FISH COMMUNITIES AND HABITAT OF THE EEL RIVER IN RELATION TO AGRICULTURE

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A Report for
the Indiana Department of Environmental Management
Office of Water Management

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ABSTRACT

The Eel River of northern Indiana is a major tributary of the Wabash River. It is approximately 177 km (110 mi) in length with an average rate of descent of 0.457 m/km (2.41 ft/mi). Approximately 79% of its 210,800 ha (814 m^2) drainage basin is devoted to row-crop agriculture.

The fish communities and habitat of the Eel River and some of its larger tributaries were studied during the summer of 1990. Fish were collected from 25 sites located throughout the Eel River. Seining with a 3/16 inch mesh seine 30 ft by 4 ft was effective in collecting small fish including darters. Backpack electrofishing was also used at most stations on two separate dates. Historic records of the fish communities were examined and, when possible, converted into Indexes of Biotic Integrity values so that changes over time could be estimated.

Habitat evaluation included a mainstem reconnaisance, a habitat survey (HEP) conducted at all collecting stations, and a synoptic turbidity survey on July 16 and 17, 1990. Estimates of the amount of woodland were made from conventional analysis of enlarged infrared photographs.

In addition, analyses of existing suspended sediment data were used to evaluate possible impacts of nonpoint-source influence from agricultural fields as well as historic records of fish kills and chemical spills within the Eel River watershed.

The 1990 fish community was much improved compared to the community found in 1982 . This improvement is believed to be temporary and is probably the result of a series of recent years when both river discharge and suspended sediment concentrations were lower than normal.

From a longer time perspective the fish community is substantially reduced, with many species which were common 50 years ago now either absent or very severely reduced. Rainbow darter, orangethroat darter, bluebreast darter, and stonecat were not collected at all. Sculpin, greenside darter, blackside darter, silver shiner, rosyface shiner, longear sunfish, and smallmouth bass were very restricted in distribution.

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Introduction

The Eel River of the North enters the Wabash River at the town of Logansport, Indiana. Its resident fishes were of interest to Jordan (1890), Ulrey (1893), Gerking (1945), and Aderkas (1962). More recent studies were conducted by Taylor (1972), Braun and Robertson (1982), Braun, Robertson, and Stefanavage (1984, 1986), Braun, Robertson, Stefanavage, and Dexter (1988), Hudson (1988), and Braun (1990).

Populations of smallmouth bass (Micropterus dolomieui) were found to be virtually lacking in 1982 by Braun and Robertson (1982) who collected from the same sites used by Taylor (1972). Exerting roughly equivalent effort and similar methods Taylor (1972) collected 98 smallmouth bass while Braun and Robertson (1982) found only 3. Most of the ensuing studies were directed toward reestablishing smallmouth bass populations in the lower part of the Eel River by stocking fin-clipped fingerlings (5130 fish on 10-28-83; 5000 on 9-17-85; and 6960 on 4-17-86). A limited number of stations were more intensively sampled and additional tributaries were also investigated.

Additional aquatic studies on the Eel River system include an instream fish water quality evaluation in Whitley County (Simon, 1989) and a survey of mussels (Henschen, 1988).

The present study was planned to provide information about the fish communities at all of Taylor's sites and some additional sites. It included an evaluation of instream and nearstream habitat from the standpoint of agricultural nonpoint sources of pollution and their possible influence on those fish communities. Additional synoptic surveys of turbidity were also conducted.

The Study Area

The Eel River is a major tributary of the Wabash River in northern Indiana. Originating in northwest Allen county near Ft. Wayne, it flows southwest for approximately 177 km (110 miles) through Kosciusko, Whitley, Wabash and Miami counties into the Wabash River at Logansport in Cass county. Its rate of descent is approximately 0.457 m/km (2.41 ft/mile) with a lower rate above RM 68 and a slightly higher rate from RM 12 downstream (Figure 1).

This area originally contained glacial lakes and swampy wetlands, but it was extensively ditched and drained prior to 1900 for agricultural use. Approximately 79% of its 2,148 km^2 (814 m^2) drainage basin area (Hoggatt 1975) is devoted to rowcrop agriculture, primarily corn and soybeans. Most of the smaller tributaries and the upper river have been channelized to facilitate drainage.

The communities in the watershed include Logansport located at its juncture with the Wabash River and North Manchester, South Whitley, and Columbia City in the upper watershed.

Low mill dams have been constructed at various locations, many of which are currently in a state of disrepair except in Logansport. The Logansport dam severely restricts the movement of Wabash River fishes into the Eel River, a factor which facilitated evaluations of watershed impacts.

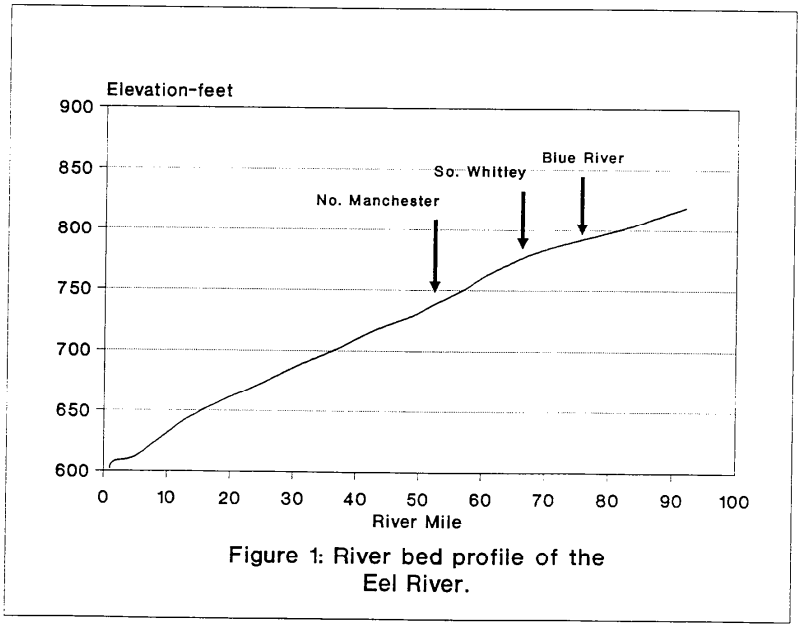


Figure 1: River bed profile of the Eel River.

Materials and Methods

The study included a) a reconnaisance float trip of the entire river, b) sampling each station twice by electrofishing, c) sampling most of these same stations once by seining, and d) conducting a habitat survey (HEP) at each station. Secchi transparency and temperature were routinely measured on each occasion. In addition, synoptic short-term profiles of turbidity, temperature, and dissolved oxygen concentration were determined on three dates.

The locations of the 22 stations sampled in June, July, and August 1990 are shown in Figure 2. Taylor's (1972) collecting site designations are encircled and each site includes the river mile distance from the Wabash River. All of the 1990 sites include those studied by Taylor (1972) except his station 7B which was inaccessible. We also seined one additional tributary station (Twelve Mile Creek) and three upper river stations (RM 82, 88, and 90).

Single stations were located on lower Twelve Mile, Paw Paw, Squirrel, Beargrass, and Sugar Creeks, and two stations were located upstream and downstream of Columbia City on Blue River. The remaining 16 stations were located on the mainstem of the Eel River. A few mainstem stations (Taylor's 2B, 2, and 3) and Squirrel Creek were not seined because of inappropriate seining habitat.

Seining was conducted with a 30-foot by 4-foot seine having 3/16 inch mesh weighed down by a heavy steel chain tied to the bottom. This method was very effective at capturing darters and minnows. Three seining passes along 20 meters of shoreline constituted each seine sample.

Electrofishing utilized a Safari Bushman 300 backpack shocker carried in a canoe or while wading, depending on place and depth. Each electrofishing sample was about 20 minutes in extent along approximately 400 meters of shoreline. This method was effective in capturing larger fish such as redhorse and suckers and species which prefer nearshore cover such as sunfish and bass.

All captured fish were identified to species, weighed and measured, then released unharmed back into the river. Those fish not easily identified in the field were preserved in formalin and brought back to the laboratory for identification (Trautman 1981).

Fish data were analyzed using the Iwb and the IBI. The 1990 Iwb values were based upon the average of two electrofishing catches at each station. The rationale of this community parameter is presented by Gammon (1980), who recommended multiple collections at each site.

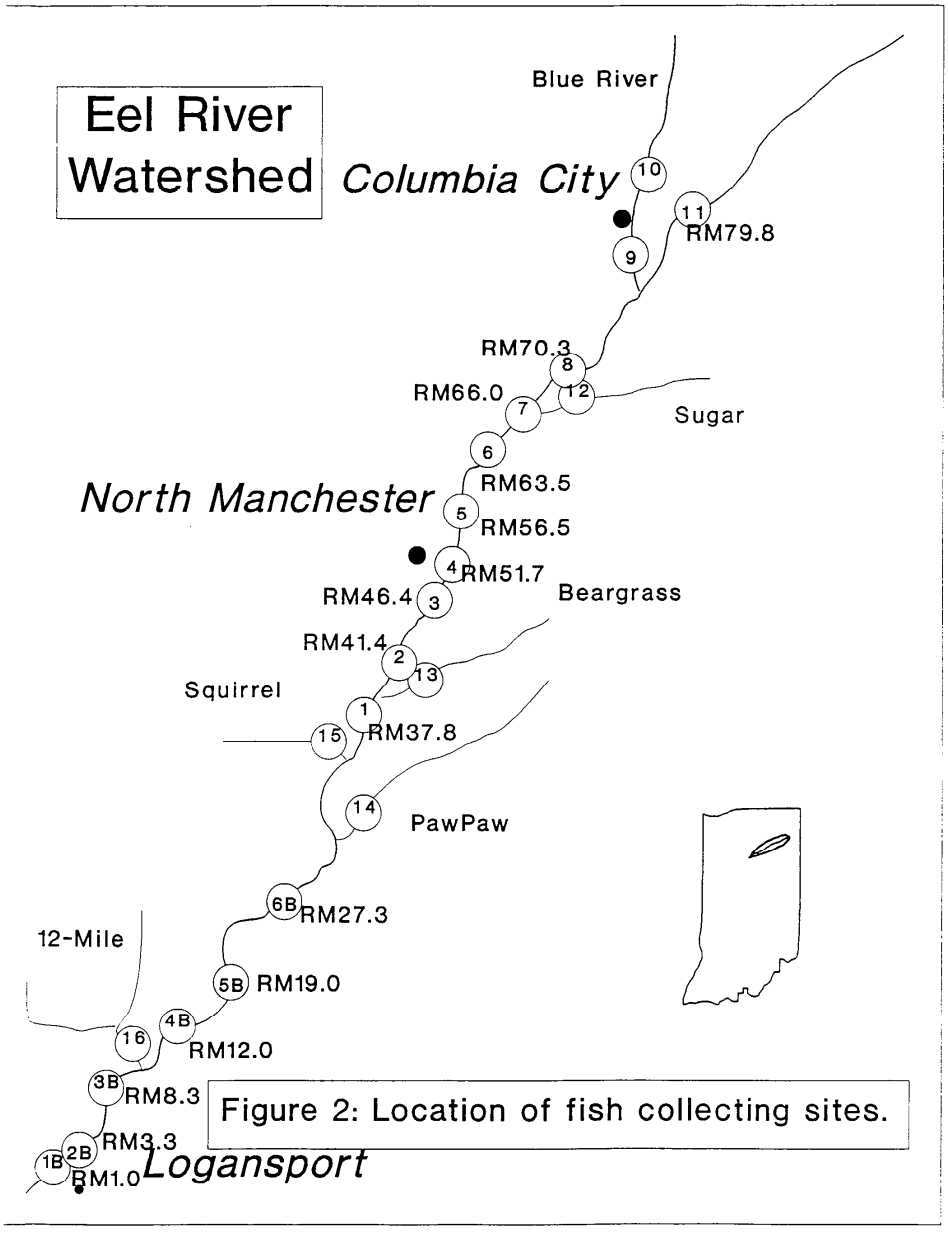


Figure 2: Location of fish collecting sites.

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 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).

The original criteria for determining IBI (Karr, et. al., 1987) were modified slightly for the Eel River (Table 1). The scaled metrics are those used in studies of the Sugar Creek system (Gammon et al. 1990A) and an agricultural analysis of several streams in west-central Indiana (Gammon et al. 1990B). They differ in some details from the criteria used in other studies. The 1990 IBI values were based upon the combined catches from electrofishing and seining. The IBIs calculated on data from earlier Eel River studies may be influenced to an unknown degree by the somewhat different methodologies used to collect fish. Taylor (1972) used a combination of electrofishing and rotenone, while Braun and Robertson (1982) used more intensive electrofishing. We have elected to use the same criteria regardless of stream order.

Table 1: Scoring criteria used to determine IBI for Eel River fish collections.

Metric	Score 1(worst)	3	5(best)
Fish species (total)	0-9	10-19	≥20
Darter species	0-1	2-3	≥4
Sunfish Species	0-1	2-3	≥4
Sucker Species	0-1	2-3	≥4
Intolerant Species	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

Habitat was quantitatively evaluated at each mainstem collecting site, except for the most downstream site near the Logansport dam and Taylor's site 1, using a habitat evaluation procedure (HEP)(Plafkin et al. 1989) adapted from Platts et al. (1987). The HEP quantifies 9 habitat characteristics summarized in Table 2. The total score for each site was based upon data from 10 transects at each site spaced 25, 50 or 100 feet apart.

Table 2: Habitat assessment scoring criteria (HEP).

Habitat Parameter	Condition			
	Excellent	good	Fair	Poor
PRIMARY INFLUENCE				
Substrate and Instream Cover				
1. substrate/cover	16-20	11-15	6-10	0-5
2. embeddedness	16-20	11-15	6-10	0-5
3. water velocity	16-20	11-15	6-10	0-5
SECONDARY INFLUENCE-				
Channel Morphology				
4. channel alteration	12-15	8-11	4-7	0-3
5. scouring/deposition	12-15	8-11	4-7	0-3
6. pool/riffle ratio	12-15	8-11	4-7	0-3
TERTIARY INFLUENCE-				
Riparian and Bank Structure				
7. bank stability	9-10	6-8	3-5	0-2
8. bank vegetation	9-10	6-8	3-5	0-2
9. bank cover	9-10	6-8	3-5	0-2

In addition, several other physical measurements were taken whenever fish collections were made and also in special longitudinal surveys. Stream turbidity was measured with a secchi disc and/or a B&L Minispec20 nephelometer. Water temperatures and dissolved oxygen readings were obtained using a YSI meter. Water velocity was measured using a Gurley pygmy meter. All distances were measured optically using a Leitz rangefinder.

Estimates of the amount of woodland were based on conventional analyses of enlarged LandSat infrared photographs taken on May 2, 1981. These were obtained from U.S. Geological Survey (ESIC), EROS Data Center, Sioux Falls, SD.

The drainage area perimeter was determined using topographic maps of tributaries. This scaled map was superimposed over the infrared photographs on a light table. Plots of land with permanent tree cover were outlined on the topographic map.

Using a light table, the marked topographic map was traced onto a fine grid. Individual grids with more than 50% woodland were marked. Grid totals were counted and the percentage woodland was calculated.

Land use in a few tributaries was not determined because of insufficient coverage of LandSat infrared photographs.

Results

Fish Communities

A total of 6,635 fish comprising 46 species were captured by electrofishing and seine. Forty species and 4154 individuals (63%) were taken by seining (Table 3). Electrofishing catches also yielded 40 species, but only 2481 individuals or 37% of the total (Table 4). Seining catches for individual collecting stations may be found in Appendix Table A. Electrofishing catches for individual collecting stations is summarized in Appendix Table B.

Bluntnose minnow (Pimephales notatus) was very common with 40.9% of the total number seined, while **sand shiner** (Notropis stramineus), **spotfin shiner** (N. spilopterus), **striped shiner** (N. chrysocephalus), **silverjaw minnow** (Ericymba buccata), and **creek chub** (Semotilus atromaculatus) together contributed another 37%.

