Microhabitat Utilization and Fish Survey of Cibolo Creek

Glenn Longley
Keith Cox
John Burch
Chad Thomas

January 29, 1998

Edwards Aquifer Research and Data Center
Southwest Texas State University, San Marcos, Texas

This project was supported by
Texas Water Development Board
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1.0 EXECUTIVE SUMMARY

The purpose of this study was to survey fish microhabitat utilization at study sites on Cibolo Creek, use the index of Biotic Integrity (IBI) proposed by Karr et al.. (1986) to assess the water quality at various study sites, and develop information of fish community habitat relationships that will be utilized in the Texas Water Development Board's (TWDB) Macrohabitat Assessment Technique (MAT) for instream flow requirements. The species of fish present in different habitats were determined. Water analyses were performed at each site during each sampling period.

2.0 INTRODUCTION

2.1 Study Area

The Cibolo Creek headwaters are located in southeastern Bandera County and the stream flows from the Edwards Plateau Region through the Blackland Prairie into the Post Oak Belt before joining the lower San Antonio River. The topography at the sample sites consists of low rolling hills. The riparian zone of the sample sites is composed of short and tall weeds and small hardwood trees. Banks along the Lower Cibolo Creek were generally high with steep sides.

The three sample sites were located in Wilson and Karnes counties and much of the land surrounding the sites was used for agriculture (ranching) purposes.

Site 3 was located immediately upstream from the Hwy. 541 bridge located west of the town of Kosciusko. Site 8 was located upstream of the low water bridge on county road 2724 east of the town of Cestohowa. Site 9 was located upstream of the Hwy. 81 bridge which is east of the town of Panna Maria.

2.2 Water Quality

This study used fish species as biological indicators of water quality. The biological methods indicate that the stream at all sites had fair to good water quality. Extensive laboratory chemical analyses were done on previous studies (Whiteside, et al. 1993 and Whiteside, et al. 1994). Temperature, dissolved oxygen, pH, and conductivity were recorded at each sample date.

2.3 Protected Species

No endangered or protected species were found at these three sites. No effort was made to collect species other than fish.

2.4 Climate

All three Cibolo Creek sites are located in South Central Texas. The rainfall has varied greatly during the 1997 season to the extent that this region experienced a drought and flood period within a 12 month period. The study area is humid sub-tropical with hot summers. Rainfall averages 33 inches annually and is heaviest in May and September (Mathews and Tallent 1996). The prevailing winds are southeasterly, often pushing warm, moist air from the Gulf of Mexico during spring, summer and fall. This leads to very sporadic rainfall, often from thunderstorms during these months. In the winter some Polar air flows into the area and is often stopped by warmer air off the Gulf. This usually results in mild winters. Rainfall during the winter is usually distributed along frontal boundaries, giving a more uniform coverage of rain than the thunderstorms that predominate during the rest of the year (Mathews and Tallent 1996).

2.5 Geology

The headwater areas substrate is composed of calichified bedrock and alluvial materials with high slope stability, high foundation strength and moderate to low permeability. The sampling areas consisted of muddy sand and alluvial material with some bedrock areas.

3.0 SITE SELECTION

3.1 Basic Strategy

An important step in environmental assessment of the aquatic communities is the selection of the study sites. TWDB staff required sites that had representative habitat and hydrologic conditions which would allow them to obtain information useful to their MAT protocol. TWDB staff participated in the selection of sites. Once sites were chosen, sampling began. Photos were made of the sites and of the microhabitats. Locations on Cibolo Creek have been proposed by Texas Water Development Board as future dam sites.

3.2 Soil Associations

In the upper study area where Blackland Prairie was the general soil type. Next to the creek dark gray to reddish brown calcareous clay loams and clays were prevalent (Arbingast, et al. 1976).

3.3 Hydrologic and Geomorphic Criteria

The intent of the study was to combine the reports of Cibolo Creek fish sampling during winter and summer seasons at three different flow ranges: low (15-20 cfs), medium (25-35 cfs), and high (50-65 cfs).

3.4 FIELD RECONNAISSANCE

As indicated under 3.1, both Edwards Aquifer Research and Data Center (EARDC) and TWDB staff were utilized to help locate suitable sites. Participating in this phase were Dr. Glenn Longley, Director of (EARDC) at Southwest Texas State University (SWTSU), and two SWTSU graduate students, John Burch and Keith Cox. Ray Mathews, fisheries biologist/ecologist (Contract Manager), James Tallent, civil engineer; and Randy Burns, hydrogeologist participated from TWDB. The ecologists offered ideas of suitable microhabitats while the geomorphologists assisted in the determination of stream segments with several flow characteristics.

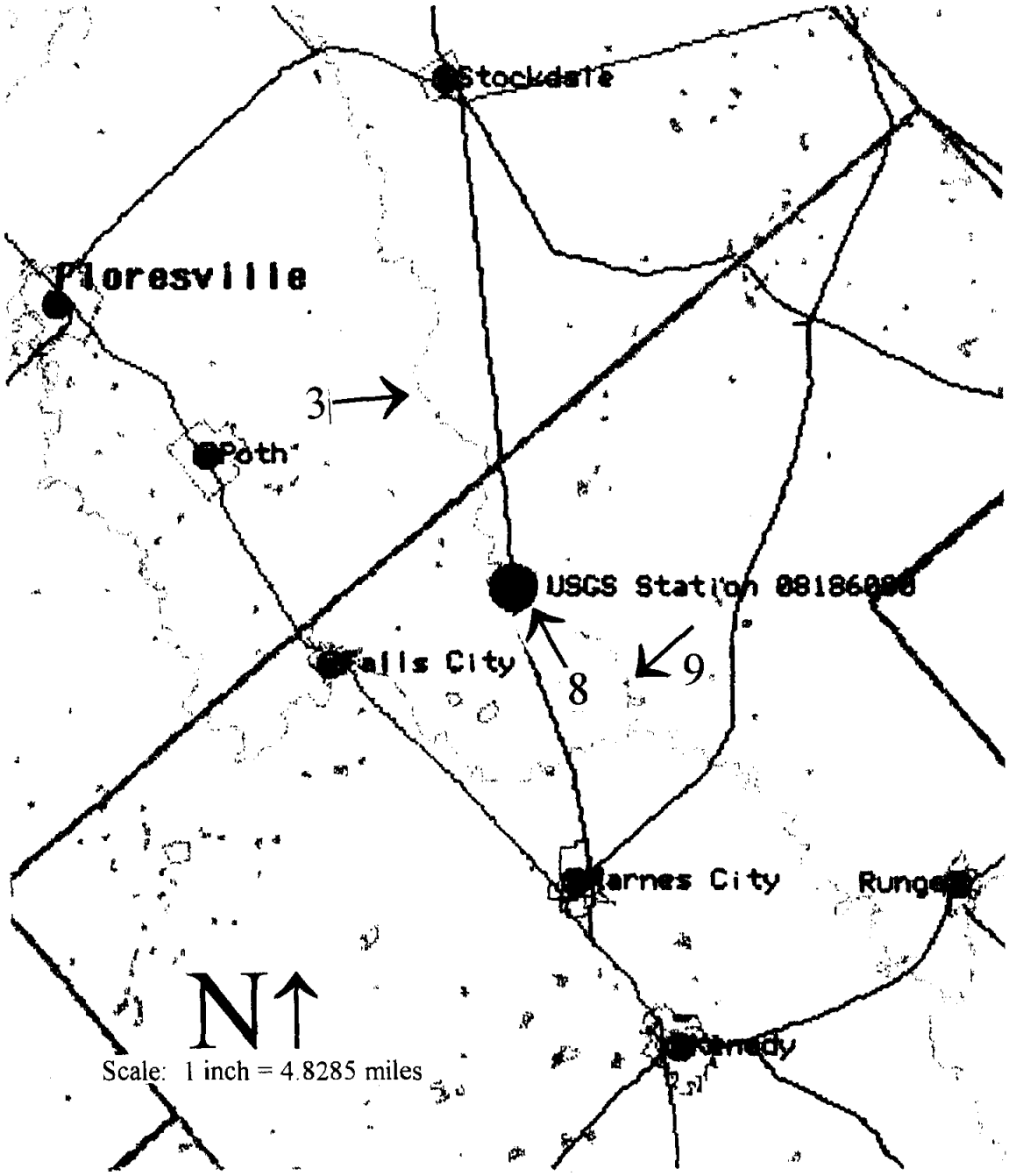


Figure 1. General study area.

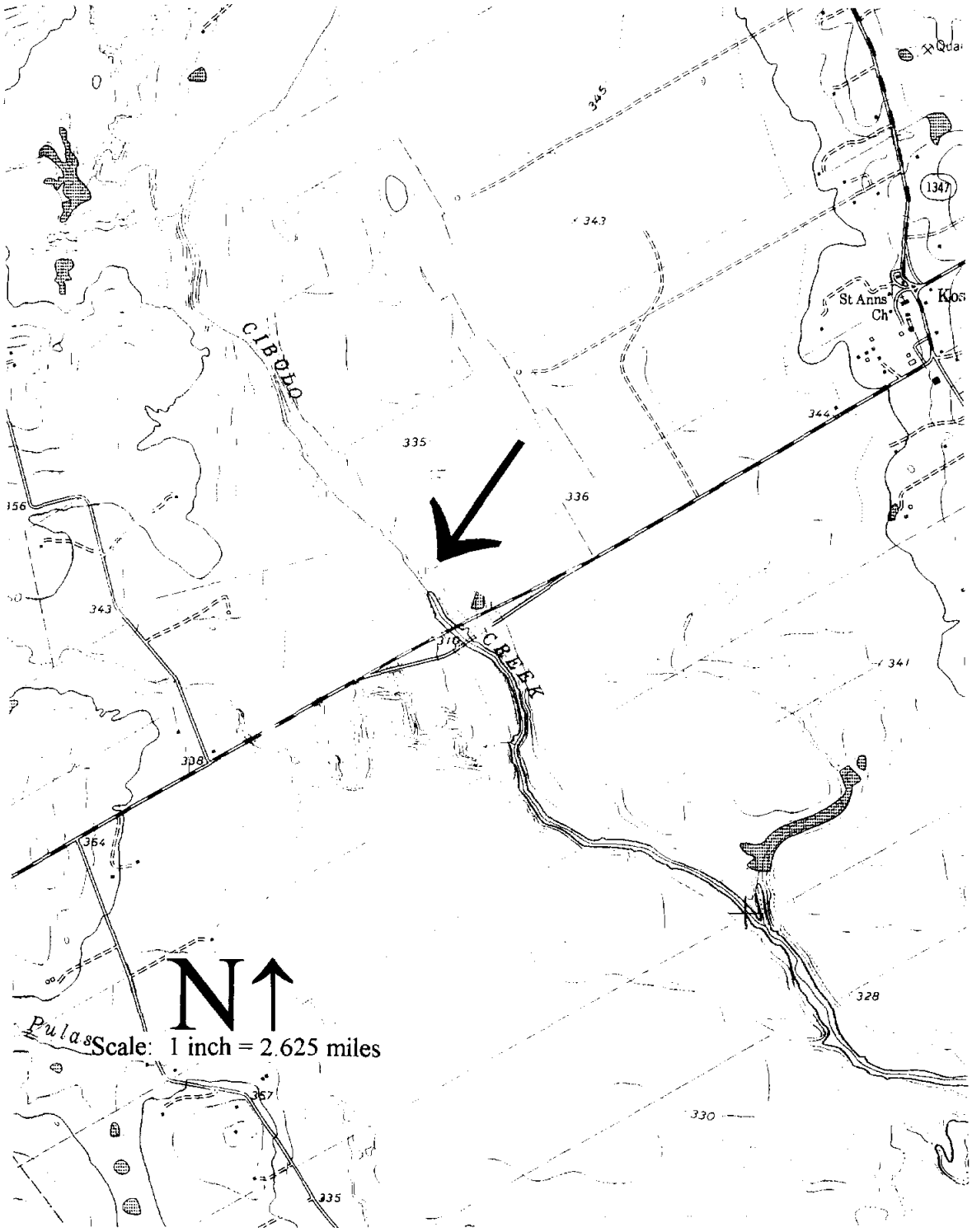


Figure 2. Site 3 - Cibolo Creek.

