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SPATIAL AND TEMPORAL VARIATION IN THE DISTRIBUTION OF FISHES OF THE LABRANCHE WETLANDS AREA OF THE LAKE PONTCHARTRAIN ESTUARY, LOUISIANA

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ABSTRACT: The LaBranche Wetlands are located along the southwestern shore of Lake Pontchartrain. During early summer of 1989 and 1990, an electrofishing survey of 6 stations in Bayou LaBranche and Bayou Trepagnier, a tributary, yielded 10,644 specimens representing 38 species in 19 families. All fishes were typical of brackish to freshwater, low gradient systems of the Gulf Coastal Plain. Members of the Lepisosteidae, Clupeidae, Fundulidae, Poeciliidae and Centrarchidae were numerical dominants. Results from rotenone samples at five of the same stations by Louisiana Department of Environmental Quality in 1986, and net samples at one common site by Thompson and Verret (1980) bring the total number of species for the LaBranche Wetlands to 52. Differences in the physicochemical characters of the two bayou systems were reflected in the dissimilar faunas between the two bayous. Results from detrended correspondence analysis (DCA) and community similarity indices indicate a high degree of variance at sites within the same bayou system over time.

The area designated as the LaBranche Wetlands is located along the south shore of Lake Pontchartrain, Louisiana (Fig. 1). The 14,000 acres of fresh-brackish marsh and wooded swamp are considered to be the most productive wetlands within the Lake Pontchartrain basin (Binet and Ensminger, 1992). The LaBranche Wetlands, as in all parts of the Lake Pontchartrain basin, have been subjected to various human-based disturbances with potential to affect the resident biota (Flowers and Isphording, 1990; Moore, 1992). Numerous studies have addressed the impacts of environmental disturbances on the estuarine biota, especially invertebrates (e.g., Poirrier and Mulino, 1975, 1977a&b). Fishes, invertebrates and plants in Lake Pontchartrain have been surveyed at irregular intervals for the past 40 years, providing a database for assessment of the impacts of human and natural disturbances

(Moore, 1992). However, other than a preliminary survey of the Blind River (Watson et al., 1981), and a report on Lake Maurepas (Hastings et al., 1987), there have been few published studies on fishes in any portion of the Lake Pontchartrain basin since Thompson and Verret (1980).

Previous scientific collections of fishes from the LaBranche Wetlands were made by the Louisiana Department of Environmental Quality (LADEQ), using rotenone at five stations in May 1986 in Bayou LaBranche and its tributary, Bayou Trepagnier. In addition, Thompson and Verret (1980) sampled near our Station T-8, close to the mouth of Bayou LaBranche, during their nekton survey of the Lake Pontchartrain basin in 1978. We made collections by electroshocking at the LADEQ stations, plus one site farther upstream in Bayou LaBranche, in May, 1989 and June, 1990. Our field sampling

extends the known data base on the Bayou Trepagnier-Bayou LaBranche stations to three different years, and along with the LADEQ and Thompson and Verret collections in April-June, 1978, provide a relatively comprehensive view of a seasonal fish community in these poorly known systems. Here we summarize the known fauna of the Bayou Trepagnier-LaBranche system and describe the distribution of fishes with respect to selected environmental variables. We also use community index measurements and a multivariate analysis to assess variation in the late spring-early summer fish assemblages across years and localities.

METHODS AND MATERIALS

Study Site

Bayou Trepagnier, near Norco, LA, receives water from the Shell Oil Company Norco Manufacturing Complex, then flows into Bayou LaBranche, which is a tributary to Lake Pontchartrain (Fig. 1). Bayou Trepagnier is smaller than Bayou LaBranche, with an average width of approximately 9-14 m and a depth of 1 m or less throughout most of its length. Most of Bayou Trepagnier flows through swamp dominated by cypress-tupelo, red maple, elm and ash which contribute to a dense canopy along most of the bayou's course. Many dead-tree snags due to storm blow-downs occur in the channel. There is little submerged or emergent aquatic vegetation, and current speeds are slow, with treated effluent water from the Shell facility providing a portion of the base flow.