The electrofishing catch was more evenly distributed with **common shiner** (N. cornutus) and **common white sucker** (Catostomus commersoni) each contributing about 15% to the catch. Substantial numbers of the following were also found: **creek chub** (Semotilus atromaculatus) (9.3%), **bluntnose minnow** (Pimephales notatus) (9%), **rock bass** (Ambloplites rupestris) (7.4%), and **northern hog sucker** (Hypentelium nigricans) (7.1%).

Smallmouth bass (Micropterus dolomeiui) adults and subadults were mostly found in the lower 50 miles of the Eel River and only in Paw Paw and Twelve mile Creeks among the tributaries. Catch rates were higher in the lower 30 miles of river and attenuated from RM 30 to RM 51.7. Three of 12 smallmouth bass 250 mm and longer were fin-clipped, indicating that they were stocked fish. Two of these were collected by electrofishing at RM 37.8(1) near Roann and the other at RM 27.3(6B) near Chili. Young-of-the-year smallmouth bass were taken only in the extreme lower part of the Eel River and in PawPaw and Twelve Mile Creeks.

Largemouth bass (Micropterus salmoides) formed a minor component of the catch. Fair numbers of small **spotted bass** (Micropterus punctulatus) were scattered throughout the mainstem and also in Paw Paw and Twelve Mile Creeks. This species had not been recorded for the Eel River before, although they might have been present since they could easily have been misidentified as small largemouth bass. Spotted bass young-of-year were found even in the otherwise poorer habitat of the upper 30 miles above South Whitley. This species has been shown to be tolerant of high turbidity and sedimentation (Gammon 1973).

Rock bass (Ambloplites rupestris) was taken at all stations except Squirrel Creek. **Longear sunfish** (Lepomis megalotis) were most common at the upper mainstem stations and in the Blue River and were

Table 3: Total seining catch at 22 stations from the Eel River and tributaries during 1990.

NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.
GIZZARD SHAD	45	1.08	0.243	0.78	0.005
BLACK BULLHEAD	1	0.02	0.030	0.10	0.030
YELLOW BULLHEAD	2	0.05	0.025	0.08	0.013
CHANNEL CATFISH	9	0.22	0.009	0.03	0.001
BLKSTRP TOPMINNOW	3	0.07	0.006	0.02	0.002
CARP	5	0.12	9.500	30.34	1.900
QBACK CARPSUCKER	2	0.05	0.040	0.13	0.020
WHITE SUCKER	53	1.28	0.527	1.68	0.010
NRTHRN HOGSUCKER	21	0.51	0.185	0.59	0.009
BLACK REDHORSE	1	0.02	0.010	0.03	0.010
GOLDEN REDHORSE	56	1.35	0.673	2.15	0.012
BLUNTNOSE MINNOW	1698	40.88	8.523	27.22	0.005
FATHEAD MINNOW	2	0.05	0.002	0.01	0.001
STONEROLLER	110	2.65	0.430	1.37	0.004
CREEK CHUB	207	4.98	0.858	2.74	0.004
BLACKNOSE DACE	38	0.91	0.077	0.25	0.002
SUCKERMTH MINNOW	2	0.05	0.013	0.04	0.007
SILVERJAW MINNOW	209	5.03	0.372	1.19	0.002
RIVER CHUB	41	0.99	0.345	1.10	0.008
BIGEYE CHUB	5	0.12	0.006	0.02	0.001
COMMON SHINER	322	7.75	2.118	6.76	0.007
SPOTFIN SHINER	346	8.33	1.369	4.37	0.004
SAND SHINER	450	10.83	3.702	11.82	0.008
ROSYFACE SHINER	70	1.69	0.245	0.78	0.004
REDFIN SHINER	149	3.59	0.630	2.01	0.004
SILVER SHINER	1	0.02	0.015	0.05	0.015
ROCKBASS	14	0.34	0.260	0.83	0.019
GREEN SUNFISH	2	0.05	0.010	0.03	0.005
BLUEGILL	31	0.75	0.266	0.85	0.009
LONGEAR SUNFISH	3	0.07	0.030	0.10	0.010
SMALLMOUTH BASS	9	0.22	0.039	0.12	0.004
LARGEMOUTH BASS	1	0.02	0.085	0.27	0.085
WHITE CRAPPIE	2	0.05	0.015	0.05	0.008
SPOTTED BASS	19	0.46	0.052	0.17	0.003
EAST SAND DARTER	4	0.10	0.008	0.03	0.002
GREENSIDE DARTER	2	0.05	0.012	0.04	0.006
JOHNNY DARTER	206	4.96	0.557	1.78	0.003
BLACKSIDE DARTER	10	0.24	0.013	0.04	0.001
DUSKY DARTER	2	0.05	0.010	0.03	0.005
MOTTLED SCULPIN	1	0.02	0.001	0.00	0.001
TOTALS- 40 SPECIES	4154	100	31.311	100	0.008

Table 4: Total electrofishing catch from the Eel River and tributaries during 1990.

OF CATCHES: 39
TOTAL # KM FISHED: 15.6

# CT./KM. =	159.04 +/- 19.54
WT./KM. =	9.45 +/- 1.31
AVE # SPEC. =	10.79 +/- .40
S-W DIV(NO) =	1.93 +/- .432E-01
S-W DIV(WT) =	1.38 +/- .623E-01
EVEN. (NO) =	.82 +/- .151E-01
EVEN (WT) =	.59 +/- .253E-01
W.B. INDEX =	6.70 +/- .128

NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
GIZZARD SHAD	20	0.81	0.651	0.44	0.033	1.282	0.042
CENTRL MUDMINNOW	8	0.32	0.064	0.04	0.008	0.513	0.004
GRASS PICKEREL	15	0.60	0.247	0.17	0.016	0.962	0.016
BLACK BULLHEAD	1	0.04	0.003	0.00	0.003	0.064	0.000
YELLOW BULLHEAD	2	0.08	0.035	0.02	0.018	0.128	0.002
CARP	12	0.48	19.641	13.33	1.637	0.769	1.259
QBACK CARPSUCKER	1	0.04	0.100	0.07	0.100	0.064	0.006
WHITE SUCKER	361	14.55	47.814	32.44	0.132	23.141	3.065
NRTHRN HOGSUCKER	177	7.13	15.434	10.47	0.087	11.346	0.989
SPOTTED SUCKER	31	1.25	1.885	1.28	0.061	1.987	0.121
BLACK REDHORSE	70	2.82	4.932	3.35	0.070	4.487	0.316
GOLDEN REDHORSE	83	3.35	11.191	7.59	0.135	5.321	0.717
GREATER REDHORSE	48	1.93	8.082	5.48	0.168	3.077	0.518
SPOTFIN SHINER	72	2.90	0.716	0.49	0.010	4.615	0.046
SAND SHINER	3	0.12	0.004	0.00	0.001	0.192	0.000
BLUNTNOSE MINNOW	223	8.99	0.765	0.52	0.003	14.295	0.049
STONEROLLER	89	3.59	0.769	0.52	0.009	5.705	0.049
CREEK CHUB	230	9.27	6.884	4.67	0.030	14.744	0.441
BLACKNOSE DACE	25	1.01	0.065	0.04	0.003	1.603	0.004
SUCKERMTH MINNOW	3	0.12	0.015	0.01	0.005	0.192	0.001
SILVERJAW MINNOW	65	2.62	0.626	0.42	0.010	4.167	0.040
RIVER CHUB	66	2.66	2.714	1.84	0.041	4.231	0.174
COMMON SHINER	366	14.75	7.067	4.80	0.019	23.462	0.453
ROSYFACE SHINER	9	0.36	0.025	0.02	0.003	0.577	0.002
REDFIN SHINER	5	0.20	0.022	0.01	0.004	0.321	0.001
SILVER SHINER	2	0.08	0.035	0.02	0.018	0.128	0.002
ROCKBASS	183	7.38	8.893	6.03	0.049	11.731	0.570
GREEN SUNFISH	59	2.38	1.024	0.70	0.017	3.782	0.066
BLUEGILL	53	2.14	0.760	0.52	0.014	3.397	0.049
LONGEAR SUNFISH	81	3.26	0.678	0.46	0.008	5.192	0.043
SMALLMOUTH BASS	46	1.85	5.309	3.60	0.115	2.949	0.340
LARGEMOUTH BASS	4	0.16	0.465	0.32	0.116	0.256	0.030
WHITE CRAPPIE	8	0.32	0.115	0.08	0.014	0.513	0.007
SPOTTED BASS	15	0.60	0.033	0.02	0.002	0.962	0.002

Table 4: (Con't.)

NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
PUMPKINSEED	4	0.16	0.185	0.13	0.046	0.256	0.012
GREENSIDE DARTER	2	0.08	0.007	0.00	0.004	0.128	0.000
FANTAIL DARTER	3	0.12	0.008	0.01	0.003	0.192	0.001
JOHNNY DARTER	24	0.97	0.036	0.02	0.002	1.538	0.002
BLACKSIDE DARTER	9	0.36	0.058	0.04	0.006	0.577	0.004
MOTTLED SCULPIN	3	0.12	0.017	0.01	0.006	0.192	0.001
TOTALS- 40 SPECIES	2481	100	147.373	100	0.059	159.039	9.447

sporadic in the lower river. **Green sunfish** (Lepomis cyanellus) also occurred at most sites, but was more abundant in the upper mainstem and in the Blue River. Substantial numbers of **bluegill** (Lepomis macrochirus) were also taken with more prevalence in the upper mainstem from RM 63.5 to RM 80.

The most abundant catostomid was **common white sucker** (Catostomus commersoni) with greatest numbers in the upper mainstem from RM 63.5 to RM 80 and in Blue River, Sugar Creek, and Beargrass Creek. They were uncommon in the lower 60 miles of the mainstem. **Northern Hog sucker** (Hypentelium nigricans) was widely distributed throughout the mainstem and most tributaries. **Spotted sucker** (Minytrema melanops) was found in good numbers only in the pool above the Logansport dam.

Golden redhorse (Moxostoma erythrurum) was the most common of the three redhorse species, but it was not all that abundant. It was absent between RM 56.5 and RM 80 as well as from all tributaries including Blue River. **Black redhorse** (Moxostoma breviceps) was almost as common as golden redhorse, but was mostly restricted to the lower 30 miles of the mainstem. **Greater redhorse** (Moxostoma valenciennesi) is a rare species throughout Indiana and most of its range, but a healthy population thrives in the Eel River system. It was particularly abundant in the lower 20 miles of river, but was also found in Paw Paw and Squirrel Creeks.

The distribution of smaller species of minnows and darters is best shown in Appendix Table A which summarizes the seining catches. **Bluntnose minnow** (Pimephales notatus) was the dominant species, occurring throughout the mainstem and tributaries. **Common shiner** (Notropis cornutus) was even more frequently encountered by electrofishing and was also widely distributed throughout the Eel River system.

Spotfin shiner (Notropis spilopterus) and **sand shiner** (Notropis stramineus) mostly occurred in the lower 50 miles of the mainstem. **Creek chub** (Semotilus atromaculatus) was common only in the tributaries. **Redfin shiner** (Notropis umbratilus) and **Rosyface shiner** (Notropis rubellus) were most common in the lower river, but also occurred in Sugar and Twelve Mile Creeks.

River chub (Nocomis micropogon) was regularly taken by seine and electrofishing mostly downriver from RM 65. A few **bigeye chub** (Hybopsis amblops) were also present in the lower river.

Among the darters, only **johnny darter** (Etheostoma nigrum) was common and widespread. **Blackside darter** (Percina maculata), **greenside darter** (Etheostoma blennioides), and **eastern sand darter** (Ammocrypta pellucida) were found only in the lower river. **Dusky darter** (Percina sciera) was taken only from upper Eel River (RM 88.0) and Beargrass Creek. **Fantail darter** (Etheostoma flabellare) was found only at RM 63.5.

Mottled sculpin (Cottus bairdi) was taken only at RM 56.5 and RM 63.5.

Important community index values are summarized in Table 5. IBI values were also calculated on less extensive data sets provided by Braun, Robertson, and Stefanavage (1985, 1986) on five collections of fish from each of three stations; 2B (RM 3.3), 3B (RM 8.3) and 3 (RM 46.4) during the years 1984 and 1985. The mean IBI values at stations 2B, 3B, and 3 were, respectively, 39.6, 42.0, and 43.6 in 1984 and 43.2, 41.2, and 42.9 in 1985.

Table 5: Fish community indices for Eel River stations.

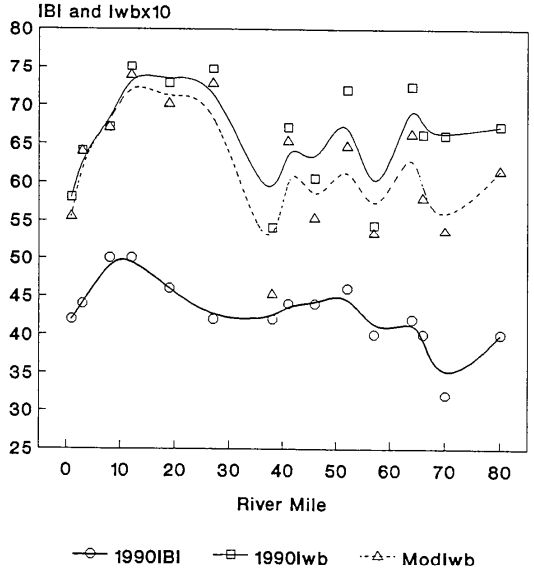
Station		1990	No. Spec. Elec.[1]			IBI		
Taylor	RM	Iwb	1972	1982	1990	1972	1982	1990
Mainstem Stations								
1B	1.0	5.8	12	13	15	38	44	44
2B	3.3	6.4	14	14	14	44	42	44
3B	8.3	6.7	10	11	12	40	38	50
4B	12.0	7.5	17	14	17	44	40	50
5B	19.0	5.3	14	17	18	38	40	46
6B	27.3	7.5	11	12	16	40	44	42
7B	32.0	5.4	17	10	-	44	36	-
1	37.8	6.7	14	8	10	38	32	42
2	41.4	6.1	18	9	17	42	34	44
3	46.4	7.2	16	11	13	46	36	44
4	51.7	5.4	10	12	16	40	40	46
5	56.5	7.2	18	13	10	44	36	40
6	63.5	6.6	13	8	13	36	36	42
7	66.0	6.6	15	9	13	36	32	40
8	70.3	6.6	12	6	16	39	28	32
11	79.8	6.7	19	9	17	42	32	40
Tributary Stations								
Twelve Mile Creek								44
PawPaw Creek								40
Squirrel Creek								40
Beargrass Creek								40
Sugar Creek								40
Blue River - upstream from Columbia City								40
Blue River - downstream from Columbia City								44

[1] Number of species taken by electrofishing only

The IBI and Iwb profiles for the Eel River mainstem are shown in Figure 3. An additional modified Iwb is also shown, wherein four tolerant species were deleted prior to calculations: carp, bluntnose minnow, creek chub, and green sunfish.

All three profiles indicate somewhat depressed fish communities in the lower river, probably because of the ponding effect of the dam, followed by relatively good communities from RM 8 to RM 25. From RM 30 to RM 80 there is considerable variation from place to place, but the communities are generally depressed, especially at RM 70.

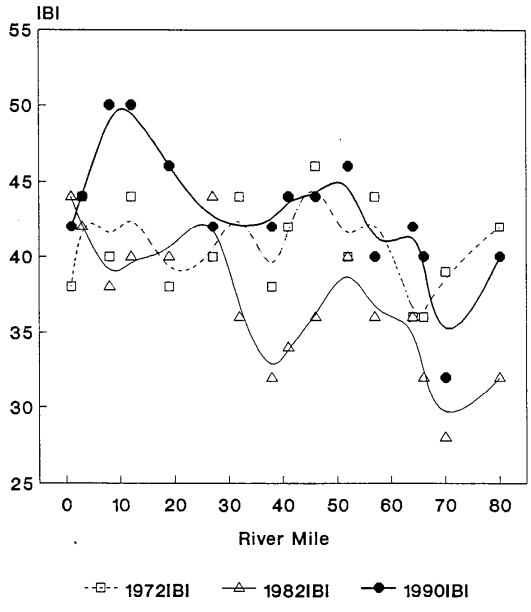
Figure 3: IBI, Iwb, & modified Iwb for Eel River fish communities in 1990.