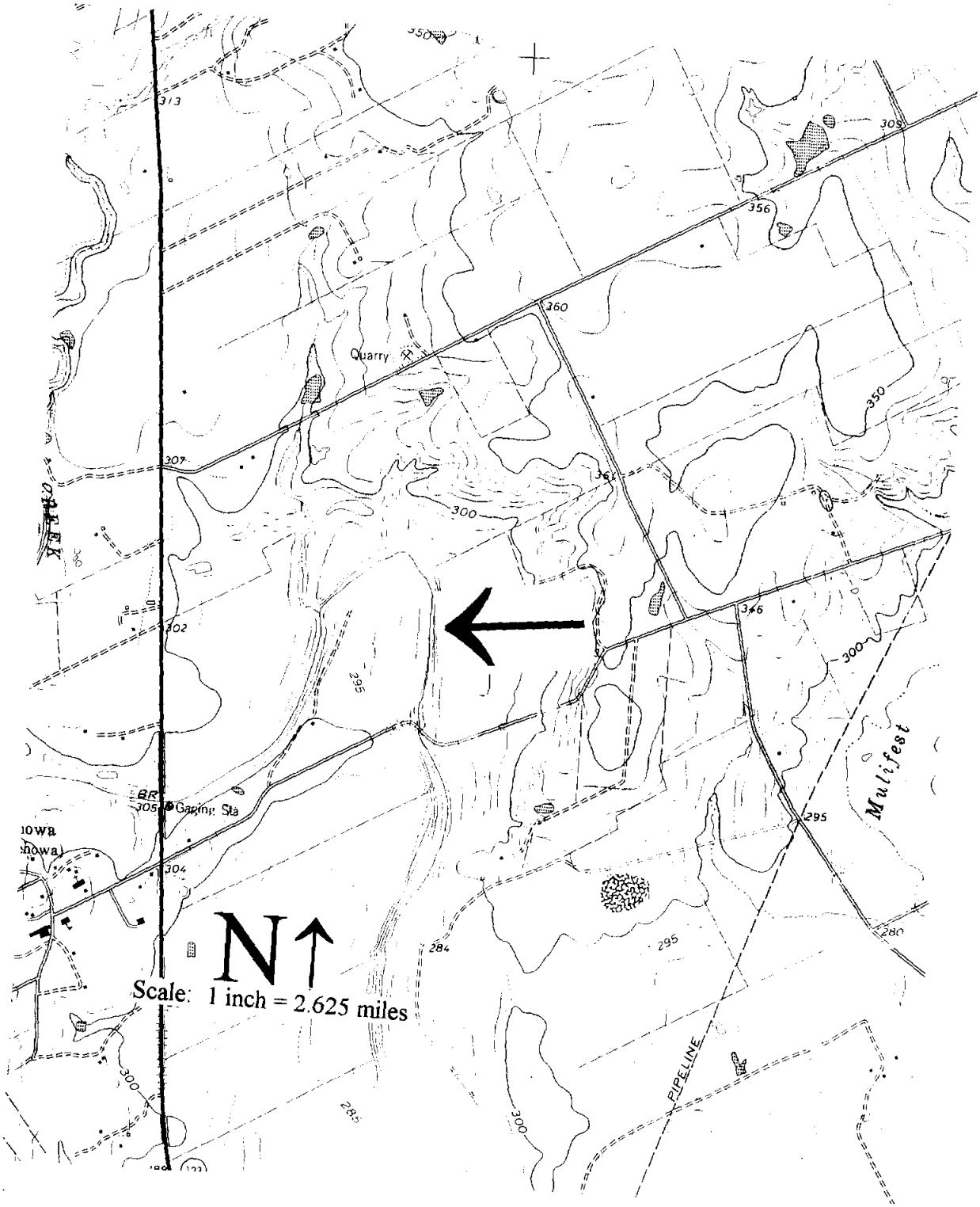


Figure 3. Site 8 - Cibolo Creek.

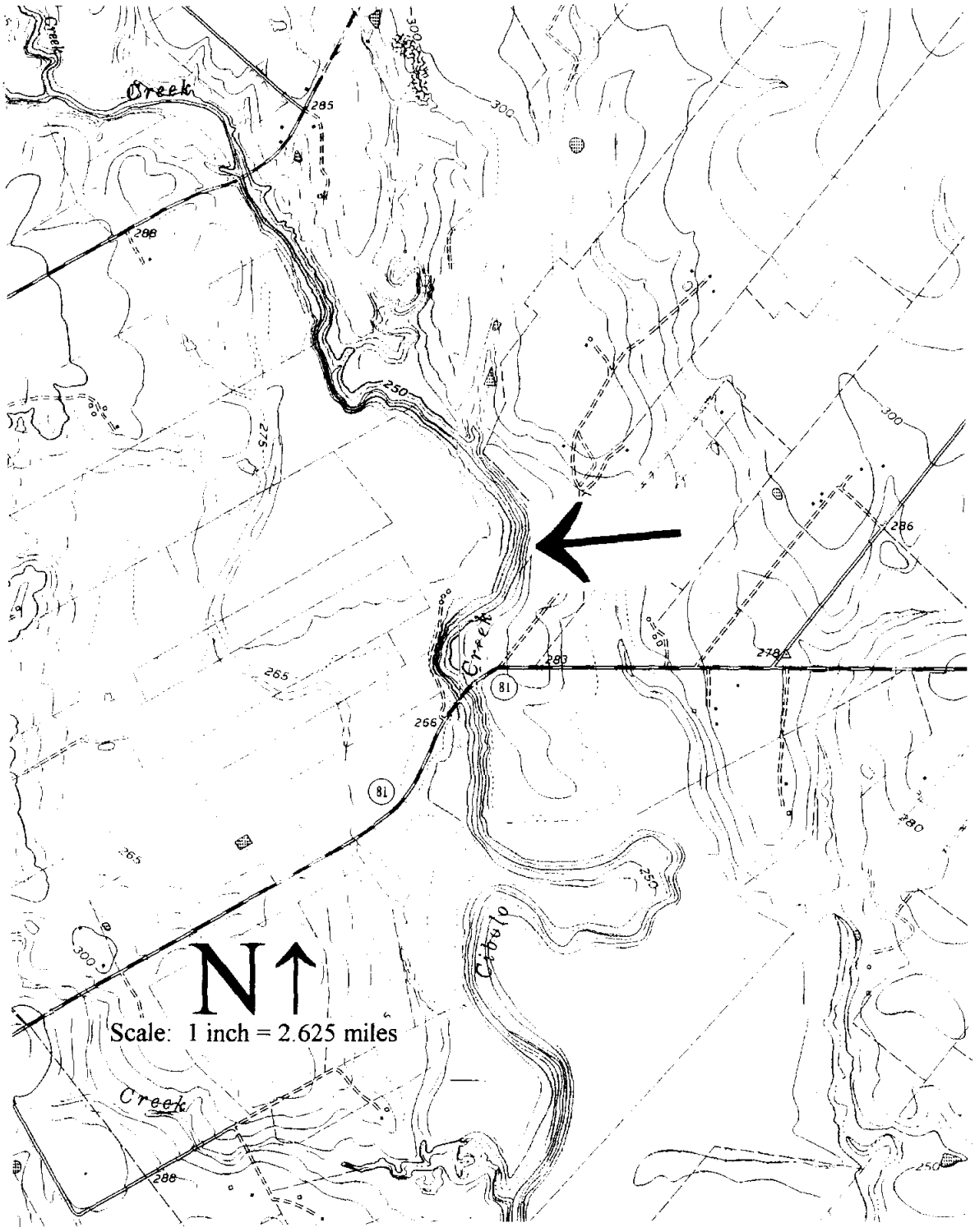


Figure 4. Site 9 - Cibolo Creek.

4.0 DATA COLLECTION

4.1 Bathymetric

This work is to be done by the TWDB.

4.2 Hydrologic

Additional work is to be done primarily by the TWDB staff. Information from the USGS gage 08186000, near Falls City, was used to determine when stream flow was within appropriate range for sampling to be performed. The mean daily flows for Cibolo Creek during 1996-1997 can be seen in Figure 5.

4.3 Habitat assessment

US Environmental Protection Agency (EPA), Texas Natural Resource Conservation Commission (TNRCC) and Texas Parks and Wildlife (TPWD) have been using IBI protocols in the state to develop criteria for stream classifications (Bayer, et al. 1992). TWDB staff have developed their own system, known as MAT, for describing instream flow needs (Mathews and Bao 1991). This study utilizes the combination of IBI protocols and MAT.

4.31 Habitat Mapping and Photodocumentation

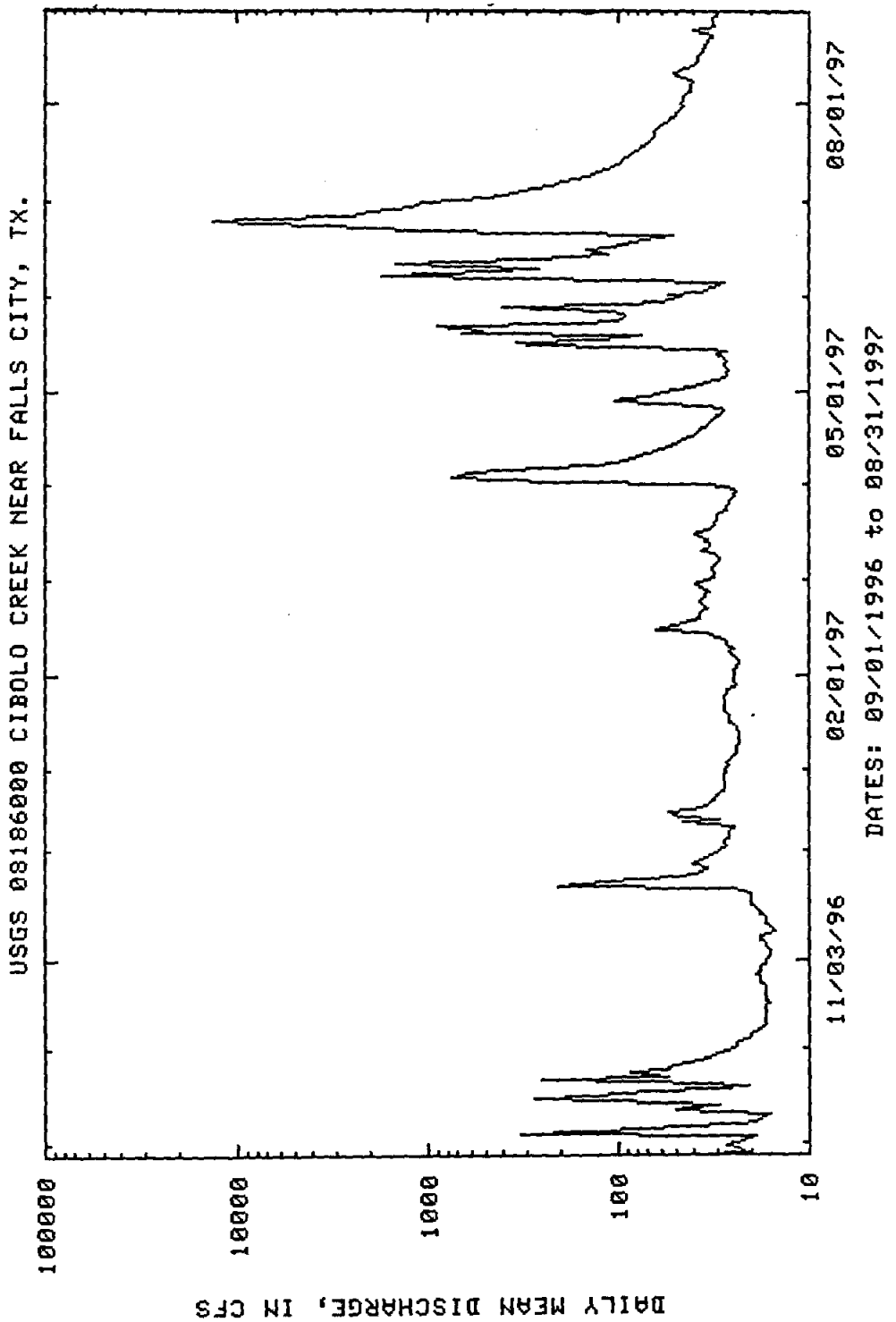
Figure 1 shows a generalizd map of the study location. Figures 2, 3 and 4 show the study sites on USGS quadrant maps. Figures 6, 7 and 8 are sketch maps showing microhabitat locations within the study site. Numbers on the maps correspond with the microhabitat code found in Appendix 1. Representative photographs of the sample sites and microhabitats within those sites are found in Appendix 3.

4.32 Microhydraulic Effect of Habitat

This work is to be completed by TWDB staff.

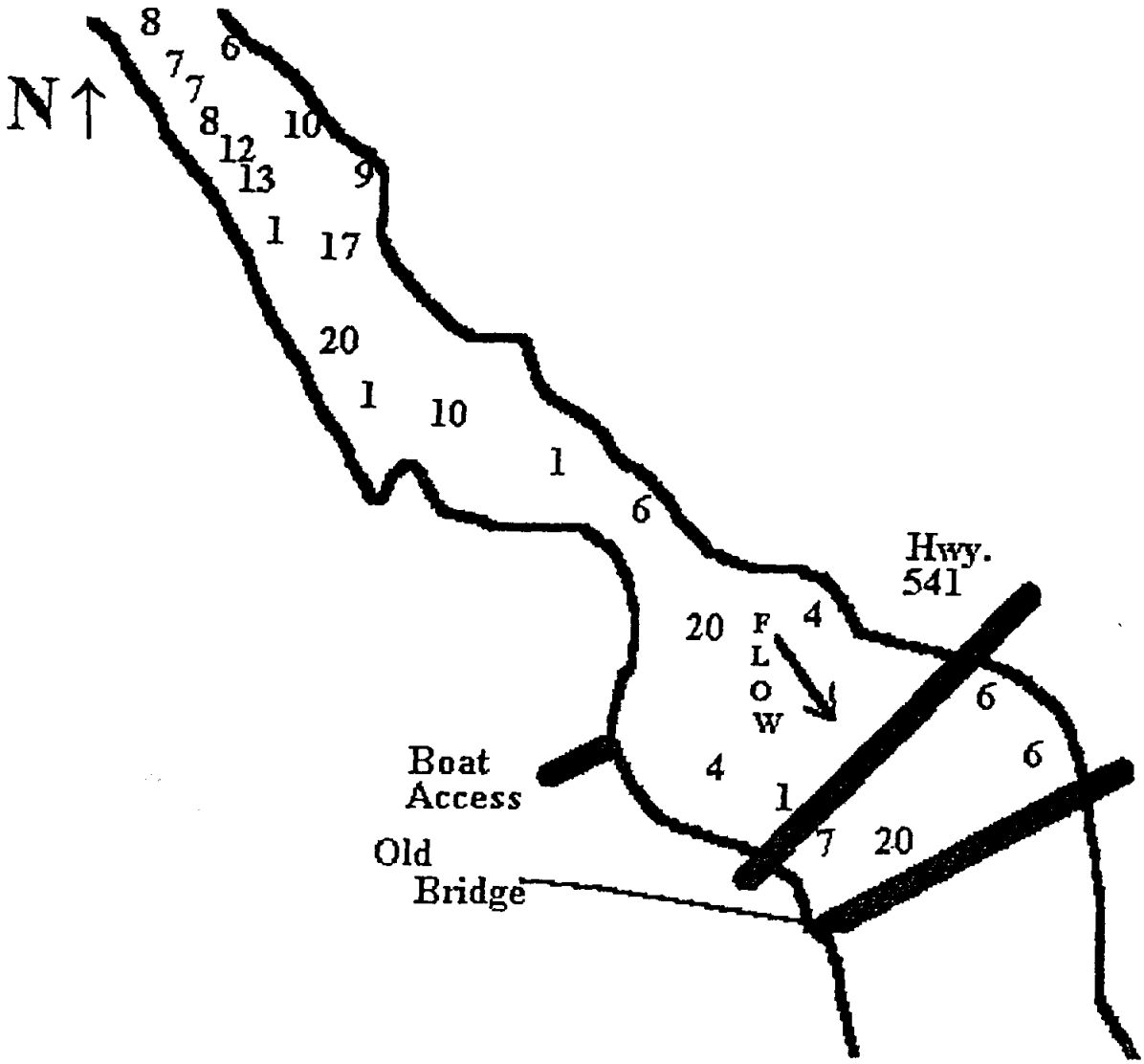
4.33 Instream Habitat Classification

Habitat is basically a locality, site or particular type of environment on a microscale that is occupied by an organism or population of organisms.



