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Fishes of Crowley's Ridge in Arkansas

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The Fishes of Crowley's Ridge in Arkansas

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ABSTRACT

Crowley's Ridge is one of the six natural geographic divisions of Arkansas which rises out of the Mississippi embayment as a relatively steep, uncultivated loessial mass. The ridge is drained by a network of headwater streams which are relatively clear with alkaline pH values and uniformly low alkalinity values. Carbon dioxide values were moderate and oxygen values were adequate.

The fish species collected were basically headwater in composition. Isolated groups of characteristically upland species indicate that environmental quality of adjacent deltaic streams was better at one time.

INTRODUCTION

No comprehensive study of the fishes or physicochemical characteristics of streams on Crowley's Ridge has been made prior to this study. Beadles (1970) studied the effect of domestic effluent on fishes in Lost Creek in Craighead County. Jenkins and Harp (1971) investigated the fish populations of upper Bayou DeView in Craighead and Greene Counties. Cather and Harp (1975) investigated the benthic macroinvertebrates and limited physicochemical characteristics of Big Creek in Craighead County.

Since topography has hindered cultivation on the ridge, relatively few streams have been channelized as yet. The purposes of this study were to locate any relict fish populations and to discern relationships which may explain their present distribution as revealed by coexisting physicochemical parameters. Crowley's Ridge is undergoing rapid changes due to increased population and intensified agricultural use. Studies of this type help elucidate the past and provide insight into trends molding the future of Crowley's Ridge.

DESCRIPTION OF AREA

Crowley's Ridge is one of the six natural geographic divisions of Arkansas. In northeastern Arkansas the ridge traverses the Gulf Coastal Plain in a general north-south arc passing through portions of Clay, Greene, Craighead, Poinsett, Cross, St. Francis, Lee, and Phillips Counties. It rises out of the Mississippi embayment as a relatively steep, uncultivated loessial mass in contrast to surrounding lowlands. At its northern Arkansas extremity in Clay County, the ridge rises to 152 m above sea level, while at its southern extremity, in Phillips County, it stands approximately 122 m above sea level. The width varies between 1.6 and 19.3 km. The ridge is not continuous but is broken by a number of wind and water gaps (Croneis, 1930).

Loessial hills comprise the major part of Crowley's Ridge which covers approximately 270,814 ha. The major soil type comprising the ridge is the Lorine Grenada Association. These soils are deep, medium textured, moderately and slowly permeable. The major soil associations adjoining the ridge to the east and west are Bottomlands and Terraces, and Loessial Plains, respectively. The Bottomlands and Terraces consist of broad alluvial plains, whereas the Loessial Plains comprise broad nearly-level areas (Soil Conservation Service, 1967).

The ridge is drained by a network of watercourses separated generally by narrow divides. The streams drain eastward into the St. Francis watershed and west into the Cache and L'Anguille River watersheds. Cache River is part of the White River drainage, and L'Anguille River empties into the St. Francis River near Marianna, Arkansas. Streams on the ridge were relatively shallow, narrow-channel passages with alternate pool and riffle areas. They were further typified either by a substrate of mud, sand and gravel, or by hard packed clay. The stream banks were alternately lined by cultivated fields and mixed forests, the latter consisting primarily of assorted hardwoods, willows, birch, and sweetgum.

METHODS AND MATERIALS

Forty-nine stations (Fig. 1) were sampled between 10 May 1975 and 17 March 1977. Forty-seven stations were sampled one time each and stations SF:22 and SF:24 were sampled two times each. Physicochemical data were taken one time each. Stations SF:1-31 drain eastward into the St. Francis watershed. Stations C:1-11 and L:1-7 drain west into the Cache and L'Anguille watersheds, respectively. Station locations are as follows:

SF:1	Quick Creek SW ¼ S21, T19N, R7E; Clay Co.
SF:2	Johnson Creek NC S6, T18N, R6E; Greene Co.
SF:3	Jordan Creek Jct. S1-12, T18N, R6E; Greene Co.
SF:4	Slavens Creek Jct S14-23, T18N, R6E; Green Co.
SF:5	Hurricane Creek S34, T17N, R6E; Greene Co.
SF:6	Locust Creek Jct S9-16, T17N, R5E; Greene Co.
SF:7	Jacks Creek S17, T17N, R5E; Greene Co.
SF:8	Eight Mile Creek S35, T16N, R5E; Greene Co.
SF:9	Village Creek Jct S16-21, T16N, R4E; Greene Co.
SF:10	Birch Creek Jct S3-10, T15N, R5E; Craighead Co.
SF:11	Thompson Creek SW ¼ S5, T15N, R4E; Craighead Co.
SF:12	Lost Creek S22, T14N, R4E; Craighead Co.
SF:13	Little Bay Ditch Jct S23-24, T14N, R4E; Craighead Co.
SF:14	Little Bay Ditch SW ¼ S28, T14N, R4E; Craighead Co.
SF:15	Little Bay Ditch NE ¼ S31, T14N, R4E; Craighead Co.
SF:16	Little Bay Ditch NW ¼ S36, T14N, R4E; Craighead Co.
SF:17	Little Bay Ditch SW ¼ S31, T14N, R4E; Craighead Co.
SF:18	Baker Creek SC S21, T11N, R3E; Poinsett Co.
SF:19	Big Creek Jct S3-4, T11N, R3E; Poinsett Co.
SF:20	Distress Creek Jct S21-22, T10N, R3E, Poinsett Co.
SF:21	Otter Creek SW ¼ S28, T9N, R3E; Poinsett Co.
SF:22	Sugar Creek S4, T9N, R3E; Cross Co.
SF:23	Pope Creek S29, T8N, R3E; Cross Co.
SF:24	Harefarm Creek S6, T7N, R3E; Cross Co.
SF:25	Apperos Creek S7, T7N, R3E; Cross Co.
SF:26	Willow Creek NE ¼ S16, T6N, R3E; Jct Cross-St. Francis Co.
SF:27	Crow Creek NE ¼ S36, T4N, R3E; St. Francis Co.
SF:28	Tuni Creek SW ¼ S20, T3N, R3E; St. Francis Co.
SF:29	Bear Creek NE ¼ S16, T1N, R3E; Lee Co.
SF:30	Storm Creek S20, T1S, R5E; Phillips Co.
SF:31	Spring Creek EC S29, T1S, R5E; Phillips Co.
C:1	Big Creek NW ¼ S16, T20N, R6E; Clay Co.
C:2	Boydsville Creek NW ¼ S36, T19N, R6E; Clay Co.
C:3	Mill Creek NE ¼ S24, T18N, R5E; Greene Co.
C:4	Big Creek SW ¼ S3, T18N, R5E; Greene Co.
C:5	Lick Creek S26, T17N, R4E; Greene Co.
C:6	Old Sugar Creek S15, T17N, R4E; Greene Co.
C:7	Old Sugar Creek SE ¼ S26, T16N, R4E; Greene Co.
C:8	Poplar Creek Jct S16-17, T16N, R3E; Greene Co.
C:9	Big Creek SE ¼ S21, T15N, R3E; Greene Co.
C:10	Mud Creek SW ¼ S18, T15N, R3E; Craighead Co.
C:11	Mud Creek Jct. S18-19, T14N, R3E; Craighead Co.
L:1	Bolivar Creek S12, T11N, R3E; Poinsett Co.
L:2	England Creek Jct. S1-36, T10N, R3E; Poinsett Co.
L:3	Hydrick Creek S35, T9N, R3E; Poinsett Co.
L:4	Prairie Creek Jct S34-3, T8N, R3E; Cross Co.
L:5	Caney Creek S25, T6N, R2E; Cross Co.
L:6	Lick Creek S8, T16N, R2E; Cross Co.
L:7	Taylor Creek S17, T6N, R2E; St. Francis Co.