IBI based upon Sugar Creek criteria and includes seining data.
Mod. Iwb deletes 'tolerant' species

In Figure 4 the 1990 IBI profile is repeated and compared to IBI profiles based upon Taylor's 1972 series of collections and the 1982 series (Braun, Robertson, and Stefanavage 1983). The 1990 fish communities are clearly much better than they were in 1982. However, both profiles indicate better communities in the lower river than in the upper river. In 1972 there is less difference between the upper and lower mainstem, but just as much variation from station to station.

Figure 4: IBI profiles of Eel River mainstem for 1972, 1982, and 1990.



Based upon Sugar Creek criteria.

Habitat Evaluation

Habitat scores for individual sites are summarized in Tables 6 and 7. Scores were generally lower in the upper part of the watershed and higher in the downstream reach. Upstream from South Whitley habitat features are uniformly low quality and homogeneous because of past channelization and recent deforestation of both banks.

Habitat scores of tributaries were generally higher than the mainstem reaches into which they flowed (Figure 5). An exception to this was Paw Paw Creek which was somewhat lower.

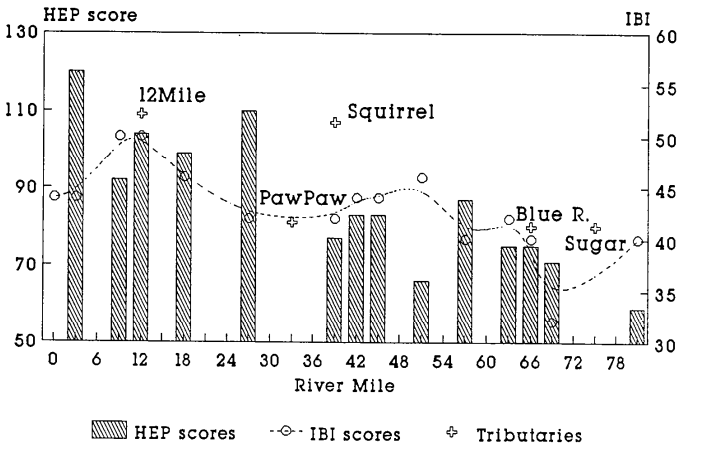
Table 6: Habitat quality scores for each mainstem collecting site.

Parameter	Collecting Site													
	2B	3B	4B	5B	6B	1	2	3	4	5	6	7	8	11
substrate/cover	20	19	18	18	19	11	12	18	8	16	17	14	6	2
embeddedness	8	8	8	8	16	8	5	8	8	8	8	8	8	2
water velocity	19	20	19	19	20	8	14	9	8	16	11	8	8	3
channel alteration	12	7	14	14	14	12	14	14	12	12	7	5	14	14
scouring/deposition	14	13	14	14	14	14	14	14	14	13	13	14	14	14
pool/riffle ratio	13	12	11	12	10	6	6	5	4	8	7	9	3	2
bank stability	9	5	7	6	7	6	7	5	3	4	5	6	7	9
bank vegetation	9	4	7	4	6	7	7	6	4	4	3	7	7	9
bank cover	7	4	6	4	4	5	4	4	5	6	4	4	4	4
Total Score	120	92	104	99	110	77	83	83	66	87	75	75	71	59

Table 7: Habitat quality scores for tributaries of Eel River.

Parameter	12Mile	PawPaw	Squirrel	Blue River Upper	Blue River Lower	Sugar
substrate/cover	18	19	19	6	16	8
embeddedness	20	8	17	3	5	16
water velocity	15	8	19	14	10	9
channel alteration	14	14	14	14	14	14
scouring/deposition	14	14	14	14	14	14
pool/riffle ratio	9	8	11	5	4	3
bank stability	6	3	4	9	6	5
bank vegetation	7	3	3	9	6	5
bank cover	6	4	6	6	5	6
Total Score	109	81	107	80	80	80

Figure 5: HEP scores in relation to the IBI for Eel River stations.



The same habitat analysis was applied to four sites on Sugar Creek near Crawfordsville. After working on Sugar Creek in 1988 and 1989 it was our subjective opinion that better habitat was available in the Sugar Creek system than in the Eel River system.

Although it was applied to only four sites, the habitat scores were higher than most of the Eel River sites. Upper Sugar Creek (RM 78.2) near Scotland Church scored 84. Sugar Creek (RM 40.0) near the old Crawfordsville coke plant scored 114. Lower Sugar Creek (RM 12.3) at Cox Ford scored 102. In addition, a site on the tributary Walnut Fork scored 88.

Turbidity and Landuse

Turbidity determinations are summarized in Tables C and D. The mean values obtained during the synoptic surveys on July 16 and 17, 1990 are portrayed graphically in Figure 6. Tributaries which were distinctly more turbid than others included Squirrel Creek, Otter Creek, Simonton Creek, Hurricane Creek, Blue River, Solon Ditch, and Johnson Ditch. A bridge was under construction in the Simonton watershed, but animals were also pastured in the stream.

The turbidity of mainstem water was high in the upper river mainly because of highly turbid Johnson Ditch. The water cleared considerably after passing through two mainstem gravel pits at RM 84 and then again became progressively more turbid as it flowed downstream.

Scattered showers fell throughout northern Indiana during the week previous to the turbidity determinations. It is not known to what extent these results may be affected by differential rainfall.

During this same period the turbidity gradually increased in the mainstem from the upper river to lower river, although there were localized sharp increases in turbidity downstream from both Johnson Ditch and South Whitley. Earlier in the summer (June 12, 1990) when water levels were higher the turbidity (NTU) was 45 in the lower 40 miles of river and 46-48 in the upper river (Table D).

In some streams lateral erosion can be a major source of sediment and turbidity. Scoured banks were a very limited component of the lower portions of the Eel River mainstem, but they were evident in the channelized upper parts.

Estimates of woodland ranged from only 7.0% in the Beargrass Creek watershed to 40.9% in the Weesaw Creek watershed (Appendix Table C). There was a greater percentage of land area in agriculture south of the mainstem and in the upper two-thirds of the Eel River watershed than north of the mainstem and in the lower third.

Woodlands were readily determined from the infrared photographs, but other kinds of permanent vegetation such as brushlands, pastures, and winter wheat were indistinguishable from one another.

Despite the 'broad-brush' analyses of landuse and limited data on turbidity, there was an inverse relationship between the percentage of tributary watersheds in woodland and the measured turbidity (Figure 7).

Figure 6: Turbidity (NTU) of Eel River and tributaries on July 16 & 17, 1990.

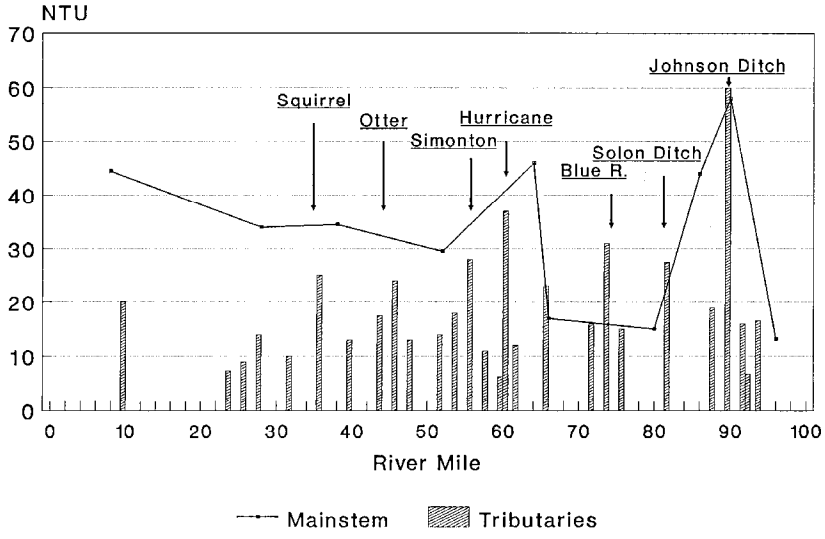
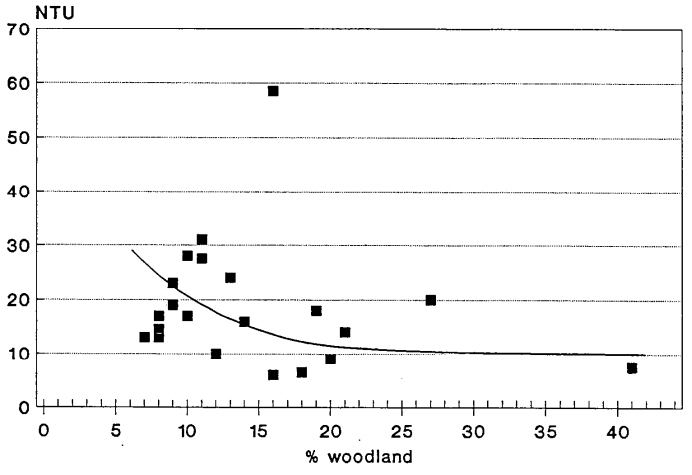


Figure 7: Turbidity of tributaries in relation to percent woodland.



Turbidity determined on 7-16 & 17, 1990.

The entire upper 33 miles of the Eel River has been stripped of its trees and bushes along both banks. During this study the trimmings had been removed from the river and were piled high here and there waiting to be burned. The overall character of the extreme upper part of the river is illustrated best by the infrared aerial photo taken on May 2, 1981 (Figure 8). Woodlands are dark red. Pastures and possibly fields of winter wheat appear reddish. Tilled fields appear either grey or, if wet, black. The thin riparian borders along ditches, tributaries, and the Eel River itself appear as red lines.

The middle Eel River and its tributaries from South Whitley to North Manchester is shown in Figure 9. The intensity of agriculture and paucity of riparian protection appears to be similar to the upper watershed.

Figure 8: Infrared aerial photograph of the upper Eel River watershed.

Figure 9: Eel River and tributaries between South Whitley and North Manchester.

Discussion

Current status

The Eel River in 1990 was found to support fairly diverse fish communities throughout most of the watershed, although the upper reaches had depressed populations and reduced numbers of species. Many species of juvenile fish were caught, with larger numbers in station 1B and Twelve Mile Creek, an indication that reproduction for many species was successful during the past couple of years.

Current status compared to past fish communities

Table 8 summarizes information about the presence of the various species over the past several decades. Gerking (1945) included all past collections in his analysis and thus recorded many more species than the more recent studies do. Roughly equivalent collecting effort was exerted for the studies of 1972 (1 hr AC), 1982 (20 min backpack), and 1990 and most of the same collecting stations were used.

Several usually common species which Braun and Robertson (1982) did not collect were found in good numbers in 1990: river chub (Nocomis micropogon), bigeye chub (Hybopsis amblops), several species of shiners (Notropis sp.) including silver shiner, spotfin shiner, rosyface shiner, and redfin shiner, blackside darter (Percina maculata), and johnny darter (Etheostoma nigrum).

Some species present in 1972 in good numbers, but found only sparingly or not at all in 1990 included mottled sculpin (Cottus bairdi), blacknose dace (Rhinichthys atratulus), madtom (Noturus sp.), suckermouth minnow (Phenacobius mirabilis), largemouth bass (Micropterus salmoides), and carp (Cyprinus carpio).

It is difficult to evaluate long-term changes in abundance of any single species of fish because of the different collecting methodologies employed. However, the comprehensive study of Gerking (1945) used the seine as the primary collecting gear and the seining collections of 1990 are quite comparable. Gerking collected from 5 mainstem sites and 4 tributaries while we collected from 12 mainstem sites and 6 tributaries.

A comparison of percent frequency of occurrence from these studies indicates rather drastic reductions for many species populations of sediment sensitive fish (Figure 10). Rock bass (Ambloplites rupestris), johnny darter (Etheostoma nigrum), and sand darter (Ammocrypta pellucida) appear to be distributed much as they were 50 years ago. However, many species have suffered marked declines including rainbow darter (Etheostoma caeruleum), orange-throat darter (E. spectabile), and bluebreast darter (E. camurum) which may be totally eliminated from the river.

Table 8: Species of fish collected from the Eel River and tributaries.

Family & Common Name (Scientific Name)	1945[a]	1972	1982	1990
Lampreys - Petromyzontidae				
Am. Brook lamprey (Lampeta lamottei)		x		
Chestnut lamprey (Ichthyomyzon castaneus)			x	
Gar Family - Lepisosteidae				
Longnose gar (Lepisosteus osseus)	x			
Herring Family - Clupeidae				
Gizzard shad (Dorosoma cepedianum)	x	x	x	x
Mudminnow Family - Umbridae				
Mudminnow (Umbra limi)	x	x	x	x
Pike Family - Esocidae				
Grass pickerel (Esox vermiculatus)	x	x	x	x
Northern pike (Esox lucius)	x			
Minnow Family - Cyprinidae				
Carp (Cyprinus carpio)		x	x	x
Stoneroller (Campostoma anomalum)	x	x	x	x
Silverjaw minnow (Ericymba buccata)	x	x	x	x
W. silvery minnow (Hybognathus nuchalis)	x			
Creek chub (Semotilus atromaculatus)	x	x	x	x
Hornyhead chub (Nocomis biguttatus)	x	x	x	
River chub (Nocomis micropogon)	x	x		x
Silver chub (Hybopsis storeriana)	x			
Bigeye chub (Hybopsis amblops)	x	x		x
Speckled chub (Hybopsis aestivalis)	x			
Suckermouth minnow(Phenacobius mirabilis)	x	x	x	x
Emerald shiner (Notropis atherinoides)	x		x	
Common shiner (Notropis cornutus)	x	x	x	x
Silver shiner (Notropis photogenis)	x	x		x
Spotfin shiner (Notropis spilopterus)	x	x		x
Blackchin shiner (Notropis heterodon)			(x)[b]	
Sand shiner (Notropis stramineus)	x			x
Rosyface shiner (Notropis rubellus)	x	x		x
Redfin shiner (Notropis umbratilis)	x	x		x
Steelcolor shiner (Notropis whipplii)	x		x	
Bluntnose minnow (Pimephales notatus)	x	x	x	x
Fathead minnow (Pimephales promelas)			x	x
Bullhead minnow (Pimephales vigilax)	x			

Table 8: (Con't.)