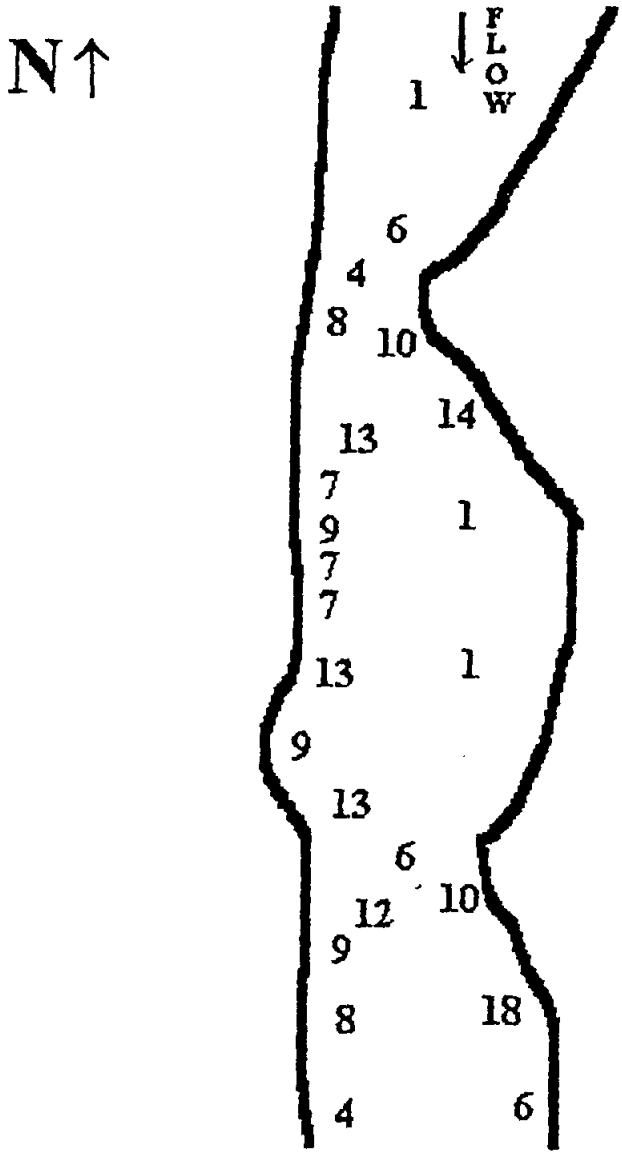
Data is provisional and subject to revision.
(Source: US Geological Survey)

Figure 5. Daily flow means at USGS gage 08186000, near Falls City, during 1996 and 1997.



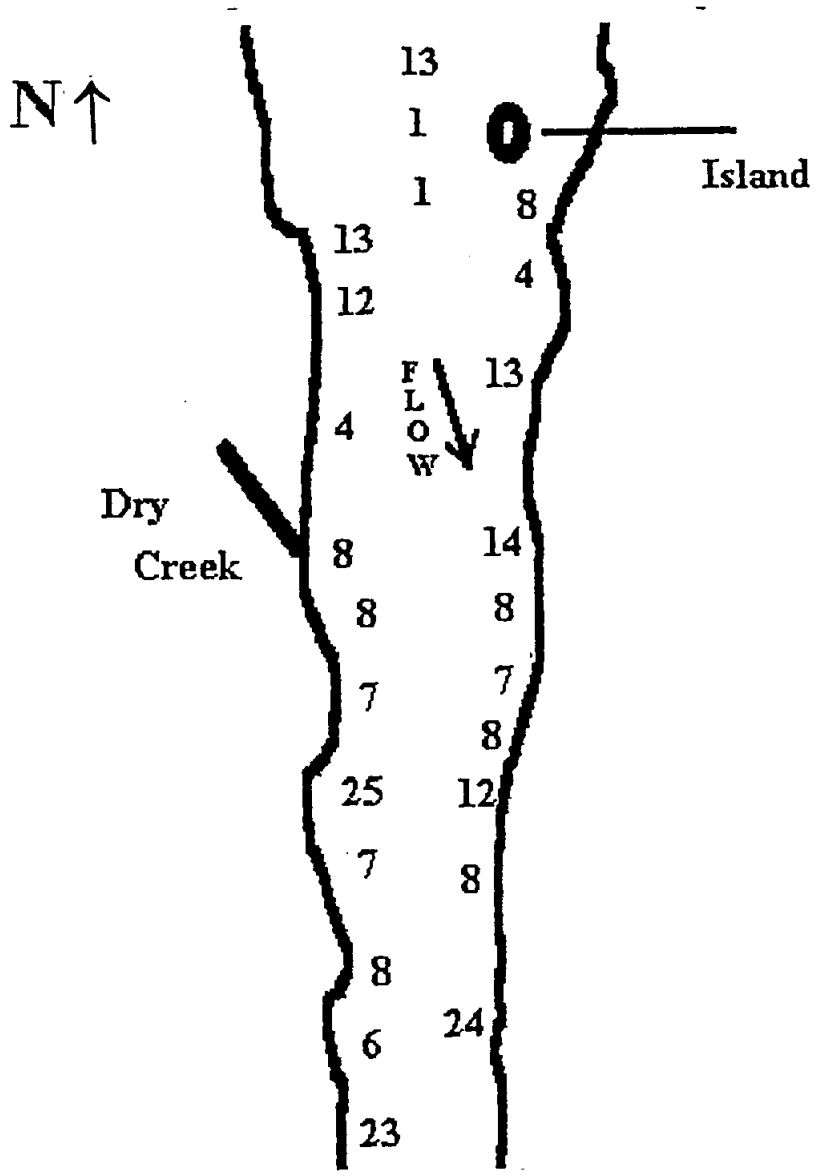
Numbers correspond with microhabitat code numbers.
(Site is 728 feet long)

Figure 6. Sketch map of site 3.



Numbers correspond with microhabitat code numbers.
(Site is 706 feet long)

Figure 7. Sketch map of site 8.



Numbers correspond with microhabitat code numbers.
(Site is 1,039 feet long)

Figure 8. Sketch map of site 9.

4.4 Biological Assessment

Water development projects such as the ones proposed alter the natural flow of a stream. It is important to know what the impact of the altered flows will be on the biological community. This information is important since it may be necessary to mitigate the effects of the altered flows by various management options.

4.41 Biological Indices

The indices used in this study have been developed by the EPA and modified for the purpose of categorizing stream segments. The water quality assessment technique chosen was the IBI found in Table 1. Reference streams wereArenosa Creek, Metate Creek, Placedo Creek, San Miguel Creek and West Caranchua Creek as used in previous studies of these sites (Whiteside, et al. 1993 and Whiteside, et al. 1994). Additionally, the MAT methodology developed by TWDB was considered and the data was collected in such a way to be useful for this type of technique.

4.42 Biological Sampling Techniques

The information gathered from sampling can be seen in bubble graphs which indicate the fish collected from different habitats (Appendices 1and 2). The Appendices includes bubble graphs that represent individual sample dates and combined sampling dates. Some of the previous work done did not break down microhabitats into the current specific categories. When combining the new data with the previous data, the more specific terms for microhabitats currently used were combined into the more generalized terms previously used. These bubble graphs have only four categories (snag, root wad, riffle and debris) and are listed in Appendix 1.

4.5 Physicochemical

The following parameters were analyzed in the field: temperature, pH, dissolved oxygen, specific conductance and flows at each microhabitat. The results, for sampling done during this study are in Table 3.

4.6 Biological Assessment of Habitat Utilization and Availability Conditions

The TWDB staff will complete this portion of the study utilizing MAT methods.

5.0 RECOMMENDATIONS AND CONCLUSIONS

The microhabitat names that were selected in this study were updated from previous studies. The previous studies used less descriptive terms such as "tree branch" to describe a branch in the water whereas this study used specific terms such as "riffle - channel snag" to describe the same thing. This discrepancy made it difficult to combine old data with the new.

The data that was collected in this study is going to be incorporated with hydrologic and bathymetric data obtained by TWDB personnel and used in their Macrohabitat Assessment Technique (MAT) model. The MAT study reach model involves analysis of biological data from microhabitats at different flows, especially the distribution of fish within those microhabitats at different flows, during summer and winter.

Table 1. Index of Biotic Integrity (IBI) for fish collected 1996 and 1997.

	Site 3					
Sample Date:	**2-Nov-96**		**7-Dec-96**		**3-Aug-97**	
Metrics Used:	**Raw Score**	**Metric Score**	**Raw Score**	**Metric Score**	**Raw Score**	**Metric Score**
Total # of Species	12	5	7	3	6	3
# of Darter/Catfish Species	2	3	1	3	1	3
# of Sunfish Species	2	3	1	1	2	3
# of Minnow Species	3	3	2	3	2	3
# of Intolerant Species	0	1	0	1	0	1
% Green Sunfish	0%	5	0%	5	0%	5
% Omnivores	29%	3	30%	3	6%	5
% Insectivores	70%	5	65%	5	94%	5
% Top Carnivores	0%	1	5%	3	0%	1
Total # of Individuals	204	3	43	1	18	1
% Hybrids	0%	5	0%	5	0%	5
% Diseased/Anomalies	0%	5	0%	5	0%	5
IBI Score		**42**		**38**		**40**
Score Interpretation		**Fair**		**Fair**		**Fair**

IBI = Index of Biotic Integrity

	Site 8				Site 9			
Sample Date:	**7-Dec-96**		**3-Aug-97**		**8-Dec-96**		**3-Aug-97**	
Metrics Used:	**Raw Score**	**Metric Score**	**Raw Score**	**Metric Score**	**Raw Score**	**Metric Score**	**Raw Score**	**Metric Score**
Total # of Species	13	5	8	3	15	5	7	3
# of Darter/Catfish Species	3	5	2	3	3	5	1	3
# of Sunfish Species	3	3	3	3	4	3	2	3
# of Minnow Species	3	3	3	3	4	5	2	3
# of Intolerant Species	0	1	0	1	0	1	0	1
% Green Sunfish	0%	5	0%	5	0%	5	0%	5
% Omnivores	9%	5	25%	3	10%	5	0%	5
% Insectivores	90%	5	58%	5	88%	5	89%	5
% Top Carnivores	1%	3	13%	5	3%	3	11%	5
Total # of Individuals	163	1	24	1	105	1	36	1
% Hybrids	0%	5	0%	5	0%	5	0%	5
% Diseased/Anomalies	0%	5	0%	5	0%	5	0%	5
IBI Score		**46**		**42**		**48**		**42**
Score Interpretation		**Good**		**Fair**		**Good**		**Fair**

IBI = Index of Biotic Integrity

Table 2. List of freshwater fishes collected from the Cibolo Creek system.

Family	Species	Common Name
Lepisosteidae	*Lepisosteus oculatus*	Spotted gar
Anguillidae	*Anguilla rostrata*	American eel
Clupeidae	*Dorosoma cepedianum*	Gizzard shad
Cyprinidae	*Campostoma anomalum*	Central stoneroller
	Cyprinella lutrensis	Red shiner
	C. venusta	Blacktail shiner
	Macrhybopsis aestivalis	Speckled chub
	Notropis stramineus	Sand shiner
	N. volucellus	Mimic shiner
	Pimephales vigilax	Bullhead minnow
Catostomidae	*Ictiobus bubalus*	Smallmouth buffalo
	Moxostoma congestum	Gray redhorse
Characidae	*Astyanax mexicanus*	Mexican tetra
Ictaluridae	*Ameiurus melas*	Black bullhead
	A. natalis	Yellow bullhead
	Ictalurus punctatus	Channel catfish
	Pylodictis olivaris	Flathead catfish
Poeciliidae	*Gambusia affinis*	Western mosquitofish
	Poecilia latipinna	Sailfin molly
Centrarchidae	*Lepomis auritus*	Redbreast sunfish
	L. cyanellus	Green sunfish
	L. gulosus	Warmouth
	L. macrochirus	Bluegill sunfish
	L. megtalotis	Longear sunfish
	L. microlophus	Redear sunfish
	L. punctatus	Spotted sunfish
	Micropterus salmoides	Largemouth bass
Percidae	*Etheostoma cholorosomum*	Bluntnose darter
	E. spectabile	Orangethroat darter
Cichlidae	*Cichlasoma cyanoguttatum*	Rio Grande cichlid

Table 3. Physicochemical data for 1996 and 1997, Cibolo Creek.

