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THE FISH COMMUNITIES OF SUGAR CREEK

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ABSTRACT: The distribution of fish in Sugar Creek and its tributaries in West Central Indiana was studied in 1988 and 1989. A battery electrofisher, seines, and hand nets were employed at 33 sites along 80 miles of the mainstem and 12 sites on tributaries. More than 16,000 individuals and 71 species of fish were collected.

These collections were compared to collections by Gerking in the early 1940s and Huffaker in 1973. Longitudinal community analyses were made using the Index of Well-being (Iwb) and the Index of Biotic Integrity (IBI). Problem areas within certain stream segments are indicated and suggestions for improvement.

INTRODUCTION

Sugar Creek originates approximately 55 km (35 miles) due north of Indianapolis in western Tipton county and flows 145 km (90 miles) southwest to its juncture with the Wabash River north of Montezuma, Indiana. Its headwaters lie at an elevation of about 282 m (924 feet) above sea level and it descends to 140 m (459 feet) at its mouth for an average fall of 1.55 m (5.1 feet) per river mile. Its elongated drainage basin area covers about 328 ha (811 square miles).

Its watershed lies entirely within the Tipton Till Plain, the flat, featureless glacial plain which covers the middle third of Indiana. Sugar Creek flows close to the surface of this plain in the upper part of the watershed, but has cut a deep trench through Mississippian and Pennsylvanian bedrock in the lower part. Sandstone and shale cliffs up to 60 m (200 feet) high border its waters at Shades and Turkey Run State Parks.

The upper watershed is largely agricultural except for the forested corridor along the creek. The rugged topography of the lower watershed, however, is clothed by an exceptional, mature forest with some rare species such as white pine and Canadian yew. The mature, diverse communities, in turn, support a wealth of vertebrate species.

Perhaps the rather remote and inaccessible placement of Sugar Creek accounts for the paucity of early information about its fish community. David Starr Jordan and his students failed to include Sugar Creek in their extensive surveys (Jordan 1890). So did his successor, Carl Eigenmann (Eigenmann and Beeson 1893).

Willis S. Blatchley was familiar with Sugar Creek and its fishes, having lived as a boy a few miles south in Bainbridge, Indiana. He mentioned the exceptional fishing it afforded for smallmouth bass (Blatchley 1938), but had few comments for other species.

Gerking (1945) was the first to extensively collect fish from Sugar Creek using a seine, as he did throughout the state. He visited 9 sites and found a total of 59 species. Sporadic collections by other investigators revealed the additional presence of gilt darter (Whitaker and Gammon 1988).

Thirty years later Huffaker (1973) collected fish at 16 sites with electrofishing apparatus and rotenone. He found 54 species among the 4,762 individual fish identified and rated the smallmouth bass fishing as excellent. A few years later Gammon and Riggs (1983) assessed the community by electrofishing and found depressed populations downstreamfrom the Crawfordsville sewage treatment plant and also in the lower 20 km (12 miles).

METHODS

Thirty-three sites were selected on the basis of habitat throughout the lower 128 km (80 miles) of the mainstem and 21 sites on 12 tributaries were also examined less intensively.

Collections were made with two different methods; electrofishing in the first half of the summer and the seine samples taken afterwards. With few exceptions, the seine samples were collected from sites close to bridges.

Electrofishing employed a Safari Bushman 300c electrofisher. The anode consists of an electrified 6-foot long dip net with a manual on-off switch on the handle and a 25-foot long cord connected to the main unit. The cathodes were dangled over both sides of the 16-foot canoe. When the water was deep electrofishing was conducted from the front end of the canoe, otherwise the shoreline was waded.

Approximately 0.3 km of shoreline comprised a sample zone. Captured fish were placed in a livewell. Upon completion of the sample site the fish were identified, weighed, and measured, then released back into the stream unharmed. Unidentified fish were preserved in 5% formalin, identified in the laboratory using Trautman (1981), and then preserved in the museum collection at DePauw University.

The second sampling method employed a 30-foot by 4-foot minnow seine with a 3/16 inch nylon mesh. Seining effectiveness was greatly increased by tying a fairly heavy steel chain to the bottom. Seining was conducted in a downstream direction for about 20 meters. An attempt was made to include above, below, and within riffle habitats. A single seine pass for each area of the sample zone was used. In addition, standard dip nets were employed in the shallower riffle areas using the "dip-and-kick" method. Here the net is placed in fast water near the rocks, then the upstream substrate is kicked vigorously towards the dip net. Each collector sampled the area until catches began to drop off. Darters are particularly susceptible to this method. All netted fish were placed in a livewell on shore and processed and recorded in a manner similar to that described above for electrofishing. About 30-45 minutes of sustained effort was spent using the seine and dipnets. The same three collectors were present in most sites.