Bayou LaBranche is 2-3 times wider (17-27 m) and at least twice as deep (1.5-2.4 m) as Bayou Trepagnier. There is less riparian forest than on Bayou Trepagnier, thus Bayou LaBranche is more open, with most of its surface receiving direct sunlight. Aquatic vegeta-

Figure 1. Numbered collecting stations (T-4 to T-21) in the Bayou LaBranche-Bayou Trepagnier system, near Norco, Louisiana.

tion in Bayou LaBranche consists of coontail, alligator weed, and duckweed. Along the shore, especially near the mouth of Bayou Trepagnier, stands of *Juncus*, *Phragmites*, and *Panicum* are common. Snags and downed trees are rare.

Collecting Methods

The Bayou Trepagnier-Bayou LaBranche system is challenging with respect to collecting fish because depth, soft substrate, turbidity, and large woody debris present problems in selecting any one best method to assess the fishes. As noted previously, LADEQ biologists made single rotenone collections in 1986 at five sites in the system, and a single similar collection on Mississippi Bayou, which enters Lake Maurepas from the southwest. To provide a more comprehensive overall picture of the fish fauna of the bayous we used electrofishing to comple-

ment the earlier sampling with rotenone.

Field sampling was as follows:

1. Three locations (T-4 = LADEQ T-3, T-5 & T-6) on Bayou Trepagnier, and three on Bayou LaBranche (T-7, T-8 & T-21) were sampled by electrofishing on 12-14 May 1989 and on 5-6 June 1990 (Fig. 1). Fishes were collected for approximately one hour of field effort (minimum of 30 minutes of actual shocking time, per system timer) in each collection, using a Mark 20 boat-mounted electrofishing unit by Coffelt Electronics. Until recently, electrofishing has been difficult or impossible in waters of high conductivity, and conductivities exceeding 2,000 micromhos are common in these bayous. However, the Coffelt Mark 20 is designed specifically for high-conductivity environments, apparently matching or exceeding the efficiency of our electrofishing in other systems (Gelwick and Matthews, 1990). This electrofishing system was very effective in stunning small (*Gambusia affinis*, *Poecilia latipinna*, *Heterandria formosa*) as well as large fishes (*Lepisosteus oculatus*, *Mugil cephalus*, *Micropterus salmoides*), indicating that the system thoroughly sampled the fish assemblages. Voucher specimens were deposited at the University of New Orleans Vertebrate Collection (UNOVC).

2. In May 1989, oxygen, temperature and conductivity were measured by YSI electronic meters at each site. In 1990, water quality sampling was provided by EA Engineering personnel assisted by M. A. Polrrier (University of New Orleans) for the time period coinciding with fish sampling.

Data Analyses

Analyses of fish community structure were carried out using similarity indices and multivariate analyses as follows. Fish assemblages at all possible pairs of stations were compared

qualitatively by the Jaccard Index (JI) (Ludwig and Reynolds, 1988) and quantitatively by a percent similarity index (PSI) (Wolda, 1981). Values for PSI and JI range from zero (if there are no items common to two assemblages) to 100% or 1.00 (if all items are in common and of identical abundance). Jaccard's Index performs well in comparisons to many other indices of association, is unbiased even at small sample sizes (Ludwig and Reynolds, 1988), and has a long history of use in general ecology (Sneath and Sokal, 1973) and fish community analysis (Lyons, 1989). The percent similarity index (PSI) is identical to the "Schoener's Index" (Schoener, 1968); its properties are well known (Linton et al., 1981); and it has been used in fish ecology, e. g., Matthews et al. (1988). We follow Matthews et al. (1988) in accepting values of ≥ 0.70 as indicative of high similarity between communities.

Overall similarities and differences among all of our and LADEQ's collections, and including the LADEQ Mississippi Bayou collection for comparison, were evaluated by detrended correspondence analysis (DCA) (Hill and Gauch, 1980) with and without downweighting of rare species and by polar coordinates analysis followed by nonmetric multidimensional scaling (Gower, 1966; Gauch, 1982). Because results of all multivariate analyses were similar, only the outcome of the DCA without downweighting of rare species is presented. Many community studies (e.g., Chang and Gauch, 1986), including some of fish (Matthews and Robison, 1988; Gelwick, 1990), have recently used DCA. DCA provides simultaneous ordination of collections and of species along axes, allowing estimation of associations of individual taxa and collecting sites. In addition to the DCA, we also produced an estimate of ecologically congruent fish groups (i.e., taxa with common distribu-

tion patterns) from maps of collective abundance of each species at all sites (with collections pooled across years within sites).