Site Number	Date	pH	S. Cond (μmhos/cm)	DO (mg/l)	Temperature (C)
3	11-2-96	8.5	858	7.2	18
	12-7-96	8.8	-	8.2	13.8
	8-3-97	7.1	1040	7.86	29.5
8	12-7-96	8.4	-	8.4	14.4
	8-3-97	7	1056	8.5	29.4
9	12-8-96	8.6	-	8.9	14.2
	8-3-97	6.9	1072	7.2	29.1

Table 4. Flow data for microhabitats on Cibolo Creek for sites 3, 8 and 9 on August 3, 1997.

Microhabitat	Site 3		Site 8		Site 9	
Code	Depth	Flow	Depth	Flow	Depth	Flow
1	0.01	1	0.25	0.08	0.5	0.5
2	0.01	1.1	0.08	0.03	0.25	0.3
3	0.25	0.8	1.4	0.03	w	w
4	0.2	0.7	w	w	0.05	1.3
5	0.01	1.3	0.03	0.04	0.13	1.2
6	0.25	0.11	0.65	0.75	0.01	0.08
7	w	w	0.01	0.03	0.23	0.9
8	0.15	0.03	0.02	0.03	0.1	0.8
9	0.65	0.1	w	w	0.03	0.03
10	0.01	0.09	0.03	1.1	0.03	1
11	0.3	1.3	0.02	0.75	0.05	1.3
12	0.2	0.08	0.03	0.8	0.1	0.9
13	0.1	1	0.04	0.03	0.05	1.3
14	0.05	0.08	1.2	0.03	0.1	1
15	0.05	0.08	0.01	0.03	0.03	0.3
16	1.1	0.02	0.2	0.2	w	w
17	0.07	1	0.03	0.3	0.01	0.75
18	0.15	0.05	0.03	0.3	0.01	0.75
19	0.35	1.5	0.04	0.5	0.06	1.1
20	0.35	0.35	0.05	0.4	w	w
21	w	w			w	w
22	w	w			w	w
23	w	w			0.2	0.7
24	w	w			0.2	0.8
25	w	w			0.1	0.8

Depth is in meters (m) and flow is meters/sec. (m/s). The character w reflects a washed out microhabitat.

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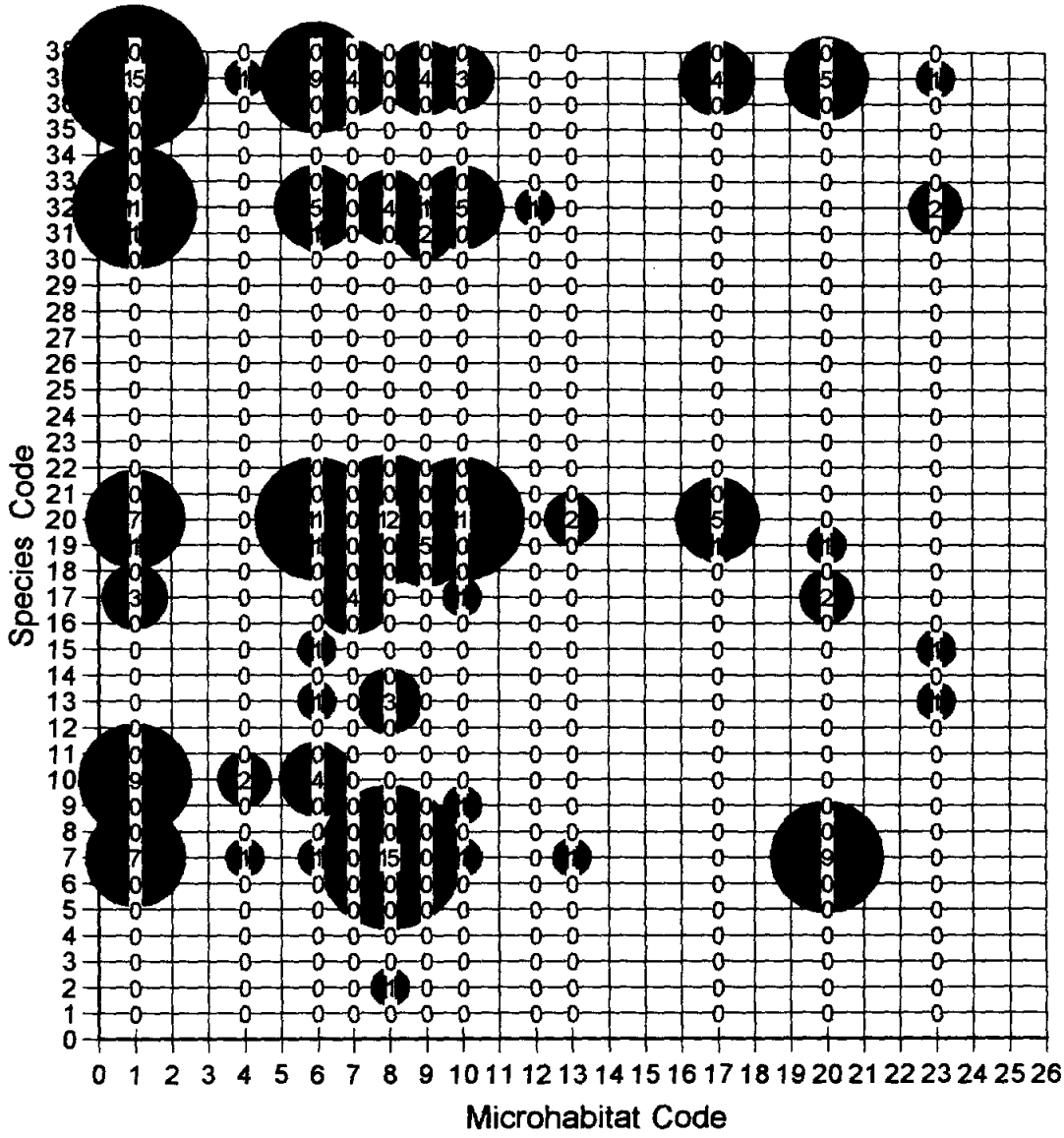
APPENDICES

Appendix 1. Fish species code for bubble graphs.

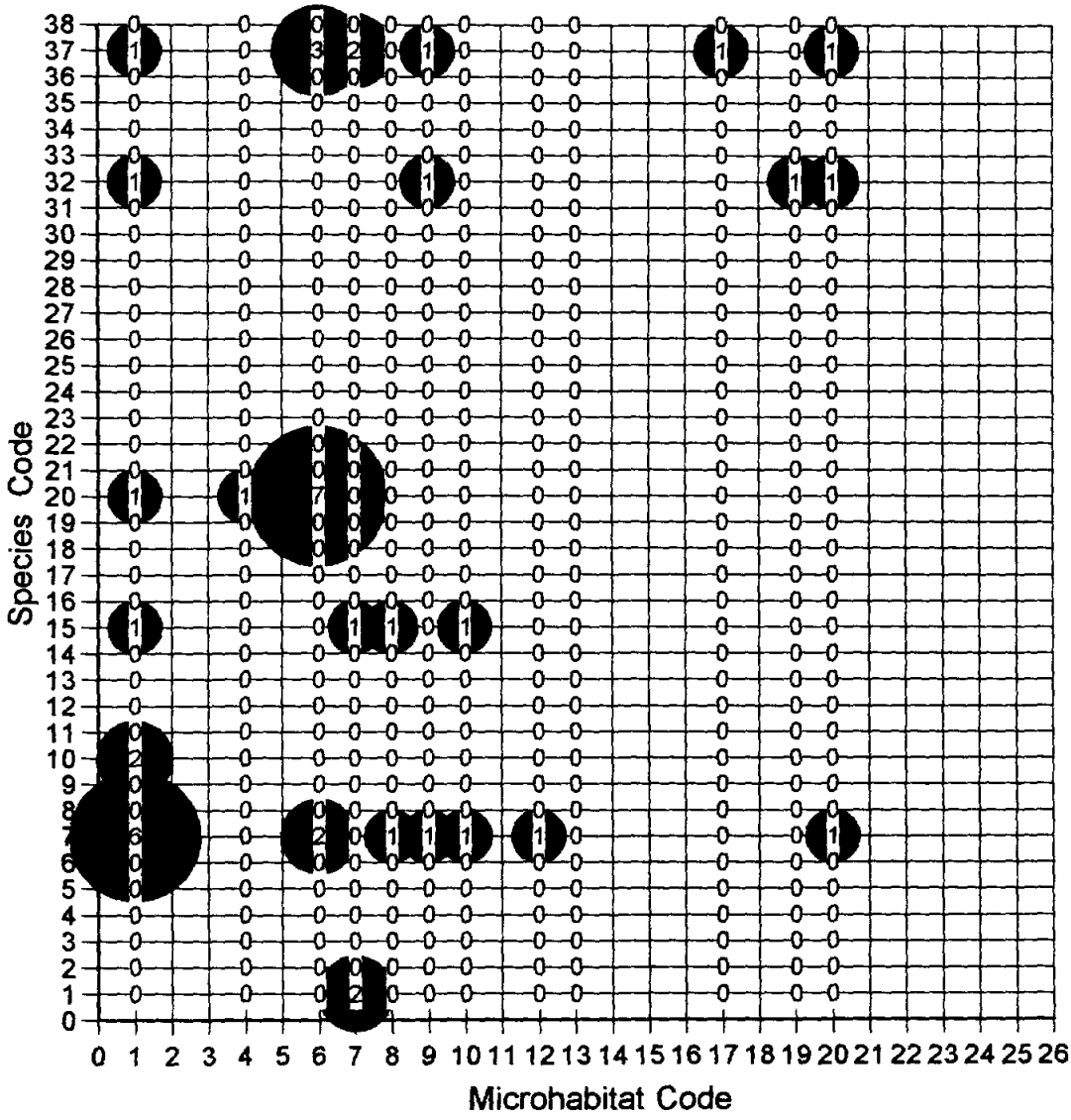
Code	Scientific Name	Common Name
1	*Anguilla rostrata*	American eel
2	*Lepisosteus oculatus*	Spotted gar
3	*Dorosoma cepedianum*	Gizzard shad
4	*Astyanax mexicanus*	Mexican tetra
5	*Hybopsis aestivalis*	Speckled chub
6	*Cyprinella venusta*	Blacktail shiner
7	*Cyprinella lutrensis*	Red shiner
8	*Notropis stramineus*	Sand shiner
9	*Notropis volucellus*	Mimic shiner
10	*Pimephales vigilax*	Bullhead minnow
11	*Campostoma anomalum*	Central stoneroller
12	*Ictiobus bubalus*	Smallmouth buffalo
13	*Moxostoma congestum*	Gray redhorse
14	*Minytrema melanops*	Spotted sucker
15	*Ictiobus bubalus*	Channel catfish
16	*Pylodictis olivaris*	Flathead catfish
17	*Ameirus natalis*	Yellow bullhead
18	*Fundulus notatus*	Blackstripe topminnow
19	*Gambusia affinis*	Western mosquitofish
20	*Poecilia latipinna*	Sailfin molly
21	*Menidia beryllina*	Inland silverside
22	*Micropterus punctulatus*	Spotted bass
23	*Erimyzin oblongus*	Creek chubsucker
24	*Micropterus treculi*	Guadalupe bass
25	*Micropterus salmoides*	Largemouth bass
26	*Lepomis gulosus*	Warmouth
27	*Lepomis cyanellus*	Green sunfish
28	*Lepomis auritus*	Redbreast sunfish
29	*Lepomis punctatus*	Spotted sunfish
30	*Lepomis microlophus*	Redear sunfish
31	*Lepomis macrochirus*	Bluegill
32	*Lepomis megalotis*	Longear sunfish
33	*Pomoxis annularis*	White crappie
34	*Pomoxis nigromaculatus*	Black crappie
35	*Percina macrolepida*	Bigscale logperch
36	*Etheostoma spectabile*	Orangethroat darter
37	*Cichlasoma cyanoguttatum*	Rio Grande cichlid
38	*Mugil cephalus*	Striped mullet

Appendix 1. Microhabitat code for bubble graphs.