Fish data were analyzed using the Iwb, a modified IBI, and correspondence analysis (COA). The 1988 Iwb values are based upon a single electrofishing catch at each station. The rationale of this community parameter is presented by Gammon (1980), who recommended multiple collections at each site. The Iwb was calculated as:

$$I_{wb} = 0.5 \ln N + 0.5 \ln W + Div._{no.} + Div._{wt.}$$

where N = number of fish captured per km

W = weight in kg of fish captured per km

$Div._{no.}$ = Shannon diversity based on numbers

$Div._{wt.}$ = Shannon diversity based on weight

The original criterion for determining IBI (Karr, *et al.*, 1987) was modified slightly for Sugar Creek. Twelve metrics are used in this analytic procedure. We used 11 as

recommended, but expanded the total fish species at each range (Table 1). Table 2 indicates the species groupings which were used. The other parameters seem appropriate to the Sugar Creek system and other streams in west-central Indiana. IBI values were calculated only for stations where combined catches from electrofishing and seining were available.

The IBI methodology has been thoroughly discussed by Karr (1981 and 1987), Karr *et al.* (1986 and 1987), and Angermeier and Karr (1986). Regional applications are summarized by Miller, *et al.* (1988).

Similarities and differences among communities throughout the length of Sugar Creek were examined using a correspondence analysis (Ludwig and Reynolds 1988). Raw species abundance data from electrofishing catches in 1979 and 1988 were used in the computations. Stream discharge during summer was highly disparate during these years with means (June, July, and August) at Crawfordsville of 21.5 m^3/sec (760 cfs) in 1979 and only 0.58 m^3/sec (20.4 cfs) in 1988.

RESULTS

Comparison with previous collections

Table 3 contains a comprehensive listing of all of the 83 species of fishes collected from Sugar Creek. Some species taken previously were not found recently. Among the 59 species Gerking (1944) collected were silvery minnow, golden shiner, mimic shiner, fathead minnow, black bullhead, and the least darter, none of which have been found since. The gilt darter was taken by Smith even earlier (Whitaker and Gammon 1988).

Species found by both Gerking and Huffaker, but not recently, include hornyhead chub, banded sculpin, bluebreast darter, and green sunfish. Huffaker alone collected river redhorse and sauger.

Seventy-two species were found in 1979-89, including 14 new species, combining collections by Gammon and Riggs (1984) and this study. Many of the new species are large river species and undoubtedly entered lower Sugar Creek from the Wabash River.

Distribution

The species of fish captured at each mainstem collecting station is summarized in Table 4. The location of each station is shown in Table 5. The collection sites are listed in alphabetical order beginning at the mouth of Sugar Creek at the Wabash River. A total of 57 species was found in 1988.

Many of these same species were collected in tributaries in 1989 (Table 6). Species are listed according to their average distribution along the stream from lower to upper sites. A total of 42 species were taken, including mottled sculpin, green sunfish, white crappie, and orangethroat darter which were not found in the mainstem. A total of 16,047 individuals and 61 species were collected from the Sugar Creek system in 1988 and 1989.

Habitat

There was no attempt to objectively evaluate habitat, but subjectively there are varied conditions available for fish throughout Sugar Creek. The transition from upper to lower portions is gradual and the stream probably appears much as it did 500 years ago.

The banks of the stream are mostly lined with mature stands of trees that give much shade to the waters. Trees are interrupted occasionally by high shale or dirt

Table 1. Criteria used to determine IBI values for Sugar Creek fish communities, including the criteria proposed by Karr, *et al.* (1987).

Metric	Sugar Creek Score			Score		
	1(worst)	3	5(best)	1(worst)	3	5(best)
Fish species (total)	0-5	6-15	≥16	0-9	10-19	≥20
Darter Species	0-1		≥4	0-1	2-3	≥4
Sunfish Species	0-1	2-3	≥4	0-1	2-3	≥4
Sucker Species	0-1	2-3	≥4	0-1	2-3	≥4
Intolerant Species	0-1	2-3	≥4	0-1	2-3	≥4
No. Individuals	0-100	101-200	≥201			
Percent individuals as:						
Green sunfish	11-100	6-10	0-5			
Omnivores	45-100	21-44	0-20			
Insect. cyprinids	0-20	21-44	45-100			
Top carnivores	0-2	3-10	≥11			
Hybrids	4-10	2-3	0-1			
Diseased	6-10	2-5	0-1			

Table 2: Species groupings used in computing the Index of Biotic Integrity (IBI) for Sugar Creek.

Sunfish	Suckers	Omnivores
longear sunfish	golden redhorse	carp
redear sunfish	black redhorse	bluntnose minnow
green sunfish	silver redhorse	
warmouth	shorthead redhorse	
bluegill	hog sucker	
white crappie	white sucker	
black crappie		
Intolerant	**Insect. cyprinids**	**Top carnivores**
speckled chub	creek chub	white bass
gravel chub	speckled chub	smallmouth bass
river chub	gravel chub	spotted bass
silver chub	river chub	largemouth bass
creek chubsucker	sand shiner	white crappie
black redhorse	spotfin shiner	black crappie
hog sucker	striped shiner	grass pickerel
stonecat	redfin shiner	flathead catfish
blacknose dace	rosyface shiner	skipjack herring
fantail darter	river shiner	longnose gar
rainbow darter	bigeye shiner	shortnose gar
rosyface shiner	steelcolor shiner	sauger
bigeye shiner	bullhead minnow	walleye
	suckermouth minnow	
	silverjaw minnow	

Table 3: List of species collected from Sugar Creek.