RESULTS

Physicochemical Conditions:

Physicochemical conditions differed markedly between the two bayous. In May 1989, conductivity in Bayou LaBranche (3,900 micromhos) was higher than in Bayou Trepagnier (2,400 to 2,550 micromhos). In June 1990 conductivity was much lower, and more similar between bayous, ranging 1200-2000 micromhos.

Water temperatures were as high as 32.5 C during our collecting periods. Oxygen concentrations were low in both systems at times. In 1989, the two upper Bayou Trepagnier stations had low oxygen concentrations (3.4 and 2.8 ppm) relative to the other four stations (6.8-8.4 ppm). In 1990 dissolved oxygen was as low as 2.1-3.7 at Bayou LaBranche stations. Oxygen values were low in the morning (e.g., 2-3 ppm) with higher values in the afternoon.

Summary of the Fauna

In electrofishing in May 1989 and June 1990 we caught 10,644 individual fishes, representing 38 species in 19 families (Table 1). Dominant families were Lepisosteidae (gars), Clupeidae (herrings), Fundulidae (topminnows), Poeciliidae (livebearers), and Centrarchidae (sunfishes). All fishes were typical of brackish to freshwater, low-gradient systems of the Gulf Coastal Plain (Neill and Turner, 1987; Hastings et al., 1987; Moore, 1992). An additional 14 species were reported by LADEQ and Thompson and Verret (1980), bringing the total number of species and families to 52 and 26, respectively (Table 1).

Despite the similarity in low conduc-

tivity during our 1990 sampling period, numerous brackish-water species were present in Bayou LaBranche, apparently as a result of its direct connection to Lake Pontchartrain. For example, in Bayou LaBranche, we collected brackish-water forms such as *Trinectes maculatus*, *Pogonias cromis*, *Microgobius gulosus*, *Leiostomus xanthurus*, *Anchoa mitchilli*, *Elops saurus*, and *Brevoortia patronus*. These species were absent in upper Bayou Trepagnier, but present in lower reaches. Overall, with respect to physicochemical conditions, the greatest difference between the two bayous was in conductivity, with the more highly conductive Bayou LaBranche apparently providing habitat for more brackish-water forms. LADEQ, using rotenone, collected 13 species in small numbers (less than 30 individuals for 12 of those species) in lower Bayou LaBranche that we did not collect by electrofishing (Table 1). All but one of the 13 were brackish-water forms that probably moved transiently into the system when salinity levels were higher.

Similarities among Stations and Years

The fish communities of Bayou LaBranche and its tributary, Bayou Trepagnier, were qualitatively dissimilar, overall ($J1 = 0.50$), across all our pooled electrofishing collections. Only 23 species were collected by electrofishing in Bayou Trepagnier compared to 34 species in Bayou LaBranche. The two bayous shared 19 species, with most species in Bayou Trepagnier also occurring in Bayou LaBranche. However, 15 species found in Bayou LaBranche were not taken in Bayou Trepagnier (Table 1). The two bayous also were dissimilar with respect to species abundance; their PSI, based on all electrofishing collections, was only 22.1%.

Collecting stations were more similar qualitatively within than between bayous. Comparison of all possible pairs

Table 1. Number of species of fishes and specimens collected at six stations by electrofishing in Bayou Trepagnier and Bayou LaBranche in May 1989 and June 1990. L and T, respectively, = species taken by LADEQ in 1986 or Thompson and Verret (1980), but not collected by us. Mnemonics used in Fig. 3 are given below species name.