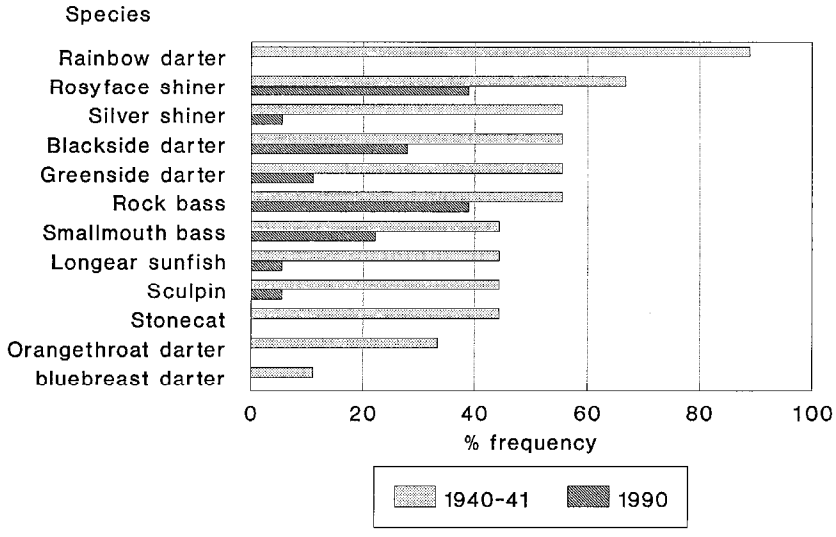
Family & Common Name (Scientific Name)	1945[a]	1972	1982	1990
Blacknose dace (Rhinichthys atratulus)	x	x	x	x
So. redbelly dace (Phoxinus erythrogaster)	x			
Golden shiner (Notemigonus crysoleucas)	x			
Sucker Family - Catostomidae				
Quillback carpsucker (Carpiodes cyprinus)		x	x	x
Highfin carpsucker (Carpiodes velifer)	x			
Black redhorse (Moxostoma duquesnei)		x	x	x
Golden redhorse (Moxostoma erythrurum)	x	x	x	x
Greater redhorse (Moxostoma valenciennesi)	x		x	x
Silver redhorse (Moxostoma anisurum)			(x)[b]	
River redhorse (Moxostoma carinatus)			(x)[b]	
No. hog sucker (Hypentelium nigricans)	x	x	x	x
White sucker (Catostomus commersoni)	x	x	x	x
W. creek chubsucker (Erimyzon oblongus)	x	x	(x)[b]	
Spotted sucker (Minytrema melanops)	x	x	x	x
Catfish Family - Ictaluridae				
Yellow bullhead (Ictalurus natalis)		x	x	x
Black bullhead (Ictalurus melas)	x	x	x	x
Channel catfish (Ictalurus punctatus)	x	x	x	x
Stonecat (Noturus flavus)	x		(x)[b]	
Tadpole madtom (Noturus gyrinus)	x	x		
Furious madtom (Noturus furiosus)	x			
Brindled madtom (Noturus miurus)		x		
Eel Family - Anguillidae				
American eel (Anguilla rostrata)	x		(x)[b]	
Pirate Perch Family - Aphredoderidae				
Pirate perch (Aphredoderus sayanus)	x			
Killifish Family - Cyprinodontidae				
Blackstripe topminnow (Fundulus notatus)	x	x		x
Banded killifish (Fundulus diaphanus)			x	

Table 8: (Con't.)

Family & Common Name (Scientific Name)	1945[a]	1972	1982	1990
Sunfish Family - Centrarchidae				
Smallmouth bass (Micropterus dolomieui)	x	x	x	x
Spotted bass (Micropterus punctulatus)				x
Largemouth bass (Micropterus salmoides)	x	x	x	x
Green sunfish (Lepomis cyanellus)	x	x	x	x
Pumpkinseed (Lepomis gibbosus)	x	x	x	x
Longear sunfish (Lepomis megalotis)	x	x	x	x
Orangespot sunfish (Lepomis humilis)	x	x	x	
Bluegill (Lepomis macrochirus)		x	x	x
Rock bass (Ambloplites rupestris)	x	x	x	x
White crappie (Pomoxis annularis)	x	x		x
Black crappie (Pomoxis nigromaculatus)		x		
Perch Family - Percidae				
Logperch (Percina caprodes)	x	x		
Gilt darter (Percina evides)	x			
Blackside darter (Percina maculata)	x	x		x
Slenderhead darter (P. phoxocephala)	x			
River darter (Percina shumardi)			x	
No. dusky darter (Percina sciera)				x
East. sand darter (Ammocrypta pellucida)	x		(x)[b]	x
Greenside darter (Etheostoma blennioides)	x	x		x
Rainbow darter (Etheostoma caeruleum)	x			
Bluebreast darter (Etheostoma camurum)	x			
Fantail darter (Etheostoma flabellare)	x			x
Least darter (Etheostoma microperca)	x			
Johnny darter (Etheostoma nigrum)	x	x		x
Orangethroat darter (Etheostoma spectabile)	x	x		
Sculpin Family - Cottidae				
Mottled sculpin (Cottus bairdi)	x	x		x

[a] Includes all collections prior to 1945.
[b] captured in 1984 and/or 1985 (Braun, Robertson, and Stefanavage, 1984, 1986)

Figure 10: Frequency of occurrence of some species collected by seining.



1940-41: 5 mainstem + 4 tributaries
1990: 12 mainstem + 6 tributaries

Changes over time in populations of clams and mussels parallel those of fish. Henschen (1988) concluded that, while the Eel River once supported a diversity of mussel species throughout its length, its currently reduced population is mostly confined to the lower river in Cass and Miami Counties.

Changes in the fish community over time

The IBI offers one way of answering questions about how the overall fish community has changed over time and how it compares to fish communities in other streams.

The mean IBI values for the Eel River mainstem stations declined from 40.7 in 1972 to 36.9 in 1982. The IBI then increased substantially to 43.1 in 1990. Other partial studies were made in 1984 and 1985 by Braun, Robertson, and Stefanavage (1984, 1986) who assessed the fish populations five times each summer at each of three stations, Taylor's #3, 3B, and 2B (RM 46.4, RM 8.3, and RM 3.3). In 1989 Braun (1990) examined populations during June at six locations between RM 15 and RM 46.4.

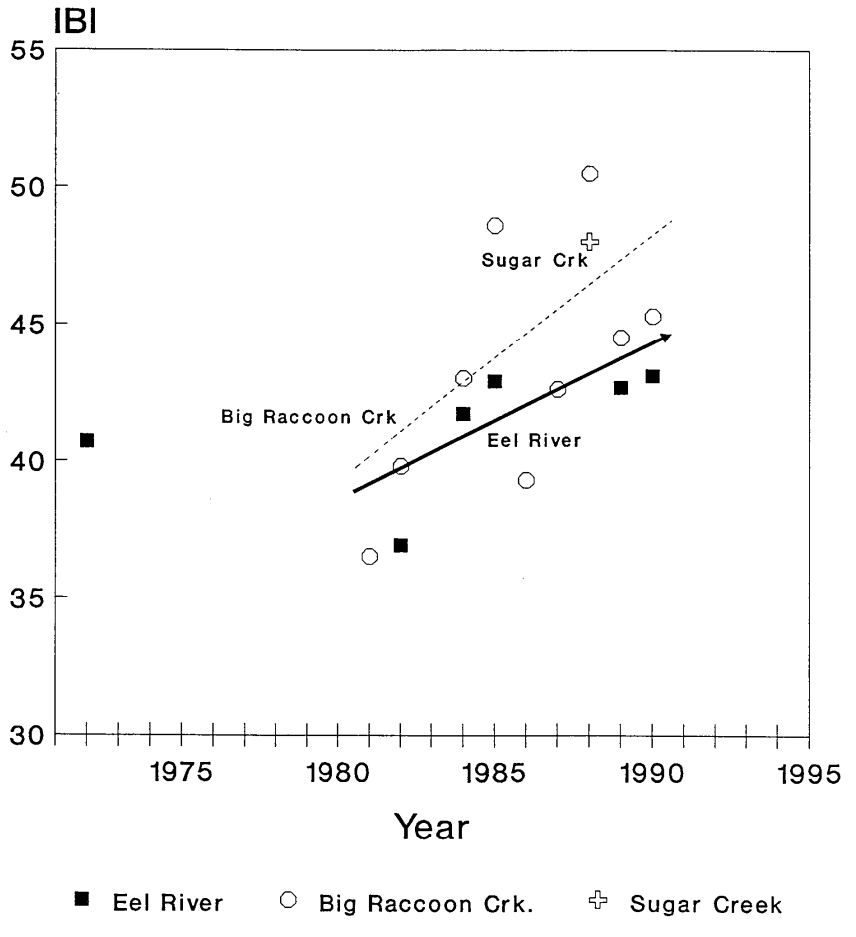
The mean IBIs from all of these studies is plotted against time in Figure 11. The intermediate partial studies are not exactly comparable to the more thorough collections of 1972, 1982, and 1990, since they do not include the poorer section of river from RM 50 to RM 80 and, therefore, may result in an inflated mean IBI value. Nevertheless, the overall Eel River fish community appears to have improved rapidly from the degraded community found in 1982.

IBI values from two other streams are also shown for comparison in Figure 11; Sugar Creek (Parke and Montgomery Counties) and Big Raccoon Creek (Putnam County).

Only 60% of lower Sugar Creek watershed is in rowcrops primarily because of hilly terrain and good riparian buffering. It is, therefore, much less subject to agricultural influence. It also supports one of the better fish communities in Indiana streams.

Upper Big Raccoon Creek is influenced almost exclusively by agricultural activities with 77% of its watershed in rowcrops. This stream system supported good fish populations 25 years ago (Gammon 1965), but darters, sunfish, and bass were severely reduced sometime prior to 1981. Each year from 1981 through 1990 (excepting 1983) three electrofishing collections at each of eight stations were made for purposes of biologically monitoring a landfill (Gammon 1990). The landfill has not measurably affected the fish community, but agriculture has and the pattern of observed change demonstrates the combined agricultural influence as moderated by natural weather and river discharge patterns.

Figure 11: Changes in Eel R. IBI compared to Big Raccoon Creek and Sugar Creek.



IBI based upon Sugar Creek criteria.

In Big Raccoon Creek the mean IBI was lowest in 1981 (IBI = 36.5) and highest in 1988 (IBI = 50.5). The dashed trend line indicates a higher rate of improvement for this fish community than for the Eel River community. The low IBI values from 1981 through 1984 probably resulted from poor reproduction and survival during unusually high water in the summers of 1979, 1981, and 1982. Darters, sunfish, and bass were virtually absent during those years, but increased significantly by the end of the decade.

The unusually high IBI value found in 1988 was associated with extremely low flows and a prolonged drought. Fish were undoubtedly concentrated and, therefore, much more vulnerable to capture.

The potential influence of habitat and turbidity

Much of the upper Eel River is characterized by low HEP values, a stream bed which has been channelized, poor riffle/pool development, and a lack of instream structure (Figure 12). In addition, riparian trees have been removed recently from many older, previously channelized sections of the river (Figure 13).

Upper Eel River flows through a series of two gravel pit lakes at river mile 84. These lakes probably act as sediment traps and may have been responsible for the improved clarity of water between RM 65 and RM 80 on July 16 and 17 as shown in Figure 5. These "lakes" and the open character of the upper channelized river also lead to elevated temperatures. Some local residents remembered fishing in the "lakes" as children and catching northern pike in clear water.

The bottom substrate usually included much fine sediment, as indicated by the low embeddedness scores for almost all mainstem stations and most tributaries. Turbidity was high virtually the entire summer. At Roann we saw a layer of mud two centimeters thick on top of flat boulders located in pools after higher water had subsided.

The lower 30 miles of Eel River contained much better habitat than the upstream reaches. Beds of water willow (Dianthera) were mostly limited to the lower 40 miles of the mainstem (Figures 14 and 15). This section had fairly good riparian protection and good instream habitat.

Habitat in the tributaries generally scored higher than the mainstem. Twelve Mile Creek, with 26.5% of its watershed in forest, contained the best habitat, followed by Squirrel Creek. The Blue River is about the same size as the Eel River where the two streams converge. With only 11% permanent vegetation cover, its turbidity readings were among the highest recorded. Fish from this stream were commonly infected with blackspot disease, as was also reported by Simon (1989). Blackspot disease was also prevalent on fish from Paw Paw Creek.

Figure 12: Channelized section of Eel River at RM 83.1.

Figure 13: Riparian trees removed at RM 70.3

Figure 14: Water willow (Dianthera) beds at RM 32.0.

Figure 15: Typical cover at RM 12.0.

Potential negative effects from point-source pollution

There is a long list of human activities which may negatively influence the fish communities of the Eel River and its tributaries at definite locations within the watershed. These point-sources of pollution may be divided approximately into (a) agricultural and (b) non-agricultural influences.

Agricultural point-source pollution in Indiana often occurs because of accidents or careless handling of animal wastes and farm chemicals. Spilled materials, animal wastes applied to fields, and the contents of waste holding lagoons may be flushed into ditches and streams following rain storms. Fish kills in the Eel River and its tributaries which have been reported to the Indiana Department of Environmental Management (IDEM) appear in Table 9.

Table 9: Fish kills reported to IDEM.

Date	Location	County	Cause
8-12-69	Paw Paw Creek	Wabash	Swine waste
7-25-75	East Fork Twelve Mile Creek	Cass	Unknown
4-24-80	Pony Creek	Wabash	Anhy. Ammonia
5-11-80	Paw Paw Creek	Wabash	Unknown
9-15-80	Beargrass Creek	Wabash	Unknown
3-31-81	Clear Creek	Whitley	Fertilizer
8- 7-81	Paw Paw Creek	Wabash	Undetermined
3-17-83	Paw Paw Creek	Wabash	Unknown
6-25-86	Paw Paw Creek	Wabash	Unknown

Additional reports of spilled materials are summarized in Table 10. These spills are not known to have resulted in fish kills, but may have exerted sublethal damage. The animal wastes category includes wastes generated by chicken, turkey, veal, and swine rearing operations.

All of the known causes of fish kills and most of the spills reported within the Eel River watershed are agriculturally based. The actual number of fish kills and spills is unknown, but would certainly far exceed the number of reported cases.

Non-agricultural point-source pollution occurs primarily from human population centers including their associated industries and landfills. Larger communities in the Eel River watershed served by municipal sewage treatment facilities (STP) include North Manchester (population = 6000), Columbia City (population = 5071), Churubusco (population = 1636), South Whitley (population = 1565), and Denver (population = 566).

Table 10: Summary of spills of various materials in the Eel River basin reported to IDEM from 1969 to 1990.

Material	Number of Reports	Percent
Fertilizer	14	35.9
Animal wastes	13	33.3
Herbicides	3	7.7
Pesticides	2	5.1
Sewage	1	2.6
Other	6	15.4
	N = 39	100.0%

However desireable it may be, it is not possible here to thoroughly evaluate the individual and collective impact of towns, industries, and landfills any more than it is to analyze the individual and aggregate effects of the various types of agricultural activities. Indeed, it is not always possible to even distinguish between agricultural and non-agricultural influences. For example, the lower 41 miles of the Eel River is listed by the Indiana Department of Environmental Management to be impaired by excessive concentrations of fecal coliform bacteria (Anonymous 1988). It is not possible to distinguish human from farm animal sources of this kind of pollution.

During the past 10 years there has been an overall reduction in the amount of organic matter (BOD) from STPs in the Eel River basin. At North Manchester the average BOD decreased from 24.6 mg/l in 1979 to 11 mg/l in 1987 while the average volume discharged decreased slightly. Columbia City STP effluent averaged 20.3 mg/l BOD in 1979 and decreased to 7.0 mg/l in 1987 with a slight increase in volume of discharge. Churubusco STP effluent BOD increased from 24.6 mg/l in 1979 to 31.0 mg/l in 1987. South Whitley STP effluent averaged 6.2 mg/l BOD in 1979 and 3.0 mg/l in 1987. The Denver STP is rather recent and has been operating only since 1984. It previously had no central treatment system and experienced wastewater problems from septic systems.

In Indiana and throughout the United States improved waste treatment in population centers has been a high priority. Undoubtedly more progress should continue to be made in controlling point source pollution. However, in all probability there has been a significant reduction in point sources of pollution from towns and industries to the Eel River during the past 10 to 20 years and these important gains should have reduced pollution intensity from those sources.

Weather and nonpoint source pollution

Unlike point source pollution, nonpoint sources of influence such as occurs from plowed fields are most severe during storm events. The discharge of rivers is roughly proportional to the amount of rainfall, hence, NPS is most severe when rainfall is great and river discharge is high. Conversely, NPS is reduced during periods of dry weather. From the standpoint of fish populations the most pronounced negative effects of NPS probably occurs during the reproductive period and in the months immediately after hatching, in other words during spring and summer.