Common Name Scientific Name	1940s	1970s	1980s
Am.brook lamprey - *Lamptera lamottei*			x
Longnose gar - *Lepisosteus osseus*	x		x
Shortnose gar - *Lepisosteus platostomus*			x
Bowfin - *Amia calva*			x
Gizzard shad - *Dorosoma cepedianum*		x	x
Skipjack herring - *Alosa chrysochloris*			x
Mooneye - *Hiodontidae tergisus*			x
Grass pickerel - *Esox americanus*	x	x	x
Carp - *Cyprinus carpio*	x	x	x
Stoneroller - *Campostoma anomalum*	x	x	x
Silverjaw minnow - *Ericymba buccata*	x	x	x
Silvery minnow - *Hybognathus nuchalis*	x		
Bigeye chub - *Hybopsis amblops*	x		x
Silver chub - *Hybopsis storeriana*	x		x
Ohio speckled chub - *Hybopsis aestivalis*	x		x
Gravel chub - *Hybopsis x-punctata*			x
Hornyhead chub - *Nocomis biguttatus*	x	x	
River chub - *Nocomis micropogon*	x		x
Golden shiner - *Notemigonus crysoleucas*	x		
Emerald shiner - *Notropis atherinoides*	x	x	x
River shiner - *Notropis blennius*			x
Striped shiner - *Notropis chrysocephalus*	x	x	x
Bigeye shiner - *Notropis boops*	x		x
Rosyface shiner - *Notropis rubellus*	x		x
Spotfin shiner - *Notropis spilopterus*	x	x	x
Sand shiner - *Notropis stramineus*		x	x
Redfin shiner - *Notropis umbatilis*	x	x	x
Mimic shiner - *Notropis volucellus*	x		
Steelcolor shiner - *Notropis whipplei*	x		x
Suckermouth minnow - *Phenacobius mirabilis*	x	x	x
Bluntnose minnow - *Pimephales notatus*	x	x	x
Fathead minnow - *Pimephales promelas*	x		
Bullhead minnow - *Pimephales vigilax*			x
Blacknose dace - *Rhinichthys atratulus*			x
Creek chub - *Semotilus atromaculatus*	x	x	x
Quillback carpsucker - *Carpiodes cyprinus*		x	x
Northern river carpsucker - *C. carpio*		x	x
Highfin carpsucker - *C. velifer*		x	x
White sucker - *Catostomus commersoni*	x	x	x
Creek chubsucker - *Erimyzon oblongus*	x		x

Northern hog sucker - *Hypentelium nigricans*	x	x	x
Spotted sucker - *Minytrema melanops*	x	x	x
Silver redhorse - *Moxostoma anisurum*	x	x	x
River redhorse - *Moxostoma carinatum*		x	
Black redhorse - *Moxostoma duquesnei*	x		x
Golden redhorse - *Moxostoma erythrurum*	x	x	x
Shorthead redhorse - *M. macrolepidotum*			x
Black bullhead - *Ictalurus melas*	x		
Yellow bullhead - *Ictalurus natalis*	x	x	x
Channel catfish - *Ictalurus punctatus*	x	x	x
Stonecat - *Noturus flavus*	x	x	x
Brindled madtom - *Noturus miurus*	x	x	x
Flathead catfish - *Pylodictis olivaris*		x	x
White bass - *Morone chrysops*		x	x
Blackstripe topminnow - *Fundulus notatus*	x		x
Brook silversides - *Labidesthes sicculus*	x		x
Banded sculpin - *Cottus bairdi*	x	x	x
Rock bass - *Amploplites rupestris*	x	x	x
Green sunfish - *Lepomis cyanellus*	x	x	x
Warmouth - *Lepomis gulosus*			x
Longear sunfish - *Lepomis megalotis*	x	x	x
Bluegill - *Lepomis macrochirus*	x	x	x
Redear sunfish - *Lepomis microlophus*			x
Smallmouth bass - *Micropterus dolomieui*	x	x	x
Spotted bass - *Micropterus punctulatus*	x	x	x
Largemouth bass - *Micropterus salmoides*	x	x	x
White crappie - *Pomoxis annularis*	x	x	x
Black crappie - *Pomoxis nigromaculatus*	x		x
Eastern sand darter - *Ammocrypta pellucida*			x
Greenside darter - *Etheostoma blennioides*	x	x	x
Rainbow darter - *Etheostoma caeruleum*	x	x	x
Bluebreast darter - *Etheostoma camarum*	x	x	
Fantail darter - *Etheostoma flabellare*	x	x	x
Least darter - *Etheostoma microperca*	x		
Johnny darter - *Etheostoma nigrum*	x	x	x
Orangethroat darter - *Etheostoma spectabile*	x		x
Logperch - *Percina caprodes*	x	x	x
Gilt darter - *Percina evides*	x		
Blackside darter - *Percina maculata*	x	x	x
Slenderhead darter - *Percina phoxocephala*			x
Dusky darter - *Percina sciera*	x		x
Sauger - *Stizostedion canadense*		x	
Walleye - *Stizostedion vitreum*			x

Table 4: Distribution of fishes in the mainstem of Sugar Creek in 1988 as determined by electrofishing (o), seining (x), or both methods (B).