Scientific Name	BAYOU TREPAGNIER				BAYOU LABRANCHE			
	T-4	T-5	T-6	N	T-7	T-8	T-21	N
DASYATIDAE								
<i>Dasyatis sabina</i> (L)								
D. SAB								
LEPISOSTEIDAE								
<i>Atractosteus spatula</i>	2		1	3				
A. SPA								
<i>Lepisosteus oculatus</i>	9	26	16	51	10	16	17	43
L. OCU								
<i>Lepisosteus platostomus</i>		2	1	1	4			
L. PLA								
AMIIDAE								
<i>Amia calva</i>	2			2				
A. CAL								
ANGUILLIDAE								
<i>Anguilla rostrata</i>					1	1		2
A. ROS								
OPHICHTHIDAE								
<i>Myrophis punctatus</i> (L)								
M. PUN								
<i>Ophichthus gomesi</i> (L)								
O. GOM								
ELOPIDAE								
<i>Elops saurus</i>						1		1
E. SAU								
CLUPEIDAE								
<i>Alosa chrysochloris</i>					4	1		5
A. CHR								
<i>Brevoortia patronus</i>			820	820	1304	637	133	2074
B. PAT								
<i>Dorosoma cepedianum</i>			14	14	1	1	1	3
D. CEP								
<i>Dorosoma petenense</i>			1	1	6			6
D. PET								
ENGRAULIDAE								
<i>Anchoa mitchilli</i>					1	2		3
A. MIT								
CYPRINIDAE								
<i>Cyprinus carpio</i>	1					1		
C. CAR								
<i>Notemigonus crysoleucas</i>							5	5
N. CRY								
CATOSTOMIDAE								
<i>Ictiobus niger</i>					1			1
I. NIG								
ARIIDAE								

Scientific Name	BAYOU TREPAGNIER				BAYOU LABRANCHE			
	T-4	T-5	T-6	N	T-7	T-8	T-21	N
<i>Arius felis</i> (T) A. FEL								
ICTALURIDAE								
<i>Ictalurus furcatus</i> I. FUR					1			1
<i>Ictalurus punctatus</i> I. PUN					3			3
<i>Pylodictis olivaris</i> (L) P. OLI								
GOBIESOCIDAE								
<i>Gobiesox strumosus</i> (L) G. STR								
BELONIDAE								
<i>Strongylura marina</i> (L) S. MAR								
CYPRINODONTIDAE								
<i>Cyprinodon variegatus</i> C. VAR	2	209	189	609	4	27	22	53
FUNDULIDAE								
<i>Fundulus chrysotus</i> F. CHR		1		1			2	2
<i>Fundulus grandis</i> F. GRA			4	4	12	3		15
<i>Fundulus pulvereus</i> F. PUL	2	137	44	183		6	17	23
<i>Lucania parva</i> L. PAR		1	10	11	15	36	11	62
POECILIIDAE								
<i>Gambusia affinis</i> G. AFF	234	4030	643	4907	23	2	72	97
<i>Heterandria formosa</i> H. FOR	1	4	6	11				
<i>Poecilia latipinna</i> P. LAT	97	431	613	1141	26	26	38	90
ATHERINIDAE								
<i>Menidia beryllina</i> M. BER			13	13	33	6	20	59
SYNGNATHIDAE								
<i>Syngnathus scovelli</i> S. SCO					2			2
MORONIDAE								
<i>Morone mississippiensis</i> M. MIS			2	2	8	5	1	14
CENTRARCHIDAE								
<i>Lepomis cyanellus</i> (L) L. CYA								
<i>Lepomis gulosus</i> L. GUL					5	3	7	15
<i>Lepomis macrochirus</i> L. MAC	4		4	8	9		9	18

Scientific Name	BAYOU TREPAGNIER				BAYOU LABRANCHE			
	T-4	T-5	T-6	N	T-7	T-8	T-21	N
<i>Lepomis microlophus</i> L. MIC	1			1		1	6	7
<i>Lepomis punctatus</i> L. PUN			1	1	14	2	36	52
<i>Lepomis symmetricus</i> L. SYM			1	1			1	1
<i>Micropterus salmoides</i> M. SAL					13		12	25
SPARIDAE								
<i>Archosargus probatocephalus</i> (L) A. PRO								
SCIAENIDAE								
<i>Aplodinotus grunniens</i> (L) A. GRU								
<i>Cynoscion arenarius</i> (L, T) C. ARE								
<i>Cynoscion nebulosus</i> (L) C. NEB								
<i>Leiostomus xanthurus</i> L. XAN			11	11	10	6	2	18
<i>Micropogonias undulatus</i> (L, T) M. UND								
<i>Pogonias cromis</i> P. CRO						1		1
MUGILIDAE								
<i>Mugil cephalus</i> M. CEP	11	5	93	109	7	4	4	15
GOBIIDAE								
<i>Gobiosoma bosc</i> (L, T) G. BOS								
<i>Microgobius gulosus</i> M. GUL					11	4	2	17
SOLEIDAE								
<i>Trinectes maculatus</i> T. MAC					1		1	2
Total Species (1989 + 1990 only)	12	10	20	23	25	22	24	34
Total Specimens (1989 + 1990 only)	367	4845	2485	7697	1524	791	421	2736

