem in the upper Barataria Estuary (Davis 2006; Fontenot 2006; Dantin 2007; Estay 2007).

Larval or juvenile stages of some species of fish expected to reproduce in the upper Barataria Estuary were not collected during this study. Adult *Amia calva*, *Ameiurus* spp., *Morone* spp., and *Micropterus salmoides* are commonly collected in the upper Barataria Estuary with gillnets (Davis 2006; Fontenot 2006; Smith 2008), but no evidence of their reproduction was seen during this study. *Aphredoderus sayanus* and *Fundulus chrysotus* both inhabit the heavily vegetated littoral zones of the upper Barataria Estuary (personal observation 2007), but neither larvae nor juveniles were collected in 2007. Larval fish studies in similar habitat in the ARB have collected larval *Aplodinotus grunniens* (Fontenot et al. 2001), but they were absent from this study.

Some fish species spawn in the upper Barataria Estuary, but their larvae may not be vulnerable to light trap collection. For fish larvae to be vulnerable to light trap collection the larvae must be positively phototaxic, or attracted to light (Marchetti et al. 2004). The average opening for the light traps in this study was 3.23 ±0.48 mm, and may have limited access to species of fish that remain under parental care until they were too large to fit through the small trap opening (Ross 2001). Numerous *Fundulus chrysotus* and *Ameiurus* spp. juveniles were collected via dip net in the shoreline vegetation during the course of the study, but none were caught in light traps. Fish with pelagic larvae, such as yellow bass, may have spawned in 2007 in the upper Barataria Estuary, but their larvae never entered the littoral zone where the light traps sampled.

Spawning and juvenile collection periods in the upper Barataria Estuary were similar to the spawning periods published for most fish. It should be noted that *Menidia beryllina* and *Anchoa mitchilli* were only collected for a short period after a strong tidal current flowed into the upper Barataria Estuary on May 31, 2007 (Appendix II).

Heterandria formosa reproduce throughout the year, but during the winter months there is a reduction in the number of pregnant females (Hellier 1967; Travis et al. 1987). Brood sizes are small, (1 – 16 offspring; Cheong et al. 1984) with brood intervals that vary from 3-8 days in summer and 31-40 days in winter (Scrimshaw 1944a, 1944b; Ross 2001). The decrease of pregnant females coupled with the long brood period may explain the absence of *Heterandria formosa* from early samples. *Heterandria formosa* exhibit clutch overlap, or superfetation, and carry up to 10 broods of different developmental stages simultaneously allowing for high fecundity and large offspring size in a small fish (Travis et al. 1987). The link between lunar illumination and CPUE for

Heterandria formosa may be due to a change in behavior that causes juveniles to become more vulnerable to light trap capture, or juveniles may be more abundant near the full moon. Although *Heterandria formosa* mainly feed during the day (Ross 2001), they may increase their nocturnal foraging around the full moon to reduce predation risk and become more vulnerable to light trap capture. One species of livebearer, *Poecilia reticulata*, shows a lunar periodicity in its spectral sensitivity, becoming more sensitive to yellow light (583 nm) around the full moon (Lang 1970). If *Heterandria formosa* became more sensitive to yellow light around the full moon this species could become more vulnerable to light trap sampling. *Heterandria formosa* could increase reproductive activity during the full moon to increase the total number of juveniles in the water, thereby increasing the chance that any individual will reach maturity. This strategy is seen in many marine species (Moyle and Cech 2000).

Contrary to our predictions, *Dorosoma* spp., *Ictiobus* spp., and *Lepomis* spp. were more abundant in the altered canal habitats than the in natural bayou habitats. Canal habitats may offer higher quality nursery areas for larval fish in the upper Barataria Estuary because of their sediment rich waters, higher dissolved oxygen, and higher specific conductance. *Pomoxis* spp. was the only larval fish species that was not more abundant in canal habitats than in bayou habitats. *Pomoxis* spp. seemed to prefer bayou habitats, with only 3 of the 64 fish collected from canal habitats. The large variation in CPUE may have precluded detecting a difference in habitat preference for *Pomoxis* spp.

The equilibrium strategist *Lepomis* spp. was the only genus more abundant in normoxic than hypoxic waters. *Lepomis* spp. may have attempted to spawn in hypoxic waters, but the larvae may have hatched and died or spawning efforts failed. Larval and juvenile *Lepomis* spp. may use oxygenated water near aquatic vegetation as a refuge (Fontenot 2001). Sampling of vegetated habitats during this study during hypoxic conditions showed little evidence that larval and juvenile *Lepomis* spp. were using littoral vegetation. *Lepomis* spp. may not spawn in hypoxic habitats because their long spawning period allows them to wait for optimal environmental conditions.

Periodic strategists like *Dorosoma* spp. and *Ictiobus* spp. had no detectable preference between normoxic and hypoxic waters, but were more abundant in the lotic canal habitats. *Dorosoma* spp. and *Ictiobus* spp. may prefer canal habitats because they are more lotic than bayou habitats or because the dissolved oxygen levels and specific conductance make the canal habitat a better nursery for their larvae (Sabo et al. 2001). Periodic strategists will spawn in suboptimal conditions, although their year class strength may be affected (Humphries et al. 2002; Zeug and Winemiller 2008b).

Opportunistic strategists (*Gambusia affinis* and *Heterandria formosa*) were common in both canal and bayou habitats. Livebearers dominated the bayou habitat most likely because of their adaptations to hypoxic environments and their ability to exploit shallow, heavily vegetated littoral habitats (Lewis 1970; Ross 2001; Winemiller et al. 2000; Boschung and Mayden 2004). The abundant vegetation of bayou habitats may provide a refuge from predation for these species.

The factor with the biggest impact on fish reproduction in the upper Barataria Estuary may be its altered hydrology (Sklar and Conner 1983; Junk et al. 1989). The higher abundance of larvae and juveniles of non-opportunistic species in the dredged habitats is an indication that the altered hydrology is affecting fish reproduction. The lack of a predictable flood pulse and lack of flushing may have a negative impact on fish reproduction in the upper Barataria Estuary (Davis 2006; Fontenot 2006). The hydrology of upper Barataria Estuary may now conform more closely to the low flow recruitment hypothesis than the flood pulse concept because of the flashy nature of its high water periods (Zeug and Winemiller 2008b). The lack of flushing causes chronic hypoxic conditions in the bayou habits and makes them poor nursery habitats for many larval fish (Sabo et al. 1991; Sabo et al. 1999a, 1999b; Fontenot et al. 2001).

All three components of ecosystem health (V-O-R) may be affected by the altered hydrology of the upper Barataria Estuary. A possible reduction in fisheries production due to the loss of natural bayou habitats as quality spawning areas for some species reduces the vigor of the system (Costanza and Mageau 1999). The absence of some fish species from the study area implies a reduction in the diversity and structure, or the organization, of the upper Barataria Estuary (Boesch and Paul 2001). The loss of the direct connection between the upper Barataria Estuary and the Mississippi River means that fish can only move between other estuaries in the Mississippi River floodplain systems through the Gulf Intracoastal Waterway or small Mississippi River diversions, such as the Davis Pond diversion. This could reduce the recolonization rate of the upper Barataria Estuary after a stressful event like a hurricane, and may lead to a reduction in the resilience of the upper Barataria Estuary (Costanza and Mageau 1999). The overall health of the upper Barataria Estuary seems to be negativity impacted by its reduced connectivity to the Mississippi River.

This study and its conclusions are limited by its short, one season duration. Future research is needed to understand the complex processes that control the health of upper Barataria Estuary. To understand how altered hydrology affects the water quality trends, fixed sites with continuous data recorders need to be placed in different habitat types throughout the area. Quarterly electrofishing surveys at fixed sites in different habitats of Bayou Chevreuil, St. James Canal, Bayou Citamon could be used to reveal seasonal and year to year variation in fish assemblages. Fish reproduction and recruitment should be characterized through multiple year light trap and push net monitoring of larval and juvenile fish. These studies would further our understanding of the function and health of the upper Barataria Estuary.

Restoration of the upper Barataria Estuary's historical connection to the Mississippi River may improve the ecosystems health. A predictable flood pulse may benefit many of the fish species in the area through improved reproduction. At the least, flushing the upper Barataria Estuary with Mississippi River water would help reduce the areas and duration of chronic hypoxia and increase quality nursery habitats for fish.

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Appendix I. Listing of all species collected with their common name, scientific name, and species code.

Species	Common Name	Code
Lepisosteus oculatus	Spotted gar	Lepi
Dorosoma spp.	Shad	Doro
Anchoa mitchilli	Bay anchovy	Anch
Notemigonus crysoleucas	Golden shiner	Cpyr
Ictiobus spp.	Buffalo	Icti
Ictalurus punctatus	Channel catfish	Icta
Gambusia affinis	Eastern mosquitofish	Gamb
Heterandria formosa	Least killifish	Hete
Poecilia latipinna	Sailfin molly	Poec
Menidia beryllina	Inland silverside	Meni
Syngnathus scovelli	Gulf pipefish	Syng
Lepomis spp.	Sunfish	Lepo
Pomoxis spp.	Crappie	Pomo
Elassoma zonatum	Banded pygmy sunfish	Elas

Appendix II. Listing of water quality variables temperature (ºC), DO (dissolved oxygen mg/L), conductivity (specific conductance µs), water color, and flow (in to or out of study area) collected from 21 February 2007 to 25 September 2007.