							lower									dam ↓							upper								
Species	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*O*	*P*	*Q*	*R*	*S*	*T*	*U*	*V*	*W*	*X*	*Y*	*Z*	*a*	*b*	*c*	*d*	*e*
longnose gar		o									o					o															
shortnose gar					o		o																								
gizzard shad													o			o	o														
stonecat	x					x	x				x	x	x				x		x		x		x		x						
yellow bullhead										o											o										
flathd. catfish									o			o			o							o									
chann. catfish	x	o	o	x		o	o	o	o	o					o	o	o														
brk silverside																					x		x			x		x	x		
grnside darter				x		x	x	x	x		x	x	x	o	x		x	x	x	B	x		x			x	x	x	x	x	x
rainbow darter	x			x		x	x		x		x	x	x		x		x	x	x	x	x		x			x	x	x	x	x	x
fantail darter	x			x		x	x					x	x					x	x		x			x		x	x	x	x	x	
johnny darter							x								x			x					x					x	x	x	
dusky darter							x																								
e. sand darter							x																								
blcksd darter	x						x																								x
carp		o						o	o	o			o	o			o				o										
hogsucker	x		o	B	o	B	B	B	x		x	B	x	o	B	o	B	B	B	x	B	o	o	o	o	o	x	x	x	x	x	
qb. carpsucker	x			x		x		x		x			x		x					o		x		o	o	o					x
hifn carpscker								x															o								
nr. carpsucker																		o													
slvr redhorse				x																							x				
blck redhorse	x		o	x		B		o			x	o	x	o	o	o	o		o	o	o	o	o	o	o			x			
gldn redhorse	x		o	B		B	o		o	o	B	o		o	x	o	o	o	B	B	o	o	B	o	o		x	x	x			
shthd redhorse			o	o	o	o	o	o	B	o		o		o		o	o														
rockbass										o		o		o							x		x						x	x	x
lrgmth bass							o																	o							
smllmth bass		x			x	o	B	B	x	x		x	x	x	o	B	o	x	B	B	B	x		B	o	o	x	x	x	x	
spotted bass	x			x	o	B																									
lngear sunfish			o	o		o	o	o		o	o			o	B	o	o	B	B		x	o	x	o	o	o	x	x	x	x	
redear sunfish												x																			
bluegill												x																		x	x
warmouth									o																						
creek chub												x															x	x	x	x	
river chub				x					x		x		x		x		x	x	x		x		B			x	x				
gravel chub	x			x																											
spckld chub	x					x																									
bigeye chub	x			x				x	x		x	x			x					x											
stoneroller	x			x		x	x	x	x		x	x	x		x		x	x	x	x	x		x			x	x	x	x	x	x
bullhd minnow	x			x				x	x		x																				
slvrjaw minnow	x			x		x	x	x	x		x	x		o	x		x	x		x			x				x	x	x	x	
blntns minnow	x			x		x	x	x			B	x	x		x	x	B	x	x	x		x			x	x	x	x	x		
sckrmth minnow	x			x		x					x						B	B			x						x				
river shiner	x			x								x															x				
emerald shiner	x			x																											
rosyfac shiner	x			x		x	x	x	x		x	x	x		x		x	x	x	x	x		x				x		x		x
spotfin shiner	x	o	o	B	o	B	B	B	x		x	B	x	o	x		B	B	B	x	x	o	B	o	o	x	x	x	x	x	x
steelcl shiner	x			x		x	x	x	x		x	x	x		x		x	x	x	x	x		x			x	x	x	x	x	x
striped shiner				x		x		x	x		x	x	x		x		x	x	x	x	x		B		o	x	x	x	x	x	x
bigeye shiner				x															x												
redfin shiner	x						x											x	o	x			x			x	x	x	x	x	x
sand shiner	x			x	o	B	x	x	x		x				x		x	x	x	x	x		x				x	x	x	x	
logperch																							x						x		
bl. topminnow																											x				
ck. chubsucker																													x		
gr. pickerel																														x	
white sucker																														x	
blacknose dace																														x	

Table 5: Location of mainstem collecting stations.

Letter Designation	Distance from mouth km	(miles)	Description
A	3.5	(2.2)	above West Union covered bridge
B	6.4	(4.0)	3 km above West Union bridge
C	8.0	(5.0)	3 km below Rockport bridge
D	13.7	(8.5)	1.5 km above Rockport bridge
E	17.4	(10.8)	below U.S. 41 bridge
F	19.6	(12.2)	above Cox Ford covered bridge
G	23.8	(14.8)	above "Narrows"
H	26.7	(16.6)	3 km above "Narrows"
I	29.0	(18.0)	above mouth of Keller Branch
J	33.8	(21.0)	above Big Branch
K	35.7	(22.2)	below Pedestal Rock in Shades S.P.
L	39.4	(24.5)	1.5 km below Deer Mill bridge
M	40.7	(25.3)	above Deer Mill bridge
N	43.1	(26.8)	near old Sycamore Ford
O	44.8	(27.8)	below Davis bridge
P	52.8	(32.8)	2 km below Yountsville bridge
Q	60.7	(37.7)	5 km above Yountsville bridge
R	64.0	(39.8)	below Crawfordsville dam
S	70.4	(43.8)	at Walnut Fork
T	74.7	(46.4)	northwest of Garfield
U	77.1	(47.9)	due north of Garfield
V	78.6	(48.8)	just above Lye Creek
W	80.2	(49.8)	below Darlington covered bridge
X	82.3	(51.1)	1.5 km above Darlington bridge
Y	87.3	(54.2)	6.5 km above Darlington bridge
Z	91.9	(57.1)	above Boone-Montgomery County line
a	98.6	(61.3)	2 km above Wolf Creek
b	111.7	(69.4)	above U.S. 65 bridge
c	118.6	(73.7)	below Mechanicsburg
d	125.8	(78.2)	near Scotland church
e	128.7	(80.0)	at Indiana 38 bridge