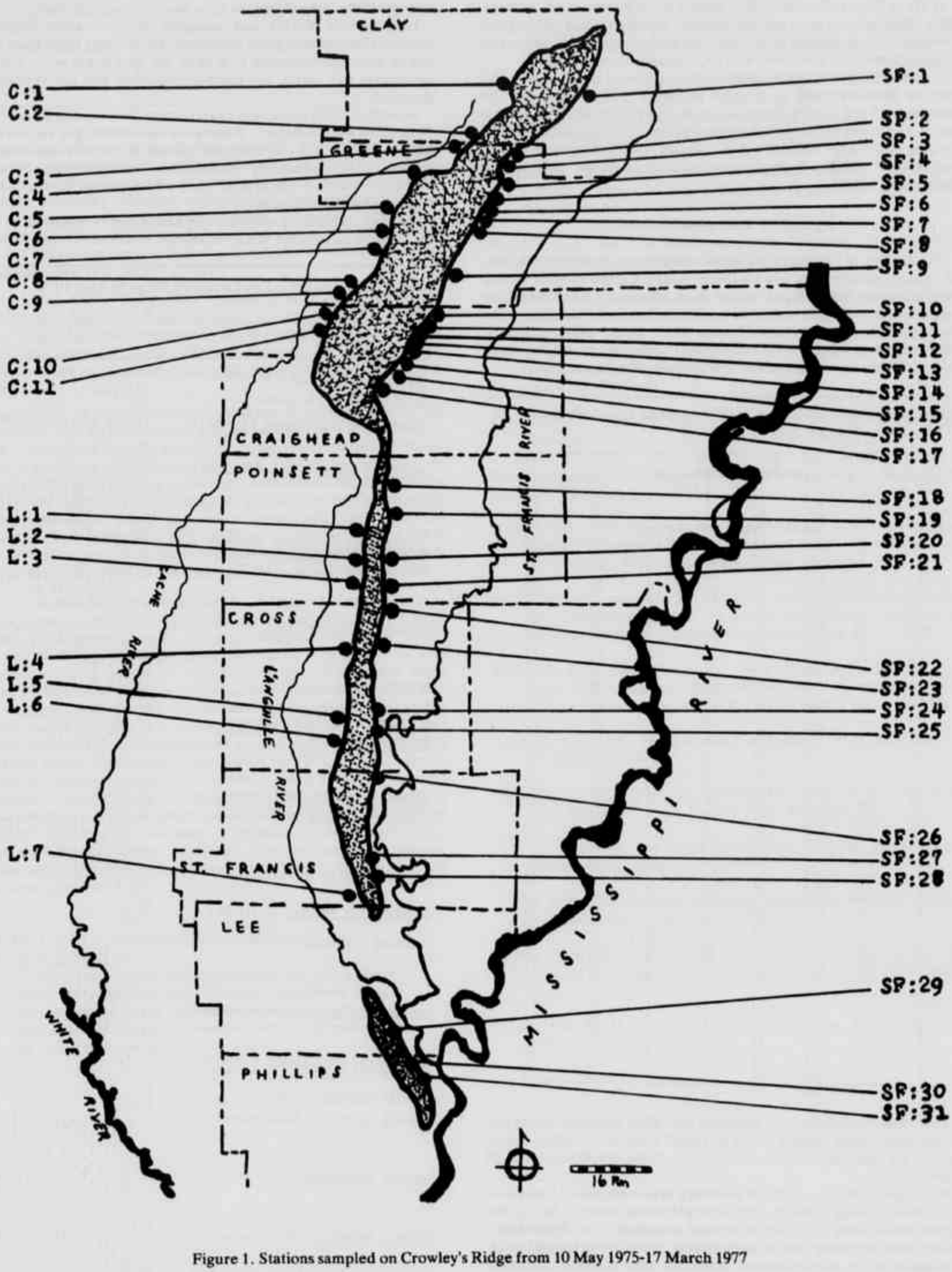

Figure 1. Stations sampled on Crowley's Ridge from 10 May 1975-17 March 1977

A Hach Water Chemistry Kit, Model A1-36B, was used to determine dissolved oxygen, carbon dioxide, alkalinity, and pH values. Turbidity was measured with a Jackson turbidimeter. Air and water temperatures were measured with a Centigrade thermometer.

Fishes were collected by seines ranging from 3.0x1.2 m with 3.2 mm bar measure mesh to 15.3x1.8 m with 6.3 mm bar mesh. The fishes were fixed in 10% formalin for three to seven days, washed in water, and preserved in 40% isopropyl alcohol. Identification was according to the keys of Eddy (1957), Moore (1969), Buchanan (1973), and Pflieger (1975). Nomenclature is in accordance with that of Bailey et al. (1970).

RESULTS AND DISCUSSION

The streams of Crowley's Ridge were relatively clear with alkaline pH values and uniformly low alkalinity values. Carbon dioxide values were moderate and oxygen values were adequate. Ambient water temperatures were due mainly to surface-volume relationships with the surrounding atmosphere (Odum, 1959; Reid, 1961). Physicochemical values (Table 1) indicated that topography and intensive land use of surrounding areas were dominant influences.