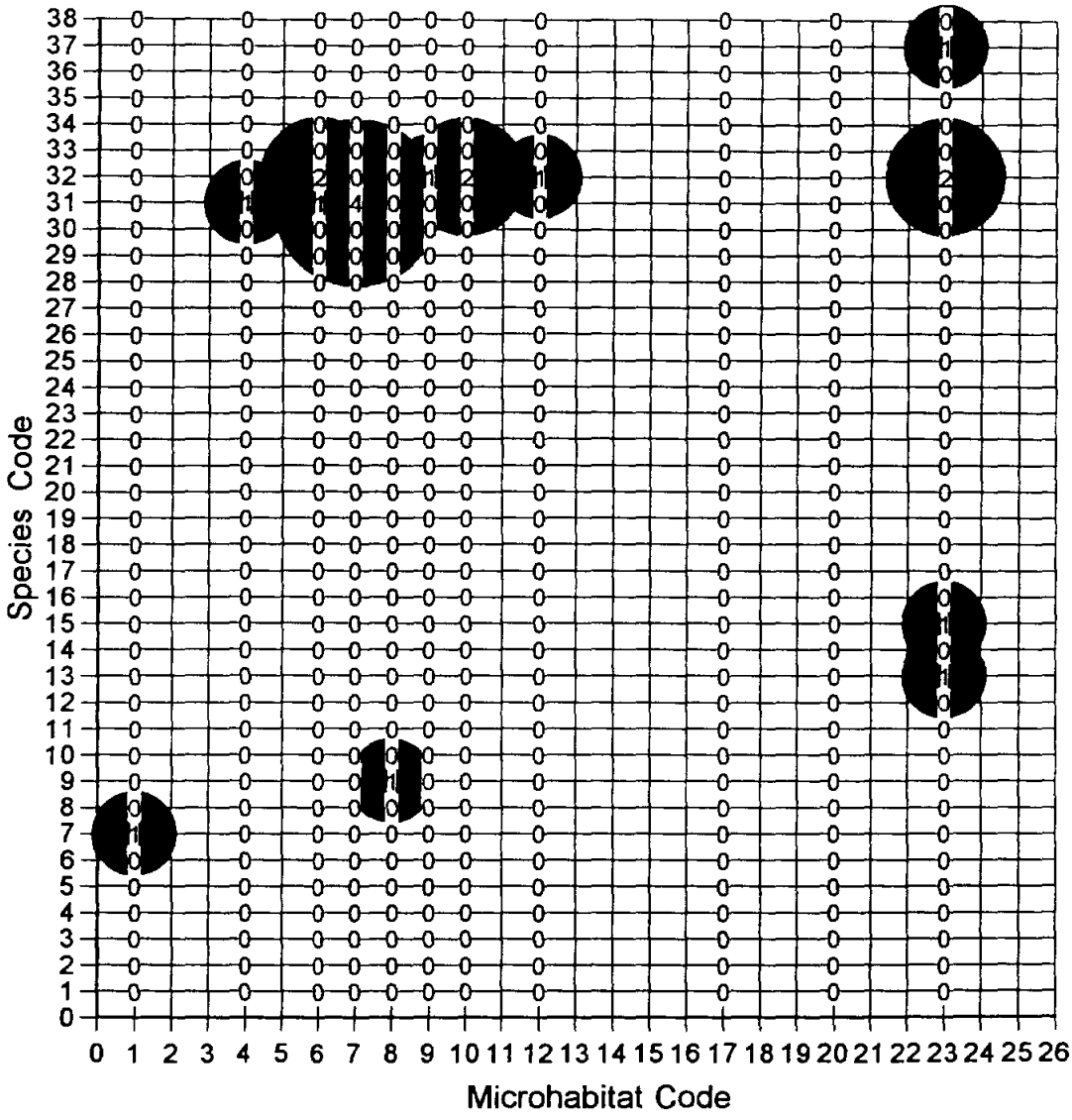
Individual Graphs		Combined Graphs	
Code	**Microhabitat**	**Code**	**Microhabitat**
1	Pool	1	Snag
2	Chute	2	Riffle
3	Rapid	3	Debris
4	Pool - Root Wad	4	Root Wad
5	Edgewater		
6	Run		
7	Run - Undercut Bank		
8	Riffle - Bank Snag		
9	Backwater		
10	Riffle		
11	Riffle - Debris dam		
12	Riffle - Snag complex		
13	Riffle - Channel snag		
14	Eddy pool		
15	Glide		
16	Run - Root Wad		
17	Pool - Bank Snag		
18	Pool - Undercut Bank		
19	Pool - Snag Complex		
20	Pool - Channel Snag		
21	Pool - Debris Dam		
22	Riffle - Debris Dam		
23	Run - Bank Snag		
24	Run - Channel Snag		
25	Backwater - Channel Snag		



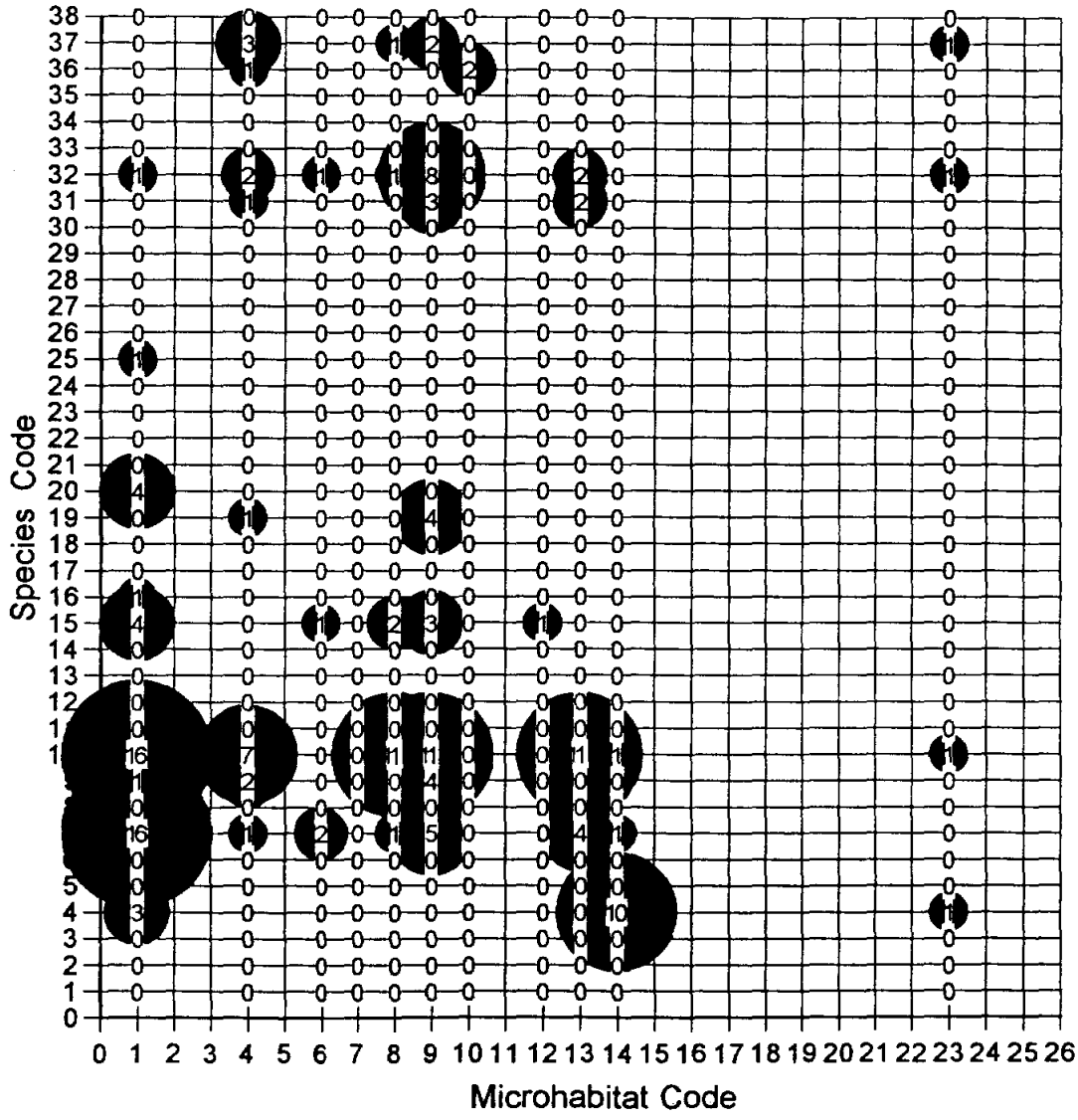
Appendix 2. Site 3 at winter low flow, Nov. 2, 1996.



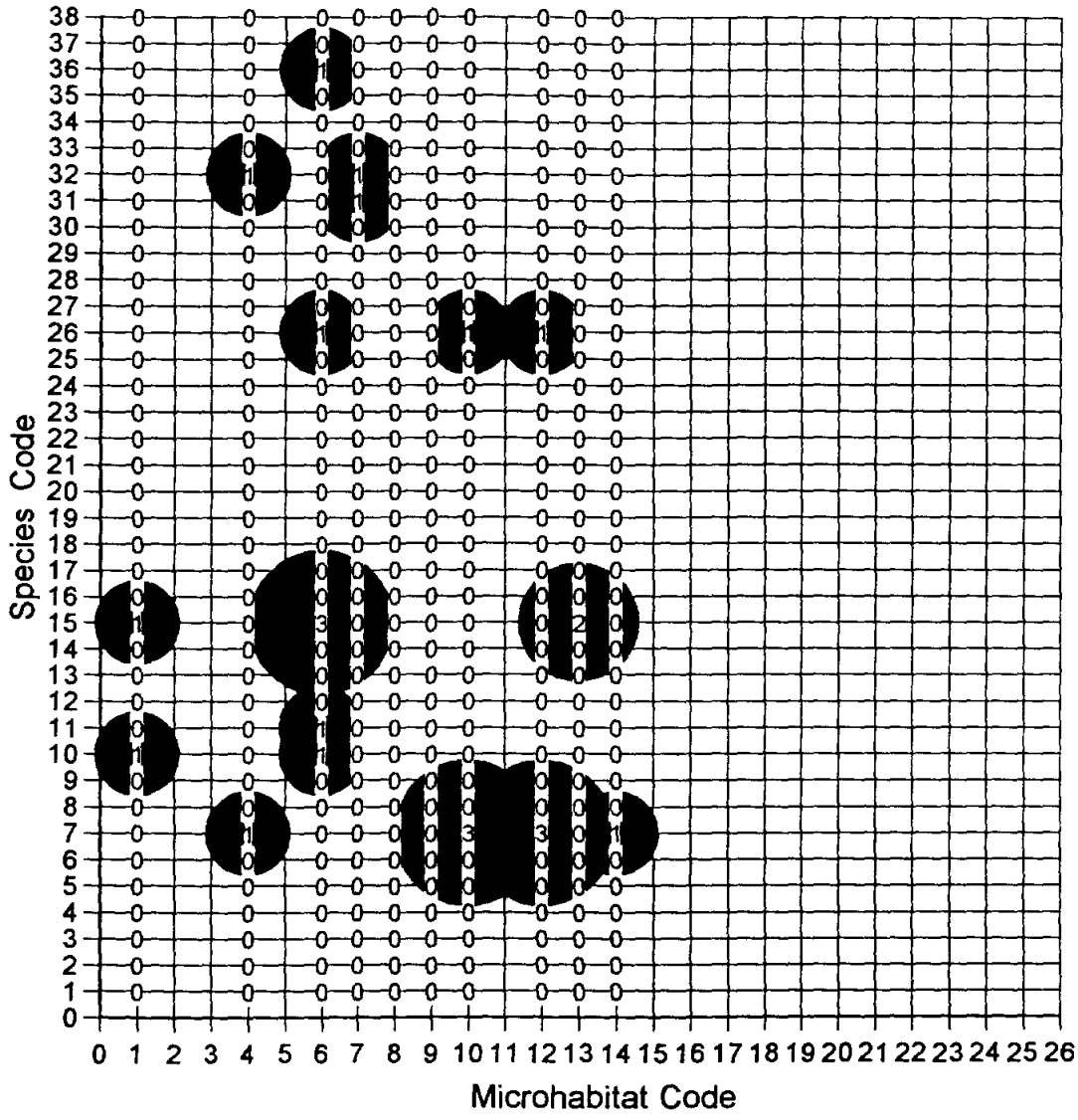
Appendix 2. Site 3 at winter medium flow, Dec. 7, 1996.



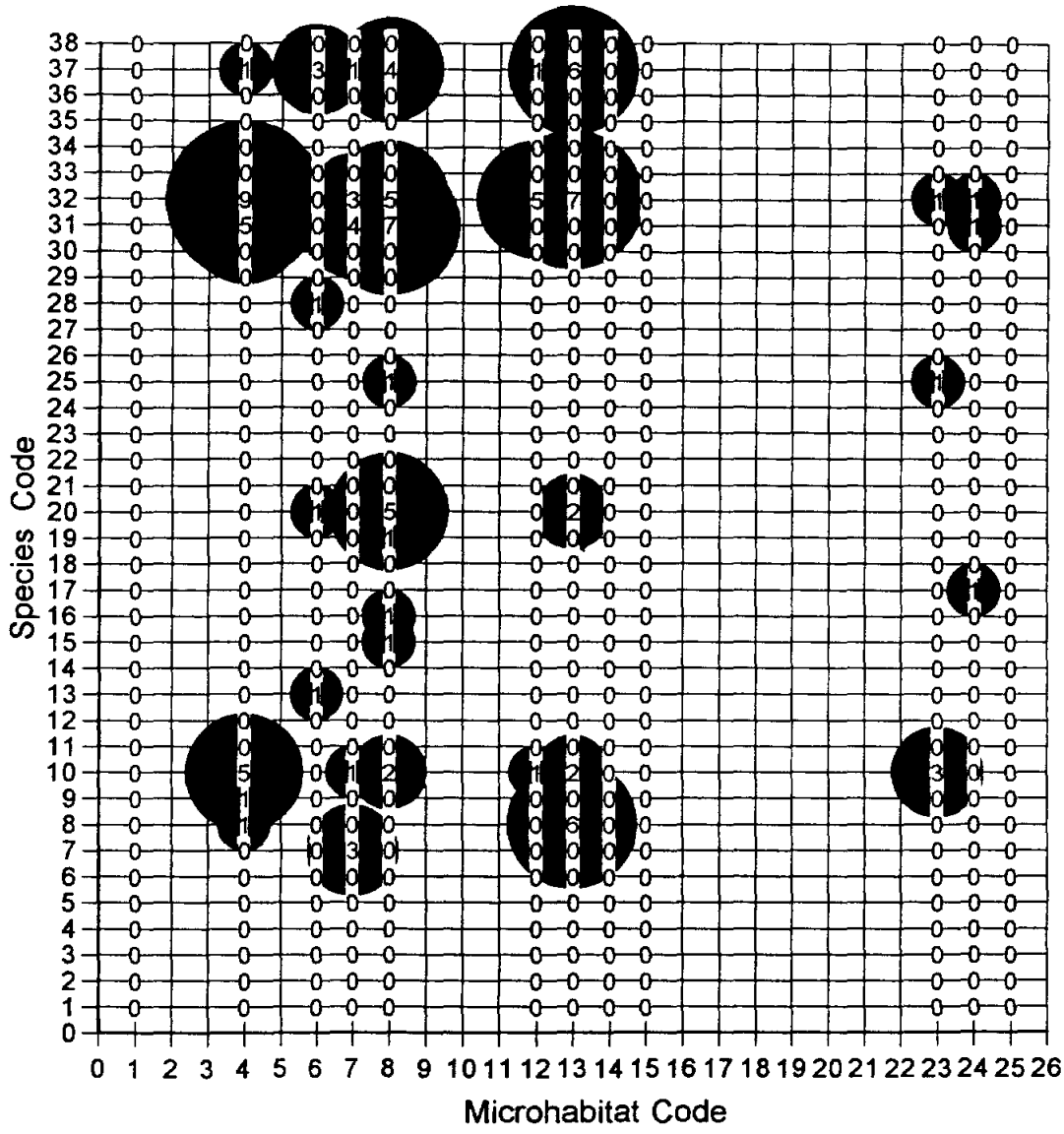
Appendix 2. Site 3 at summer medium flows, Aug. 3, 1997.



