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Crowley's Ridge Biological Station--An Educational Center

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LICHENS OF ARKANSAS II. ADDITIONAL STATE RECORDS THROUGH COMPUTER SEARCH

The lichen herbarium of the American Bryological and Lichenological Society (ABLS) is housed along with the University of Minnesota herbarium (MIN), at the University of Minnesota. Both collections have been computerized (Wetmore, C.M. 1979. Herbarium computerization at the University of Minnesota. Systematic Botany 4(4):339-350.) and are separated from each other by different data bases. Printouts of the Arkansas lichens contained in these herbaria revealed additional records for Arkansas lichens not previously reported (Moore, Jewel E. 1979. Lichens of Arkansas I. A summary of current information. Proc. Ark. Acad. Sci. 33:85-87.): *Leptogium sinuatum* (Huds.) Mass., *Physcia constigata* (Nyl.) Norrl. and Nyl., and *Caloplaca flavovirescens* (Wulf.) Dalla Torre and Sarnth collected by C. Wetmore in Franklin County, Ozark National Forest, Cherry Bend Campground, 1 June 1966; *Peltigera malacea* (Ach.) Funck collected by Delzie Demaree on West Mountain, Hot Springs National Park, 9 March 1954; *Cladonia cariosa* (Ach,) Spreng. collected by Delzie Demaree at Optimus, Stone County, 20 May 1960; and *Cladonia pyxidata* (L.) Hoffm. collected by Delzie Demaree at Daisy, Ouachita National Forest, in Pike County, 6 January 1963.

These six additions to the lichens of Arkansas bring the state list to 241 species. The systematic synopsis of the lichens of Arkansas, with common names (from Nearing, G. G. The Lichen Book. Publ. by the author. Ridgewood, New Jersey) is available from Arkansas Biota (Moore, Jewel E. 1981. Systematic synopsis of the Lichens of Arkansas. Arkansas Biota, publ. by Ark. Acad. Sci.).

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CROWLEY'S RIDGE BIOLOGICAL STATION—AN EDUCATIONAL CENTER

Arkansas may be divided into two principal regions based upon topography, geological substrate, and dominant vegetation—the Interior Highlands of the northwestern part of the state and the Gulf Coastal Plain of the southeastern part. Within the Gulf Coastal Plain is the unique geological feature known as Crowley's Ridge (Call, 1891; Foti, 1974). The ridge rises about 250 feet above the flat Mississippi Alluvial Plain and extends about 150 miles in length from Helena northward into Missouri. Crowley's Ridge Biological Station is located on two acres on Titanic Road, about two miles south of Pollard, in Clay County. There are two buildings which can be used for pioneer-type living and for laboratory work. The site is near some of the gravel pits so characteristic of the upper part of the ridge where gravel and sand are obtained for commercial uses. Surrounding the station are forest stands of oak-hickory-tulip poplar and fields for pasture and wheat production. Deep gullies, frequently encountered on the ridge, and petrified wood of trees from the Eocene Tertiary gravels are found in some of these fields.

While the station itself is small, there are ample opportunities for field studies associated with Crowley's Ridge. Big Lake National Wildlife Refuge in Mississippi County, and the adjacent Arkansas Game and Fish Commission lake yield good habitats for studying game and waterfowl associated with such cypress lakes. This area is part of the Sunken Lands which resulted from the New Madrid Earthquake of 1811-13. Also in Mississippi County are the heronries near Luxora and Burdette from which the state record for nesting glossy ibis was first reported (Hanebrink and Cochran, 1966). Other nesting species at these heronries include little blue heron, great egret, cattle egret, snowy egret, Louisiana heron, and black-crowned night heron. Other records for nesting birds and bird migrations are needed to complete the work already begun on these ridge inhabitants (Hanebrink, 1980). Research on the fishes of Crowley's Ridge has been published (Fulmer and Harp, 1977), but field studies on other animals of the ridge are needed.

Research on the forest stands of Crowley's Ridge (Clark et al., 1974; Clark, 1977) indicates that the oak-hickory-pine edaphic climax forest and the white oak-beech stands (present status of the beech-maple climax forest) establish baselines allowing comparison of the extant and extinct forest stands of the ridge. As a rule, the oak-hickory-pine forest follows the irregular outcroppings of the droughty soils in the northern part of the ridge; the white oak-beech stands coincide with the Pleistocene loess which covers the southern portion of the ridge and disappears on the ridge summits where the Tertiary sands and gravels produce the soils of the Brandon-Lexington association. The tulip poplar, unique to the Crowley's Ridge area of Arkansas, reproduces in the cut-over white oak-beech forests. Mud slides also are conducive to this invasion, as well as to invasion by the cucumber magnolia. The relict stand of two trees of bigleaf magnolia (Moore, 1953; Figler, 1981) is in Clay County; as is Chalk Bluff Natural Area (Marsh, 1977), which can be used for sampling and describing the forest types of the ridge. The distribution of Arkansas vascular plants (Smith, 1978) indicates a need for basic inventory-type field work on the ridge and throughout the state.

A field studies class from the University of Central Arkansas used Crowley's Ridge Biological Station to make excursions to some of these habitats on the ridge. The station is not so large, nor as developed, as the Ouachita Biological Station (Speairs, 1976), but it can be used as a research center for individuals or college classes to study Crowley's Ridge.