Table 1. Physicochemical values of streams on Crowley's Ridge, 10 May 1975-17 March 1977

Station	Turb. (ppm)	pH	Alk. (ppm)	CO_2 (ppm)	O_2 (ppm)	Air T °C	Water T °C
SF:1	---*	7.4	51	4	10	20	18
2	---	7.2	68	5	9	23	22
3	---	7.6	51	4	9	20	18
4	---	8.5	51	5	11	24	20
5	---	7.4	51	11	8	23	17
6	---	7.6	51	7	8	23	18
7	---	8.1	51	8	8	28	27
8	---	9.3	17	19	4	27	32
9	---	6.7	34	40	7	28	23
10	153	6.5	34	20	6	24	23
11	---	6.7	17	15	8	23	22
12	32	6.8	17	10	8	20	19
13	---	9.2	34	3	6	24	13
14	57	9.2	17	5	7	26	25
15	94	7.1	68	10	6	25	24
16	---	9.3	34	2	5	15	13
17	45	7.0	51	15	9	21	19
18	---	7.4	34	10	12	29	25
19	---	8.5	34	5	8	32	27
20	---	9.0	34	10	8	32	27
21	---	9.0	34	6	9	29	27
22	---	8.0	34	9	10	28	26
23	---	7.0	17	8	8	26	29
24	---	8.5	34	9	9	27	29
25	---	10.0	51	6	9	33	32
26	---	9.3	273	4	9	27	26
27	---	9.1	137	5	8	30	30
28	---	8.3	86	4	8	30	30
29	---	8.0	137	8	5	29	23
30	59	8.6	291	3	7	18	10
31	---	7.3	496	13	2	8	18
C:1	---	7.5	51	11	10	22	21
2	---	7.6	51	13	9	26	26
3	---	7.4	34	9	9	25	25
4	---	7.5	51	10	10	24	23
5	---	9.8	34	11	9	25	23
6	---	8.0	51	9	9	28	26
7	---	9.0	34	3	6	9	11
8	---	7.0	34	13	11	28	29
9	---	7.0	17	10	8	30	24
10	122	8.8	51	8	5	18	13
11	---	8.2	34	11	9	29	26
L:1	---	9.0	120	6	4	32	32
2	---	9.2	51	5	8	31	33
3	---	9.6	205	7	4	30	25
4	62	9.3	34	7	9	10	8
5	---	9.3	291	9	4	33	31
6	---	7.5	68	8	3	35	31
7	---	9.8	103	5	6	32	28

*--- Less than 25 ppm

Turbidimetric values were generally low. High turbidity values following heavy rains were a result of runoff from surrounding lands. Due to low gradient and decreased flow, these conditions were of short duration.

Fluctuating pH value and low alkalinity values suggested a relatively limited buffering capacity. Prevalent pH values were 6.7 to 8.2, but higher values were obtained on several occasions. The discordant values were primarily due to agricultural runoff from loessial soils, accumulation of allochthonous materials, and minimal buffering capacity. In light of alkalinity values and the absence of phenolpthalein alkalinity, pH values may have been erroneously high.

Low carbon dioxide and adequate oxygen values suggest the relative absence of organic pollutants. No effluent pipes from industries or municipalities were ever seen. An occasional sewer pipe from residences was found, but neither foul odors nor gas bubbles were detected.

A total of 7,272 specimens representing 33 species in 21 genera and 10 families were collected. Number of speciemens per station ranged from 4 to 525. Two to fourteen species were collected at a given station. Fish community composition in tributaries of Cache, L'Anguille and St. Francis rivers showed no obvious differences when compared with each other.

The fish community was basically headwater in composition (Table 2). Ubiquitous species were invariably headwater forms. *Semotilis*

