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Occurrence of the Land Planarians Bipalium kewense and Geoplana Sp. in Arkansas

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GENERAL NOTES

WINTER FEEDING OF FINGERLING CHANNEL CATFISH IN CAGES*

Private warmwater fish culture of channel catfish (*Ictalurus punctatus*) in the United States began in the early 1950's (Brown, E. E., World Fish Farming. Cultivation, and Economics 1977. AVI Publishing Co., Westport, Conn. 396 pp). Early culture techniques consisted of stocking, harvesting, and feeding catfish only during the warmer months. With both the refinement of culture techniques and increased marketing demands, year-round production is increasing among commercial fish farmers. However, minimal research has been conducted on winter feeds and feeding practices for catfish production. Thus, a winter feeding experiment on cage culture was conducted to determine the practicality of overwintering fingerling catfish. The objectives of the study were to determine whether or not it would be economically feasible to feed fingerling catfish in cages and to observe fingerling growth, survival, and general physical condition with and without supplemental feeding.

Fingerling catfish were stocked 1 December 1980 and harvested 13 March 1981 for a total of 103 days. Three weight-counts were taken to stock an estimated 250 fingerlings in each of six cages (2.5 kg of fingerlings). Fish were placed in 0.9 cubic meter floating cages anchored in a 1.6 ha farm pond located on the University of Arkansas at Pine Bluff Agricultural Research Station. Cage construction was identical to that of Newton and Merkowsky (1976. Using lights to attract insects for caged catfish. Ark. Farm Res. J., 25:8). Water below the cages ranged from 1.1 to 1.6 meters in depth. Three cages of fingerling catfish were fed a 36% protein ration formulated as floating pellets. Feeding rate was based upon daily water temperature (Table 1). The other three cages received no supplemental feed, thereby serving as a control. Fed caged catfish fingerlings gained an average of 411 g, an increase of 16% over initial stocking weight (Table 2). Individuals showed a significant increase from an average of 9.75 g to 12.59 g (Table 3). This gain was similar to that reported by Felts (1977. Effects of various winter feeding regimens on weight and body composition changes in channel catfish in ponds. M. S. Thesis, Auburn, University, 42 pp) for catfish reared in ponds during winter. Survival for the fed fish averaged 95%. Fed caged fish each received a total of 247 g of 36% protein ration. The catfish were fed on 43 days of the 103 day trial. Average water temperature was 10° C (50° F) and ranged from 3.3° C (38° F) to 17.2° C (63° F). Dissolved oxygen was monitored five days a week between 12:00 noon and 2:00 p.m. Dissolved oxygen averaged 11.1 ppm throughout the period.

From review of the Literature of pond studies, it was presumed that nonfed catfish would lose weight. Lovell and Sirikul (1974. Winter feeding of channel catfish. Proc. Twenty-eighth Ann. Conf. S. E. Assoc. Game and Fish Comm. 28:208-216) overwintered 0.45 kg catfish and reported that unfed fish lost 9.1% of their body weight. Felts (1977) found that unfed overwintering catfish lost 6.3% of their body weight. The nonfed fish in this study showed a slight weight gain (Table 2). Initial individual weights were 9.75 g and final weights were 10.98 g. Survival for the nonfed fish averaged 92%. The authors cannot state any definite reasons for the weight gain by nonfed catfish. Plans are to repeat this study to verify this gain. Stomach content analyses will be performed to determine if the fish are ingesting any natural organisms, such as zooplankton or small sunfishes, that may be in the cages.

Table 1. Percent of rations fed to caged fingerling catfish relative to daily water temperature from 1 December 1980 - 13 March 1981.

Percent body weight fed	Water temperature (centigrade)
No feed	=< 7
0.5	7 - 10
1.0	10 - 16
2.0	16 - 21
3.0	21 - 24
4.0	24 - 27

Table 2. Average weight gains and percent survival for fingerling catfish overwintered in cages at UA-PB.

	Cage	Total Initial weight (g)	Total Final weight (g)	Weight gain or loss (g)	Percent survival
	1	Data lost due to fish escapement			
	3	2,437	2,863	425	90
	5	2,437	2,835	397	100
	Averages	2,437	2,849	411	95
Nonfed	2	2,437	2,355	-84	87
	4	2,437	2,608	178	89
	6	2,437	2,721	284	100
	Averages	2,437	2,561	124	92

Table 3. Average individual sizes and gains for catfish overwintered in cages at UA-PB.

Cage	Individual stocking weight (g)	Individual harvest weight (g)	Individual gain (g)
3	9.75	12.76	3.01
5	9.75	12.42	2.67
Averages	9.75	12.59	2.84
2	9.75	10.78	1.03
4	9.75	11.67	1.92
6	9.75	10.50	0.75
Averages	9.75	10.98	1.23

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OCCURRENCE OF THE LAND PLANARIANS *BIPALIUM KEWENSE* AND *GEOPLANA* SP. IN ARKANSAS

Land planarians (Phylum Platyhelminthes, Order Tricladida; Suborder Terricola) are primarily long, slender flatworms found in moist, dark habitats such as under-leaf mold, boards, logs, and concrete slabs. These helminths are among the most primitive metazoans that can live successfully in a terrestrial environment. They require an atmosphere with high humidity since prolonged exposure to air presents a danger of dehydration. A protective mucous coat secreted by the planarians prevents dehydration, in part, and this material can be seen as a noticeable slime trail which marks the flatworm's migratory routes on land. The damp jungles of the tropics and subtropics are ideal for survival of Terricola, where the most abundant numbers and greatest variety of species occur (Hyman, 1951). Fewer species of land planaria are found indigenous to temperate climates, such as Europe and North America, indicating that environmental factors other than humidity may restrict the distribution of these invertebrates.