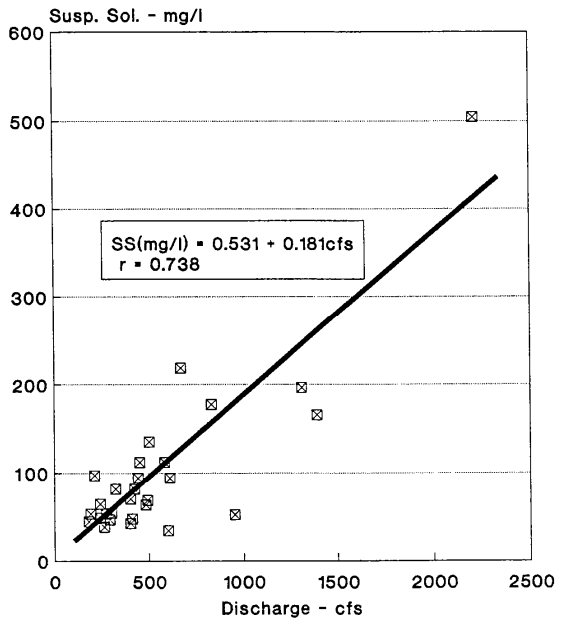
From October 1974 through September 1980 the U. S. Geological Survey Water Resources Division determined daily sediment loads for the Eel River near Logansport (Anonymous 1974 through 1980). Data from the Eel River and rivers throughout Indiana is analyzed and discussed by Crawford and Mansue (1988). They estimated that for the Eel River the mean annual suspended sediment yield was 178 tons/square mile/year and the flow-weighted mean annual suspended sediment concentration was 89 mg/l (median = 53 mg/l). These values are high for the northern moraine/lake portion of Indiana which Crawford and Mansue found to have the lowest sediment yield. It should be noted that only that part of the Eel River watershed north of the mainstem resides in the moraine area. The portion of the watershed situated south of the mainstem is located in the Tipton Till Plain where both parameters were generally much larger.

Using only the monthly data from May through August for the years 1974 through 1980 there is an obvious direct relationship between discharge and the concentration of suspended solids (Figure 16). The regression equation obtained was then used to estimate the suspended solids concentration for the months May through August for the years following 1980 (Figure 17). The values used in the figures are presented in Appendix Tables E and F.

Suspended solids concentrations were highest during May and June at which times relatively high levels occurred during half of the years since 1974. "Wet" summers of relatively high suspended solids concentration include the years 1974, 1975, 1980, 1981, 1982, and 1986. "Dry" summers when Eel River water was relatively clear include the period from 1976 through 1979, 1983 through 1985, and 1987 through 1988.

During "dry" summers the effects of point sources of pollution such as from population centers would theoretically increase, but nonpoint source pollution should have been less than normal. For streams influenced mostly by NPS the fish communities following a sequence of "dry" summers should improve. The Eel River fish communities did improve, but less than might have been expected compared to communities in Big Raccoon Creek. The difference might be attributable to additional point source pollution in the Eel River system and/or to greater agricultural impacts.

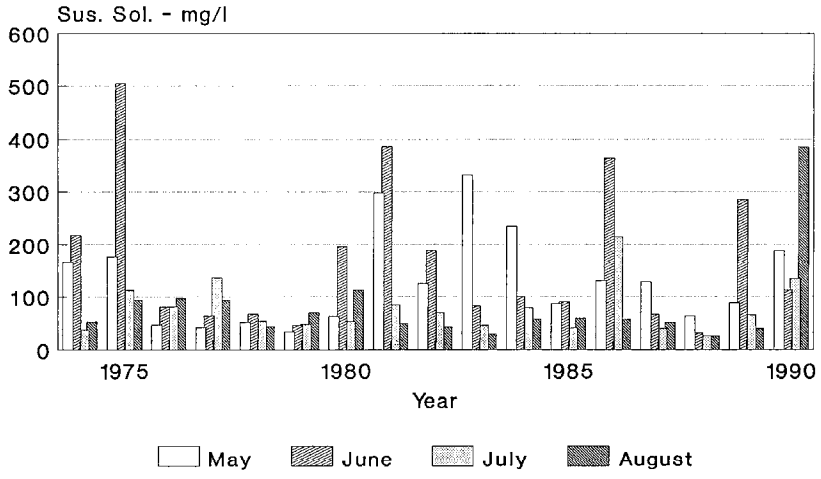
Figure 16: Suspended solids vs stream discharge: 1974 - 1980 (May - August).



The depressed fish communities found by Braun and Robertson (1982) were probably the result of two consecutive "wet" summers in 1980 and 1981 and their 1982 study itself was conducted during a relatively "wet" summer when collecting efficiency was less than optimal.

The summers of 1989 and 1990 have been relatively "wet". Expected reproductive success and survivorship through the first year of life should be lower than normal and we predict that the fish communities in 1991 will be negatively affected and exhibit lower IBI values.

Figure 17: Measured and estimated suspended solids concentration in summer for the Eel River.



Measured 1974-1980
Estimated 1981-1989

Major world events and their effect on agriculture

Interpreting the changes in fish communities of the Eel River as they relate to agriculture requires a detailed knowledge of agricultural events in the Eel River Basin, an understanding which is not as yet available. Nevertheless, some widespread events may have applicability to the Eel River scene. Between 1972 and 1973 world grain prices doubled (Brown 1989). In the U.S. as a whole, farmers not only returned idled cropland to use, they also plowed millions of acres of highly erodible land. Between 1972 and 1976 the U.S. area in grain climbed some 24%, as did soil erosion. By 1977, American farmers were losing an estimated 6 tons of soil for every ton of grain produced. If events in the Eel River basin followed these overall trends then it is likely that erosion and sediment delivery to the Eel River and its tributaries increased during the 1970s with negative effects on the aquatic communities.

During the 1980s some positive events may have reduced agricultural effects on the aquatic communities. Beginning in 1986 the U.S. initiated a 5-year Conservation Reserve Program (CRP) whose goal was converting at least 40 million acres of highly erodible cropland (about 11% of the total cropland) into grassland or woodlot. By mid-1989, 32 million acres were committed, but congressional committees eliminated funding for further additions (Brown and Young 1990).

It is not known if these national events extended to the Eel River watershed. Crawford and Mansue (1988) examined seasonal trends in streamflow, suspended-sediment concentration, flow-adjusted suspended-sediment concentration, and suspended-sediment discharge at the Eel River, among other stations. Over the period 1969 through 1981 there were statististically nonsignificant decreases in all of these parameters.

In October 1990 Congress passed a new farm bill, some provisions of which may influence future agricultural activities.

Miscellaneous observations

In terms of human use, we rarely saw any kind of fishing, camping, canoeing, or recreational use of the river. At river mile 46, we noticed at least 100 meters of north shoreline had been piled high with bedsprings in an attempt to reduce bank erosion. In that area there was a hillside covered with metal trash and smoking liquid cascading down with a factory nearby.

The aesthetically poorest part of river was the confluence of the Blue and Eel Rivers, where much miscellaneous metal and glass had been dumped on the south bank. Approximately 100 meters of bank had been resurfaced with its riparian zone stripped for agricultural use. Nevertheless, two adult beavers were dwelling in the opposite north bank.

Summary

1. The Eel River appears to be negatively influenced by agriculture throughout most of its watershed. The lower third of the mainstem and its associated tributaries appears to be somewhat better buffered from agricultural fields and supports better fish communities than the upper two-thirds.

2. Turbidity and sediment loads throughout the Eel River are very high during periods of wet weather. This was very evident throughout the summer of 1990 when rains were frequent.

3. Many species of fish known to be intolerant of sedimentation are either absent or occur in very low abundance. This includes mottled sculpin (Cottus bairdi), rainbow darter (Etheostoma caeruleum), orangethroat darter (E. spectabile), fantail darter (E. fabellare), bluebreast darter (E. camurum), greenside darter (E. blennioides), longear sunfish (Lepomis megalotis), and smallmouth bass (Micropterus dolomieui).

4. Species which are tolerant to turbidity and sedimentation are widely distributed. The spotted bass (Micropterus punctulatus) has recently entered the Eel River and is now found throughout the mainstem and even occurs in some tributaries.

5. Quantitative evaluations of habitat quality indicate fairly good instream conditions in the lower 48 km of the mainstem and in Twelve Mile and Squirrel Creeks. Habitat quality was poor elsewhere in the mainstem and also in PawPaw Creek, Sugar Creek, and the Blue River. The degree of embeddedness of coarse substrates was uniformly high at mainstem stations, although a few tributaries were satisfactory.

6. The fish community of the Eel River will probably continue to be negatively influenced by agricultural activities unless efforts are made to reduce their negative influence. Periods of dry summers may permit the recovery of depressed populations of fish, but a sequence of wet summers leading to high suspended sediment loads will probably result in depressed populations.

7. Riparian trees have recently been totally removed from both banks of the upper third of the Eel River mainstem. Entire sections have been completely dredged. This practice not only increases nearstream erosion, but it removes the primary shade trees resulting in elevated temperatures in the stream. There is a destructive cycle of field erosion, sediment deposition, riparian destruction, and dredging which is a poor technological substitute for intelligent land management practices leading to reduced erosion.

Recommendations

1. The Eel River is essentially a linear stream. Its drainage basin is long and narrow and its tributaries are generally small first and second order streams. Improving landuse in these tributaries will be necessary in order to improve the mainstem of the Eel River. Thorough surveys of all tributary watersheds should be conducted using both Geographic Information System (GIS) technology and ground study.

2. Twelve Mile Creek, PawPaw Creek, and, possibly, Squirrel Creek appear to be less influenced by agriculture than other tributaries. These tributaries may act as refugia for sensitive species during periods of stress and serve as species reservoirs to replenish the mainstem during more benevolent times. They should receive special attention to ensure that:

    a) the streamside riparian buffer zone is maintained,
    b) tilled fields do not impinge on the stream itself,
    c) hogs and cattle are not pastured directly in the streams,
    d) appropriate forms of conservation tillage are encouraged.
    e) animal wastes are properly disposed.

3. Several other tributaries appear to be more environmentally degraded than others. Otter Creek, Simonton Creek, Hurricane Creek, Blue River, Solon Ditch, and Johnson Ditch delivered higher than average sediment loads to the Eel River during the survey of July 16 and 17, 1990. While this survey is only a brief "snapshot" in time, it nevertheless suggests that these streams may have greater than average negative impacts on the Eel River system. They should also receive the same items of attention listed above.

4. Streams in the upper watershed are referred to as this-or-that "drain" or "ditch" rather than something-or-other "creek". No doubt this reflects their primary function for many decades. Nevertheless, these streams are permanent "creeks". With help they could and should be rehabilitated to support aquatic life. With a proper "green belt" riparian system they could also assist in supporting an abundance of birds and mammals and contribute toward making this entire area more heterogeneous and less of a monoculture. We recommend that these headwaters and perhaps other small tributaries be further sampled to determine the present nature of their aquatic communities in contrast to the communities they should support.

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APPENDIX TABLES

Table A: Number of each species collected by seining from the Eel River collecting stations during summer 1990.

Common Name	Total Number	Mainstem								
		1B	3B	4B	5B	6B	1	4	5	6
GIZZARD SHAD	45	17	10	-	12	6	-	-	-	-
BLACK BULLHEAD	1	-	-	-	-	-	-	-	-	-
YELLOW BULLHEAD	2	-	-	-	-	-	-	-	-	-
CHANNEL CATFISH	9	9	-	-	-	-	-	-	-	-
BLKSTRP TPMINNOW	3	-	-	-	-	-	-	-	-	-
CARP	5	-	-	-	-	-	-	-	-	4
QBACK CARPSUCKER	2	-	-	-	2	-	-	-	-	-
WHITE SUCKER	53	-	1	-	-	2	-	-	1	4
NRTHRN HOGSUCKER	21	-	1	2	6	-	-	-	1	5
BLACK REDHORSE	1	-	-	-	-	-	-	-	-	-
GOLDEN REDHORSE	56	1	10	1	7	9	-	-	-	-
SPOTFIN SHINER	346	11	8	18	6	40	5	44	1	-
SAND SHINER	450	-	26	93	18	16	187	65	1	-
BLUNTNOSE MINNOW	1698	3	112	234	165	154	118	183	6	50
FATHEAD MINNOW	2	-	1	-	1	-	-	-	-	-
STONEROLLER	110	-	2	15	10	22	-	5	-	14
CREEK CHUB	207	-	1	-	-	1	-	1	24	1
BLACKNOSE DACE	38	-	-	-	-	-	-	-	-	-
SUCKERMTH MINNOW	2	-	-	-	-	-	-	1	-	-
SILVERJAW MINNOW	209	-	16	17	21	-	1	26	1	20
RIVER CHUB	41	-	1	19	-	-	-	7	4	4
COMMON SHINER	322	3	2	7	13	5	-	2	2	12
ROSYFACE SHINER	70	2	13	13	-	11	-	4	-	6
REDFIN SHINER	149	15	2	1	4	37	-	-	-	-
SILVER SHINER	1	-	1	-	-	-	-	-	-	-
BIGEYE CHUB	5	-	3	1	-	-	-	1	-	-
ROCKBASS	14	-	-	1	-	1	4	-	-	-
GREEN SUNFISH	2	-	-	-	-	-	-	-	-	-
BLUEGILL	31	4	-	-	-	5	-	-	-	1
LONGEAR SUNFISH	3	-	-	-	-	3	-	-	-	-
SMALLMOUTH BASS	9	2	1	-	-	-	-	-	-	-
LARGEMOUTH BASS	1	-	-	-	-	-	-	-	-	-
WHITE CRAPPIE	2	-	-	-	-	-	-	-	-	-
SPOTTED BASS	19	2	1	-	-	5	-	-	-	-
EAST SAND DARTER	4	-	1	2	1	-	-	-	-	-
GREENSIDE DARTER	2	-	-	-	-	-	1	-	-	-
JOHNNY DARTER	206	1	-	15	-	7	14	4	5	10
BLACKSIDE DARTER	10	4	1	2	-	2	-	-	-	1
DUSKY DARTER	2	-	-	-	-	-	-	-	-	-
MOTTLED SCULPIN	1	-	-	-	-	-	-	-	-	1

Table A: (Con't.)

Common Name	Mainstem			Tributaries					
	7	8	11	9	10	12	13	14	16*
GIZZARD SHAD	-	-	-	-	-	-	-	-	-
BLACK BULLHEAD	-	-	-	-	-	-	-	-	-
YELLOW BULLHEAD	-	-	1	-	-	-	-	-	-
CHANNEL CATFISH	-	-	-	-	-	-	-	-	-
BLKSTRP TPMINNOW	-	-	-	-	-	-	-	-	-
CARP	-	-	-	-	-	-	-	-	-
QBACK CARPSUCKER	-	-	-	-	-	-	-	-	-
WHITE SUCKER	-	1	8	-	-	2	-	15	6
NRTHRN HOGSUCKER	-	-	-	-	1	-	-	2	2
BLACK REDHORSE	-	-	-	-	-	-	-	1	-
GOLDEN REDHORSE	6	-	-	-	-	9	-	2	4
SPOTFIN SHINER	-	-	-	-	-	-	14	1	6
SAND SHINER	-	-	-	-	-	-	-	2	1
BLUNTNOSE MINNOW	171	1	4	10	6	198	105	23	20
FATHEAD MINNOW	-	-	-	-	-	-	-	-	-
STONEROLLER	-	-	-	-	2	20	9	10	-
CREEK CHUB	59	1	-	2	5	37	-	37	32
BLACKNOSE DACE	-	-	-	1	-	30	7	-	-
SUCKERMTH MINNOW	-	-	-	-	-	-	-	1	-
SILVERJAW MINNOW	32	-	-	1	-	63	-	9	2
RIVER CHUB	-	-	-	-	-	-	-	-	2
COMMON SHINER	15	1	1	82	9	23	45	54	11
ROSYFACE SHINER	-	-	-	-	-	-	-	-	12
REDFIN SHINER	-	-	-	-	-	-	1	56	-
SILVER SHINER	-	-	-	-	-	-	-	-	-
BIGEYE CHUB	-	-	-	-	-	-	-	-	-
ROCKBASS	1	-	-	1	1	-	-	4	-
GREEN SUNFISH	-	-	-	-	-	-	-	2	-
BLUEGILL	-	-	3	-	-	-	1	-	5
LONGEAR SUNFISH	-	-	-	-	-	-	-	-	-
SMALLMOUTH BASS	-	-	-	-	-	-	-	3	2
LARGEMOUTH BASS	-	-	-	-	-	-	-	-	-
WHITE CRAPPIE	-	-	1	-	-	-	-	-	-
SPOTTED BASS	-	1	-	-	-	-	-	2	5
EAST SAND DARTER	-	-	-	-	-	-	-	-	-
GREENSIDE DARTER	-	-	-	-	-	-	-	-	1
JOHNNY DARTER	84	1	-	-	4	14	25	10	6
BLACKSIDE DARTER	-	-	-	-	-	-	-	-	-
DUSKY DARTER	-	-	-	-	-	-	1	-	-
MOTTLED SCULPIN	-	-	-	-	-	-	-	-	-

* Twelve Mile Creek

Table A: (Con't.)