Table 2. Fishes collected on Crowley's Ridge 10 May 1975-17 March 1977

Taxa	Stations
Dorosoma cepedianum (Rafinesque)	SF:14,15,29
Esox americanus	SF:11,31
Cyprinus carpio Linnaeus	SF:27 L:5
Notemigonus crysoleucas (Mitchill)	SF:4,8,10,12,14,15,17,20,26,31 C:2,5,6,9,10 L:5,6
Semotilis atromaculatus (Mitchill)	SF:2,3,4,5,6,7,8,9,10,11,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,30 C:1,2,3,5,6,7,8,9,10,11 L:2,3,4,6,7
Phoxinus erythrogaster (Rafinesque)	SF:22
Notropis atherinoides Rafinesque	SF:20
Notropis umbratilis (Girard)	SF:2,3,4,5,6,7,8,10,11,12,13,14,15,16,17,18,20,21,22,23,26,27 C:1,2,4,5,6,9,11 L:1,2,3,7
Notropis chrysocephalus (Rafinesque)	SF:1,2,3,4,5,6,8,9,10,11,13,14,15,16,18,19,20,21,22,23,24,25,26,27 C:1,2,3,5,6 L:2,3
Notropis venustus (Girard)	SF:6,8,9,14,17,20,25 C:4,6
Notropis lutrensis (Baird and Girard)	SF:26,27
Hybognathus nuchalis Agassiz	SF:20,25,26,27
Pimphales notatus (Rafinesque)	SF:6,8,13,25,27
Campostoma oligolepis Hubbs and Greene	SF:19,20,21,22,23,24,25,26,27 C:7 L:2
Campostoma anomalum (Agassiz)	SF:20,24
Minytrema melanops (Rafinesque)	SF:15
Erimyzon oblongus (Mitchill)	SF:3,4,5,6,7,8,10,11,14,16,17,18,21,22,23,25,26,31 C:1,2,3,4,5,8,9,10,11 L:2,3,4,6,7
Ictalurus melas (Rafinesque)	SF:2,8,10,28,29 C:2,8 L:4
Aphredoderus sayanus (Gilliams)	SF:10 C:10
Fundulus olivaceus (Storer)	SF:1,2,3,4,5,6,7,8,9,10 11,12,13,14,15,17,19,20,21,22,24,25,27,28,30 C:1,2,3,4,5,6,7,8,9,10,11 L:1,2,4,7
Gambusia affinis (Baird and Girard)	SF:1,2,3,4,5,6,7,8,10,14,17,26,27,31 C:6 L:2,5,7
Micropterus punctulatus (Rafinesque)	SF:7,8
Micropterus salmoides (Lacepede)	SF:15,25,27 L:5
Lepomis gulosus (Cuvier)	SF:13,14,30 C:10
Lepomis cyanellus Rafinesque	SF:1,2,3,4,5,6,8,9,10,11,12,13,14,16,17,18,19,20,21,26,30,31 C:1,2,3,4,5,6,8,9,10 L:1,2,3,4,5,6,7
Lepomis macrochirus (Rafinesque)	SF:3,6,7,8,11,12,13,14,15,17,20,23,25,26,27,28,31 C:2,3,4,5 L:3
Lepomis megalotis (Rafinesque)	SF:7,8,9,13,14,15,19,22,25,30 C:5,6,10
Centrarchus macropterus (Lacepede)	SF:31
Percina caprodes (Rafinesque)	SF:30

Etheostoma asprigene (Forbes)	SF:30
Etheostoma caeruleum Storer	SF:24
Etheostoma gracile (Girard)	SF:4,5,7,10,14,16,30 C:10
Etheostoma proeliare (Hay)	SF:6,13,15,22,30 C:7 L:1,2,3,7

atromaculatus prefers the headwaters of small, warm-water streams and many migrate to larger pools in late summer. *Gambusia affinis* frequents headwater pools in intermittent streams. *Notropis umbratilis, Fundulus olivaceus,* and *Lepomis cyanellus* primarily inhabit pools of small warm-water streams (Tratuman, 1957). The propensity of *Notropis chrysocephalus* and *Erimyzon oblongus* for sand and gravel bottom pools in the headwaters of small streams may explain their relative abundance.

To a lesser extent there were species present characteristic of pond-marsh bioces. *Notemigonus crysoleucas, Lepomis macrochirus, Lepomis megalotis, Micropterus punctulatus,* and *Micropterus salmoides* were collected. Reasons for their presence may be overflow of adjacent stock ponds and upstream migration for spawning.

Degradation of surrounding deltaic lands is suggested when the composition and diversity of fish species on Crowley's Ridge is compared with that of nearby deltaic streams. Observations of Black (1940) correlated with distribution and habitat descriptions by Pfleiger (1971) also suggest a previously more diverse ichthyofauna in northeastern Arkansas. Relict disjunct populations of *Campostoma anomalum, Phoxinus erythrogaster,* and *Etheostoma caeruleum* were collected. These fishes were located 38 km by land and over 150 km by water from nearest known populations. Habitat requirements suggest that intervening waters must have been better at one time.

In lieu of the relatively small nature of streams sampled, thirty-three species is a relatively diverse group. Twenty-four species were reported from upper Tyronza River, a comparatively larger watershed east of Crowley's Ridge (Harp, In Press). Degradation of surrounding areas is apparent. Physicochemical values have been altered by increased population pressures and subsequent land use. Channelization has reduced the number of pool-riffle bioces. Agricultural runoff introduces a variety of pesticides. Toxaphene and DDT in particular have been shown to exceed recommended maxima (Arkansas Water Quality Inventory Report for 1975, 1976). Degradation has not been as apparent on Crowley's Ridge due to topography hinderance although it is now increasing. Diversity was accentuated by *Esox americanus, Notropis atherinoides, Notropis venustus, Notropis lutrensis, Hybognathus nuchalis, Pimphales notatus, Minytrema melanops, Aphredoderus sayanus, Centrarchus macropterus, Percina caprodes, Etheostoma asprigene, Etheostoma gracile,* and *Etheostoma proeliare.*

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