of stations on Bayou Trepagnier in 1989 produced JI values ranging 0.40-0.54 (Table 2), and a similar comparison within Bayou LaBranche yielded JI values from 0.42 to 0.59. Comparisons between station-pairs from different bayous were lower (JI = 0.18-0.39, with the exception that T-6 and T-21 had JI = 0.55). In 1990 trends were similar (Table 2), with higher

values of JI for station-pairs within the same bayou, and generally lower JI values when stations from different bayous were compared.

The PSI values in Table 3 show that in 1989 percent similarity was greater for station pairs within than between bayous. However, Station T-6 was approximately equal in similarity to other sites in both

Table 2. Jaccard's Index (JI) similarities for electrofishing collections in Bayou Trepagnier and Bayou LaBranche for 1989 and 1990.

1989						
Bayou Trepagnier T-5	.545	—				
Bayou Trepagnier T-6	.500	.400	—			
Bayou LaBranche T-7	.208	.182	.391	—		
Bayou LaBranche T-8	.217	.190	.391	.423	—	
Bayou LaBranche T-21	.350	.333	.550	.565	.591	
	T-4	T-5	T-6	T-7	T-8	
1990						
Bayou Trepagnier T-5	.714	—				
Bayou Trepagnier T-6	.263	.368	—			
Bayou LaBranche T-7	.125	.208	.577	—		
Bayou LaBranche T-8	.000	.118	.476	.478	—	
Bayou LaBranche T-21	.222	.263	.440	.444	.318	
	T-4	T-5	T-6	T-7	T-8	

bayous (Table 3). Upstream Bayou Trepagnier sites T-4 and T-5 were dissimilar to all Bayou LaBranche sites (Table 3). Trends were similar in 1990 (Table 3), with the exception that the uppermost Bayou LaBranche Station (T-21) was somewhat more similar to upper Bayou Trepagnier stations.

There were substantial inter-year differences in fish assemblages at most stations (Table 4). Collections at T-6 and T-7 were relatively similar in 1989 and 1990 (Table 4), with PSI and JI values higher than at other locations. However, at most stations only about half or fewer of the total species for the station were collected in both years. The relatively high qualitative and quantitative differences

Table 3. Percent Similarity Indices (PSI) for electrofishing collections in Bayou Trepagnier and Bayou LaBranche for 1989 and 1990.

1989						
Bayou Trepagnier T-5	79.4	—				
Bayou Trepagnier T-6	47.6	49.1	—			
Bayou LaBranche T-7	6.8	5.8	45.9	—		
Bayou LaBranche T-8	5.5	6.2	45.4	90.3	—	
Bayou LaBranche T-21	23.2	22.0	60.0	65.4	65.0	
	T-4	T-5	T-6	T-7	T-8	
1990						
Bayou Trepagnier T-5	94.4	—				
Bayou Trepagnier T-6	40.0	44.0	—			
Bayou LaBranche T-7	2.9	3.2	37.7	—		
Bayou LaBranche T-8	0.0	0.3	38.2	60.0	—	
Bayou LaBranche T-21	41.5	46.5	54.1	14.0	20.3	
	T-4	T-5	T-6	T-7	T-8	

between years at most stations suggest that this bayou system has a fish fauna that moves substantially among sites, that species abundances may differ overall among years, or that short-term movements of fishes into or out of the bayou (e.g., when tidal salinities change the system) influence local assemblage composition.

An additional estimation of temporal variation in these bayous is provided by comparing collections by ourselves

Table 4. Intra-station similarity of Bayou Trepagnier and Bayou LaBranche Stations, comparing May 1989 to June 1990, by electrofishing.