Date	Site	Habitat	Temperature	DO	Conductivity	Color	Flow
2/21/2007	1	Canal	14.5	2.74	187.3	sediment	out
2/21/2007	2	Canal	14	3	176.5	sediment	out
2/21/2007	3	Canal	15.2	2.88	157.4	sediment	out
2/21/2007	4	Bayou	15.6	2.76	151.2	mixed	out
2/21/2007	5	Bayou	15.5	2.53	150.8	tea	out
2/21/2007	6	Bayou	15.6	2.48	151.6	tea	out
2/21/2007	7	Bayou	16	2.43	152.8	tea	out
3/7/2007	1	Canal	18.4	9.46	237	sediment	out
3/7/2007	2	Canal	17.6	7.25	221.2	sediment	out
3/7/2007	3	Canal	16.2	2.96	192.4	mixed	out
3/7/2007	4	Bayou	16.2	2.83	186.9	tea	out
3/7/2007	5	Bayou	15.9	2.67	185.7	tea	out
3/7/2007	6	Bayou	16	2.65	187.6	tea	out
3/7/2007	7	Bayou	16.4	2.48	196.9	tea	out
3/17/2007	1	Canal	19.4	1.54	255.3	tea	out
3/17/2007	2	Canal	18.8	1.58	247.6	sediment	out
3/17/2007	3	Canal	18.8	1.64	184.7	sediment	out
3/17/2007	4	Bayou	19	1.42	175.2	sediment	out
3/17/2007	5	Bayou	18.8	1.19	179.3	sediment	out
3/17/2007	6	Bayou	18.7	1.12	181.2	sediment	out
3/17/2007	7	Bayou	18.6	1.05	182.2	sediment	out
3/23/2007	1	Canal	23.2	3.33	263.9	sediment	out
3/23/2007	2	Canal	22.4	3.62	257.2	sediment	out
3/23/2007	3	Canal	22.3	2.33	211.1	sediment	out
3/23/2007	4	Bayou	22	1.75	208.2	tea	out
3/23/2007	5	Bayou	22.2	1.72	210.4	tea	out
3/23/2007	6	Bayou	22	1.53	210.4	tea	out
3/23/2007	7	Bayou	22	1.35	213.9	tea	out
3/29/2007	1	Canal	25.6	4.65	290.8	sediment	out
3/29/2007	2	Canal	25.5	3.45	291.5	sediment	out
3/29/2007	3	Canal	26.1	2.32	258	mixed	out
3/29/2007	4	Bayou	25.8	1.23	244.4	tea	out
3/29/2007	5	Bayou	25.5	1.72	241.7	tea	out
3/29/2007	6	Bayou	25	1.11	240.9	tea	out
3/29/2007	7	Bayou	25.1	1.05	240.5	tea	out
4/12/2007	1	Canal	21.3	3.51	350.4	tea	out
4/12/2007	2	Canal	20.5	4.53	331.5	tea	out
4/12/2007	3	Canal	23.3	3.39	287.1	tea	out

Date	Site	Habitat	Temperature	DO	Conductivity	Color	Flow
4/12/2007	4	Bayou	21.9	2.01	269.2	tea	out
4/12/2007	5	Bayou	22.9	1.99	281.5	tea	out
4/12/2007	6	Bayou	21.1	1	268	tea	out
4/12/2007	7	Bayou	23	1.83	276.5	tea	out
4/18/2007	1	Canal	20.9	2	321.7	sediment	out
4/18/2007	2	Canal	20.9	1.92	233.4	sediment	out
4/18/2007	3	Canal	22.1	2.34	304	sediment	out
4/18/2007	4	Bayou	22.8	2.4	273	tea	out
4/18/2007	5	Bayou	23.1	2.62	276	tea	out
4/18/2007	6	Bayou	20.8	2.63	274	tea	out
4/18/2007	7	Bayou	23	2.6	273.9	tea	out
4/25/2007	1	Canal	24.7	2.51	310.6	tea	out
4/25/2007	2	Canal	25.1	3.18	314.5	tea	out
4/25/2007	3	Canal	25.6	5.41	337.2	tea	out
4/25/2007	4	Bayou	25.5	3.95	337.7	tea	out
4/25/2007	5	Bayou	25	2.59	331.9	tea	out
4/25/2007	6	Bayou	25.8	2.72	330.6	tea	out
4/25/2007	7	Bayou	25.2	1.53	313.4	tea	out
5/2/2007	1	Canal	26.2	6.74	351.2	tea	out
5/2/2007	2	Canal	26.9	7.95	349.8	tea	out
5/2/2007	3	Canal	26.5	5.2	388	tea	out
5/2/2007	4	Bayou	28.2	10.25	336.2	tea	out
5/2/2007	5	Bayou	27.1	5.1	315.9	tea	out
5/2/2007	6	Bayou	27.2	5.07	318.6	tea	out
5/2/2007	7	Bayou	27.4	5.69	320.7	tea	out
5/13/2007	1	Canal	27.5	7.49	332.3	sediment	out
5/13/2007	2	Canal	28.5	8.23	338.3	sediment	out
5/13/2007	3	Canal	27.4	4.01	293.1	sediment	out
5/13/2007	4	Bayou	26.3	2.49	261.1	mixed	out
5/13/2007	5	Bayou	26.2	2.19	242.6	mixed	out
5/13/2007	6	Bayou	26.1	1.34	246.7	mixed	out
5/13/2007	7	Bayou	26.4	1.4	238.5	mixed	out
5/19/2007	1	Canal	24.7	3.29	289.5	sediment	out
5/19/2007	2	Canal	23.6	2.56	276.3	sediment	out
5/19/2007	3	Canal	23.9	3.18	205.1	sediment	out
5/19/2007	4	Bayou	23.7	2.72	193.8	mixed	out
5/19/2007	5	Bayou	23.6	2.44	194.2	mixed	out
5/19/2007	6	Bayou	23.6	2.08	192.7	mixed	out
5/19/2007	7	Bayou	23.5	1.73	187.8	mixed	out
5/31/2007	1	Canal	26.1	6.8	494	sediment	out
5/31/2007	2	Canal	25.6	6.02	420.2	sediment	in
5/31/2007	3	Canal	24.5	4.31	334	mixed	in

Date	Site	Habitat	Temperature	DO	Conductivity	Color	Flow
5/31/2007	4	Bayou	24.9	4.75	369.7	mixed	in
5/31/2007	5	Bayou	25.4	5.02	427.9	sediment	in
5/31/2007	6	Bayou	26	5.26	479	sediment	in
5/31/2007	7	Bayou	26.5	3.5	384	sediment	in
6/7/2007	1	Canal	31	10.2	331.7	sediment	in
6/7/2007	2	Canal	30.1	9.32	359.5	sediment	in
6/7/2007	3	Canal	27.9	3.57	337.9	mixed	in
6/7/2007	4	Bayou	26.9	1.63	257.6	mixed	in
6/7/2007	5	Bayou	27.2	2.37	208.6	sediment	in
6/7/2007	6	Bayou	27.6	2.73	184.7	sediment	in
6/7/2007	7	Bayou	26.1	1.03	152.4	sediment	in
6/15/2007	1	Canal	29.4	4.94	268.3	sediment	out
6/15/2007	2	Canal	29.8	5.27	270.1	sediment	out
6/15/2007	3	Canal	28.4	2.33	215.9	sediment	out
6/15/2007	4	Bayou	27.8	0.88	176.1	sediment	out
6/15/2007	5	Bayou	27.7	0.86	167.1	sediment	out
6/15/2007	6	Bayou	27.5	0.74	166.8	tea	out
6/15/2007	7	Bayou	27.4	0.72	164.6	tea	out
6/20/2007	1	Canal	27	3.35	157.7	sediment	out
6/20/2007	2	Canal	27.1	3.33	159.4	sediment	out
6/20/2007	3	Canal	28	3.24	166.3	sediment	out
6/20/2007	4	Bayou	30.8	3.59	173	sediment	out
6/20/2007	5	Bayou	28.9	1.74	134.8	sediment	out
6/20/2007	6	Bayou	29.1	1.72	126.5	sediment	out
6/20/2007	7	Bayou	28.4	1.51	118.4	sediment	out
6/30/2007	1	Canal	26.5	1.65	171.6	sediment	out
6/30/2007	2	Canal	26.5	1.65	160.4	sediment	out
6/30/2007	3	Canal	26.9	1.43	147.3	sediment	out
6/30/2007	4	Bayou	27.2	1.09	151.6	mixed	out
6/30/2007	5	Bayou	26.9	0.87	150.4	mixed	out
6/30/2007	6	Bayou	26.8	0.86	148.7	mixed	out
6/30/2007	7	Bayou	26.5	0.95	146.3	mixed	out
7/12/2007	1	Canal	31.9	2.14	234.8	sediment	out
7/12/2007	2	Canal	32.5	2.6	248.1	sediment	out
7/12/2007	3	Canal	31.9	2.07	210	sediment	out
7/12/2007	4	Bayou	30.9	1.01	183.2	tea	out
7/12/2007	5	Bayou	31.5	0.68	183	tea	out
7/12/2007	6	Bayou	31.2	0.57	183	tea	out
7/12/2007	7	Bayou	30.8	0.62	179.9	tea	out
7/21/2007	1	Canal	28.7	1.56	260	sediment	out
7/21/2007	2	Canal	31.7	1.64	262.7	sediment	out
7/21/2007	3	Canal	28.9	2.21	240.3	sediment	out

Date	Site	Habitat	Temperature	DO	Conductivity	Color	Flow
7/21/2007	4	Bayou	28.5	1.44	122	sediment	out
7/21/2007	5	Bayou	28.3	1.32	121.9	sediment	out
7/21/2007	6	Bayou	28	1.25	122.9	sediment	out
7/21/2007	7	Bayou	27.6	1.22	61.6	sediment	out
7/25/2007	1	Canal	30.8	7.72	241.6	sediment	out
7/25/2007	2	Canal	31.6	9.25	247.5	sediment	out
7/25/2007	3	Canal	31.1	3.16	175.6	mixed	out
7/25/2007	4	Bayou	29.2	1.32	167.1	tea	out
7/25/2007	5	Bayou	29.1	1.31	168.8	tea	out
7/25/2007	6	Bayou	28.8	1.01	169.7	tea	out
7/25/2007	7	Bayou	28.7	1.09	168.8	tea	out
8/3/2007	1	Canal	29.8	1.44	186.2	sediment	out
8/3/2007	2	Canal	28.8	1.38	180.1	sediment	out
8/3/2007	3	Canal	28.7	1.48	164.5	sediment	out
8/3/2007	4	Bayou	28.5	1.16	100.2	sediment	out
8/3/2007	5	Bayou	28.2	0.89	100	sediment	out
8/3/2007	6	Bayou	28.1	0.84	99.8	sediment	out
8/3/2007	7	Bayou	28.1	0.84	99	sediment	out
8/9/2007	1	Canal	32.2	3.32	217.2	sediment	out
8/9/2007	2	Canal	32	3.03	188.9	sediment	out
8/9/2007	3	Canal	31.4	2.05	165.7	sediment	out
8/9/2007	4	Bayou	30.4	0.79	119.2	tea	out
8/9/2007	5	Bayou	30.2	0.53	116.6	tea	out
8/9/2007	6	Bayou	29.9	0.36	116	tea	out
8/9/2007	7	Bayou	29.8	0.34	115.2	tea	out
8/16/2007	1	Canal	31.6	5.93	198.9	mixed	out
8/16/2007	2	Canal	31.2	12.41	195.8	mixed	out
8/16/2007	3	Canal	31.4	3.49	143	mixed	out
8/16/2007	4	Bayou	30.3	1.22	141.4	tea	out
8/16/2007	5	Bayou	29.4	1.43	140.5	tea	out
8/16/2007	6	Bayou	29.4	0.63	141	tea	out
8/16/2007	7	Bayou	29.2	0.54	142.5	tea	out
8/22/2007	1	Canal	30.3	2.51	178.8	mixed	out
8/22/2007	2	Canal	32.1	4.59	191.8	mixed	out
8/22/2007	3	Canal	32	3.63	144.2	mixed	out
8/22/2007	4	Bayou	30.4	1.24	134.7	tea	out
8/22/2007	5	Bayou	29.5	0.68	134	tea	out
8/22/2007	6	Bayou	30.4	0.59	138.5	tea	out
8/22/2007	7	Bayou	30.1	1.41	137	tea	out
8/29/2007	1	Canal	29.3	3.42	173.6	sediment	out
8/29/2007	2	Canal	29.3	4	180.5	sediment	out
8/29/2007	3	Canal	29.5	4.5	145.9	mixed	out