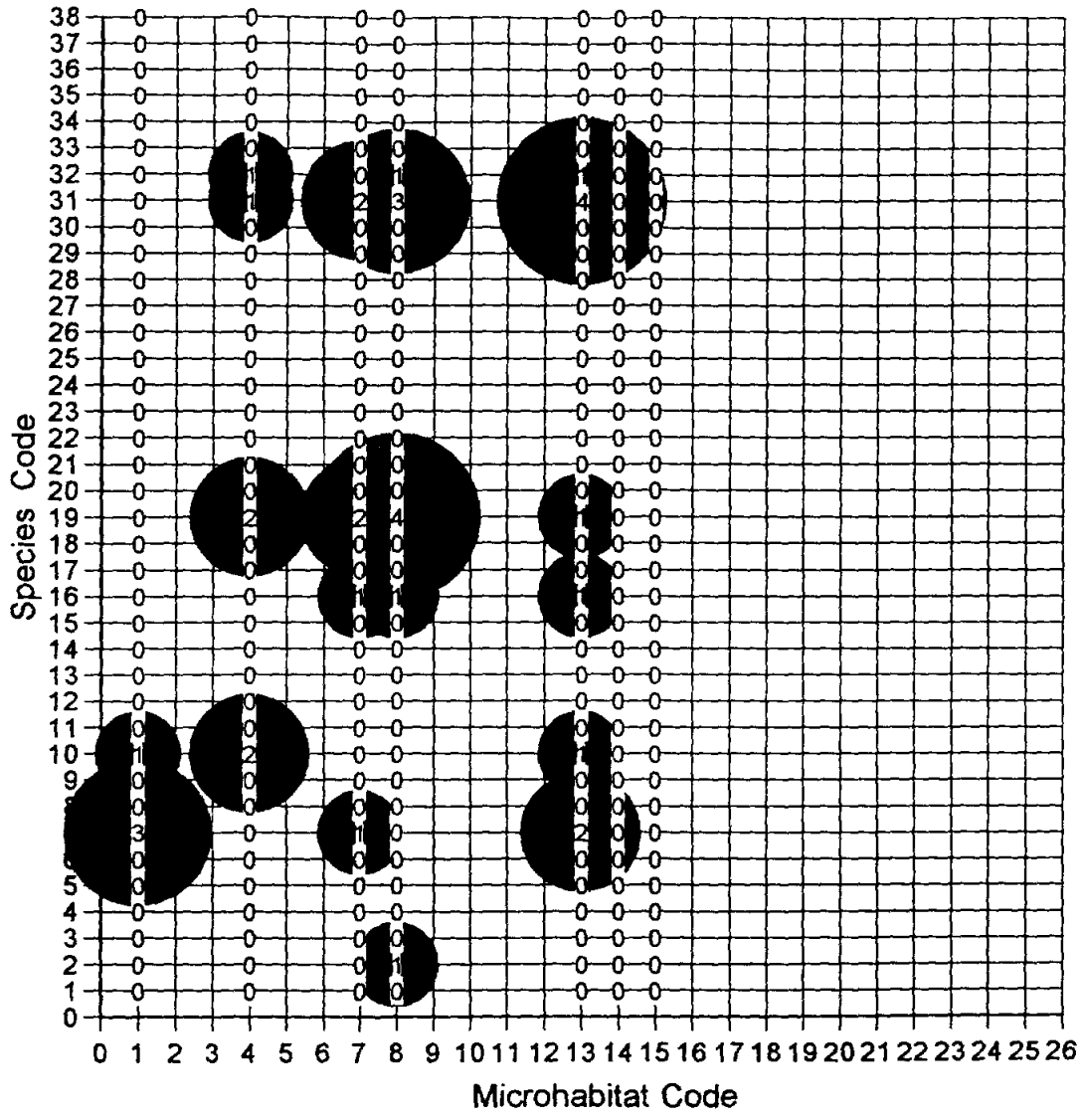
Appendix 2. Site 8 at winter high flow, Dec. 7, 1996.



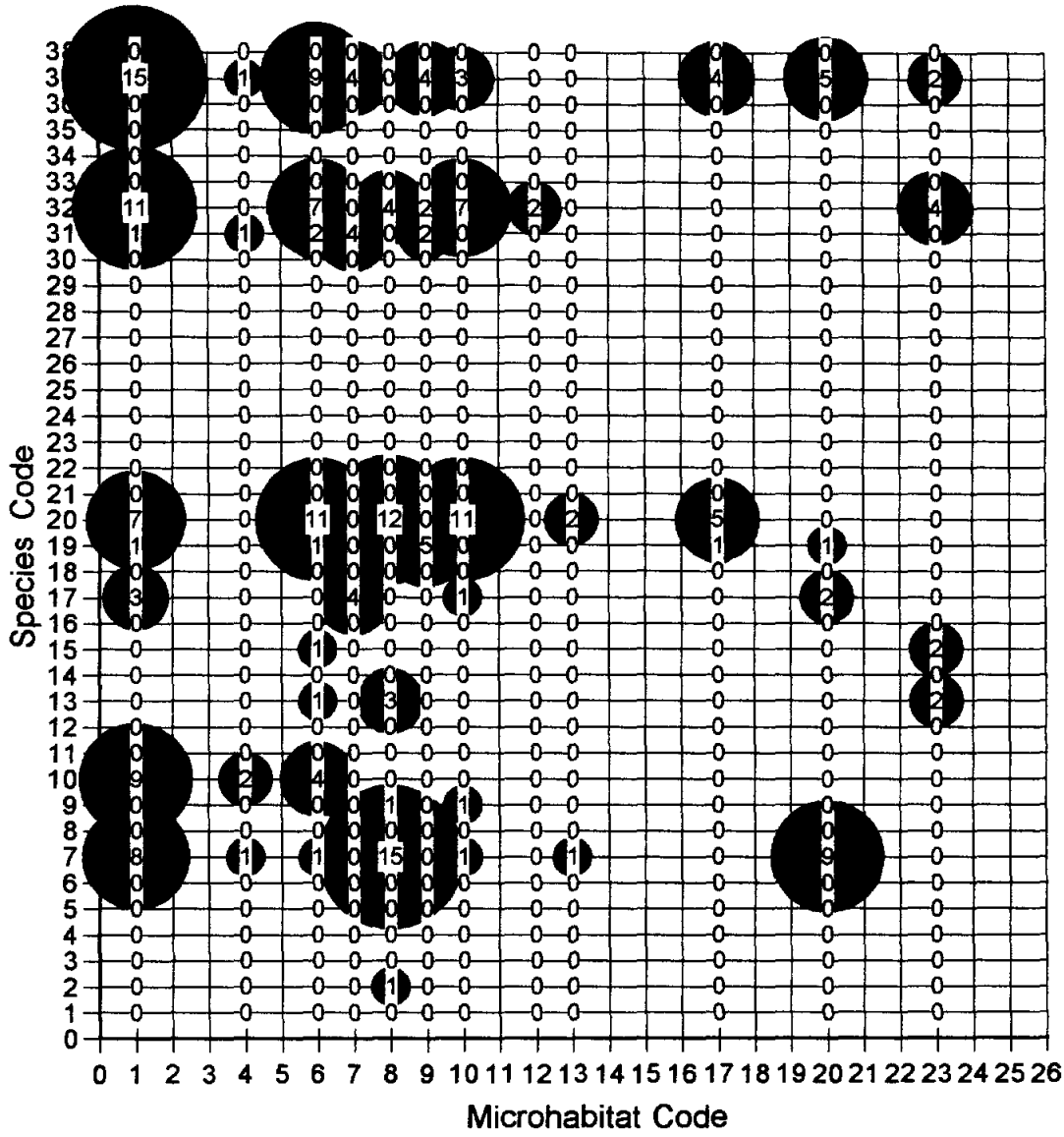
Appendix 2. Site 8 at summer medium flow, Aug. 3, 1997.



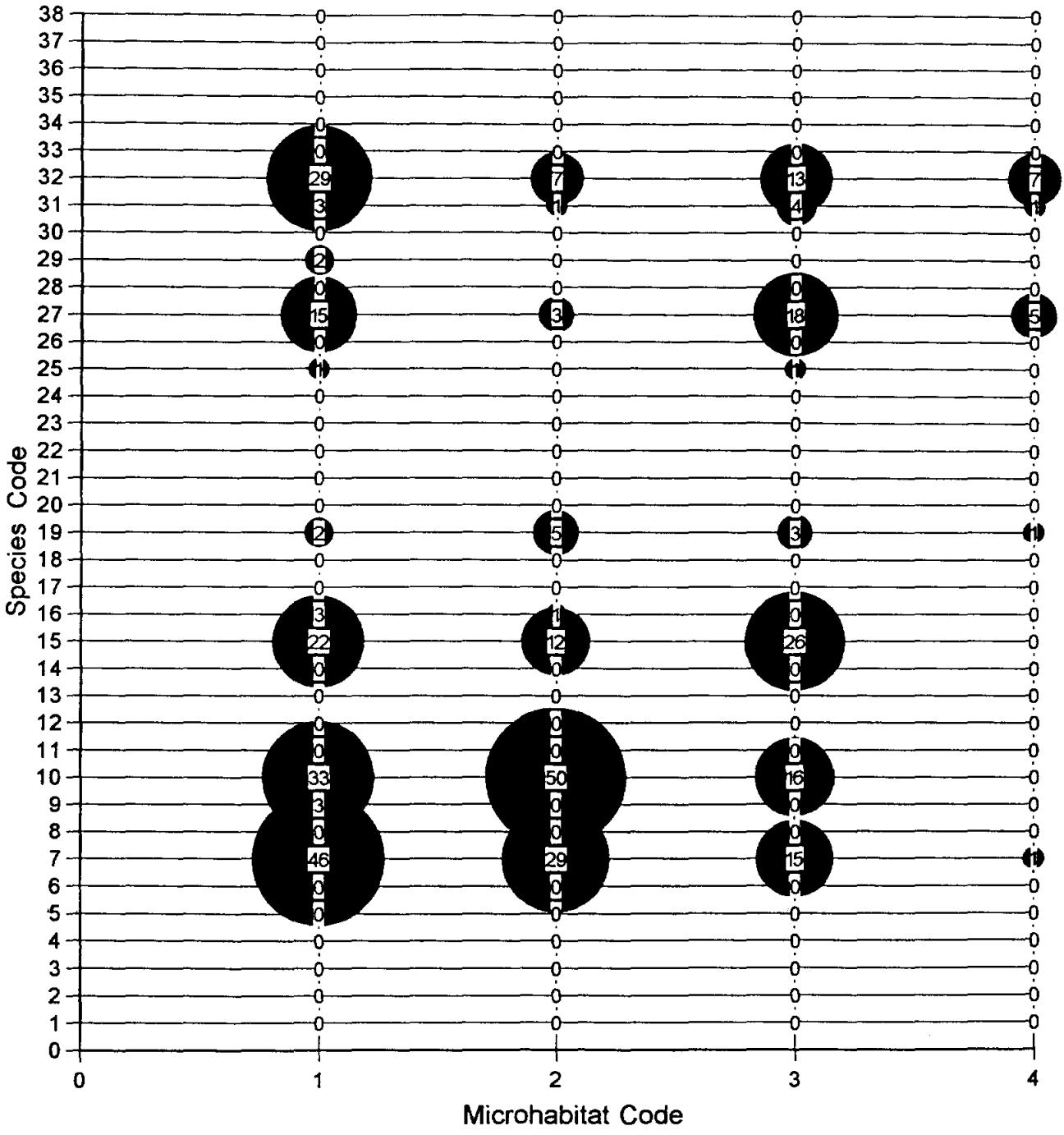
Appendix 2. Site 9 at winter medium flow, Dec. 8, 1996.