Table 6: Distribution of fishes in tributaries of Sugar Creek as determined by seining in 1989.

		lower				dam ↓				upper		
Species	a*	b	c	d	e	f	g	h	i	j	k	l
no. riv. carpsucker		x		x								
gizzard shad		x		x								
channel catfish		x		x								
bigeye chub	x	x		x	x		x					
stonecat				x								
hogsucker	x	x		x	x	x	x	x				
blacknose dace	x			x	x				x			
spotted bass		x		x		x		x				
rainbow darter	x	x		x	x	x	x			x		
mottled sculpin					x							
suckermth minnow		x						x				
silverjaw minnow	x	x		x	x	x	x				x	
sand shiner	x	x	x	x	x	x	x	x			x	
rosyface shiner		x		x		x	x	x				
white sucker	x		x	x	x			x			x	
fantail darter	x		x	x		x		x			x	
redfin shiner		x	x	x	x	x	x	x			x	
rockbass		x	x	x			x	x			x	
black redhorse		x		x		x						x
spotfin shiner	x	x	x	x	x	x	x	x	x	x	x	
stoneroller	x	x	x	x	x	x	x	x	x	x	x	
bluntnose minnow	x	x	x	x	x	x	x	x	x	x	x	x
creek chub	x	x	x	x	x	x	x	x	x	x	x	
striped shiner	x	x	x	x	x	x	x	x	x	x	x	x
golden redhorse		x		x		x	x	x			x	
smallmouth bass		x	x	x	x	x	x	x		x	x	x
hifin carpsucker		x										x
green sunfish			x			x					x	
longear sunfish			x	x	x	x	x	x			x	x
river chub				x	x	x	x	x				
bluegill				x	x	x	x				x	
brook silversides				x							x	
johnny darter					x		x	x				x
greenside darter					x	x	x				x	
bigeye shiner						x	x	x				
grass pickerel						x	x				x	
yellow bullhead							x				x	
blackstripe topminnow							x	x		x	x	x
creek chubsucker							x					
carp								x				x
silver redhorse											x	
white crappie											x	
quillback carpsucker												x
orangethroat darter												x

* a = Rush, b = Sugar Mill, c = Indian, d = Offield, e = Black, f = Walnut Branch, g = Little Sugar, h = Lye, i = Honey, k = Wolf, l = Prairie