Date	Site	Habitat	Temperature	DO	Conductivity	Color	Flow
8/29/2007	4	Bayou	28.6	3.7	136.9	tea	out
8/29/2007	5	Bayou	28.8	2.5	128.8	tea	out
8/29/2007	6	Bayou	28.8	3.3	139.1	tea	out
8/29/2007	7	Bayou	28.6	2.6	142.1	tea	out
9/5/2007	1	Canal	29.6	2.42	172.6	sediment	out
9/5/2007	2	Canal	29.4	3.33	182.6	sediment	out
9/5/2007	3	Canal	29.9	4.42	206.2	sediment	out
9/5/2007	4	Bayou	30.6	3.52	192.7	sediment	out
9/5/2007	5	Bayou	29.9	2.51	196.1	sediment	out
9/5/2007	6	Bayou	29.9	2.25	199.5	sediment	out
9/5/2007	7	Bayou	29.8	1.91	202.7	sediment	out
9/25/2007	1	Canal	28.5	3.85	130.5	sediment	out
9/25/2007	2	Canal	28.5	3.36	123.6	sediment	out
9/25/2007	3	Canal	27.4	3.36	130.6	mixed	out
9/25/2007	4	Bayou	27.1	1.83	124.1	tea	out
9/25/2007	5	Bayou	26.2	0.92	123.7	brown	out
9/25/2007	6	Bayou	26	0.8	119.2	brown	out
9/25/2007	7	Bayou	25.9	1.05	99.2	brown	out

Appendix II. List of each larvae or juvenile fish collected including: date, site, trap, habitat, species, stage, number, effort, and CPUE. Species codes listed in appendix I.

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
3/7/2007	1	A	Canal	Icti	larvae	1	2.5	0.40
3/7/2007	1	B	Canal	Icti	larvae	2	2.5	0.80
3/7/2007	2	A	Canal	Icti	larvae	1	2.93	0.34
3/7/2007	2	C	Canal	Icti	larvae	32	2.93	10.92
3/7/2007	2	B	Canal	Icti	larvae	49	2.93	16.72
3/7/2007	3	B	Canal	Icti	larvae	1	3.3	0.30
3/7/2007	3	C	Canal	Icti	larvae	1	3.3	0.30
3/7/2007	3	A	Canal	Icti	larvae	7	3.3	2.12
3/7/2007	4	C	Bayou	Icti	larvae	3	3.73	0.80
3/7/2007	6	A	Bayou	Icti	larvae	2	4.63	0.43
3/17/2007	1	C	Canal	Doro	larvae	5	3.43	1.46
3/17/2007	2	B	Canal	Doro	larvae	2	3.23	0.62
3/17/2007	2	A	Canal	Doro	larvae	14	3.23	4.33
3/17/2007	3	A	Canal	Doro	larvae	1	3.07	0.33
3/17/2007	3	B	Canal	Doro	larvae	1	3.07	0.33
3/17/2007	3	C	Canal	Doro	larvae	3	3.07	0.98
3/17/2007	5	C	Bayou	Doro	larvae	1	2.53	0.40
3/17/2007	6	B	Bayou	Doro	larvae	1	2.2	0.45
3/17/2007	7	C	Bayou	Doro	larvae	1	1.88	0.53
3/17/2007	1	B	Canal	Icti	larvae	67	3.43	19.53
3/17/2007	1	A	Canal	Icti	larvae	72	3.43	20.99
3/17/2007	1	C	Canal	Icti	larvae	203	3.43	59.18
3/17/2007	2	C	Canal	Icti	larvae	7	3.23	2.17
3/17/2007	2	B	Canal	Icti	larvae	90	3.23	27.86
3/17/2007	2	A	Canal	Icti	larvae	164	3.23	50.77
3/17/2007	3	A	Canal	Icti	larvae	5	3.07	1.63
3/17/2007	3	B	Canal	Icti	larvae	18	3.07	5.86
3/17/2007	3	C	Canal	Icti	larvae	146	3.07	47.56
3/17/2007	4	B	Bayou	Icti	larvae	1	2.8	0.36
3/17/2007	4	C	Bayou	Icti	larvae	7	2.8	2.50
3/17/2007	5	A	Bayou	Icti	larvae	2	2.53	0.79
3/17/2007	5	C	Bayou	Icti	larvae	9	2.53	3.56
3/17/2007	6	C	Bayou	Icti	larvae	3	2.2	1.36
3/17/2007	6	B	Bayou	Icti	larvae	7	2.2	3.18
3/17/2007	6	A	Bayou	Icti	larvae	9	2.2	4.09
3/17/2007	7	C	Bayou	Icti	larvae	2	1.88	1.06
3/17/2007	7	B	Bayou	Icti	larvae	12	1.88	6.38
3/17/2007	7	A	Bayou	Icti	larvae	21	1.88	11.17
3/17/2007	4	B	Bayou	Pomo	larvae	16	2.8	5.71
3/17/2007	4	A	Bayou	Pomo	larvae	29	2.8	10.36
3/17/2007	5	C	Bayou	Pomo	larvae	5	2.53	1.98

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
3/17/2007	6	C	Bayou	Pomo	larvae	1	2.2	0.45
3/17/2007	6	B	Bayou	Pomo	larvae	4	2.2	1.82
3/17/2007	7	A	Bayou	Pomo	larvae	1	1.88	0.53
3/17/2007	7	C	Bayou	Pomo	larvae	5	1.88	2.66
3/23/2007	6	B	Bayou	Cypr	larvae	1	3.28	0.30
3/23/2007	1	A	Canal	Icti	larvae	1	2.25	0.44
3/23/2007	1	B	Canal	Icti	larvae	5	2.25	2.22
3/23/2007	2	C	Canal	Icti	larvae	3	2.45	1.22
3/23/2007	2	A	Canal	Icti	larvae	4	2.45	1.63
3/23/2007	2	B	Canal	Icti	larvae	8	2.45	3.27
3/23/2007	3	B	Canal	Icti	larvae	1	2.67	0.37
3/23/2007	3	C	Canal	Icti	larvae	1	2.67	0.37
3/29/2007	1	A	Canal	Gamb	juvenile	1	4.17	0.24
3/29/2007	1	A	Canal	Icti	larvae	5	4.17	1.20
3/29/2007	2	C	Canal	Lepo	larvae	1	3.92	0.26
3/29/2007	3	A	Canal	Lepo	larvae	1	3.67	0.27
3/29/2007	2	B	Canal	Pomo	larvae	3	3.92	0.77
4/12/2007	1	C	Canal	Doro	larvae	1	2.03	0.49
4/12/2007	1	A	Canal	Doro	larvae	3	2.03	1.48
4/12/2007	2	B	Canal	Doro	larvae	4	2.25	1.78
4/12/2007	2	A	Canal	Doro	larvae	5	2.25	2.22
4/12/2007	1	C	Canal	Gamb	juvenile	2	2.03	0.99
4/12/2007	2	A	Canal	Gamb	juvenile	1	2.25	0.44
4/12/2007	2	B	Canal	Gamb	juvenile	1	2.25	0.44
4/12/2007	2	C	Canal	Gamb	juvenile	8	2.25	3.56
4/12/2007	3	C	Canal	Gamb	juvenile	2	2.47	0.81
4/12/2007	4	A	Bayou	Gamb	juvenile	2	2.83	0.71
4/12/2007	4	B	Bayou	Gamb	juvenile	4	2.83	1.41
4/12/2007	6	B	Bayou	Gamb	juvenile	1	3.4	0.29
4/12/2007	7	B	Bayou	Gamb	juvenile	1	3.67	0.27
4/12/2007	7	C	Bayou	Gamb	juvenile	3	3.67	0.82
4/12/2007	7	C	Bayou	Hete	juvenile	1	3.67	0.27
4/12/2007	1	C	Canal	Lepo	larvae	1	2.03	0.49
4/12/2007	2	A	Canal	Lepo	larvae	1	2.25	0.44
4/12/2007	2	B	Canal	Lepo	larvae	1	2.25	0.44
4/12/2007	4	A	Bayou	Lepo	larvae	1	2.83	0.35
4/12/2007	3	B	Canal	Pomo	juvenile	1	2.47	0.40
4/12/2007	7	A	Bayou	Pomo	juvenile	1	3.67	0.27
4/18/2007	7	B	Bayou	Cypr	larvae	1	2.13	0.47
4/18/2007	1	C	Canal	Doro	larvae	1	4.45	0.22
4/18/2007	7	A	Bayou	Elas	juvenile	1	2.13	0.47
4/18/2007	1	A	Canal	Gamb	juvenile	1	4.45	0.22
4/18/2007	2	B	Canal	Gamb	juvenile	1	4.09	0.24
4/18/2007	2	C	Canal	Gamb	juvenile	3	4.09	0.73
4/18/2007	3	C	Canal	Gamb	juvenile	1	3.78	0.26