Station	Total Species	No. Shared Species	JI	PSI
Bayou Trepagnier T-4	12	3	0.250	41.9
Bayou Trepagnier T-5	10	4	0.400	34.7
Bayou Trepagnier T-6	21	12	0.571	76.8
Bayou LaBranche T-7	25	16	0.640	90.4
Bayou LaBranche T-8	22	8	0.364	57.6
Bayou LaBranche T-21	24	10	0.417	34.6

(1989-90) and LADEQ (1986) at Station T-8 to collections of Thompson and Verret (1980), who sampled fish in 1978 by nets and trawls near the vicinity of our station T-8. Their collections (April-June) produced 12 species, compared to a total of 17 species for LADEQ and our sampling combined (Table 5). Strict comparison is not appropriate, because our samples combined with those of LADEQ represent a combination of rotenone and electrofishing and multiple years. However, relatively low PSI and JI values of 58.2% and 0.61, respectively, comparing the collections a decade apart, support the conclusion that fish assemblages in these bayous are highly variable. Dramatic differences are seen in abundance of *Micropogonias undulatus*, *Lucania parva* and *Fundulus grandis* between collections by Thompson and Verret (1980) and collections in 1986-90 (Table 5). There is no reason to believe that these differences in abundances of species, which were common at least once at the site, were related to perma-

nent changes in environmental conditons. Instead, they probably reflect the dynamic nature of the salinity gradients and other physical variables in the ever-changing conditions that typify the lower reaches of these bayou systems in the fresh-brackish water transition near Lake Pontchartrain.

Multivariate Summary

In the detrended correspondence analysis (Fig. 2) axes 1 and 2 had eigenvalues of 0.901 and 0.169, respectively, and thus incorporated most of the variance in the data. Fishes of the LaBranche wetlands consist of groups with affinities ranging across a gradient from small stream-freshwater sites to larger stream-brackish sites. All middle or upper Bayou Trepagnier samples (T-4 and T-5) occupied a relatively small region in the upper left part of Figure 2, indicating that they were faunistically similar overall. Lower Bayou LaBranche stations are the most subject to brackish water episodes. All collections from T-7 and T-8

Figure 2. Scatterplot of our electrofishing collections and those of LADEQ (by rotenone) on the first two axes of the detrended correspondence analysis. Collection sites are coded as T-4 to T-21/89 or 90, corresponding to stations on map in Figure 1 and the year of electrofishing collections (1989 or 1990). DEQ = collections by LADEQ; "MISS BAYOU" = the single Mississippi Bayou LADEQ rotenone collection, included for comparison.

Table 5. Abundance of fishes in Thompson and Verret (for April, May, June, July 1978) collections near mouth of Bayou LaBranche with collections at Station T-8 by LADEQ and ourselves in 1986-1990, for 18 most abundant fishes.

	Thompson & Verrett	LADEQA & our collections
<i>Anchoa mitchilli</i>	1161	3743
<i>Brevoortia patronus</i>	1206	1437
<i>Micropogonias undulatus</i>	1097	46
<i>Menidia beryllina</i>	28	64
<i>Cyprinodon variegatus</i>	6	10
<i>Lucania parva</i>	0	123
<i>Poecilia latipinna</i>	4	28
<i>Leiostomus xanthurus</i>	24	10
<i>Gambusia affinis</i>	0	3
<i>Fundulus grandis</i>	318	13
<i>Arius felis</i>	16	0
<i>Mugil cephalus</i>	25	10
<i>Lepomis punctatus</i>	0	6
<i>Lepomis microlophus</i>	0	12
<i>Ictalurus furcatus</i>	0	1
<i>Cynoscion arenarius</i>	0	23
<i>Gobiosoma bosc</i>	1	22

Similarity (1978 vs 1986-90):

Jaccards Index = 0.611; PSI = 58.2

were in the right half of Figure 2, mostly toward the bottom, suggesting that the fish assemblages at those stations were at the opposing end of the environmental gradient from assemblages in upper Bayou Trepagnier. This separation by as much as 4.00 units on Axis 1 indicates a complete faunal turnover across this gradient (Gauch, 1982). As suggested in the similarity analyses (above) the lowermost station on Bayou Trepagnier (T-6) was intermediate faunistically, lying between the upper Trepagnier and the LaBranche clusters in Figure 2. Upper Bayou LaBranche (T-21) collections differed markedly between years, and were widely separated at middle and top of Figure 2.