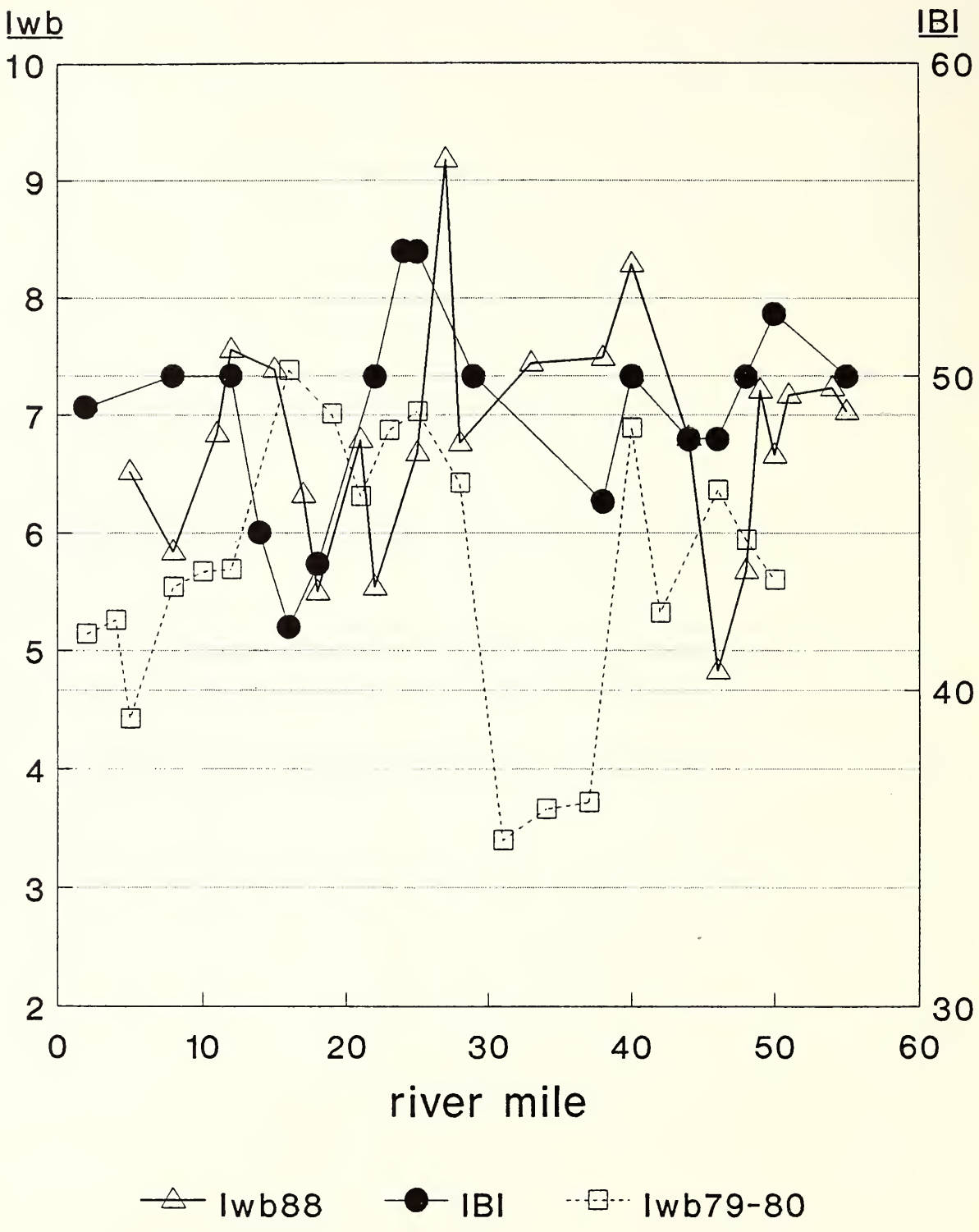

Figure 1. Longitudinal profiles of 1988 IBI, and 1988 and 1979 Iwb.

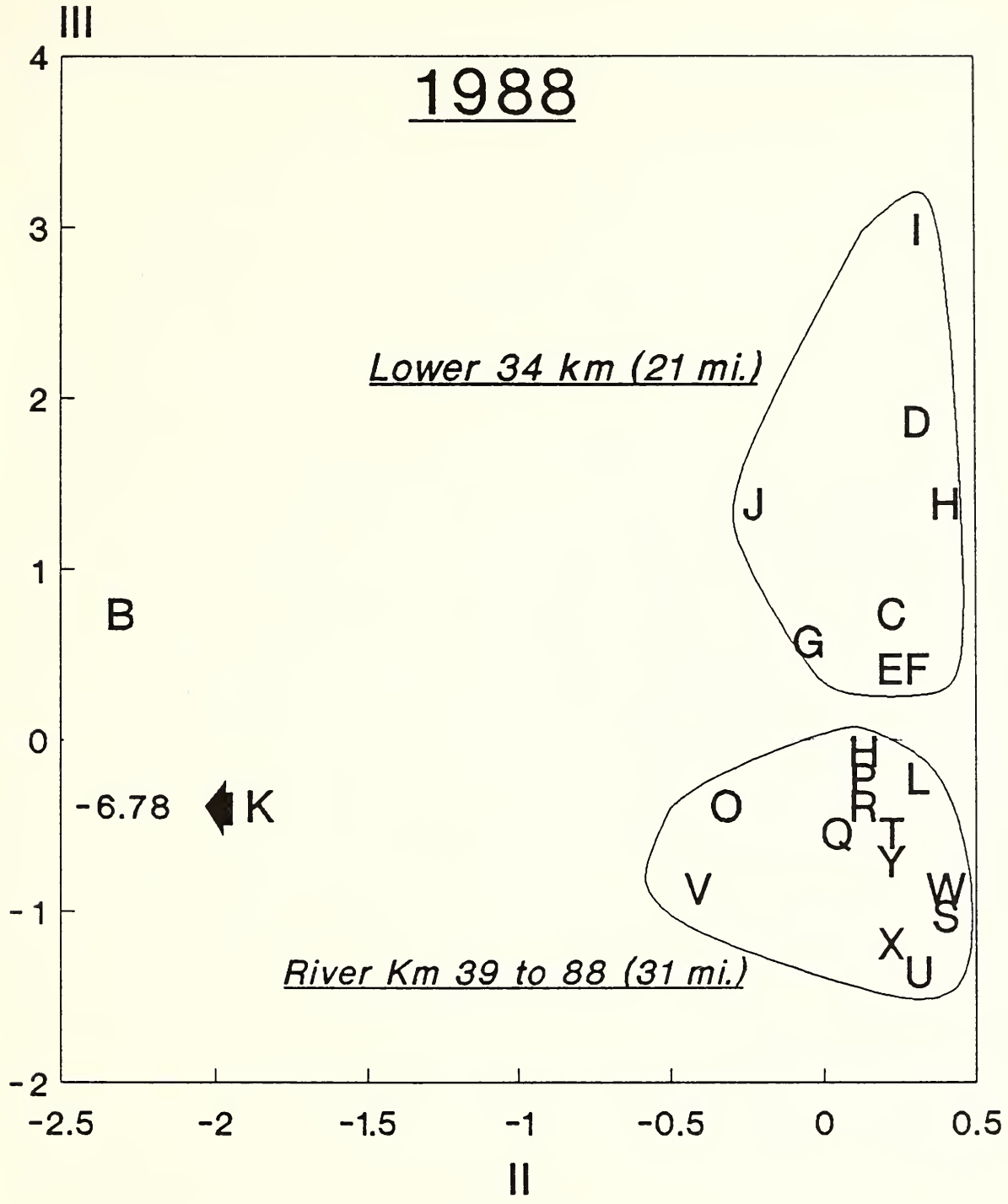

Figure 2. Trends in Sugar Creek fish community assemblages in 1988 as determined by Correspondence Analysis.