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
4/18/2007	4	A	Bayou	Gamb	juvenile	1	3.01	0.33
4/18/2007	4	B	Bayou	Gamb	juvenile	1	3.01	0.33
4/18/2007	4	C	Bayou	Gamb	juvenile	1	3.01	0.33
4/18/2007	5	A	Bayou	Gamb	juvenile	1	2.78	0.36
4/18/2007	5	C	Bayou	Gamb	juvenile	2	2.78	0.72
4/18/2007	5	B	Bayou	Gamb	juvenile	6	2.78	2.16
4/18/2007	7	C	Bayou	Gamb	juvenile	1	2.13	0.47
4/18/2007	7	B	Bayou	Gamb	juvenile	3	2.13	1.41
4/18/2007	4	B	Bayou	Hete	juvenile	1	3.01	0.33
4/18/2007	4	A	Bayou	Hete	juvenile	2	3.01	0.66
4/18/2007	1	B	Canal	Lepo	larvae	1	4.45	0.22
4/18/2007	1	C	Canal	Lepo	larvae	1	4.45	0.22
4/18/2007	2	A	Canal	Lepo	larvae	1	4.09	0.24
4/25/2007	7	A	Bayou	Elas	juvenile	1	3.97	0.25
4/25/2007	1	A	Canal	Gamb	juvenile	2	1.98	1.01
4/25/2007	1	C	Canal	Gamb	juvenile	2	1.98	1.01
4/25/2007	2	B	Canal	Gamb	juvenile	1	2.3	0.43
4/25/2007	2	C	Canal	Gamb	juvenile	2	2.3	0.87
4/25/2007	2	A	Canal	Gamb	juvenile	3	2.3	1.30
4/25/2007	3	B	Canal	Gamb	juvenile	3	3.08	0.97
4/25/2007	3	C	Canal	Gamb	juvenile	4	3.08	1.30
4/25/2007	4	B	Bayou	Gamb	juvenile	1	3.43	0.29
4/25/2007	5	A	Bayou	Gamb	juvenile	1	3.58	0.28
4/25/2007	5	C	Bayou	Gamb	juvenile	4	3.58	1.12
4/25/2007	6	B	Bayou	Gamb	juvenile	1	3.8	0.26
4/25/2007	6	C	Bayou	Gamb	juvenile	2	3.8	0.53
4/25/2007	7	A	Bayou	Gamb	juvenile	1	3.97	0.25
4/25/2007	7	B	Bayou	Gamb	juvenile	1	3.97	0.25
4/25/2007	7	C	Bayou	Gamb	juvenile	1	3.97	0.25
4/25/2007	1	B	Canal	Hete	juvenile	1	1.98	0.51
4/25/2007	3	C	Canal	Hete	juvenile	2	3.08	0.65
4/25/2007	6	A	Bayou	Hete	juvenile	1	3.8	0.26
4/25/2007	6	C	Bayou	Hete	juvenile	1	3.8	0.26
4/25/2007	4	B	Bayou	Lepo	larvae	1	3.43	0.29
4/25/2007	4	C	Bayou	Lepo	larvae	1	3.43	0.29
5/2/2007	4	B	Bayou	Doro	larvae	1	2.3	0.43
5/2/2007	1	C	Canal	Gamb	juvenile	3	3.83	0.78
5/2/2007	1	B	Canal	Gamb	juvenile	4	3.83	1.04
5/2/2007	1	A	Canal	Gamb	juvenile	6	3.83	1.57
5/2/2007	2	B	Canal	Gamb	juvenile	6	3.13	1.92
5/2/2007	3	B	Canal	Gamb	juvenile	1	2.83	0.35
5/2/2007	3	C	Canal	Gamb	juvenile	3	2.83	1.06
5/2/2007	4	B	Bayou	Gamb	juvenile	2	2.3	0.87
5/2/2007	4	C	Bayou	Gamb	juvenile	2	2.3	0.87
5/2/2007	5	A	Bayou	Gamb	juvenile	1	2.05	0.49

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
5/2/2007	6	A	Bayou	Gamb	juvenile	1	1.83	0.55
5/2/2007	6	C	Bayou	Gamb	juvenile	1	1.83	0.55
5/2/2007	7	C	Bayou	Gamb	juvenile	1	1.63	0.61
5/2/2007	6	C	Bayou	Hete	juvenile	6	1.83	3.28
5/2/2007	7	B	Bayou	Hete	juvenile	1	1.63	0.61
5/2/2007	7	C	Bayou	Hete	juvenile	1	1.63	0.61
5/2/2007	2	A	Canal	Lepo	larvae	1	3.13	0.32
5/2/2007	3	C	Canal	Lepo	larvae	1	2.83	0.35
5/2/2007	3	B	Canal	Lepo	larvae	2	2.83	0.71
5/2/2007	3	A	Canal	Lepo	larvae	4	2.83	1.41
5/2/2007	4	C	Bayou	Lepo	larvae	9	2.3	3.91
5/2/2007	4	B	Bayou	Lepo	larvae	21	2.3	9.13
5/2/2007	5	C	Bayou	Lepo	larvae	2	2.05	0.98
5/2/2007	7	B	Bayou	Lepo	larvae	1	1.63	0.61
5/13/2007	1	B	Canal	Doro	larvae	1	1.93	0.52
5/13/2007	5	C	Bayou	Elas	juvenile	1	3.01	0.33
5/13/2007	1	C	Canal	Gamb	juvenile	3	1.93	1.55
5/13/2007	1	B	Canal	Gamb	juvenile	6	1.93	3.11
5/13/2007	1	A	Canal	Gamb	juvenile	8	1.93	4.15
5/13/2007	2	A	Canal	Gamb	juvenile	1	2.2	0.45
5/13/2007	2	B	Canal	Gamb	juvenile	3	2.2	1.36
5/13/2007	2	C	Canal	Gamb	juvenile	6	2.2	2.73
5/13/2007	3	B	Canal	Gamb	juvenile	1	2.37	0.42
5/13/2007	3	C	Canal	Gamb	juvenile	1	2.37	0.42
5/13/2007	4	B	Bayou	Gamb	juvenile	2	2.77	0.72
5/13/2007	5	B	Bayou	Gamb	juvenile	1	3.01	0.33
5/13/2007	5	C	Bayou	Gamb	juvenile	1	3.01	0.33
5/13/2007	6	C	Bayou	Gamb	juvenile	1	3.17	0.32
5/13/2007	7	B	Bayou	Gamb	juvenile	1	3.43	0.29
5/13/2007	7	A	Bayou	Gamb	juvenile	2	3.43	0.58
5/13/2007	7	C	Bayou	Gamb	juvenile	4	3.43	1.17
5/13/2007	4	A	Bayou	Hete	juvenile	1	2.77	0.36
5/13/2007	6	B	Bayou	Hete	juvenile	1	3.17	0.32
5/13/2007	2	A	Canal	Icta	juvenile	1	2.2	0.45
5/13/2007	1	C	Canal	Lepo	juvenile	1	1.93	0.52
5/13/2007	1	A	Canal	Lepo	larvae	1	1.93	0.52
5/13/2007	1	B	Canal	Lepo	larvae	2	1.93	1.04
5/13/2007	1	C	Canal	Lepo	larvae	3	1.93	1.55
5/13/2007	2	B	Canal	Lepo	larvae	3	2.2	1.36
5/13/2007	2	A	Canal	Lepo	larvae	8	2.2	3.64
5/13/2007	3	C	Canal	Lepo	juvenile	3	2.37	1.27
5/13/2007	3	A	Canal	Lepo	larvae	1	2.37	0.42
5/13/2007	3	B	Canal	Lepo	larvae	1	2.37	0.42
5/13/2007	3	C	Canal	Lepo	larvae	3	2.37	1.27
5/13/2007	4	B	Bayou	Lepo	juvenile	18	2.77	6.50

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
5/13/2007	4	A	Bayou	Lepo	larvae	2	2.77	0.72
5/13/2007	5	C	Bayou	Lepo	juvenile	1	3.01	0.33
5/13/2007	5	A	Bayou	Lepo	larvae	2	3.01	0.66
5/13/2007	6	B	Bayou	Lepo	juvenile	1	3.17	0.32
5/13/2007	6	B	Bayou	Lepo	larvae	1	3.17	0.32
5/13/2007	6	C	Bayou	Lepo	larvae	1	3.17	0.32
5/19/2007	1	B	Canal	Doro	larvae	1	3.87	0.26
5/19/2007	1	A	Canal	Doro	larvae	3	3.87	0.78
5/19/2007	2	B	Canal	Doro	larvae	1	3.12	0.32
5/19/2007	2	A	Canal	Doro	larvae	7	3.12	2.24
5/19/2007	3	C	Canal	Doro	larvae	1	3.83	0.26
5/19/2007	3	B	Canal	Doro	larvae	3	3.83	0.78
5/19/2007	3	A	Canal	Elas	juvenile	1	3.83	0.26
5/19/2007	3	C	Canal	Elas	juvenile	1	3.83	0.26
5/19/2007	7	A	Bayou	Elas	juvenile	1	2.57	0.39
5/19/2007	1	A	Canal	Gamb	juvenile	1	3.87	0.26
5/19/2007	1	C	Canal	Gamb	juvenile	8	3.87	2.07
5/19/2007	2	C	Canal	Gamb	juvenile	2	3.12	0.64
5/19/2007	2	A	Canal	Gamb	juvenile	3	3.12	0.96
5/19/2007	2	B	Canal	Gamb	juvenile	4	3.12	1.28
5/19/2007	3	C	Canal	Gamb	juvenile	1	3.83	0.26
5/19/2007	3	B	Canal	Gamb	juvenile	2	3.83	0.52
5/19/2007	4	B	Bayou	Gamb	juvenile	1	3.13	0.32
5/19/2007	4	C	Bayou	Gamb	juvenile	1	3.13	0.32
5/19/2007	4	A	Bayou	Gamb	juvenile	3	3.13	0.96
5/19/2007	5	C	Bayou	Gamb	juvenile	1	2.92	0.34
5/19/2007	5	B	Bayou	Gamb	juvenile	2	2.92	0.68
5/19/2007	6	B	Bayou	Gamb	juvenile	2	2.75	0.73
5/19/2007	7	B	Bayou	Gamb	juvenile	7	2.57	2.72
5/19/2007	5	B	Bayou	Hete	juvenile	3	2.92	1.03
5/19/2007	6	B	Bayou	Hete	juvenile	2	2.75	0.73
5/19/2007	4	B	Bayou	Lepi	juvenile	1	3.13	0.32
5/19/2007	5	A	Bayou	Lepi	juvenile	2	2.92	0.68
5/19/2007	6	C	Bayou	Lepi	juvenile	1	2.75	0.36
5/19/2007	7	C	Bayou	Lepi	juvenile	1	2.57	0.39
5/19/2007	1	A	Canal	Lepo	larvae	1	3.87	0.26
5/19/2007	1	B	Canal	Lepo	larvae	2	3.87	0.52
5/19/2007	1	C	Canal	Lepo	larvae	36	3.87	9.30
5/19/2007	2	C	Canal	Lepo	larvae	3	3.12	0.96
5/19/2007	2	A	Canal	Lepo	larvae	21	3.12	6.73
5/19/2007	2	B	Canal	Lepo	larvae	68	3.12	21.79
5/19/2007	3	B	Canal	Lepo	juvenile	1	3.83	0.26
5/19/2007	3	C	Canal	Lepo	juvenile	4	3.83	1.04
5/19/2007	3	A	Canal	Lepo	larvae	2	3.83	0.52
5/19/2007	3	B	Canal	Lepo	larvae	2	3.83	0.52