Common Name	RM82.0	RM88.0	RM90.0
GIZZARD SHAD	-	-	-
BLACK BULLHEAD	-	-	1
YELLOW BULLHEAD	-	1	-
CHANNEL CATFISH	-	-	-
BLKSTRP TPMINNOW	-	3	-
CARP	1	-	-
QBACK CARPSUCKER	-	-	-
WHITE SUCKER	-	5	8
NRTHRN HOGSUCKER	-	-	-
BLACK REDHORSE	-	-	-
GOLDEN REDHORSE	-	-	-
SPOTFIN SHINER	-	-	-
SAND SHINER	-	-	-
BLUNTNOSE MINNOW	100	10	4
FATHEAD MINNOW	-	-	-
STONEROLLER	-	-	-
CREEK CHUB	-	6	-
BLACKNOSE DACE	-	-	-
SUCKERMTH MINNOW	-	-	-
SILVERJAW MINNOW	-	-	-
RIVER CHUB	-	-	-
COMMON SHINER	-	1	1
ROSYFACE SHINER	-	-	-
REDFIN SHINER	-	-	-
SILVER SHINER	-	-	-
BIGEYE CHUB	-	-	-
ROCKBASS	-	-	-
GREEN SUNFISH	-	-	-
BLUEGILL	1	3	3
LONGEAR SUNFISH	-	-	-
SMALLMOUTH BASS	-	-	-
LARGEMOUTH BASS	1	-	-
WHITE CRAPPIE	-	-	1
SPOTTED BASS	2	1	-
EAST SAND DARTER	-	-	-
GREENSIDE DARTER	-	-	-
JOHNNY DARTER	-	6	-
BLACKSIDE DARTER	-	-	-
DUSKY DARTER	-	1	-
MOTTLED SCULPIN	-	-	-

Table B: Electrofishing catches at collecting sites of the Eel River and tributaries during 1990.

River: EEL River mile: 1.0 (Taylor site 1B)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	111.25	+/- 28.75
WT./KM. =	2.84875	+/- .271249
AVE # SPEC. =	10	+/- 0
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	1.90283	+/- .128103
S-W DIV(WT) =	1.03269	+/- .336768
EVEN. (NO) =	.826389	+/- .556346E-01
EVEN (WT) =	.448491	+/- .146256
W.B. INDEX =	5.79529	+/- .284909
MOD. I.W.B. =	5.73966	+/- .273995

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
13	GIZZARD SHAD	19	21.35	0.646	28.35	0.034	23.750	0.808
107	WHITE SUCKER	1	1.12	0.001	0.04	0.001	1.250	0.001
111	SPOTTED SUCKER	25	28.09	1.320	57.92	0.053	31.250	1.650
113	BLACK REDHORSE	1	1.12	0.030	1.32	0.030	1.250	0.038
114	GOLDEN REDHORSE	1	1.12	0.035	1.54	0.035	1.250	0.044
143	BLUNTNOSE MINNOW	5	5.62	0.005	0.22	0.001	6.250	0.006
158	COMMON SHINER	2	2.25	0.018	0.79	0.009	2.500	0.023
165	ROCKBASS	1	1.12	0.040	1.76	0.040	1.250	0.050
167	GREEN SUNFISH	2	2.25	0.017	0.75	0.009	2.500	0.021
169	BLUEGILL	1	1.12	0.010	0.44	0.010	1.250	0.012
170	LONGEAR SUNFISH	13	14.61	0.083	3.64	0.006	16.250	0.104
173	WHITE CRAPPIE	4	4.49	0.012	0.53	0.003	5.000	0.015
175	SPOTTED BASS	12	13.48	0.021	0.92	0.002	15.000	0.026
177	REDEAR SUNFISH	1	1.12	0.040	1.76	0.040	1.250	0.050
190	BLACKSIDE DARTER	1	1.12	0.001	0.04	0.001	1.250	0.001
TOTALS- 15	SPECIES	89	100.00	2.279	100.00	0.026	111.250	2.849

Table B: (Con't.)

River: EEL River mile: 3.3 (Taylor site 2B)

OF CATCHES: 3
TOTAL # KM FISHED: 1.2

# CT./KM. =	86.6667	+/- 19.2209
WT./KM. =	4.45917	+/- .505159
AVE # SPEC. =	8.66667	+/- .666667
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	1.89648	+/- .392594E-01
S-W DIV(WT) =	1.5642	+/- .175215E-01
EVEN. (NO) =	.881696	+/- .216942E-01
EVEN (WT) =	.728292	+/- .303075E-01
W.B. INDEX =	6.40362	+/- .169731
MOD. I.W.B. =	6.38642	+/- .184344

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/
107	WHITE SUCKER	1	0.96	0.074	1.38	0.074	0.833	0.
109	NRTHRN HOGSUCKER	2	1.92	0.290	5.42	0.145	1.667	0.
111	SPOTTED SUCKER	1	0.96	0.045	0.84	0.045	0.833	0.
113	BLACK REDHORSE	26	25.00	1.893	35.38	0.073	21.667	1.
114	GOLDEN REDHORSE	10	9.62	0.580	10.84	0.058	8.333	0.
116	GREATER REDHORSE	2	1.92	0.615	11.49	0.308	1.667	0.
139	SPOTFIN SHINER	9	8.65	0.033	0.62	0.004	7.500	0.
157	RIVER CHUB	8	7.69	0.348	6.50	0.044	6.667	0.
158	COMMON SHINER	25	24.04	0.553	10.33	0.022	20.833	0.
165	ROCKBASS	7	6.73	0.447	8.35	0.064	5.833	0.
169	BLUEGILL	1	0.96	0.010	0.19	0.010	0.833	0.
170	LONGEAR SUNFISH	1	0.96	0.045	0.84	0.045	0.833	0.
171	SMALLMOUTH BASS	8	7.69	0.414	7.74	0.052	6.667	0.
221	ROSYFACE SHINER	3	2.88	0.004	0.07	0.001	2.500	0.
TOTALS- 14	SPECIES	104	100.00	5.351	100.00	0.051	86.667	4.

Table B: (Con't.)

River: EEL River mile: 8.3 (Taylor site 3B)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	221.25	+/- 141.25
WT./KM. =	7.2375	+/- 1.3225
AVE # SPEC. =	9	+/- 0
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	1.46535	+/- .45897
S-W DIV(WT) =	1.6965	+/- .254188E-01
EVEN. (NO) =	.666911	+/- .208886
EVEN (WT) =	.772109	+/- .115703E-01
W.B. INDEX =	6.71176	+/- .365918E-01
MOD. I.W.B. =	6.71176	+/- .365918E-01

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
109	NRTHRN HOGSUCKER	13	7.34	0.796	13.75	0.061	16.250	0.995
113	BLACK REDHORSE	10	5.65	0.743	12.83	0.074	12.500	0.929
114	GOLDEN REDHORSE	5	2.82	0.420	7.25	0.084	6.250	0.525
116	GREATER REDHORSE	7	3.95	0.800	13.82	0.114	8.750	1.000
139	SPOTFIN SHINER	2	1.13	0.004	0.07	0.002	2.500	0.005
157	RIVER CHUB	6	3.39	0.202	3.49	0.034	7.500	0.253
158	COMMON SHINER	119	67.23	1.294	22.35	0.011	148.750	1.618
165	ROCKBASS	6	3.39	0.124	2.14	0.021	7.500	0.155
170	LONGEAR SUNFISH	1	0.56	0.045	0.78	0.045	1.250	0.056
171	SMALLMOUTH BASS	6	3.39	1.349	23.30	0.225	7.500	1.686
221	ROSYFACE SHINER	1	0.56	0.003	0.05	0.003	1.250	0.004
255	SILVER SHINER	1	0.56	0.010	0.17	0.010	1.250	0.012
TOTALS- 12	SPECIES	177	100.00	5.790	100.00	0.033	221.250	7.238

Table B: (Con't.)

River: EEL River mile: 12.0 (Taylor site 4B)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	181.25	+/- 31.25
WT./KM. =	12.5694	+/- 7.76188
AVE # SPEC. =	13	+/- 1
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	2.11637	+/- .936686E-02
S-W DIV(WT) =	1.64584	+/- .121581E-01
EVEN. (NO) =	.826707	+/- .212178E-01
EVEN (WT) =	.643132	+/- .240927E-01
W.B. INDEX =	7.50019	+/- .444772
MOD. I.W.B. =	7.47466	+/- .464314

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/
13	GIZZARD SHAD	1	0.69	0.005	0.05	0.005	1.250	0.
109	NRTHRN HOGSUCKER	36	24.83	3.913	38.91	0.109	45.000	4.
113	BLACK REDHORSE	16	11.03	0.679	6.75	0.042	20.000	0.
114	GOLDEN REDHORSE	1	0.69	0.020	0.20	0.020	1.250	0.
116	GREATER REDHORSE	10	6.90	1.999	19.88	0.200	12.500	2.
139	SPOTFIN SHINER	4	2.76	0.015	0.15	0.004	5.000	0.
140	SAND SHINER	1	0.69	0.002	0.02	0.002	1.250	0.
143	BLUNTNOSE MINNOW	6	4.14	0.007	0.07	0.001	7.500	0.
147	STONEROLLER	3	2.07	0.022	0.22	0.007	3.750	0.
151	SUCKERMTH MINNOW	1	0.69	0.002	0.02	0.002	1.250	0.
157	RIVER CHUB	11	7.59	0.715	7.11	0.065	13.750	0.
158	COMMON SHINER	24	16.55	0.619	6.15	0.026	30.000	0.
165	ROCKBASS	18	12.41	1.505	14.97	0.084	22.500	1.
170	LONGEAR SUNFISH	2	1.38	0.054	0.54	0.027	2.500	0.
171	SMALLMOUTH BASS	9	6.21	0.493	4.90	0.055	11.250	0.
183	GREENSIDE DARTER	1	0.69	0.003	0.03	0.003	1.250	0.
221	ROSYFACE SHINER	1	0.69	0.003	0.03	0.003	1.250	0.
TOTALS- 17	SPECIES	145	100.00	10.056	100.00	0.069	181.250	12.

Table B: (Con't.)

River: EEL River mile: 19.0 (Taylor site 5B)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	151.25	+/- 6.25
WT./KM. =	9.46575	+/- 5.33075
AVE # SPEC. =	13	+/- 1
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	2.12041	+/- .284714E-01
S-W DIV(WT) =	1.61966	+/- .204542
EVEN. (NO) =	.828061	+/- .137999E-01
EVEN (WT) =	.635168	+/- .989463E-01
W.B. INDEX =	7.27759	+/- .121973
MOD. I.W.B. =	7.11037	+/- .235163

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
105	QBACK CARPSUCKER	1	0.83	0.100	1.32	0.100	1.250	0.125
107	WHITE SUCKER	2	1.65	0.200	2.64	0.100	2.500	0.250
109	NRTHRN HOGSUCKER	19	15.70	0.922	12.18	0.049	23.750	1.153
113	BLACK REDHORSE	10	8.26	0.852	11.25	0.085	12.500	1.065
114	GOLDEN REDHORSE	7	5.79	0.285	3.76	0.041	8.750	0.356
116	GREATER REDHORSE	18	14.88	3.220	42.52	0.179	22.500	4.024
139	SPOTFIN SHINER	14	11.57	0.053	0.70	0.004	17.500	0.066
143	BLUNTNOSE MINNOW	20	16.53	0.040	0.53	0.002	25.000	0.050
147	STONEROLLER	1	0.83	0.015	0.20	0.015	1.250	0.019
157	RIVER CHUB	5	4.13	0.150	1.98	0.030	6.250	0.188
158	COMMON SHINER	6	4.96	0.085	1.12	0.014	7.500	0.106
165	ROCKBASS	5	4.13	0.107	1.41	0.021	6.250	0.134
167	GREEN SUNFISH	4	3.31	0.103	1.36	0.026	5.000	0.129
169	BLUEGILL	1	0.83	0.048	0.63	0.048	1.250	0.060
171	SMALLMOUTH BASS	4	3.31	1.203	15.89	0.301	5.000	1.504
172	LARGEMOUTH BASS	1	0.83	0.115	1.52	0.115	1.250	0.144
173	WHITE CRAPPIE	1	0.83	0.070	0.92	0.070	1.250	0.088
221	ROSYFACE SHINER	2	1.65	0.005	0.07	0.003	2.500	0.006
TOTALS- 18	SPECIES	121	100.00	7.573	100.00	0.063	151.250	9.466

Table B: (Con't.)

River: EEL River mile: 27.3 (Taylor site 6B)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	187.5	+/- 60
WT./KM. =	16.8248	+/- 3.66983
AVE # SPEC. =	13	+/- 2
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	2.15046	+/- .250313E-01
S-W DIV(WT) =	1.33143	+/- .696259E-01
EVEN. (NO) =	.844857	+/- .415168E-01
EVEN (WT) =	.521791	+/- .442157E-02
W.B. INDEX =	7.47101	+/- .37132
MOD. I.W.B. =	7.16137	+/- .636752

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/
104	CARP	2	1.33	3.487	25.91	1.744	2.500	4.
109	NRTHRN HOGSUCKER	26	17.33	1.602	11.90	0.062	32.500	2.
113	BLACK REDHORSE	4	2.67	0.620	4.61	0.155	5.000	0.
114	GOLDEN REDHORSE	29	19.33	4.966	36.90	0.171	36.250	6.
139	SPOTFIN SHINER	25	16.67	0.480	3.57	0.019	31.250	0.
143	BLUNTNOSE MINNOW	6	4.00	0.012	0.09	0.002	7.500	0.
147	STONEROLLER	2	1.33	0.008	0.06	0.004	2.500	0.
157	RIVER CHUB	5	3.33	0.257	1.91	0.051	6.250	0.
158	COMMON SHINER	19	12.67	0.507	3.77	0.027	23.750	0.
165	ROCKBASS	15	10.00	0.727	5.40	0.048	18.750	0.
167	GREEN SUNFISH	3	2.00	0.027	0.20	0.009	3.750	0.
169	BLUEGILL	3	2.00	0.036	0.27	0.012	3.750	0.
171	SMALLMOUTH BASS	6	4.00	0.695	5.16	0.116	7.500	0.
190	BLACKSIDE DARTER	2	1.33	0.020	0.15	0.010	2.500	0.
221	ROSYFACE SHINER	2	1.33	0.010	0.07	0.005	2.500	0.
225	REDFIN SHINER	1	0.67	0.005	0.04	0.005	1.250	0.
TOTALS-	16 SPECIES	150	100.00	13.460	100.00	0.090	187.500	16.

Table B: (Con't.)

River: EEL River mile: 37.8 (Taylor site 1)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	45	+/- 15
WT./KM. =	6.9125	+/- 1.6025
AVE # SPEC. =	6.5	+/- 1.5
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	1.63207	+/- .158564
S-W DIV(WT) =	.955221	+/- .113509
EVEN. (NO) =	.888325	+/- .272126E-01
EVEN (WT) =	.518468	+/- .451825E-02
W.B. INDEX =	5.41403	+/- .327296
MOD. I.W.B. =	4.91579	+/- .638104

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
104	CARP	1	2.78	2.390	43.22	2.390	1.250	2.988
107	WHITE SUCKER	1	2.78	0.350	6.33	0.350	1.250	0.438
114	GOLDEN REDHORSE	3	8.33	1.390	25.14	0.463	3.750	1.738
139	SPOTFIN SHINER	1	2.78	0.020	0.36	0.020	1.250	0.025
143	BLUNTNOSE MINNOW	4	11.11	0.004	0.07	0.001	5.000	0.005
158	COMMON SHINER	3	8.33	0.100	1.81	0.033	3.750	0.125
165	ROCKBASS	13	36.11	0.646	11.68	0.050	16.250	0.808
167	GREEN SUNFISH	2	5.56	0.021	0.38	0.011	2.500	0.026
171	SMALLMOUTH BASS	4	11.11	0.605	10.94	0.151	5.000	0.756
187	JOHNNY DARTER	4	11.11	0.004	0.07	0.001	5.000	0.005
TOTALS- 10	SPECIES	36	100.00	5.530	100.00	0.154	45.000	6.912

Table B: (Con't.)