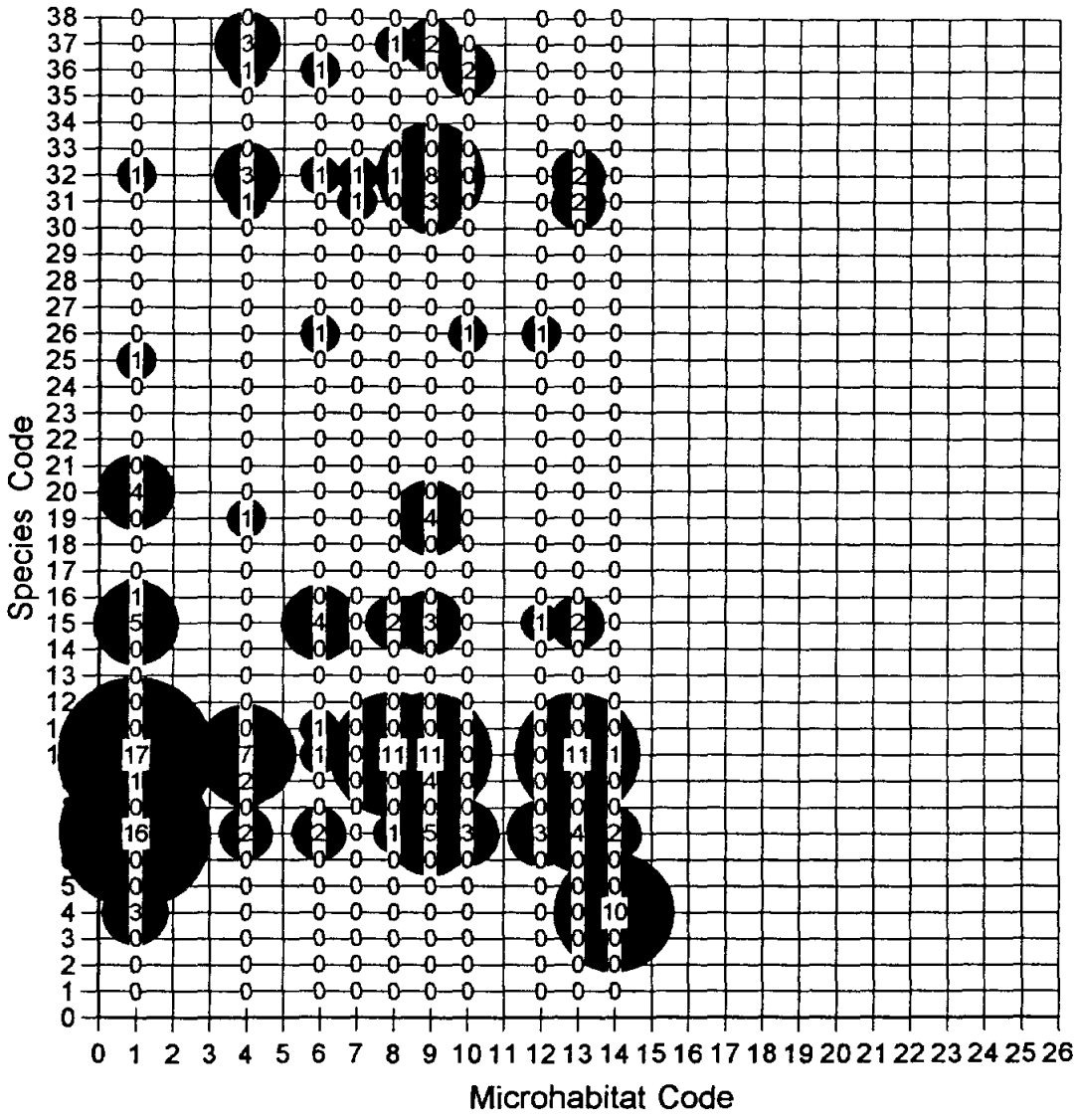
Appendix 2. Site 9 at summer medium flow, Aug. 3, 1997.



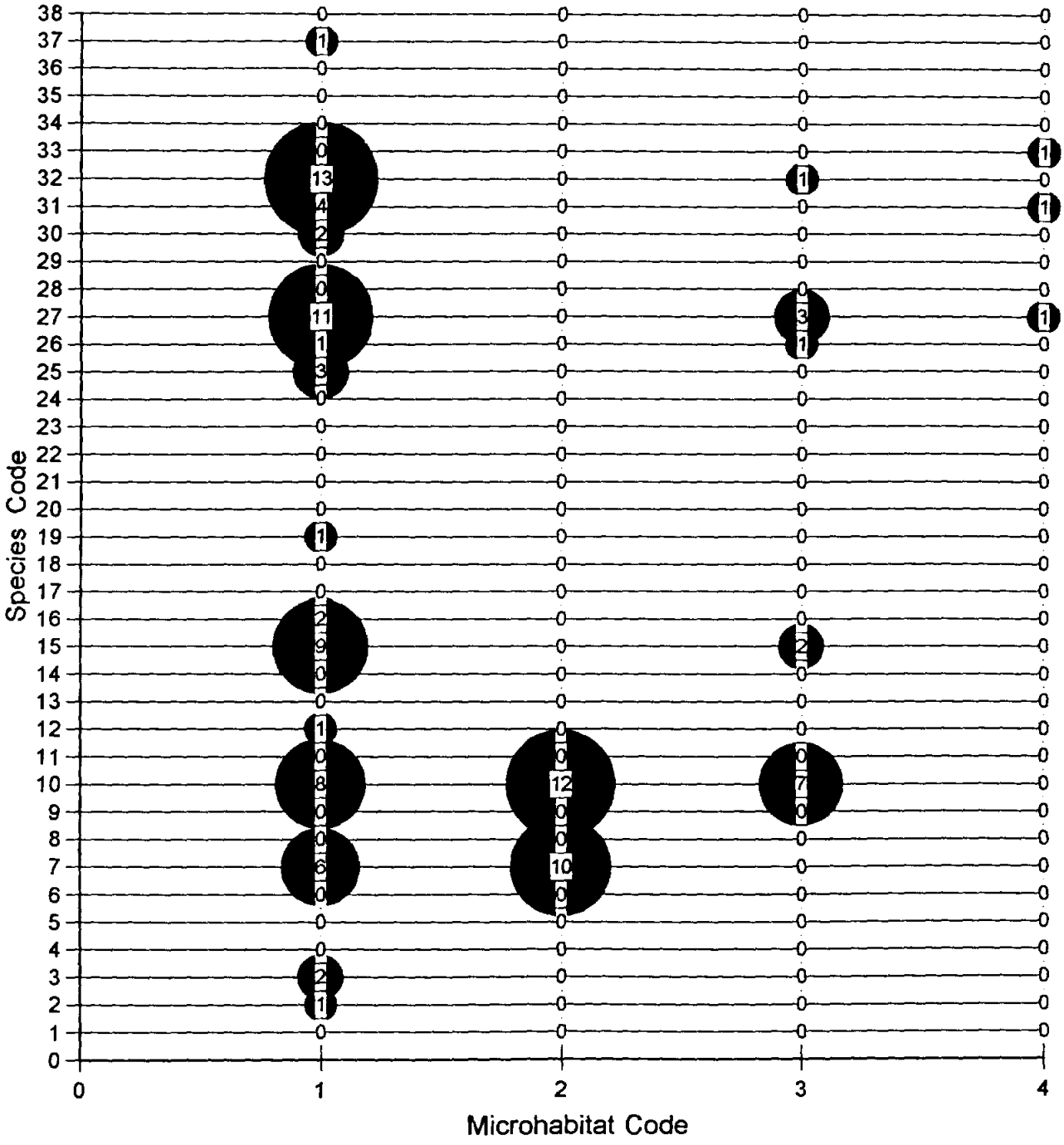
Appendix 2. Cibolo Creek (Site 3) at medium flows, Aug. 3, 1997 and Dec. 7, 1997.



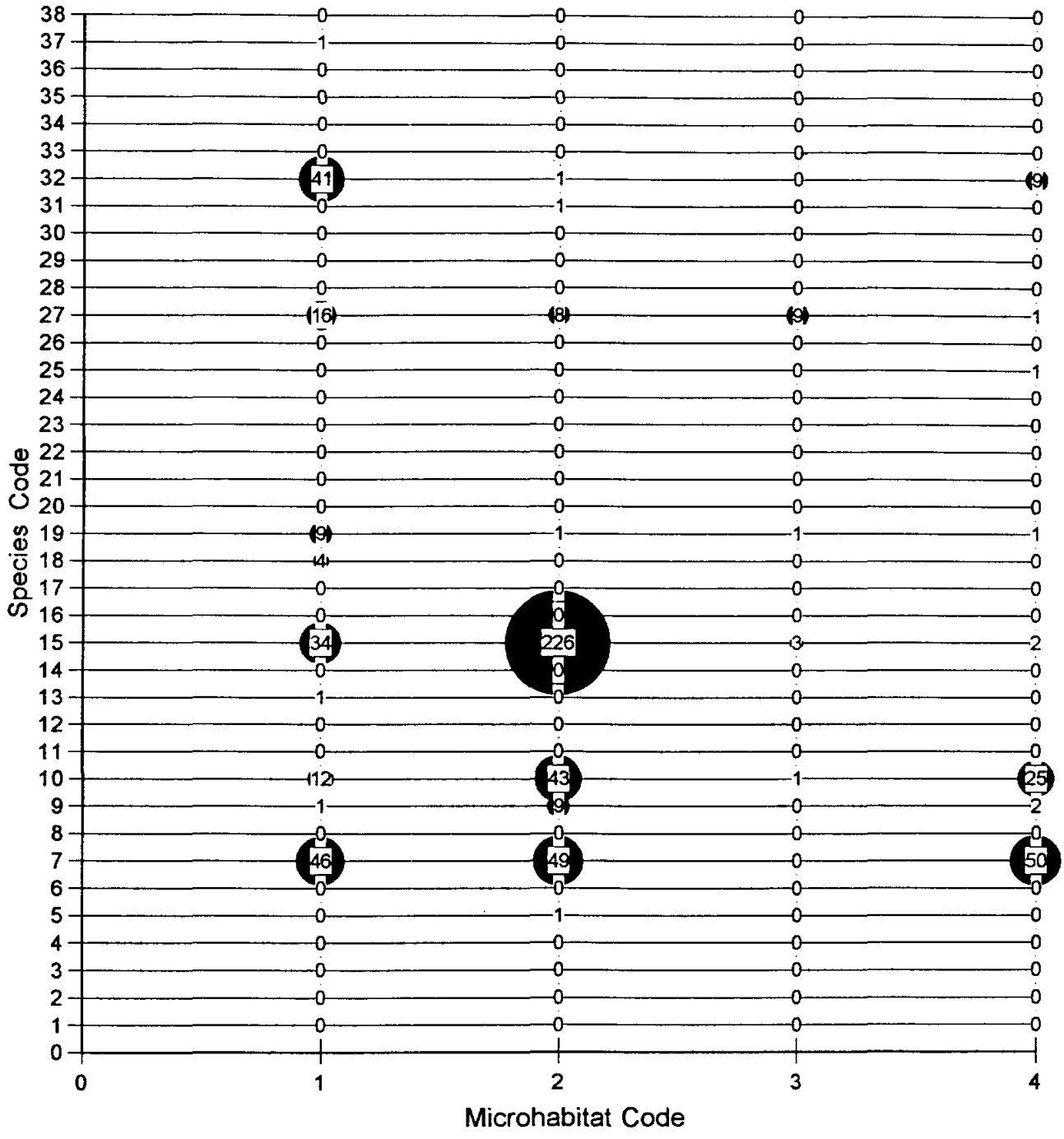
Appendix 2. Site 3 at high flows, Feb. 6, 1993 and Aug 10, 1992.



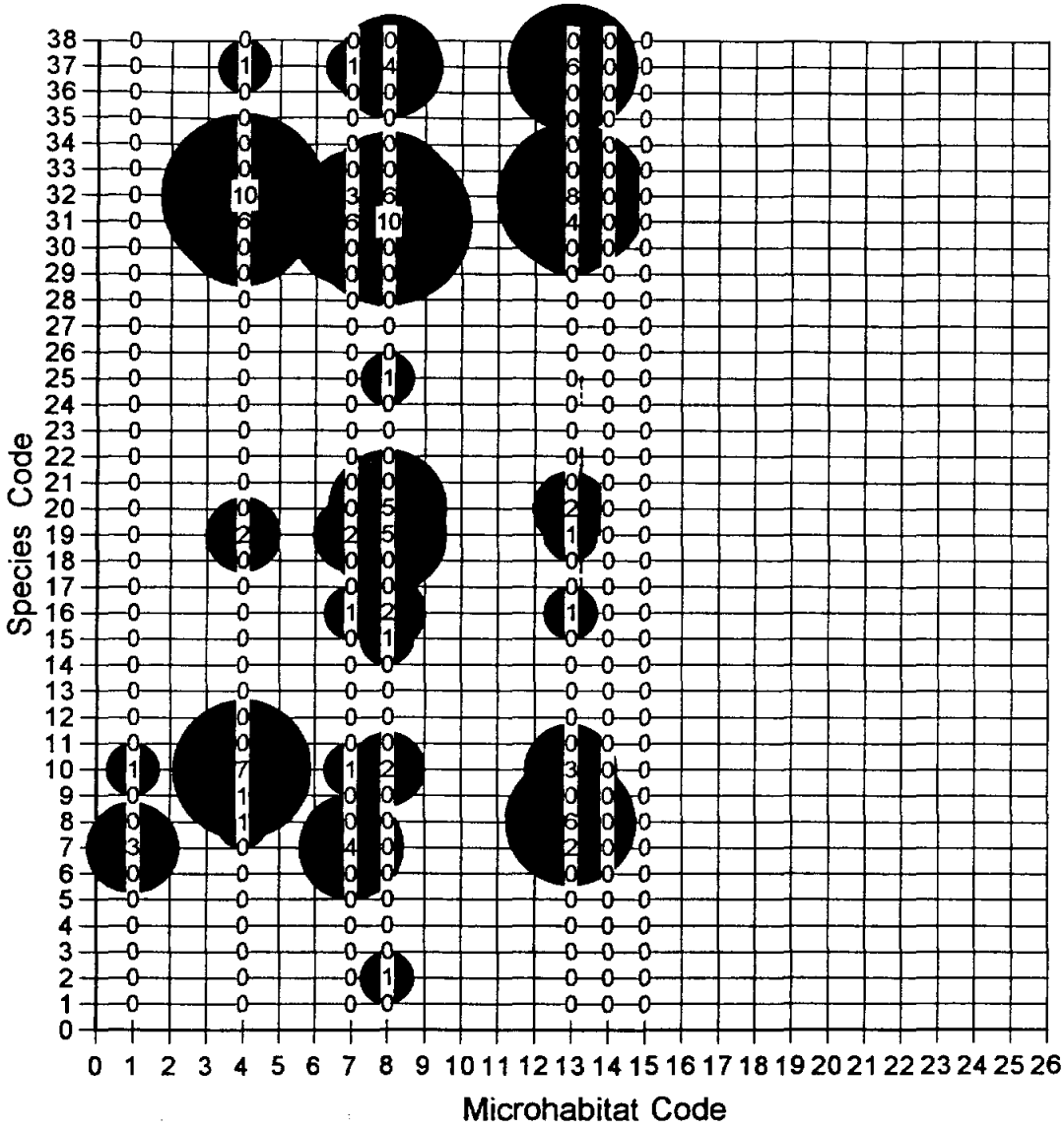
Appendix 2. Site 8 at medium flows, Dec. 7, 1996 and Aug. 3, 1997.