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
5/19/2007	3	C	Canal	Lepo	larvae	72	3.83	18.80
5/19/2007	4	B	Bayou	Lepo	juvenile	2	3.13	0.64
5/19/2007	4	C	Bayou	Lepo	juvenile	7	3.13	2.24
5/19/2007	4	B	Bayou	Lepo	larvae	1	3.13	0.32
5/19/2007	4	C	Bayou	Lepo	larvae	9	3.13	2.88
5/19/2007	5	A	Bayou	Lepo	juvenile	3	2.92	1.03
5/19/2007	5	B	Bayou	Lepo	larvae	1	2.92	0.34
5/19/2007	5	C	Bayou	Lepo	larvae	1	2.92	0.34
5/19/2007	5	A	Bayou	Lepo	larvae	11	2.92	3.77
5/19/2007	6	C	Bayou	Lepo	juvenile	1	2.75	0.36
5/19/2007	6	A	Bayou	Lepo	larvae	2	2.75	0.73
5/19/2007	6	C	Bayou	Lepo	larvae	11	2.75	4.00
5/19/2007	7	A	Bayou	Lepo	larvae	6	2.57	2.33
5/19/2007	7	C	Bayou	Lepo	larvae	10	2.57	3.89
5/19/2007	1	C	Canal	Pomo	juvenile	1	3.87	0.26
5/31/2007	1	A	Canal	Anch	juvenile	1	2.17	0.46
5/31/2007	2	C	Canal	Anch	juvenile	3	2.37	1.27
5/31/2007	1	B	Canal	Doro	larvae	1	2.17	0.46
5/31/2007	1	B	Canal	Elas	juvenile	1	2.17	0.46
5/31/2007	1	C	Canal	Gamb	juvenile	1	2.17	0.46
5/31/2007	3	B	Canal	Gamb	juvenile	3	2.58	1.16
5/31/2007	3	C	Canal	Gamb	juvenile	3	2.58	1.16
5/31/2007	5	A	Bayou	Gamb	juvenile	1	3.05	0.33
5/31/2007	7	B	Bayou	Gamb	juvenile	2	3.43	0.58
5/31/2007	7	C	Bayou	Gamb	juvenile	2	3.43	0.58
5/31/2007	3	C	Canal	Hete	juvenile	2	2.58	0.78
5/31/2007	4	B	Bayou	Hete	juvenile	2	2.83	0.71
5/31/2007	5	A	Bayou	Hete	juvenile	1	3.05	0.33
5/31/2007	5	C	Bayou	Hete	juvenile	2	3.05	0.66
5/31/2007	1	C	Canal	Lepo	larvae	22	2.17	10.14
5/31/2007	1	B	Canal	Lepo	larvae	24	2.17	11.06
5/31/2007	1	A	Canal	Lepo	larvae	30	2.17	13.82
5/31/2007	2	B	Canal	Lepo	juvenile	1	2.37	0.42
5/31/2007	2	A	Canal	Lepo	larvae	1	2.37	0.42
5/31/2007	2	B	Canal	Lepo	larvae	2	2.37	0.84
5/31/2007	2	C	Canal	Lepo	larvae	2	2.37	0.84
5/31/2007	3	C	Canal	Lepo	larvae	1	2.58	0.39
5/31/2007	3	A	Canal	Lepo	larvae	8	2.58	3.10
5/31/2007	4	B	Bayou	Lepo	larvae	15	2.83	5.30
5/31/2007	5	C	Bayou	Lepo	larvae	4	3.05	1.31
5/31/2007	5	B	Bayou	Lepo	larvae	86	3.05	28.20
5/31/2007	6	A	Bayou	Lepo	larvae	1	3.25	0.31
5/31/2007	6	C	Bayou	Lepo	larvae	24	3.25	7.38
5/31/2007	6	B	Bayou	Lepo	larvae	26	3.25	8.00
5/31/2007	7	A	Bayou	Lepo	larvae	2	3.43	0.58

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
5/31/2007	2	A	Canal	Meni	juvenile	1	2.37	0.42
6/7/2007	1	A	Canal	Doro	larvae	1	3.65	0.27
6/7/2007	2	A	Canal	Doro	larvae	1	3.43	0.29
6/7/2007	2	C	Canal	Doro	larvae	1	3.43	0.29
6/7/2007	1	C	Canal	Elas	juvenile	1	3.65	0.27
6/7/2007	3	C	Canal	Elas	juvenile	1	3.18	0.31
6/7/2007	1	B	Canal	Gamb	juvenile	1	3.65	0.27
6/7/2007	1	A	Canal	Gamb	juvenile	2	3.65	0.55
6/7/2007	4	C	Bayou	Gamb	juvenile	1	2.85	0.35
6/7/2007	4	B	Bayou	Gamb	juvenile	2	2.85	0.70
6/7/2007	5	B	Bayou	Gamb	juvenile	5	2.6	1.92
6/7/2007	7	C	Bayou	Gamb	juvenile	6	2.07	2.90
6/7/2007	5	B	Bayou	Hete	juvenile	1	2.6	0.38
6/7/2007	7	B	Bayou	Hete	juvenile	7	2.07	3.38
6/7/2007	1	C	Canal	Icta	juvenile	1	3.65	0.27
6/7/2007	6	C	Bayou	Icta	juvenile	1	2.27	0.44
6/7/2007	1	C	Canal	Lepo	larvae	1	3.65	0.27
6/7/2007	1	A	Canal	Lepo	larvae	2	3.65	0.55
6/7/2007	3	C	Canal	Lepo	juvenile	4	3.18	1.26
6/7/2007	3	A	Canal	Lepo	larvae	1	3.18	0.31
6/7/2007	3	B	Canal	Lepo	larvae	1	3.18	0.31
6/7/2007	4	B	Bayou	Lepo	juvenile	1	2.85	0.35
6/7/2007	4	A	Bayou	Lepo	larvae	6	2.85	2.11
6/7/2007	4	C	Bayou	Lepo	larvae	16	2.85	5.61
6/7/2007	4	B	Bayou	Lepo	larvae	23	2.85	8.07
6/7/2007	5	B	Bayou	Lepo	juvenile	1	2.6	0.38
6/7/2007	5	C	Bayou	Lepo	larvae	6	2.6	2.31
6/7/2007	5	B	Bayou	Lepo	larvae	13	2.6	5.00
6/7/2007	5	A	Bayou	Lepo	larvae	17	2.6	6.54
6/7/2007	6	C	Bayou	Lepo	larvae	4	2.27	1.76
6/7/2007	6	B	Bayou	Lepo	larvae	5	2.27	2.20
6/7/2007	6	A	Bayou	Lepo	larvae	27	2.27	11.89
6/7/2007	7	A	Bayou	Lepo	juvenile	1	2.07	0.48
6/7/2007	7	A	Bayou	Lepo	larvae	6	2.07	2.90
6/7/2007	2	C	Canal	Meni	juvenile	1	3.43	0.29
6/7/2007	2	B	Canal	Meni	juvenile	4	3.43	1.17
6/7/2007	7	B	Bayou	Poec	juvenile	1	2.07	0.48
6/7/2007	3	C	Canal	Syng	juvenile	1	3.18	0.31
6/15/2007	5	A	Bayou	Elas	juvenile	1	2.92	0.34
6/15/2007	1	A	Canal	Gamb	juvenile	4	1.88	2.13
6/15/2007	2	B	Canal	Gamb	juvenile	1	2.08	0.48
6/15/2007	2	A	Canal	Gamb	juvenile	2	2.08	0.96
6/15/2007	3	A	Canal	Gamb	juvenile	2	2.32	0.86
6/15/2007	4	A	Bayou	Gamb	juvenile	1	2.68	0.37
6/15/2007	4	B	Bayou	Gamb	juvenile	1	2.68	0.37