The DCA results corroborated overall patterns in similarity and differences detected in the paired-station similarity

analyses above. Additionally, the DCA made clear that the 1986 fish collection in Mississippi Bayou, of the adjacent Lake Maurepas system, was distinct faunally from our collections in these Lake Pontchartrain bayous, as it was distinct from all LaBranche/Trepagnier samples in Figure 2. We acknowledge that temporal variation could exacerbate these perceived differences, but apparently, in spite of some shared common species, each wetland associated with the lakes has the potential for a unique fauna (and, therefore, needs to be treated individually in fish investigations).

The DCA simultaneously provided an ordination of species (Fig. 3) based on their abundances in samples. Approximate clusters of species on the Axis 1 vs. 2 scatterplot (Fig. 3) indicated the relationships between particular fish species. Two very tight clusters of species emphasizing the distinctiveness of some collections were noted. In the upper part of Figure 3 are eight species (in brackets) with identical DCA scores, including *Notropis maculatus* (N. MAC), *Ictiobus cyprinella* (I. CYP), *Sclaeonops ocellatus* (S. OCE), *Amelurus melas* (A. MEL), *A. natalis* (A. NAT), *Aphredoderus sayanus* (A. SAY), *Centrarchus macropterus* (C. MAC), and *Pomoxis nigromaculatus* (P. NIG), which are mostly freshwater taxa, with the exception of *S. ocellatus*. The position of those species in multivariate space therefore coincides with the location of Mississippi Bayou in Figure 2. Similarly, the location of six species to the right in Figure 3, including *Anchoa mitchilli*, *Cynoscion nebulosus*, and four others, corresponds to the LADEQ 1986 sample at T-8 (Fig. 2.)

Figures 2 and 3 exhibit other species-samples associations. To the left in Figure 3 are species such as *Gambusia affinis*, *Poecilia latipinna*, *Cyprinodon variegatus*, or *Fundulus pulvereus* that were unique to or most abundant in up-

Figure 3. Scatterplot of all fish species on the first two axes of the detrended correspondence analysis. Mnemonics for individual species are given in text or Table 1. Note that axes 1 and 2 are identical in Figures 2 and 3, thus stations and species can be superimposed for interpretation.

per Bayou Trepagnier. Slightly more toward the upper center of Figure 3 are species associated with only one collection in upper Bayou LaBranche, such as *Micropterus salmoides*. At the other end of the environmental gradient from fresh to brackish water lie species such as *Alosa chrysochloris* and *Syngnathus scovelli* (lower right of Figure 3) that occurred mostly in lower Bayou LaBranche stations. Overall, there appeared to be three or four loosely associated clusters of species in multivariate space, e.g., those predominately or exclusively in upper LaBranche or Trepagnier, in Mississippi Bayou, in lower LaBranche and Trepagnier, and those almost exclusively in one LADEQ sample in lower Bayou LaBranche.

The DCA of species, combined with spatial distribution patterns of individual taxa, make possible assessment of ecological relationships among species groups in the system. We projected the total abundance of each species per col-

lecting station (across all surveys) onto maps of the Bayou LaBranche-Trepagnier system. From visual inspection of all maps, we assigned the fishes of the system to ecological categories based on a combination of spatial distribution and abundance (Table 6). These groups agree reasonably well with clusters on the DCA scatterplot (Fig. 3), but are not identical. Ecological associations assigned from distribution maps ranged from taxa such as *Lepisosteus oculatus*, *Cyprinodon*

variegatus and *Mugil cephalus*, that were widespread in the system (Group 1), to those such as *Heterandria formosa* that were scarce or "occasional" in the system (Group 5), to taxa narrowly distributed within the system, such as *Ophichthus gomesi* and *Syngnathus scovelli*, which were found only at the most downstream station near Lake Pontchartrain (Group 6). These ecological groups, as defined in Table 6, represent our best overall estimate of habitat guilds

Table 6. Ecological habitat groups of fishes, as determined from distribution patterns for individual species within the Bayou LaBranche-Trepagnier system. L and T, respectively, = species taken by LADEQ in 1986 or Thompson and Verret (1980), but not collected by us.