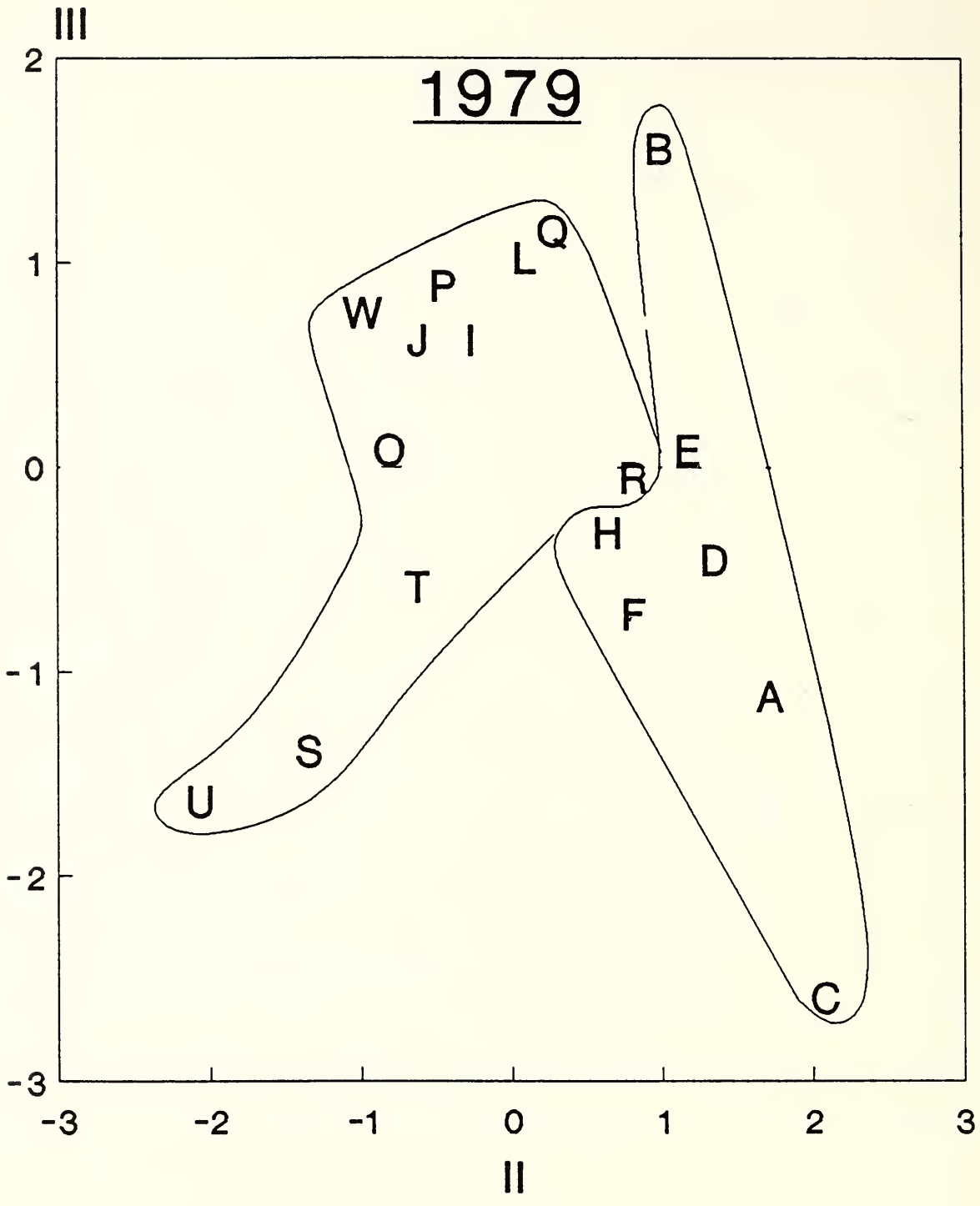

Figure 3. Trends in Sugar Creek fish community assemblages in 1979 as determined by Correspondence Analysis.

cutbanks. Pools and riffles often have bedrock bottoms, sometimes extending for distances of more than 1 km. However, the bottom is usually composed of gravel and/or sand, occasionally dotted with rocks or boulders. Large gravel bars on the shores are common.

Emergent vegetation frequently occurs near the shoreline, with occasional floating vegetation in the upper sections of the stream. Logjams and wooded snags provide cover for fish in many areas. Twenty meters wide and less than 2 meters deep, the pools alternate with riffles at 0.5 km intervals. Small tributaries enter Sugar Creek at frequent intervals. Small waterfalls traverse the stream's width at two locations.

Man's presence is evidenced by bridges every 4 or 5 miles and by agricultural fields occasionally paralleling the banks.
Residences along the stream are very rare.