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
6/15/2007	5	C	Bayou	Gamb	juvenile	1	2.92	0.34
6/15/2007	5	B	Bayou	Gamb	juvenile	2	2.92	0.68
6/15/2007	6	A	Bayou	Gamb	juvenile	1	3.12	0.32
6/15/2007	6	C	Bayou	Gamb	juvenile	1	3.12	0.32
6/15/2007	7	B	Bayou	Gamb	juvenile	2	3.28	0.61
6/15/2007	7	A	Bayou	Gamb	juvenile	4	3.28	1.22
6/15/2007	6	A	Bayou	Hete	juvenile	1	3.12	0.32
6/15/2007	6	C	Bayou	Hete	juvenile	1	3.12	0.32
6/15/2007	7	C	Bayou	Hete	juvenile	3	3.28	0.91
6/15/2007	1	A	Canal	Icta	juvenile	1	1.88	0.53
6/15/2007	2	A	Canal	Icta	juvenile	1	2.08	0.48
6/15/2007	6	B	Bayou	Lepi	juvenile	1	3.12	0.32
6/15/2007	7	B	Bayou	Lepi	juvenile	1	3.28	0.30
6/15/2007	1	A	Canal	Lepo	larvae	4	1.88	2.13
6/15/2007	1	B	Canal	Lepo	larvae	10	1.88	5.32
6/15/2007	1	C	Canal	Lepo	larvae	22	1.88	11.70
6/15/2007	2	C	Canal	Lepo	larvae	5	2.08	2.40
6/15/2007	2	B	Canal	Lepo	larvae	7	2.08	3.37
6/15/2007	2	A	Canal	Lepo	larvae	11	2.08	5.29
6/15/2007	6	A	Bayou	Lepo	larvae	1	3.12	0.32
6/20/2007	1	C	Canal	Anch	juvenile	1	3.3	0.30
6/20/2007	3	A	Canal	Anch	juvenile	1	3.02	0.33
6/20/2007	1	C	Canal	Doro	larvae	2	3.3	0.61
6/20/2007	5	C	Bayou	Doro	larvae	4	2.31	1.73
6/20/2007	1	C	Canal	Gamb	juvenile	7	3.3	2.12
6/20/2007	2	C	Canal	Gamb	juvenile	3	3.19	0.94
6/20/2007	2	B	Canal	Gamb	juvenile	13	3.19	4.08
6/20/2007	3	A	Canal	Gamb	juvenile	1	3.02	0.33
6/20/2007	3	C	Canal	Gamb	juvenile	17	3.02	5.63
6/20/2007	5	B	Bayou	Gamb	juvenile	2	2.31	0.87
6/20/2007	5	C	Bayou	Gamb	juvenile	23	2.31	9.96
6/20/2007	6	B	Bayou	Gamb	juvenile	2	2.24	0.89
6/20/2007	7	B	Bayou	Gamb	juvenile	1	2.01	0.50
6/20/2007	7	A	Bayou	Gamb	juvenile	4	2.01	1.99
6/20/2007	2	B	Canal	Hete	juvenile	1	3.19	0.31
6/20/2007	4	B	Bayou	Hete	juvenile	1	2.49	0.40
6/20/2007	7	C	Bayou	Hete	juvenile	1	2.01	0.50
6/20/2007	6	B	Bayou	Lepi	juvenile	1	2.24	0.45
6/20/2007	1	B	Canal	Lepo	juvenile	1	3.3	0.30
6/20/2007	1	C	Canal	Lepo	larvae	1	3.3	0.30
6/20/2007	2	C	Canal	Lepo	juvenile	4	3.19	1.25
6/20/2007	2	B	Canal	Lepo	larvae	2	3.19	0.63
6/20/2007	2	C	Canal	Lepo	larvae	21	3.19	6.58
6/20/2007	3	C	Canal	Lepo	juvenile	1	3.02	0.33
6/20/2007	3	A	Canal	Lepo	larvae	1	3.02	0.33

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
6/20/2007	3	B	Canal	Lepo	larvae	1	3.02	0.33
6/20/2007	3	C	Canal	Lepo	larvae	4	3.02	1.32
6/20/2007	6	A	Bayou	Lepo	larvae	1	2.24	0.45
6/20/2007	7	B	Bayou	Lepo	juvenile	1	2.01	0.50
6/20/2007	7	A	Bayou	Lepo	larvae	4	2.01	1.99
6/20/2007	3	C	Canal	Poec	juvenile	3	3.02	0.99
6/30/2007	3	B	Canal	Elas	juvenile	1	3.57	0.28
6/30/2007	5	B	Bayou	Elas	juvenile	1	2.78	0.36
6/30/2007	1	B	Canal	Gamb	juvenile	4	4.12	0.97
6/30/2007	1	A	Canal	Gamb	juvenile	7	4.12	1.70
6/30/2007	2	A	Canal	Gamb	juvenile	4	3.82	1.05
6/30/2007	3	B	Canal	Gamb	juvenile	1	3.57	0.28
6/30/2007	3	A	Canal	Gamb	juvenile	2	3.57	0.56
6/30/2007	3	C	Canal	Gamb	juvenile	70	3.57	19.61
6/30/2007	4	B	Bayou	Gamb	juvenile	3	3.17	0.95
6/30/2007	4	A	Bayou	Gamb	juvenile	5	3.17	1.58
6/30/2007	4	C	Bayou	Gamb	juvenile	5	3.17	1.58
6/30/2007	5	A	Bayou	Gamb	juvenile	3	2.78	1.08
6/30/2007	5	C	Bayou	Gamb	juvenile	6	2.78	2.16
6/30/2007	6	A	Bayou	Gamb	juvenile	1	2.57	0.39
6/30/2007	6	B	Bayou	Gamb	juvenile	2	2.57	0.78
6/30/2007	6	C	Bayou	Gamb	juvenile	3	2.57	1.17
6/30/2007	7	C	Bayou	Gamb	juvenile	2	2.15	0.93
6/30/2007	4	A	Bayou	Hete	juvenile	11	3.17	3.47
6/30/2007	5	A	Bayou	Hete	juvenile	1	2.78	0.36
6/30/2007	5	B	Bayou	Hete	juvenile	2	2.78	0.72
6/30/2007	1	A	Canal	Lepo	juvenile	1	4.12	0.24
6/30/2007	1	B	Canal	Lepo	juvenile	1	4.12	0.24
6/30/2007	1	A	Canal	Lepo	larvae	1	4.12	0.24
6/30/2007	1	B	Canal	Lepo	larvae	4	4.12	0.97
6/30/2007	2	C	Canal	Lepo	larvae	4	3.82	1.05
6/30/2007	3	C	Canal	Lepo	juvenile	1	3.57	0.28
7/12/2007	6	C	Bayou	Elas	juvenile	1	2.47	0.40
7/12/2007	1	A	Canal	Gamb	juvenile	3	3.35	0.90
7/12/2007	1	C	Canal	Gamb	juvenile	5	3.35	1.49
7/12/2007	1	B	Canal	Gamb	juvenile	8	3.35	2.39
7/12/2007	2	B	Canal	Gamb	juvenile	6	3.3	1.82
7/12/2007	2	C	Canal	Gamb	juvenile	6	3.3	1.82
7/12/2007	3	C	Canal	Gamb	juvenile	3	3.1	0.97
7/12/2007	3	B	Canal	Gamb	juvenile	14	3.1	4.52
7/12/2007	3	A	Canal	Gamb	juvenile	32	3.1	10.32
7/12/2007	4	C	Bayou	Gamb	juvenile	1	2.85	0.35
7/12/2007	4	A	Bayou	Gamb	juvenile	5	2.85	1.75
7/12/2007	4	B	Bayou	Gamb	juvenile	26	2.85	9.12
7/12/2007	5	B	Bayou	Gamb	juvenile	5	2.6	1.92

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
7/12/2007	5	C	Bayou	Gamb	juvenile	14	2.6	5.38
7/12/2007	5	A	Bayou	Gamb	juvenile	23	2.6	8.85
7/12/2007	6	A	Bayou	Gamb	juvenile	1	2.47	0.40
7/12/2007	6	C	Bayou	Gamb	juvenile	2	2.47	0.81
7/12/2007	7	C	Bayou	Gamb	juvenile	3	2.18	1.38
7/12/2007	7	B	Bayou	Gamb	juvenile	4	2.18	1.83
7/12/2007	2	B	Canal	Hete	juvenile	1	3.3	0.30
7/12/2007	4	B	Bayou	Hete	juvenile	1	2.85	0.35
7/12/2007	5	B	Bayou	Hete	juvenile	1	2.6	0.38
7/12/2007	6	C	Bayou	Hete	juvenile	1	2.47	0.40
7/21/2007	1	A	Canal	Doro	larvae	1	2.18	0.46
7/21/2007	1	C	Canal	Doro	larvae	1	2.18	0.46
7/21/2007	2	C	Canal	Doro	larvae	1	2.45	0.41
7/21/2007	2	A	Canal	Doro	larvae	2	2.45	0.82
7/21/2007	1	A	Canal	Gamb	juvenile	1	2.18	0.46
7/21/2007	1	C	Canal	Gamb	juvenile	1	2.18	0.46
7/21/2007	1	B	Canal	Gamb	juvenile	2	2.18	0.92
7/21/2007	2	C	Canal	Gamb	juvenile	1	2.45	0.41
7/21/2007	2	A	Canal	Gamb	juvenile	2	2.45	0.82
7/21/2007	2	B	Canal	Gamb	juvenile	3	2.45	1.22
7/21/2007	3	C	Canal	Gamb	juvenile	16	2.72	5.88
7/21/2007	3	B	Canal	Gamb	juvenile	68	2.72	25.00
7/21/2007	3	A	Canal	Gamb	juvenile	283	2.72	104.04
7/21/2007	4	A	Bayou	Gamb	juvenile	2	3	0.67
7/21/2007	4	B	Bayou	Gamb	juvenile	21	3	7.00
7/21/2007	4	C	Bayou	Gamb	juvenile	23	3	7.67
7/21/2007	5	C	Bayou	Gamb	juvenile	3	3.35	0.90
7/21/2007	5	A	Bayou	Gamb	juvenile	22	3.35	6.57
7/21/2007	5	B	Bayou	Gamb	juvenile	23	3.35	6.87
7/21/2007	6	A	Bayou	Gamb	juvenile	2	3.63	0.55
7/21/2007	6	B	Bayou	Gamb	juvenile	8	3.63	2.20
7/21/2007	7	C	Bayou	Gamb	juvenile	11	3.9	2.82
7/21/2007	7	A	Bayou	Gamb	juvenile	13	3.9	3.33
7/21/2007	7	B	Bayou	Gamb	juvenile	16	3.9	4.10
7/21/2007	7	A	Bayou	Hete	juvenile	1	3.9	0.26
7/21/2007	1	B	Canal	Lepo	larvae	1	2.18	0.46
7/21/2007	1	C	Canal	Lepo	larvae	5	2.18	2.29
7/21/2007	2	C	Canal	Lepo	larvae	5	2.45	2.04
7/21/2007	3	C	Canal	Lepo	juvenile	1	2.72	0.37
7/21/2007	6	A	Bayou	Lepo	larvae	1	3.63	0.28
7/21/2007	7	A	Bayou	Lepo	juvenile	2	3.9	0.51
7/21/2007	5	B	Bayou	Poec	juvenile	2	3.35	0.60
7/21/2007	5	C	Bayou	Poec	juvenile	2	3.35	0.60
7/21/2007	7	B	Bayou	Poec	juvenile	1	3.9	0.26
7/21/2007	7	A	Bayou	Poec	juvenile	2	3.9	0.51