River: EEL River mile: 41.4 (Taylor site 2)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	123.75	+/- 31.25
WT./KM. =	3.23875	+/- 1.20625
AVE # SPEC. =	12	+/- 0
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	2.05321	+/- .180466E-01
S-W DIV(WT) =	1.7174	+/- .091055
EVEN. (NO) =	.826271	+/- .725472E-02
EVEN (WT) =	.691133	+/- .366439E-01
W.B. INDEX =	6.71353	+/- .433778
MOD. I.W.B. =	6.53009	+/- .600264

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/
23	GRASS PICKEREL	3	3.03	0.010	0.39	0.003	3.750	0.
29	BLACK BULLHEAD	1	1.01	0.003	0.12	0.003	1.250	0.
107	WHITE SUCKER	1	1.01	0.035	1.35	0.035	1.250	0.
109	NRTHRN HOGSUCKER	4	4.04	0.480	18.53	0.120	5.000	0.
111	SPOTTED SUCKER	2	2.02	0.420	16.21	0.210	2.500	0.
114	GOLDEN REDHORSE	8	8.08	0.130	5.02	0.016	10.000	0.
139	SPOTFIN SHINER	6	6.06	0.029	1.12	0.005	7.500	0.
143	BLUNTNOSE MINNOW	17	17.17	0.029	1.12	0.002	21.250	0.
147	STONEROLLER	2	2.02	0.010	0.39	0.005	2.500	0.
157	RIVER CHUB	18	18.18	0.594	22.93	0.033	22.500	0.
158	COMMON SHINER	16	16.16	0.370	14.28	0.023	20.000	0.
165	ROCKBASS	9	9.09	0.225	8.68	0.025	11.250	0.
167	GREEN SUNFISH	1	1.01	0.004	0.15	0.004	1.250	0.
170	LONGEAR SUNFISH	5	5.05	0.093	3.59	0.019	6.250	0.
171	SMALLMOUTH BASS	4	4.04	0.150	5.79	0.038	5.000	0.
183	GREENSIDE DARTER	1	1.01	0.004	0.15	0.004	1.250	0.
225	REDFIN SHINER	1	1.01	0.005	0.19	0.005	1.250	0.
TOTALS- 17	SPECIES	99	100.00	2.591	100.00	0.026	123.750	3.

Table B: (Con't.)

River: EEL River mile: 46.4 (Taylor site 3)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	76.25	+/- 13.75
WT./KM. =	6.91875	+/- 5.06875
AVE # SPEC. =	9.5	+/- 1.5
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	1.87915	+/- .101304
S-W DIV(WT) =	1.23997	+/- .291807E-01
EVEN. (NO) =	.840439	+/- .145238E-01
EVEN (WT) =	.557634	+/- .526979E-01
W.B. INDEX =	6.05262	+/- .630454
MOD. I.W.B. =	5.60499	+/- .205927

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
104	CARP	2	3.28	3.118	56.33	1.559	2.500	3.898
109	NRTHRN HOGSUCKER	14	22.95	1.025	18.52	0.073	17.500	1.281
114	GOLDEN REDHORSE	4	6.56	0.140	2.53	0.035	5.000	0.175
139	SPOTFIN SHINER	6	9.84	0.049	0.89	0.008	7.500	0.061
143	BLUNTNOSE MINNOW	1	1.64	0.004	0.07	0.004	1.250	0.005
148	CREEK CHUB	10	16.39	0.420	7.59	0.042	12.500	0.525
157	RIVER CHUB	5	8.20	0.195	3.52	0.039	6.250	0.244
158	COMMON SHINER	10	16.39	0.280	5.06	0.028	12.500	0.350
165	ROCKBASS	3	4.92	0.190	3.43	0.063	3.750	0.238
169	BLUEGILL	1	1.64	0.040	0.72	0.040	1.250	0.050
170	LONGEAR SUNFISH	2	3.28	0.004	0.07	0.002	2.500	0.005
177	REDEAR SUNFISH	1	1.64	0.060	1.08	0.060	1.250	0.075
225	REDFIN SHINER	2	3.28	0.010	0.18	0.005	2.500	0.012
TOTALS- 13	SPECIES	61	100.00	5.535	100.00	0.091	76.250	6.919

Table B: (Con't.)

River: EEL River mile: 51.7 (Taylor site 4)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	98.75	+/- 1.25
WT./KM. =	11.4725	+/- 2.065
AVE # SPEC. =	12	+/- 0
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	2.13741	+/- .814918E-01
S-W DIV(WT) =	1.55316	+/- .178309
EVEN. (NO) =	.860156	+/- .327922E-01
EVEN (WT) =	.625037	+/- .071757
W.B. INDEX =	7.19857	+/- .162474
MOD. I.W.B. =	6.77474	+/- .299345

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM
23	GRASS PICKEREL	4	5.06	0.067	0.73	0.017	5.000	0.08
104	CARP	2	2.53	3.430	37.37	1.715	2.500	4.28
107	WHITE SUCKER	3	3.80	0.500	5.45	0.167	3.750	0.62
109	NRTHRN HOGSUCKER	6	7.59	0.750	8.17	0.125	7.500	0.93
111	SPOTTED SUCKER	3	3.80	0.100	1.09	0.033	3.750	0.12
113	BLACK REDHORSE	1	1.27	0.020	0.22	0.020	1.250	0.02
114	GOLDEN REDHORSE	15	18.99	3.225	35.14	0.215	18.750	4.03
139	SPOTFIN SHINER	2	2.53	0.018	0.20	0.009	2.500	0.02
143	BLUNTNOSE MINNOW	12	15.19	0.040	0.44	0.003	15.000	0.05
158	COMMON SHINER	11	13.92	0.434	4.73	0.039	13.750	0.54
165	ROCKBASS	9	11.39	0.405	4.41	0.045	11.250	0.50
167	GREEN SUNFISH	2	2.53	0.023	0.25	0.012	2.500	0.02
170	LONGEAR SUNFISH	4	5.06	0.025	0.27	0.006	5.000	0.03
171	SMALLMOUTH BASS	3	3.80	0.070	0.76	0.023	3.750	0.08
177	REDEAR SUNFISH	1	1.27	0.070	0.76	0.070	1.250	0.08
187	JOHNNY DARTER	1	1.27	0.001	0.01	0.001	1.250	0.00
TOTALS- 16	SPECIES	79	100.00	9.178	100.00	0.116	98.750	11.47

Table B: (Con't.)

River: EEL River mile: 56.5 (Taylor site 5)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	51.25	+/- 28.75
WT./KM. =	8.07125	+/- 6.43375
AVE # SPEC. =	7.5	+/- 2.5
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	1.76279	+/- .335727
S-W DIV(WT) =	1.01073	+/- .166326
EVEN. (NO) =	.899028	+/- .012343
EVEN (WT) =	.549035	+/- .182313
W.B. INDEX =	5.43932	+/- 1.03186
MOD. I.W.B. =	4.61751	+/- .92886

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
104	CARP	2	4.88	4.649	72.00	2.325	2.500	5.811
107	WHITE SUCKER	5	12.20	0.475	7.36	0.095	6.250	0.594
109	NRTHRN HOGSUCKER	6	14.63	0.249	3.86	0.042	7.500	0.311
139	SPOTFIN SHINER	3	7.32	0.015	0.23	0.005	3.750	0.019
157	RIVER CHUB	5	12.20	0.185	2.87	0.037	6.250	0.231
158	COMMON SHINER	5	12.20	0.130	2.01	0.026	6.250	0.163
165	ROCKBASS	10	24.39	0.607	9.40	0.061	12.500	0.759
167	GREEN SUNFISH	1	2.44	0.010	0.15	0.010	1.250	0.012
171	SMALLMOUTH BASS	1	2.44	0.120	1.86	0.120	1.250	0.150
204	MOTTLED SCULPIN	3	7.32	0.017	0.26	0.006	3.750	0.021
TOTALS- 10	SPECIES	41	100.00	6.457	100.00	0.157	51.250	8.071

Table B: (Con't.)

River: EEL River mile: 63.5 (Taylor site 6)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	170	+/- 15
WT./KM. =	6.1505	+/- 1.5195
AVE # SPEC. =	11	+/- 1
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	2.09188	+/- .103322
S-W DIV(WT) =	1.69323	+/- .323041E-01
EVEN. (NO) =	.873519	+/- .989899E-02
EVEN (WT) =	.707867	+/- .134588E-01
W.B. INDEX =	7.24358	+/- .305993
MOD. I.W.B. =	6.6811	+/- .205357

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM
30	YELLOW BULLHEAD	1	0.74	0.025	0.51	0.025	1.250	0.03
107	WHITE SUCKER	25	18.38	1.715	34.85	0.069	31.250	2.14
109	NRTHRN HOGSUCKER	25	18.38	1.296	26.35	0.052	31.250	1.62
143	BLUNTNOSE MINNOW	6	4.41	0.026	0.53	0.004	7.500	0.03
147	STONEROLLER	16	11.76	0.161	3.27	0.010	20.000	0.20
148	CREEK CHUB	19	13.97	0.648	13.17	0.034	23.750	0.81
151	SUCKERMTH MINNOW	1	0.74	0.010	0.20	0.010	1.250	0.01
158	COMMON SHINER	16	11.76	0.438	8.90	0.027	20.000	0.54
165	ROCKBASS	10	7.35	0.333	6.77	0.033	12.500	0.41
169	BLUEGILL	12	8.82	0.247	5.02	0.021	15.000	0.30
170	LONGEAR SUNFISH	1	0.74	0.010	0.20	0.010	1.250	0.01
185	FANTAIL DARTER	3	2.21	0.008	0.16	0.003	3.750	0.01
190	BLACKSIDE DARTER	1	0.74	0.003	0.06	0.003	1.250	0.00
TOTALS- 13	SPECIES	136	100.00	4.920	100.00	0.036	170.000	6.15

Table B: (Con't.)

River: EEL River mile: 66.0 (Taylor site 7)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	92.5	+/- 22.5
WT./KM. =	4.14125	+/- 1.54375
AVE # SPEC. =	10.5	+/- 2.5
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	2.05074	+/- .163362
S-W DIV(WT) =	1.64633	+/- .266735
EVEN. (NO) =	.885425	+/- .222114E-01
EVEN (WT) =	.704646	+/- .412019E-01
W.B. INDEX =	6.61852	+/- .750025
MOD. I.W.B. =	5.8559	+/- .882117

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
21	CENTRL MUDMINNOW	2	2.70	0.015	0.45	0.008	2.500	0.019
23	GRASS PICKEREL	3	4.05	0.070	2.11	0.023	3.750	0.088
107	WHITE SUCKER	10	13.51	1.225	36.98	0.123	12.500	1.531
109	NRTHRN HOGSUCKER	1	1.35	0.430	12.98	0.430	1.250	0.538
143	BLUNTNOSE MINNOW	5	6.76	0.018	0.54	0.004	6.250	0.023
148	CREEK CHUB	7	9.46	0.410	12.38	0.059	8.750	0.513
158	COMMON SHINER	4	5.41	0.180	5.43	0.045	5.000	0.225
165	ROCKBASS	5	6.76	0.630	19.02	0.126	6.250	0.788
167	GREEN SUNFISH	11	14.86	0.086	2.60	0.008	13.750	0.108
169	BLUEGILL	14	18.92	0.177	5.34	0.013	17.500	0.221
170	LONGEAR SUNFISH	9	12.16	0.066	1.99	0.007	11.250	0.083
175	SPOTTED BASS	1	1.35	0.004	0.12	0.004	1.250	0.005
187	JOHNNY DARTER	2	2.70	0.002	0.06	0.001	2.500	0.003
TOTALS- 13	SPECIES	74	100.00	3.313	100.00	0.045	92.500	4.141

Table B: (Con't.)

River: EEL River mile: 70.3 (Taylor site 8)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	135	+/- 65
WT./KM. =	6.64	+/- 1.7875
AVE # SPEC. =	12	+/- 4
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	2.04519	+/- .237509
S-W DIV(WT) =	1.24739	+/- .458988
EVEN. (NO) =	.84631	+/- .230011E-01
EVEN (WT) =	.497296	+/- .118152
W.B. INDEX =	6.60704	+/- 1.09695
MOD. I.W.B. =	4.94258	+/- 1.42276

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM
21	CENTRL MUDMINNOW	2	1.85	0.023	0.43	0.012	2.500	0.02
23	GRASS PICKEREL	4	3.70	0.092	1.73	0.023	5.000	0.11
104	CARP	1	0.93	1.417	26.68	1.417	1.250	1.77
107	WHITE SUCKER	19	17.59	2.413	45.43	0.127	23.750	3.01
140	SAND SHINER	1	0.93	0.001	0.02	0.001	1.250	0.00
143	BLUNTNOSE MINNOW	32	29.63	0.075	1.41	0.002	40.000	0.09
148	CREEK CHUB	7	6.48	0.275	5.18	0.039	8.750	0.34
153	SILVERJAW MINNOW	3	2.78	0.006	0.11	0.002	3.750	0.00
157	RIVER CHUB	1	0.93	0.020	0.38	0.020	1.250	0.02
158	COMMON SHINER	6	5.56	0.103	1.94	0.017	7.500	0.12
165	ROCKBASS	9	8.33	0.435	8.19	0.048	11.250	0.54
167	GREEN SUNFISH	10	9.26	0.346	6.51	0.035	12.500	0.43
169	BLUEGILL	5	4.63	0.080	1.51	0.016	6.250	0.10
170	LONGEAR SUNFISH	3	2.78	0.015	0.28	0.005	3.750	0.01
175	SPOTTED BASS	1	0.93	0.005	0.09	0.005	1.250	0.00
187	JOHNNY DARTER	4	3.70	0.006	0.11	0.002	5.000	0.00
TOTALS- 16	SPECIES	108	100.00	5.312	100.00	0.049	135.000	6.64

Table B: (Con't.)

River: EEL River mile: 79.8 (Taylor site 11)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	120	+/- 30
WT./KM. =	4.565	+/- 2.68
AVE # SPEC. =	11.5	+/- 1.5
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	1.95072	+/- .380828E-01
S-W DIV(WT) =	1.75301	+/- .42489
EVEN. (NO) =	.804706	+/- .059022
EVEN (WT) =	.712946	+/- .136153
W.B. INDEX =	6.7349	+/- .177927
MOD. I.W.B. =	6.07286	+/- .412156

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
21	CENTRL MUDMINNOW	3	3.13	0.016	0.44	0.005	3.750	0.020
30	YELLOW BULLHEAD	1	1.04	0.010	0.27	0.010	1.250	0.012
107	WHITE SUCKER	13	13.54	1.840	50.38	0.142	16.250	2.300
109	NRTHRN HOGSUCKER	2	2.08	0.350	9.58	0.175	2.500	0.438
143	BLUNTNOSE MINNOW	14	14.58	0.041	1.12	0.003	17.500	0.051
147	STONEROLLER	3	3.13	0.046	1.26	0.015	3.750	0.058
148	CREEK CHUB	3	3.13	0.095	2.60	0.032	3.750	0.119
150	BLACKNOSE DACE	1	1.04	0.002	0.05	0.002	1.250	0.003
157	RIVER CHUB	1	1.04	0.025	0.68	0.025	1.250	0.031
158	COMMON SHINER	3	3.13	0.120	3.29	0.040	3.750	0.150
165	ROCKBASS	5	5.21	0.385	10.54	0.077	6.250	0.481
167	GREEN SUNFISH	7	7.29	0.122	3.34	0.017	8.750	0.153
169	BLUEGILL	9	9.38	0.082	2.25	0.009	11.250	0.103
170	LONGEAR SUNFISH	24	25.00	0.120	3.29	0.005	30.000	0.150
172	LARGEMOUTH BASS	3	3.13	0.350	9.58	0.117	3.750	0.438
173	WHITE CRAPPIE	3	3.13	0.033	0.90	0.011	3.750	0.041
177	REDEAR SUNFISH	1	1.04	0.015	0.41	0.015	1.250	0.019
TOTALS- 17	SPECIES	96	100.00	3.652	100.00	0.038	120.000	4.565

Table B: (Con't.)