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RATION/DENSITY COMPARISONS WITH CAGED CHANNEL CATFISH*

Caged fish culture as a production method for rearing catfish and trout was first started in the United States in the late 1960's and has now become more practical than ever for certain situations (Newton, 1980). This is especially true for the utilization of farm ponds which are suitable for cages because the fish cannot be easily harvested otherwise. Since 1967, university and governmental researchers have studied and developed caged catfish culture for the fish farming industry (Lewis, 1969; Schmittou, 1969; Collins, 1971). They first dealt with culture techniques involving potentials and adaptations of the method. They used numerous types of cages and gradually refined studies to include nutritional trials, stocking sizes and rates, genetics, and fish health (Collins, 1978).

Research conducted during the 1970's, primarily in Arkansas and Oklahoma, has further refined cage culture methodology and application potentials (Collins, 1971; Collins, 1978; Newton, 1980; Kilambi et al., 1977). These studies are valuable because they demonstrate the variety of situations for using cage culture, the improved feed quality for confined fish culture, and the resource potential for both home and commercial ventures.

Cages are ideal for evaluating rations for fish diets (Newton and Dean, 1978; Newton et al., 1980). The need continues for testing available rations for efficient and economical fish production. This study compares two rations of similar protein levels, 33% and 36%, but quite different in cost with three stocking densities of channel catfish.

A total of 18 cages were stocked with catfish fingerlings during May 1980. The cages (0.9 m^3) were arranged in units of three across the south end of a 1.6 ha farm pond on the University of Arkansas at Pine Bluff Agricultural Research Station as described previously by Newton and Merkowsky (1976). Six cages were each stocked with 200, 350, and 500 fingerlings (average wt. 28 g), respectively, in a randomized pattern. Experimental conditions were triplicated simultaneously for ration and density evaluations. Three cages of each fish density were fed either a 36% protein trout ration or a 33% protein catfish ration formulated as floating pellets. All fish were fed five days per week at the rate of 4% of their estimated body weight, regardless of density or ration combinations.

The study period began 14 May and ended on 30 August due to an oxygen depletion which killed fish in approximately two-thirds of the cages. Nevertheless, all data were collected from each cage similar to usual harvest operations in previous studies (Newton et al., 1980). Statistical comparisons revealed no significant differences between data collected from dead or live fish. Therefore, the relative validity of the assumptions and determinations reported herein are believed to be accurate for practical comparisons among density and ration combinations.

Evaluations of the rations and stocking densities were based upon weight gain, food conversion efficiency (FCE), survival, and production costs per kilogram of catfish produced. Comparisons between rations revealed no significant differences among net production, FCE, and survival. Due to the difference in feed costs (the 33% protein ration was $16/45.5 kg, while the 36% protein ration was $25/45.5 kg) the 33% protein ration was the most cost efficient at all stocking densities (Table 1). With either ration, the cost per kilogram of fish produced was less at the higher stocking densities (350 and 500 fish); however, production costs were still lower for all densities with the 33% protein catfish ration. The greatest net profit per cage was obtained with the highest fish density for both rations.

There were significant differences in net production among each stocking density, although survival and FCE were similar (Table 2). Fish stocked at 350 per cage had higher average individual gains than fish stocked at 200 or 500 per cage, which had similar average gains. Both FCE and survival were consistently within normal ranges necessary for successful caged catfish production. Survival was unusually high, until the occurrence of the oxygen depletion. One of the disadvantages of cage culture is that caged fish are more susceptible to oxygen problems than fish in an open pond.

Since the fish stocked at 350 per cage had higher individual gains with both rations, it appears that this stocking density was optimum for producing larger size fish. Fish density considerations have been studied for some time (Schmittou, 1969; Konikoff and Lewis, 1974), and it has been determined that generally a minimum number of 5-6 fish per 30 cm^3 is required to avoid behavioral problems. We have used 7-8 fish in most of our studies; however, the maximum or optimum number to stock deserves further attention. A high quality, less expensive catfish ration out-performed a more expensive trout ration on the basis of fish production, economy, and availability.

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Table 1. Economics of raising channel catfish in cages with either a 33% ration or a 36% protein ration.

Ration	Stocking density	Gross sales	Total expenses	Net profit per cage	Production cost/kg of fish
33% protein catfish ration	200	$ 69.98	$ 49.08	$ 20.90	53¢
	350	$142.00	$ 78.16	$ 63.84	41¢
	500	$162.43	$ 90.32	$ 71.94	42¢
36% protein trout ration	200	$ 65.90	$ 57.44	$ 8.43	65¢
	350	$140.03	$ 98.02	$ 42.01	52¢
	500	$166.24	$112.37	$ 53.87	51¢

33% protein ration 35¢/kg
36% protein ration 55¢/kg

Channel catfish live weight selling price $1.65/kg

Fixed expenses:
Cage cost and depreciation (5 yrs)

Variable expenses:
Fingerlings, feed, and labor

Table 2. Production of channel catfish reared in cages at three stocking densities and fed 33% and 36% protein rations.

33% protein ration				
Stocking density	Percent survival	Net production (kilograms)	Food conversion efficiency	Average fish gain (grams)
200	94	37	1.14	196
350	99	77	1.29	221
500	95	85	1.27	181

36% protein ration				
Stocking density	Percent survival	Net production (kilograms)	Food conversion efficiency	Average fish gain (grams)
200	90	34	1.22	193
350	97	75	1.33	235
500	99	87	1.25	176