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
7/25/2007	1	A	Canal	Gamb	juvenile	1	2.83	0.35
7/25/2007	2	A	Canal	Gamb	juvenile	1	2.67	0.37
7/25/2007	2	C	Canal	Gamb	juvenile	1	2.67	0.37
7/25/2007	3	A	Canal	Gamb	juvenile	5	2.48	2.02
7/25/2007	3	B	Canal	Gamb	juvenile	8	2.48	3.23
7/25/2007	3	C	Canal	Gamb	juvenile	115	2.48	46.37
7/25/2007	4	C	Bayou	Gamb	juvenile	5	2.28	2.19
7/25/2007	4	A	Bayou	Gamb	juvenile	11	2.28	4.82
7/25/2007	4	B	Bayou	Gamb	juvenile	19	2.28	8.33
7/25/2007	5	C	Bayou	Gamb	juvenile	5	2.05	2.44
7/25/2007	5	B	Bayou	Gamb	juvenile	18	2.05	8.78
7/25/2007	5	A	Bayou	Gamb	juvenile	19	2.05	9.27
7/25/2007	6	A	Bayou	Gamb	juvenile	4	1.87	2.14
7/25/2007	6	C	Bayou	Gamb	juvenile	5	1.87	2.67
7/25/2007	6	B	Bayou	Gamb	juvenile	7	1.87	3.74
7/25/2007	7	A	Bayou	Gamb	juvenile	17	1.68	10.12
7/25/2007	7	C	Bayou	Gamb	juvenile	33	1.68	19.64
7/25/2007	7	B	Bayou	Gamb	juvenile	35	1.68	20.83
7/25/2007	5	C	Bayou	Hete	juvenile	1	2.05	0.49
7/25/2007	5	B	Bayou	Hete	juvenile	3	2.05	1.46
7/25/2007	5	C	Bayou	Poec	juvenile	4	2.05	1.95
7/25/2007	7	B	Bayou	Poec	juvenile	1	1.68	0.60
8/3/2007	1	A	Canal	Gamb	juvenile	1	2.78	0.36
8/3/2007	2	B	Canal	Gamb	juvenile	1	3	0.33
8/3/2007	3	A	Canal	Gamb	juvenile	3	3.17	0.95
8/3/2007	3	B	Canal	Gamb	juvenile	3	3.17	0.95
8/3/2007	3	C	Canal	Gamb	juvenile	10	3.17	3.15
8/3/2007	4	A	Bayou	Gamb	juvenile	1	3.38	0.30
8/3/2007	4	B	Bayou	Gamb	juvenile	7	3.38	2.07
8/3/2007	5	C	Bayou	Gamb	juvenile	1	3.63	0.28
8/3/2007	5	A	Bayou	Gamb	juvenile	2	3.63	0.55
8/3/2007	5	B	Bayou	Gamb	juvenile	7	3.63	1.93
8/3/2007	6	B	Bayou	Gamb	juvenile	1	3.78	0.26
8/3/2007	6	C	Bayou	Gamb	juvenile	2	3.78	0.53
8/3/2007	6	A	Bayou	Gamb	juvenile	3	3.78	0.79
8/3/2007	7	A	Bayou	Gamb	juvenile	6	4	1.50
8/3/2007	7	C	Bayou	Gamb	juvenile	7	4	1.75
8/3/2007	4	C	Bayou	Hete	juvenile	1	3.38	0.30
8/3/2007	6	A	Bayou	Hete	juvenile	1	3.78	0.26
8/3/2007	7	C	Bayou	Hete	juvenile	1	4	0.25
8/3/2007	1	B	Canal	Lepo	larvae	1	2.78	0.36
8/3/2007	7	A	Bayou	Lepo	juvenile	1	4	0.25
8/3/2007	7	C	Bayou	Lepo	juvenile	1	4	0.25
8/3/2007	7	A	Bayou	Lepo	larvae	1	4	0.25
8/3/2007	5	B	Bayou	Poec	juvenile	1	3.63	0.28

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
8/9/2007	2	C	Canal	Gamb	juvenile	1	3.02	0.33
8/9/2007	2	B	Canal	Gamb	juvenile	3	3.02	0.99
8/9/2007	3	A	Canal	Gamb	juvenile	2	2.82	0.71
8/9/2007	3	B	Canal	Gamb	juvenile	23	2.82	8.16
8/9/2007	4	A	Bayou	Gamb	juvenile	3	2.58	1.16
8/9/2007	4	B	Bayou	Gamb	juvenile	3	2.58	1.16
8/9/2007	5	C	Bayou	Gamb	juvenile	1	2.4	0.42
8/9/2007	5	B	Bayou	Gamb	juvenile	2	2.4	0.83
8/9/2007	6	B	Bayou	Gamb	juvenile	1	2.02	0.50
8/9/2007	3	B	Canal	Hete	juvenile	1	2.82	0.35
8/9/2007	4	B	Bayou	Hete	juvenile	2	2.58	0.78
8/9/2007	3	C	Canal	Lepo	juvenile	1	2.82	0.35
8/9/2007	4	A	Bayou	Poec	juvenile	1	2.58	0.39
8/16/2007	1	C	Canal	Gamb	juvenile	1	1.78	0.56
8/16/2007	2	C	Canal	Gamb	juvenile	1	1.9	0.53
8/16/2007	2	A	Canal	Gamb	juvenile	2	1.9	1.05
8/16/2007	3	C	Canal	Gamb	juvenile	2	2.06	0.97
8/16/2007	3	A	Canal	Gamb	juvenile	3	2.06	1.46
8/16/2007	3	B	Canal	Gamb	juvenile	3	2.06	1.46
8/16/2007	4	B	Bayou	Gamb	juvenile	1	2.28	0.44
8/16/2007	4	A	Bayou	Gamb	juvenile	2	2.28	0.88
8/16/2007	4	C	Bayou	Gamb	juvenile	3	2.28	1.32
8/16/2007	6	B	Bayou	Gamb	juvenile	1	2.66	0.38
8/16/2007	7	B	Bayou	Gamb	juvenile	1	2.86	0.35
8/16/2007	7	A	Bayou	Gamb	juvenile	2	2.86	0.70
8/16/2007	3	C	Canal	Hete	juvenile	1	2.06	0.49
8/16/2007	6	B	Bayou	Hete	juvenile	1	2.66	0.38
8/16/2007	7	A	Bayou	Note	juvenile	1	2.86	0.35
8/16/2007	4	C	Bayou	Poec	juvenile	1	2.28	0.44
8/16/2007	5	A	Bayou	Poec	juvenile	1	2.53	0.40
8/16/2007	6	C	Bayou	Poec	juvenile	1	2.66	0.38
8/16/2007	6	B	Bayou	Poec	juvenile	3	2.66	1.13
8/22/2007	1	B	Canal	Gamb	juvenile	2	3.48	0.57
8/22/2007	1	C	Canal	Gamb	juvenile	2	3.48	0.57
8/22/2007	1	A	Canal	Gamb	juvenile	3	3.48	0.86
8/22/2007	2	C	Canal	Gamb	juvenile	1	3.28	0.30
8/22/2007	2	B	Canal	Gamb	juvenile	3	3.28	0.91
8/22/2007	3	C	Canal	Gamb	juvenile	1	3.08	0.32
8/22/2007	3	B	Canal	Gamb	juvenile	3	3.08	0.97
8/22/2007	3	A	Canal	Gamb	juvenile	7	3.08	2.27
8/22/2007	4	A	Bayou	Gamb	juvenile	3	2.92	1.03
8/22/2007	5	A	Bayou	Gamb	juvenile	3	2.62	1.15
8/22/2007	6	B	Bayou	Gamb	juvenile	2	2.37	0.84
8/22/2007	6	A	Bayou	Gamb	juvenile	4	2.37	1.69
8/22/2007	7	A	Bayou	Gamb	juvenile	3	2	1.50

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
8/22/2007	7	B	Bayou	Gamb	juvenile	5	2	2.50
8/22/2007	7	C	Bayou	Gamb	juvenile	6	2	3.00
8/22/2007	4	C	Bayou	Hete	juvenile	2	2.92	0.68
8/22/2007	5	A	Bayou	Hete	juvenile	1	2.62	0.38
8/22/2007	5	C	Bayou	Hete	juvenile	1	2.62	0.38
8/22/2007	6	B	Bayou	Hete	juvenile	1	2.37	0.42
8/22/2007	6	C	Bayou	Hete	juvenile	2	2.37	0.84
8/22/2007	1	A	Canal	Lepo	larvae	2	3.48	0.57
8/22/2007	1	B	Canal	Lepo	larvae	3	3.48	0.86
8/22/2007	1	C	Canal	Lepo	larvae	11	3.48	3.16
8/22/2007	2	B	Canal	Lepo	larvae	4	3.28	1.22
8/22/2007	2	C	Canal	Lepo	larvae	7	3.28	2.13
8/22/2007	2	A	Canal	Lepo	larvae	90	3.28	27.44
8/29/2007	1	C	Canal	Gamb	juvenile	1	2.3	0.43
8/29/2007	2	A	Canal	Gamb	juvenile	1	2.5	0.40
8/29/2007	2	C	Canal	Gamb	juvenile	1	2.5	0.40
8/29/2007	3	C	Canal	Gamb	juvenile	1	2.78	0.36
8/29/2007	4	A	Bayou	Gamb	juvenile	1	3.05	0.33
8/29/2007	4	B	Bayou	Gamb	juvenile	1	3.05	0.33
8/29/2007	4	C	Bayou	Gamb	juvenile	4	3.05	1.31
8/29/2007	5	A	Bayou	Gamb	juvenile	1	3.3	0.30
8/29/2007	5	C	Bayou	Gamb	juvenile	1	3.3	0.30
8/29/2007	5	B	Bayou	Gamb	juvenile	7	3.3	2.12
8/29/2007	6	C	Bayou	Gamb	juvenile	1	3.47	0.29
8/29/2007	7	C	Bayou	Gamb	juvenile	1	3.65	0.27
8/29/2007	7	A	Bayou	Gamb	juvenile	7	3.65	1.92
8/29/2007	4	B	Bayou	Hete	juvenile	2	3.05	0.66
8/29/2007	5	B	Bayou	Hete	juvenile	1	3.3	0.30
8/29/2007	6	C	Bayou	Hete	juvenile	1	3.47	0.29
8/29/2007	7	A	Bayou	Hete	juvenile	1	3.65	0.27
8/29/2007	1	A	Canal	Lepo	larvae	5	2.3	2.17
8/29/2007	1	B	Canal	Lepo	larvae	5	2.3	2.17
8/29/2007	1	C	Canal	Lepo	larvae	8	2.3	3.48
8/29/2007	2	B	Canal	Lepo	larvae	2	2.5	0.80
8/29/2007	2	C	Canal	Lepo	larvae	4	2.5	1.60
8/29/2007	2	A	Canal	Lepo	larvae	14	2.5	5.60
8/29/2007	3	A	Canal	Lepo	larvae	2	2.78	0.72
8/29/2007	3	C	Canal	Lepo	larvae	4	2.78	1.44
9/5/2007	1	A	Canal	Gamb	juvenile	1	3.17	0.32
9/5/2007	1	B	Canal	Gamb	juvenile	9	3.17	2.84
9/5/2007	1	C	Canal	Gamb	juvenile	10	3.17	3.15
9/5/2007	2	A	Canal	Gamb	juvenile	1	3.02	0.33
9/5/2007	2	C	Canal	Gamb	juvenile	2	3.02	0.66
9/5/2007	2	B	Canal	Gamb	juvenile	3	3.02	0.99
9/5/2007	3	B	Canal	Gamb	juvenile	1	2.82	0.35