River: Blue R. below Columbia City (Taylor site 9)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	351.25	+/- 36.25
WT./KM. =	28.6808	+/- 15.2942
AVE # SPEC. =	13	+/- 2
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	1.85371	+/- .283133
S-W DIV(WT) =	.979805	+/- .193048
EVEN. (NO) =	.722024	+/- .670449E-01
EVEN (WT) =	.380601	+/- .524978E-01
W.B. INDEX =	7.35605	+/- .127043
MOD. I.W.B. =	6.04965	+/- .982987E-01

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM
21	CENTRL MUDMINNOW	1	0.36	0.010	0.04	0.010	1.250	0.01
23	GRASS PICKEREL	1	0.36	0.008	0.03	0.008	1.250	0.01
107	WHITE SUCKER	95	33.81	17.710	77.19	0.186	118.750	22.13
109	NRTHRN HOGSUCKER	5	1.78	1.020	4.45	0.204	6.250	1.27
140	SAND SHINER	1	0.36	0.001	0.00	0.001	1.250	0.00
143	BLUNTNOSE MINNOW	15	5.34	0.080	0.35	0.005	18.750	0.10
147	STONEROLLER	5	1.78	0.089	0.39	0.018	6.250	0.11
148	CREEK CHUB	43	15.30	1.051	4.58	0.024	53.750	1.31
150	BLACKNOSE DACE	1	0.36	0.006	0.03	0.006	1.250	0.00
158	COMMON SHINER	46	16.37	1.080	4.71	0.023	57.500	1.35
165	ROCKBASS	46	16.37	1.700	7.41	0.037	57.500	2.12
167	GREEN SUNFISH	5	1.78	0.115	0.50	0.023	6.250	0.14
169	BLUEGILL	5	1.78	0.023	0.10	0.005	6.250	0.02
170	LONGEAR SUNFISH	10	3.56	0.048	0.21	0.005	12.500	0.06
175	SPOTTED BASS	1	0.36	0.003	0.01	0.003	1.250	0.00
187	JOHNNY DARTER	1	0.36	0.001	0.00	0.001	1.250	0.00
TOTALS- 16	SPECIES	281	100.00	22.945	100.00	0.082	351.250	28.68

Table B: (Con't.)

River: Blue River above Columbia City (Taylor site 10)

OF CATCHES: 2
TOTAL # KM FISHED: .8

# CT./KM. =	216.25	+/- 61.25
WT./KM. =	19.3079	+/- 5.03791
AVE # SPEC. =	11	+/- 0
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	1.51347	+/- .122129
S-W DIV(WT) =	.989137	+/- .625643E-01
EVEN. (NO) =	.631165	+/- .509321E-01
EVEN (WT) =	.412502	+/- .260914E-01
W.B. INDEX =	6.63255	+/- .219577
MOD. I.W.B. =	4.45411	+/- .247508

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
104	CARP	2	1.16	1.150	7.45	0.575	2.500	1.438
107	WHITE SUCKER	86	49.71	10.580	68.50	0.123	107.500	13.225
109	NRTHRN HOGSUCKER	5	2.89	0.567	3.67	0.113	6.250	0.709
143	BLUNTNOSE MINNOW	4	2.31	0.032	0.21	0.008	5.000	0.040
147	STONEROLLER	1	0.58	0.012	0.08	0.012	1.250	0.015
148	CREEK CHUB	47	27.17	2.564	16.60	0.055	58.750	3.205
150	BLACKNOSE DACE	1	0.58	0.004	0.03	0.004	1.250	0.005
158	COMMON SHINER	12	6.94	0.345	2.23	0.029	15.000	0.431
165	ROCKBASS	3	1.73	0.090	0.58	0.030	3.750	0.113
167	GREEN SUNFISH	1	0.58	0.020	0.13	0.020	1.250	0.025
169	BLUEGILL	1	0.58	0.007	0.05	0.007	1.250	0.009
170	LONGEAR SUNFISH	5	2.89	0.064	0.41	0.013	6.250	0.080
187	JOHNNY DARTER	5	2.89	0.011	0.07	0.002	6.250	0.014
TOTALS- 13	SPECIES	173	100.00	15.446	100.00	0.089	216.250	19.308

Table B: (Con't.)

River: Sugar Creek (Taylor site 12)

OF CATCHES: 1
TOTAL # KM FISHED: .4

# CT./KM. =	667.5	+/- 0
WT./KM. =	13.3775	+/- 0
AVE # SPEC. =	11	+/- 0
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	1.74785	+/- 0
S-W DIV(WT) =	1.28308	+/- 0
EVEN. (NO) =	.728908	+/- 0
EVEN (WT) =	.535085	+/- 0
W.B. INDEX =	7.57948	+/- 0
MOD. I.W.B. =	6.21528	+/- 0

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM
107	WHITE SUCKER	54	20.22	3.240	60.55	0.060	135.000	8.10
109	NRTHRN HOGSUCKER	1	0.37	0.260	4.86	0.260	2.500	0.65
143	BLUNTNOSE MINNOW	55	20.60	0.275	5.14	0.005	137.500	0.68
147	STONEROLLER	2	0.75	0.016	0.30	0.008	5.000	0.04
148	CREEK CHUB	66	24.72	0.792	14.80	0.012	165.000	1.98
150	BLACKNOSE DACE	11	4.12	0.031	0.58	0.003	27.500	0.07
153	SILVERJAW MINNOW	62	23.22	0.620	11.59	0.010	155.000	1.55
158	COMMON SHINER	11	4.12	0.088	1.64	0.008	27.500	0.22
165	ROCKBASS	1	0.37	0.020	0.37	0.020	2.500	0.05
167	GREEN SUNFISH	2	0.75	0.007	0.13	0.004	5.000	0.01
187	JOHNNY DARTER	2	0.75	0.002	0.04	0.001	5.000	0.00
TOTALS- 11	SPECIES	267	100.00	5.351	100.00	0.020	667.500	13.37

Table B: (Con't.)

River: Beargrass Creek (Taylor site 13)

OF CATCHES: 1
TOTAL # KM FISHED: .4

# CT./KM. =	317.5	+/- 0
WT./KM. =	18.8948	+/- 0
AVE # SPEC. =	10	+/- 0
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	1.86338	+/- 0
S-W DIV(WT) =	.373344	+/- 0
EVEN. (NO) =	.809256	+/- 0
EVEN (WT) =	.162141	+/- 0
W.B. INDEX =	6.58641	+/- 0
MOD. I.W.B. =	4.54973	+/- 0

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
107	WHITE SUCKER	41	32.28	7.025	92.94	0.171	102.500	17.562
143	BLUNTNOSE MINNOW	16	12.60	0.055	0.73	0.003	40.000	0.137
147	STONEROLLER	23	18.11	0.173	2.28	0.008	57.500	0.431
148	CREEK CHUB	18	14.17	0.135	1.79	0.007	45.000	0.337
150	BLACKNOSE DACE	9	7.09	0.018	0.24	0.002	22.500	0.045
158	COMMON SHINER	13	10.24	0.110	1.45	0.008	32.500	0.275
165	ROCKBASS	2	1.57	0.025	0.33	0.013	5.000	0.063
167	GREEN SUNFISH	3	2.36	0.010	0.13	0.003	7.500	0.025
187	JOHNNY DARTER	1	0.79	0.002	0.03	0.002	2.500	0.005
190	BLACKSIDE DARTER	1	0.79	0.006	0.08	0.006	2.500	0.015
TOTALS- 10	SPECIES	127	100.00	7.558	100.00	0.060	317.500	18.895

Table B: (Con't.)

River: PawPaw Creek (Taylor site 14)

OF CATCHES: 1
TOTAL # KM FISHED: .4

# CT./KM. =	197.5	+/- 0
WT./KM. =	8.0325	+/- 0
AVE # SPEC. =	14	+/- 0
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	2.08979	+/- 0
S-W DIV(WT) =	1.8215	+/- 0
EVEN. (NO) =	.791871	+/- 0
EVEN (WT) =	.690209	+/- 0
W.B. INDEX =	7.59591	+/- 0
MOD. I.W.B. =	7.46806	+/- 0

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM
109	NRTHRN HOGSUCKER	5	6.33	0.591	18.39	0.118	12.500	1.47
113	BLACK REDHORSE	2	2.53	0.095	2.96	0.048	5.000	0.23
116	GREATER REDHORSE	8	10.13	1.394	43.39	0.174	20.000	3.48
143	BLUNTNOSE MINNOW	4	5.06	0.016	0.50	0.004	10.000	0.04
147	STONEROLLER	31	39.24	0.217	6.75	0.007	77.500	0.54
148	CREEK CHUB	3	3.80	0.150	4.67	0.050	7.500	0.37
151	SUCKERMTH MINNOW	1	1.27	0.003	0.09	0.003	2.500	0.00
158	COMMON SHINER	8	10.13	0.139	4.32	0.017	20.000	0.34
165	ROCKBASS	6	7.59	0.252	7.84	0.042	15.000	0.63
167	GREEN SUNFISH	5	6.33	0.113	3.53	0.023	12.500	0.28
171	SMALLMOUTH BASS	1	1.27	0.210	6.54	0.210	2.500	0.52
187	JOHNNY DARTER	3	3.80	0.006	0.19	0.002	7.500	0.01
225	REDFIN SHINER	1	1.27	0.002	0.06	0.002	2.500	0.00
255	SILVER SHINER	1	1.27	0.025	0.78	0.025	2.500	0.06
TOTALS- 14	SPECIES	79	100.00	3.213	100.00	0.041	197.500	8.03

Table B: (Con't.)

River: Squirrel Creek (Taylor site 15)

OF CATCHES: 1
TOTAL # KM FISHED: .4

# CT./KM. =	95	+/- 0
WT./KM. =	4.66	+/- 0
AVE # SPEC. =	11	+/- 0
AVE TEMP =	0	+/- 0
S-W DIV(NO) =	2.14715	+/- 0
S-W DIV(WT) =	1.40649	+/- 0
EVEN. (NO) =	.895431	+/- 0
EVEN (WT) =	.58655	+/- 0
W.B. INDEX =	6.60008	+/- 0
MOD. I.W.B. =	6.13884	+/- 0

###	NAME	# CT.	% CT.	WT.(KG)	% WT.	AV. WT.	#/KM	WT/KM.
107	WHITE SUCKER	4	10.53	0.431	23.12	0.108	10.000	1.078
109	NRTHRN HOGSUCKER	7	18.42	0.892	47.85	0.127	17.500	2.230
116	GREATER REDHORSE	3	7.89	0.054	2.90	0.018	7.500	0.135
143	BLUNTNOSE MINNOW	1	2.63	0.006	0.32	0.006	2.500	0.015
148	CREEK CHUB	7	18.42	0.344	18.45	0.049	17.500	0.860
150	BLACKNOSE DACE	2	5.26	0.004	0.21	0.002	5.000	0.010
157	RIVER CHUB	1	2.63	0.023	1.23	0.023	2.500	0.058
158	COMMON SHINER	7	18.42	0.075	4.02	0.011	17.500	0.188
170	LONGEAR SUNFISH	1	2.63	0.006	0.32	0.006	2.500	0.015
187	JOHNNY DARTER	1	2.63	0.001	0.05	0.001	2.500	0.003
190	BLACKSIDE DARTER	4	10.53	0.028	1.50	0.007	10.000	0.070
TOTALS- 11	SPECIES	38	100.00	1.864	100.00	0.049	95.000	4.660

Table C: Physical data for Eel River tributaries.

Tributary	RM Location	Order	NTU 7-16	NTU 7-17	DBA (mi^2)	%Forest
TwelveMile	10.0	2	22	18	53.1	26.5
Weesaw	23.1	2	7	8	23.2	40.9
Washonis	27.1	2	8	10	6.0	19.5
Flowers	27.4	2	10	18	9.9	21.1
PawPaw	32.2	3	7	13	54.9	12.2
Squirrel	36.9	3	19	31	39.9	-
Beargrass	40.9	2	8	18	23.2	7.0
Silver	44.0	2	17	18	31.3	-
Otter	46.9	1	22	26	10.0	13.0
Clear	48.8	2	14	12	20.7	7.7
Pont	51.4	2	18	16	29.4	7.7
Swank	54.2	1	18	18	9.9	18.7
Simonton	54.9	2	-	28	12.3	10.4
Wheeler	58.3	1	-	11	5.4	-
Plunge	59.3	2	6	6	12.7	15.9
Hurricane	59.4	1	-	37	11.7	-
Crazy	61.0	1	12	12	14.3	-
Sugar	66.6	2	20	26	30.7	8.7
Stony	71.7	1	14	18	12.6	-
Blue River	75.1	3	36	26	80.6	11.2
Gangwer Ditch	75.4	1	12	17	19.8	7.6
Solon Ditch	81.6	2	28	27	8.2	11.1
Johnson Drain	88.8	2	10	28	8.6	8.5
Johnson Ditch	89.5	2	89	30	11.1	16.0
Dawson Ditch	91.9	1	18	14	4.0	13.6
Benward Ditch	92.0	2	6	7	8.7	18.2
Geller Ditch	93.0	1	-	17	5.9	9.9

Table D: Turbidity (NTU) of mainstem Eel River.

River Mile	6-12-90	7-16-90	7-17-90
8.3	-	37	52
12.0	45	-	-
19.0	45	-	-
27.3	45	33	35
37.8	-	30	39
42.5	45	-	-
52.5	-	21	38
63.5	46	59	33
66.0	46	20	14
79.8	-	16	14
82.0	46	-	-
86.0	47	44	44
88.0	48	-	-
90.0	-	69	47
95.0	-	10	17

Table E: Mean summer discharge (cfs) of the Eel River at Logansport from 1970 to 1988.

	Month				Summer
Year	May	June	July	August	Mean
1970	1204	368	259	277	527
1971	605	900	220	168	473
1972	719	436	402	281	460
1973	616	1239	450	644	737
1974	1390	667	258	190	626
1975	832	2208	450	436	982
1976	412	417	317	209	339
1977	403	241	501	608	438
1978	950	486	304	181	480
1979	606	291	239	403	385
1980	484	1308	272	578	661
1981	1644	2134	462	272	1128
1982	688	1043	383	237	588
1983	1827	452	251	165	674
1984	1297	547	435	316	649
1985	479	494	223	324	380
1986	716	2015	1184	313	1057
1987	705	370	219	283	394
1988	351	176	140	139	202
1989	485	1573	361	217	659
1990[a]	1040	616	735	2122	1128

[a] Provisional estimates

Table F: Measured and estimated suspended solids concentration (mg/l) for the Eel River during summer months. Values were measured from 1974 through 1980 and estimated from 1981 through 1990.

Year	Month				Summer Mean
	May	June	July	August	
1974	165	218	38	53	119
1975	177	504	112	94	222
1976	47	81	81	97	77
1977	42	64	135	94	84
1978	52	68	54	44	54
1979	34	46	48	70	50
1980	63	196	53	112	106
1981	298	386	84	50	205
1982	125	189	70	43	107
1983	331	82	46	30	122
1984	235	100	79	58	118
1985	87	90	41	59	69
1986	130	365	215	57	192
1987	128	68	40	52	72
1988	64	32	26	26	37
1989	88	285	66	40	120
1990[a]	189	112	134	385	205

[a] Based on provisional estimates of discharge.