DISCUSSION

Of the more than 16,000 specimens collected, spotfin shiners and steelcolor shiners comprised 32% of the catch with a 2:1 ratio of the former to the latter. Other common fish in order of abundance were rainbow darter, rosyface shiner, greenside darter, striped shiner, sand shiner, bluntnose minnow, and silverjaw minnow. Yearling and young-of-the-year smallmouth bass formed the 12th most abundant species. These species, together with a few others, occurred throughout most of the length of Sugar Creek.

Community composition in the lower 15 km (10 mi) differed from the composition upstream in having several species which are more characteristic of the Wabash River; shortnose gar, spotted bass, emerald shiner, river shiner, speckled chub, and gravel chub. Of the 13 new recent records, most are species which probably entered Sugar Creek from the Wabash River; shortnose gar, skipjack herring, mooneye, river shiner, bullhead minnow, slenderhead darter, and walleye.

Smallmouth bass is the primary sportfish species in Sugar Creek. Adults and subadults were found nearly everywhere except in the lower 18 km (11 miles). Yearlings were found in shallow riffle areas throughout the lower 120 km (75 miles) of the mainstem and in many tributaries as well.

The electrofishing catch of smallmouth bass in 1979 was 2.33% by numbers and 2.6% by weight. In 1980 these values increased to 5.19% by numbers and 6.95% by weight. In 1988 they were quite similar with 5.3% by numbers and 2.4% by weight. Huffaker (1973) collected 72 smallmouth bass in his extensive survey, 1.15% of the total number.

Sauger were fairly common in Sugar Creek in the early 1970s, but none have been found recently. The abundance of this species in Sugar Creek, and also of white bass, walleye, channel catfish, and flathead catfish, is almost certainly correlated with their density in the Wabash River.

We failed to find evidence of bluebreast darters (*Etheostoma camurum*) anywhere, although we collected intensively several times at RKm 77.1 (RM 47.9) where Huffaker (1973) found them. We did find a single eastern sand darter (*Ammocrypta pellucida*) at Turkey Run State Park.

The two sampling methods complemented each other quite well. Electrofishing was more selective for larger species in deeper water, while seining and dip-nets were more selective for small individuals in shallow areas. However, it was not always possible to position good sites for both methods close to each other.

The unusual clarity of water in 1988 somewhat reduced the efficiency of electrofishing by enabling some fish to see and avoid the shocking boat. Schools of carpsucker, in particular, avoided capture in this way. The low flow also severely restricted movement by boat so that it was not possible to seine some of the more remote stations during late summer.

Community assessments for 1988 are shown in Figure 1. The average Iwb values for 1979 and 1980 are included for comparison (Gammon and Riggs, 1984).

Analyses by both the Iwb and IBI indicate fish communities of generally good quality throughout most of the river. Karr, *et al.* (1987) categorize 6 classes of IBI: excellent (57-60), good (48-52), fair (39-44), poor (28-35), very poor (12-23), and no fish (0). Sugar Creek sites varied from a low of 42 to highs of 54, indicating generally good communities.

Iwb values varied from a low of 5.54 to a high of 9.18, although most values fell between 6.5 and 7.5. Gammon (1989) categorized four classes of quality for fish communities in the Wabash River: excellent (>8.5), good (7.0-8.5), fair (5.5-7.0), and poor (<5.5). Using this criteria 10 of the 23 sites were in the good to excellent range. The others were fair except for a depressed area below Darlington (RM50), probably the result of poor habitat in the form of several miles of wide, shallow pools over bedrock. Both methods indicate that the best fish communities are located in the vicinity of Deer Mill and Shades State Park. Both methods indicate gradually depressed communities as the stream flows through Turkey Run State Park. There was a poor correlation of the two indices on a site by site basis, perhaps because the Iwb was based on only a single sample rather than on suggested multiple samples.

Some improvements have occurred since 1979-80. Fish communities in the lower 10 miles of river improved, perhaps because of the 1988 drought and attendant reductions in lateral erosion. There has also been a distinct improvement in the community downstream from Crawfordsville since 1979-80. The low flows of 1988 should have aggravated any problem that might exist here, but there was no sign of depression.

In 1988 the fish communities were divided into two main groupings (Figure 2), a lower stream assemblage and an upper stream assemblage, with a transition at the "Narrows". The physical presence of the Crawfordsville dam did not affect community composition upstream to any measurable degree.

The communities at stations B (RKm 6.4) and K (RKm 35.7) differed significantly from their neighbors. Station B lacked redhorse (*Moxostoma sp.*) both in 1988 and 1979 (Figure 3). Station K at Pedestal Rock was sampled only in 1988 and was notable for an absence of hog suckers, redhorse, and minnows and an abundance of carp. Twelve of the 22 carp captured in 1988 were found at that particular site. This anomaly may be indicative of a local problem.

The COA results lend support to the contention that fish communities are being negatively influenced downstream from the "Narrows", perhaps because of the same agricultural contributions of sediment which were so apparent in 1979 (Gammon and Riggs 1984).

Despite general improvements in the character of the Sugar Creek fish community in recent years there is cause for concern. Analyses of fish by the Indiana Department of Environmental Management revealed high levels of PCBs in fish collected upstream from Crawfordsville in Little Sugar Creek and in Sugar Creek itself. The source is probably an old industry near Smartsville which burned down two decades ago. Fish

taken from the lower river, however, contained PCB concentrations below the U.S. Food and Drug Administration action level of 2.0 ppm.

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