Date	Site	Trap	Habitat	Species	Stage	Number	Effort	CPUE
9/5/2007	3	C	Canal	Gamb	juvenile	1	2.82	0.35
9/5/2007	3	A	Canal	Gamb	juvenile	15	2.82	5.32
9/5/2007	4	A	Bayou	Gamb	juvenile	1	2.62	0.38
9/5/2007	4	B	Bayou	Gamb	juvenile	7	2.62	2.67
9/5/2007	5	C	Bayou	Gamb	juvenile	2	2.3	0.87
9/5/2007	5	A	Bayou	Gamb	juvenile	5	2.3	2.17
9/5/2007	6	C	Bayou	Gamb	juvenile	1	2.15	0.47
9/5/2007	7	B	Bayou	Gamb	juvenile	1	1.95	0.51
9/5/2007	7	C	Bayou	Gamb	juvenile	1	1.95	0.51
9/5/2007	7	A	Bayou	Gamb	juvenile	2	1.95	1.03
9/5/2007	3	A	Canal	Hete	juvenile	1	2.82	0.35
9/5/2007	1	B	Canal	Lepo	juvenile	8	3.17	2.52
9/5/2007	1	C	Canal	Lepo	larvae	2	3.17	0.63
9/5/2007	1	A	Canal	Lepo	larvae	9	3.17	2.84
9/5/2007	1	B	Canal	Lepo	larvae	10	3.17	3.15
9/5/2007	2	C	Canal	Lepo	juvenile	5	3.02	1.66
9/5/2007	2	B	Canal	Lepo	larvae	1	3.02	0.33
9/5/2007	2	A	Canal	Lepo	larvae	6	3.02	1.99
9/5/2007	2	C	Canal	Lepo	larvae	11	3.02	3.64
9/5/2007	3	B	Canal	Lepo	juvenile	1	2.82	0.35
9/5/2007	3	C	Canal	Lepo	juvenile	2	2.82	0.71
9/5/2007	3	A	Canal	Lepo	larvae	2	2.82	0.71
9/5/2007	3	C	Canal	Lepo	larvae	15	2.82	5.32
9/5/2007	1	B	Canal	Poec	juvenile	2	3.17	0.63
9/5/2007	7	B	Bayou	Poec	juvenile	1	1.95	0.51
9/25/2007	3	B	Canal	Gamb	juvenile	1	3.72	0.27
9/25/2007	3	A	Canal	Gamb	juvenile	3	3.72	0.81
9/25/2007	5	C	Bayou	Gamb	juvenile	5	3.17	1.58
9/25/2007	6	B	Bayou	Gamb	juvenile	1	2.63	0.38
9/25/2007	6	A	Bayou	Gamb	juvenile	2	2.63	0.76
9/25/2007	1	B	Canal	Lepo	juvenile	1	4.25	0.24
9/25/2007	2	C	Canal	Lepo	juvenile	1	4.08	0.25

BIOGRAPHIAL SKETCH

Sean Jackson was born on September 9, 1979, in Vicksburg, Mississippi. Growing up he always had a passion for fish. He decided to become a Marine Biologist at a young age and never deviated from that path. He graduated from the University of Southern Mississippi in 2005 with his Bachelors of Science in Marine Biology. While at the University of Southern Mississippi Sean worked in their ichthyology lab and museum. Sean enrolled in the Marine and Environmental Biology graduate program and Nicholls State University in 2005. There he studied larval fish in the upper Barataria Estuary.

CURRICULUM VITAE

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Sean Jackson

Education

[2009] **Nicholls State University**

M.S. Marine and Environmental Biology

- Thesis research: Abundance and diversity of larval and juvenile fishes of the upper Barataria Estuary

Relevant biology classes taken:

- Marine and Environmental Biology I
- Marine and Environmental Biology II
- Advanced Oceanography
- Environmental Diagnostics and Biomarkers
- Aquatic Toxicology
- Ecological Restoration
- Marine Conservation and Management
- Applied Ecology
- Marine and Environmental Regulation Law and Policy Workshop

[2005] **University of Southern Mississippi**

B.S. Marine Biology

Completed classes at the U.S.M. Gulf Coast Research Lab in the summers of 1999 and 2000.

Upper level biology classes taken:

- Marine Biology
- Marine Ichthyology
- Ichthyology
- Biology of Fishes
- Population and Community Ecology
- Populations Genetics
- Microbial Ecology
- Environmental Physiology

Work experience

[04/2007-11/2007] **Nicholls State University**

Graduate Research Assistant

- Supervisor: Dr. Allyse Ferrara

- Assisted in a survey of zebra mussels in Bayou Lafourche, Louisiana.

Duties included:

- Collection and identification of freshwater bivalves via ponar grabs, bridge scraping, and tile settlement cages
- Collection of water quality data
- Boat operation

[06/2005-12/2007] **Nicholls State University**

Graduate Teaching and Research Assistant

- Supervisor: Dr. Quenton Fontenot
- Taught introductory biology lab courses.
- Assisted with field and laboratory work on the following thesis projects:

Duties included:

- Presenting weekly lectures on introductory biological material focusing on the diversity of life
- Use of collection gear such as gill nets, electrofishing, dipneting, seining, and hook and line
- Fish Identification
- Extracting and reading aging structures such as otoliths and gular plates
- Gonad collection and analysis
- Collection of water quality data
- Daytime and nighttime small boat operation

[06/2005-06/2006] **NOAA Fisheries Contractor**

Headboat Surveyor

- Supervisor: Michael Burton
- Collected population data from fish caught on headboats (large charter boats) operating on the Louisiana coast.

Duties included:

- Fish identification
- Collection of length and weight data
- Collection of population data
- Collection of otoliths from selected species

[05/2004-08/2004] **University of Southern Mississippi**

Biological Field Technician

- Supervisor: Dr. Brian Kreiser
- Participated in a study of Alabama shad (Species of Concern) in rivers of southern Mississippi.

Duties included:

- Fish collection using electroshock and seine
- Fish identification
- Collection of fin clips for genetic analysis
- Collection stream habitat and water quality data

[09/2003-08/2004] University of Southern Mississippi

Ichthyology Museum **Laboratory** Technician

- Supervisor: Dr. Steve Ross
- This museum contains over 70,000 cataloged lots consisting of 520,000 specimens representing over 800 taxa.

Duties included:

- Identification of freshwater, estuarine, and marine fishes
- Preserving, Categorizing, labeling, and shelving fishes

[01/2002-08/2002] Mississippi Dept. of Environmental Quality

Biological Field and Laboratory Technician

- Supervisor: Eric Pederson

Duties included:

- Collection of water samples/biological samples from South Mississippi
- Maintained excel database of water quality data
- Sorted benthic invertebrates from statewide stream samples
- Investigated reports of environmental concern such as fish kills and algal blooms

Volunteer experience

- I have been volunteering at Habitat for Humanity since 1990. I have helped build houses during every spring break since I have been in college.
- In the summer of 1998, I worked with the Student Conservation Association. We constructed a boardwalk in the mountains of Washington State and performed various trail maintenance activities.

Other Skills

I am proficient with the following software packages:

- Microsoft Excel
- Microsoft Powerpoint
- Microsoft Excel
- SAS
- FAST

Field and Laboratory Skills

- Day and nighttime operation of small boat/trailer

- Fish collection methods: dipnet, gillnet, boat mounted electrofishing, larval fish light trap, hook and line, castnet, and seine
- Fish identification: larval to adult stages
- Water quality monitoring
- Fish aging structure removal and reading: otoliths, spines, and gular plates
- Fin clip collection and processing for genetic analysis
- External fish tagging
- Maintenance and care of live fish and aquaria
- Larval fish rearing
- induced spawning of spotted gar
- General data management and analysis

Current research

My current research interests include floodplain and fish ecology. My thesis research focused on the floodplain ecology of the upper Barataria Estuary through analysis of diversity and abundance of larval and juvenile fishes collected via light trap sampling. The bayous and canals that drain most of the land in the upper Barataria Estuary are surrounded by Cypress - Tupelo swamps and stands of bottomland hardwoods. The upper Barataria Estuary had a historical connection to the Mississippi River, but this connection was lost with the construction of flood control levees and the closing of distributaries. Since the channelization of the Mississippi River, the only source of water in the upper Barataria Estuary is rainfall. The lack of a natural flood pulse from the Mississippi River has altered the hydrology of the upper Barataria Estuary. Larval fish and water quality data were collected weekly from seven fixed sites in the upper Barataria Estuary from February through September 2007 using light trap sampling. Three sites were located in dredged canal habitats characterized by steep dredge spoil banks and little floodplain access. Four of the sites were located in bayou habitats characterized by low banks and floodplain access. A total of 4,110 fish representing 11 families and 15 genera were collected from 9 February 2007 until 25 September 2007. Water quality analysis showed that canal sites had higher specific conductance and dissolved oxygen than bayou sites. Bayou sites were found to be hypoxic (DO $\leq$ 2.0 mg/L) 62% of sample trips. Larval *Dorosoma* spp., *Ictiobus* spp., and *Lepomis* spp. were more abundant in the dredged canal habitat than the bayou habitat. *Heterandria formosa* juveniles were the only species more abundant in the bayou habitat than the canal habitat. The altered hydrology, specifically, the lack of river water flushing may be contributing to chronic hypoxia in the bayou habitats of the upper Barataria Estuary leading to a negative impact on fish reproduction.