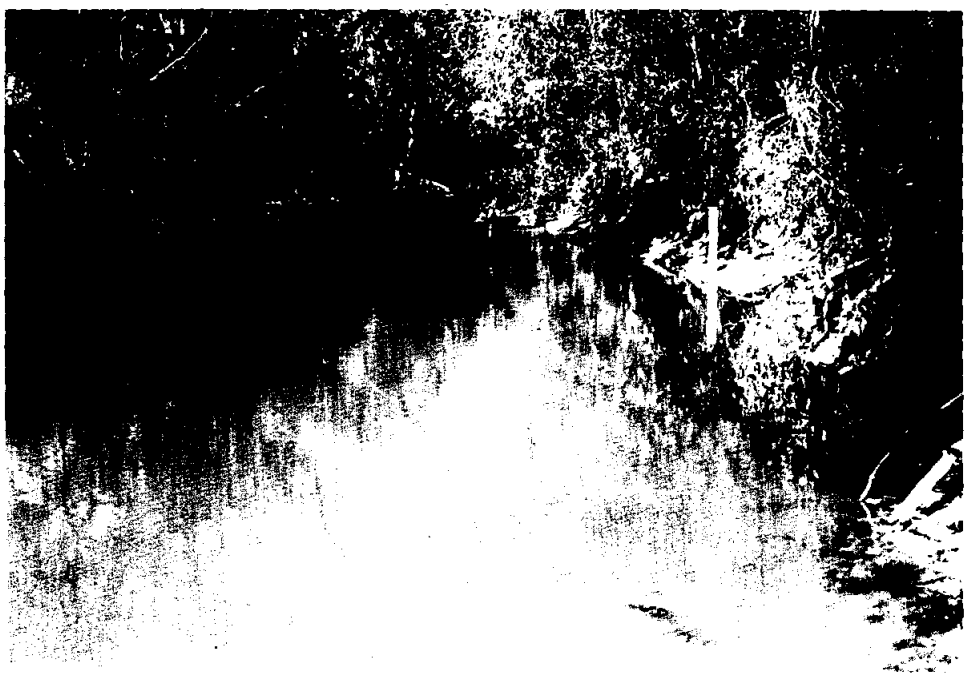
Appendix 2. Site 9 at high flows, Jan. 5, 1993 and Sept. 2, 1992.



Appendix 2. Site 8 at high flows, Dec. 8, 1992 and Aug. 14, 1992.



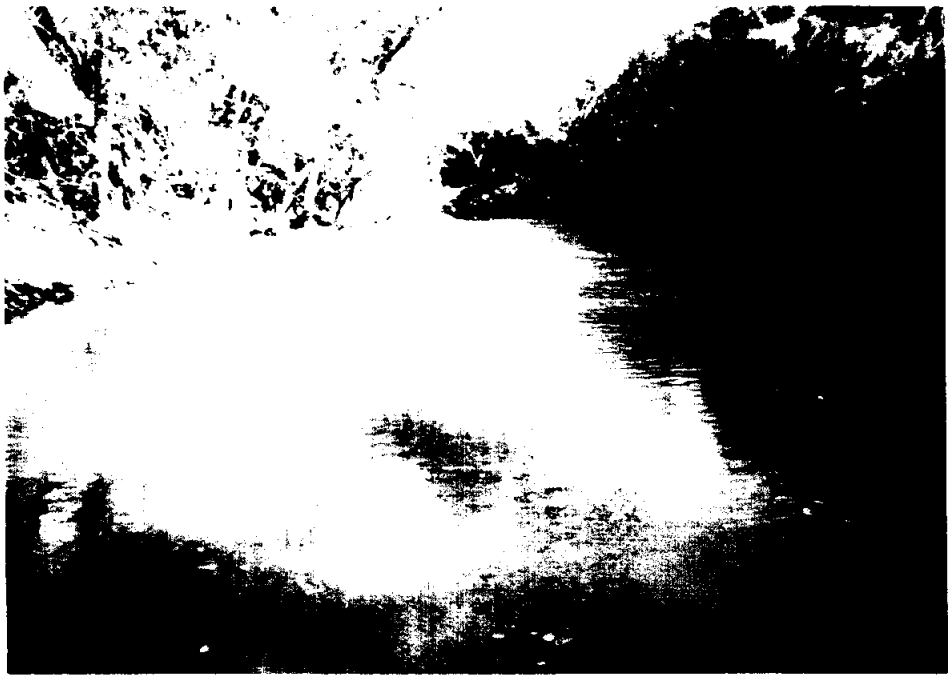
Appendix 2. Site 9 at medium flows, Dec. 8, 1996 and August 3, 1997.



Site 3 - Upstream View

Site 3 - Downstream View

Appendix 3. Representative photographs of sample sites.



Site 8 - Upstream View

Site 8 - Downstream View

Appendix 3. Representative photographs of sample sites.

Site 9 - Upstream View

Site 9 - Downstream View

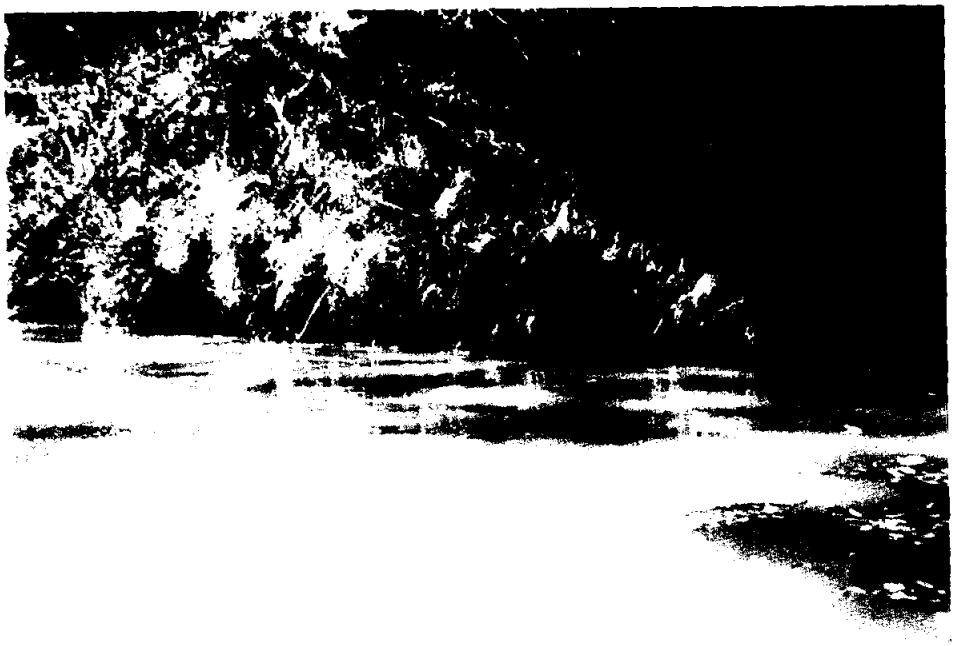
Appendix 3. Representative photographs of sample sites.

Pool

Root Wad

Appendix 4. Representative microhabitat photographs.

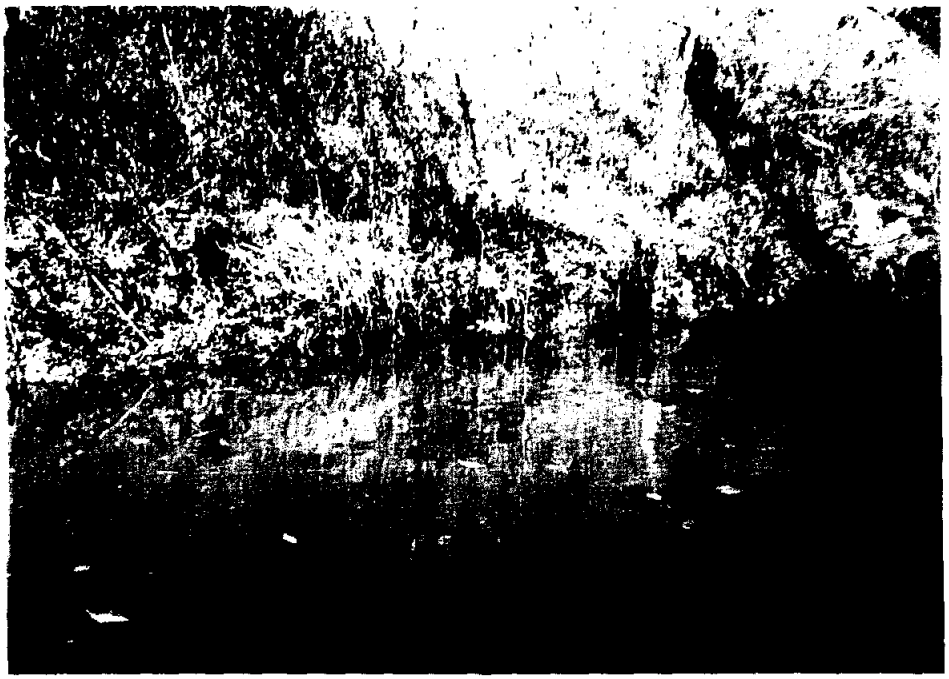
Run



Undercut Bank

Appendix 4. Representative microhabitat photographs.

Bank Snag



Backwater

Appendix 4. Representative microhabitat photographs.

Riffle

Snag Complex

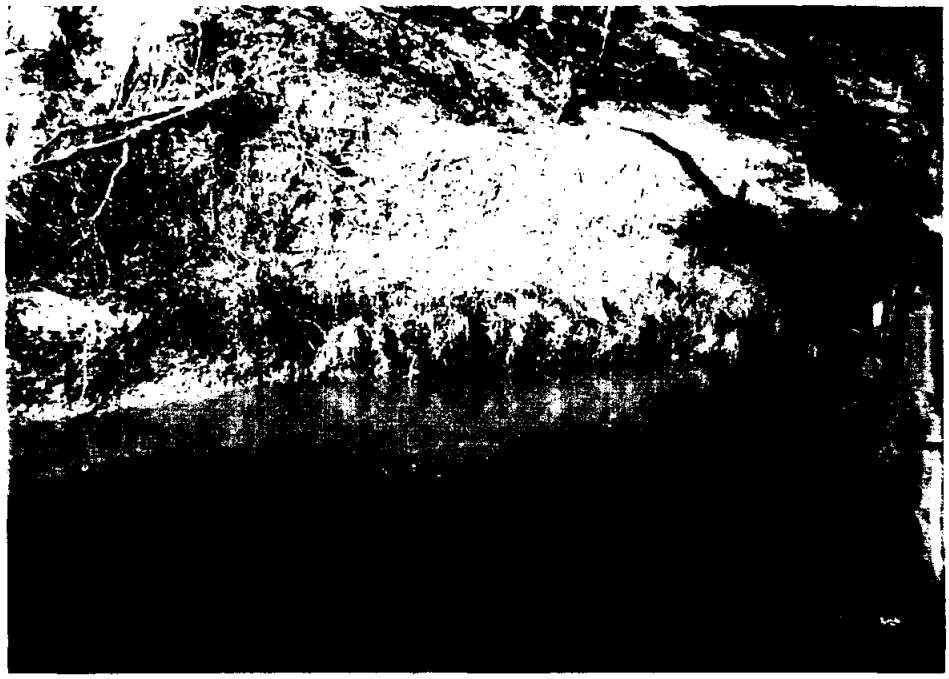
Appendix 4. Representative microhabitat photographs.

Channel Snag

Eddy Pool

Appendix 4. Representative microhabitat photographs.

Pool-Bank Snag



Pool-Undercut Bank

Appendix 4. Representative microhabitat photographs.

Pool-Channel Snag

Run-Bank Snag

Appendix 4. Representative microhabitat photographs.

Run-Channel Snag

Backwater-Channel Snag

Appendix 4. Representative microhabitat photographs.