<p>Group 1: Widespread throughout the system, although some in low number per site.</p> <p><i>Lepisosteus oculatus</i> <i>Cyprinodon variegatus</i> <i>Fundulus grandis</i> <i>Fundulus pulvereus</i> <i>Gambusia affinis</i> <i>Poecilia latipinna</i> <i>Mugil cephalus</i> <i>Lepomis macrochirus</i></p> <p>Group 2: Collected only in Bayou Trepagnier.</p> <p><i>Atractosteus spatula</i> <i>Amla calva</i> <i>Anguilla rostrata</i> <i>Notemigonus crysoleucas</i> <i>Fundulus chrysotus</i> <i>Lepomis symmetricus</i></p> <p>Group 3: Throughout Bayou LaBranche and (some species) at most downstream site on Bayou Trepagnier.</p> <p><i>Elops saurus</i> <i>Brevoortia patronus</i> <i>Dorosoma cepedianum</i> <i>Lucania parva</i> <i>Menidia beryllina</i> <i>Morone mississippiensis</i> <i>Lepomis gulosus</i> <i>Lepomis microlophus</i> <i>Lepomis punctatus</i> <i>Micropterus salmoides</i> <i>Leiostomus xanthurus</i> <i>Microgobius gulosus</i> <i>Trinectes maculatus</i></p> <p>Group 4: Collected only at lower Bayou LaBranche or Bayou Trepagnier stations T-6, T-7, T-8.</p> <p><i>Myrophis punctatus</i></p>	<p><i>Alosa chrysochloris</i> <i>Dorosoma petenense</i> <i>Anchoa mitchilli</i> <i>Ictalurus punctatus</i> <i>Ictalurus furcatus</i> <i>Strongylura marina</i> <i>Syngnathus</i> sp. (L) <i>Aplodinotus grunniens</i> <i>Micropogonias undulatus</i> <i>Gobiosoma bosc</i></p> <p>Group 5: Scarce and occasional in distribution; nowhere abundant.</p> <p><i>Lepisosteus platostomus</i> <i>Heterandria formosa</i></p> <p>Group 6: Collected only at lowermost site nearest Lake Pontchartrain (T-8).</p> <p><i>Ophichthus gomesi</i> <i>Ictiobus niger</i> <i>Syngnathus scovelli</i> <i>Lepomis cyanellus</i> <i>Dasyatis sabina</i> <i>Cyprinus carpio</i> <i>Pylodictis olivaris</i> (L) <i>Gobiesox strumosus</i> <i>Cynoscion nebulosus</i> <i>Pogonias chromis</i> <i>Archosargus probatocephalus</i></p> <p>Group 7: Collected only at T-10 in Mississippi Bayou</p> <p><i>Notropis maculatus</i> <i>Ictiobus cyprinellus</i> <i>Amelurus natalis</i> <i>Amelurus melas</i> <i>Aphredoderus sayanus</i> <i>Centrarchus macropterus</i> <i>Pomoxis nigromaculatus</i></p>
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for fishes in the bayou system, and could be useful for future monitoring in these or other streams of the Lake Pontchartrain drainage.

DISCUSSION

Physically and environmentally, Bayou LaBranche and Bayou Trepagnier offer different habitats for fishes, but are occupied collectively by an ichthyofauna that blends components of freshwater and brackish-water taxa. Differences in size, salinity or riparian vegetation could cause substantial differences in fish communities in the two systems. Low JI and PSI values indicate that the two bayous have substantially different faunas, and within each bayou the fish assemblages can be quite variable in time. The bayous are highly variable physically, with fish assemblages that reflect a combination of tolerance of fluctuating conditions, mobility among sites, and a composition corresponding to such variation.

There is a paucity of detailed reports of fish assemblages in such bayous, at least in part because of the extreme difficulty of access and collecting. This summary provides a relatively thorough description for one season of the fishes of the important LaBranche Wetlands. These kinds of habitats throughout the Lake Pontchartrain drainage and the entire Gulf Coast are undergoing continued environmental change due to anthropogenic activities. The results reported here provide a baseline against which future changes in the LaBranche Wetlands can be measured. Furthermore, our results suggest that surveys of fishes in coastal bayous should be designed with an awareness of the high variance in fish assemblages in space and time.

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