In the United States a few, relatively small (12 mm length) native land planarian species occur which include *Microplana atrocyaneus, M. rufocephalata, Rhyncodemus sylvaticus, R. americanus,* and *Diporodemus indigenous.* These helminths have been reported from various sites in

the midwest and eastern United States (Hyman, 1954; Ogren, 1955). Several exotic species of land planarians apparently have been introduced to the United States from the tropics, including *Dolichoplana striata*, *Geoplana vaga*, *G. Mexicana*, *Bipalium kewense*, and *B. adventitium* (Hyman, 1954). These animals are thought to have been introduced by way of imported plants, and in many cases they have been discovered in greenhouses. *B. kewense* is the most ubiquitous of these exotics and seems well established outdoors in the midsouth and southeastern United States in Florida, Georgia (Hyman, 1943), Louisiana, Alabama (Dundee and Dundee, 1963), North Carolina, South Carolina, Mississippi (Hyman, 1954), Tennessee (Chandler, 1974) and Kentucky (Cole, 1969). *B. kewense* also has been found in other areas of the U. S. such as Oklahoma (Wallen, 1954), Washington, D. C., New Jersey, Illinois, California, Hawaii and Puerto Rico (Hyman, 1943). A related species, *B. adventitium*, has been described from California and New York (Hyman, 1954; Klots, 1960; Dindal, 1970).

Two land planarians have been reported previously from Arkansas. A single specimen of *Microplana atrocyaneus* was collected at Stair Bluff, Marion County, on September 6, 1942 (Hyman, 1943). Daly et al. (1976, 1977) reported collecting *Bipalium kewense* from central Arkansas for their studies on pseudoparasitism by this worm, and further information on those collections is reported in this note.

B. kewense is a conspicuous flatworm, of 17 cm or more in length, with a pronounced lunate or spade-like head (Fig. 1A). These large land planarians are brightly marked with five dark brown stripes running the length of the body on a light brown or olivaceous background. *B. kewense* is easily seen but random searching through what appears to be typical habitat is usually unrewarding due to its relative scarcity. To increase collecting efficiency, the assistance of the *Arkansas Gazette* was requested, and the general public was asked to report the location of these animals in the Little Rock area. Field trips were made in response to these reports which provided ten sites at which successful collections of *B. kewense* were made. These sites were distributed randomly in the urban areas of Little Rock and North Little Rock (Pulaski Co.), but no sightings were made from rural or farm areas. The planarians were found under wet boards, logs, or rotting trees. Several worms were usually found at one time, and a few sites yielded more worms on repeat visits. The most productive area was a semi-natural back yard (pesticides were not used). At this site, numerous *B. kewense* were removed from under old railroad ties and concrete patio slabs. Large specimens of *B. kewense* also were reported on driveways in Little Rock after a heavy rain. Since these animals cannot survive submersion in water (Hyman, 1951), the rain must have stimulated the worms to migrate to escape flooded conditions in their usual habitat. Greenhouses were visited but, with one exception, land planarians were not found. At one nursery planaria were collected from the bottom of metal buckets used for holding saplings or bushes that were kept constantly watered. Approximately 70-80 fully differentiated and asexually produced fragments (zooids) of *B. kewense* were ultimately collected during the spring and early summer of 1971 and 1972. Also, at this time Dr. Arthur Johnson of Hendrix College reported that a student had found one specimen of *B. kewense* in Conway (Faulkner Co.) that had measured 17 cm long. In recent years the senior author has not been able to find these worms at collection sites which were previously productive. The recent lack of sightings in the central Arkansas area may be related to the relatively severe winters several years prior to 1980. Barnwell (1969) has suggested cold as a factor restricting the distribution of *B. kewense*. However, two specimens were reported to the senior author from the southern section of the state in early fall 1979, and late spring 1980, at Camden (Ouachita Co.), indicating that *B. kewense* has not disappeared from Arkansas.

In the summer of 1974 another exotic land planarian was brought to the University of Arkansas for Medical Sciences, (UAMS). This specimen was discovered under a rock by Dr. Robert Lowery in a back yard across the street from the UAMS. This planarian was flat, elongated, pointed at both ends and bluish-black (Fig. 1b). Minute eyespots were found on the peripheral edge of the worm and extended along each side to about 1/5 of its length. This planarian measured 6.5 cm in length by 1 cm in width. The initial appearance of the worm suggested that it was *Geoplana vaga*. In contrast to *B. kewense*, *G. vaga* has been found infrequently in the U.S., having been reported from California (Hyman, 1943), Georgia (Olewine, 1972), and Texas (Barnwell, 1978). However, upon microscopic examination of the genitalia (a major taxonomic feature of geoplanids), the penis did not match the original description for *G. vaga* by Hyman (1943). Sections of this specimen have been sent outside the country to an authority on *Geoplana* taxonomy for further study. The organism is apparently either a new species of *Geoplana* or a species of *Geoplana* newly described in the United States, or both.

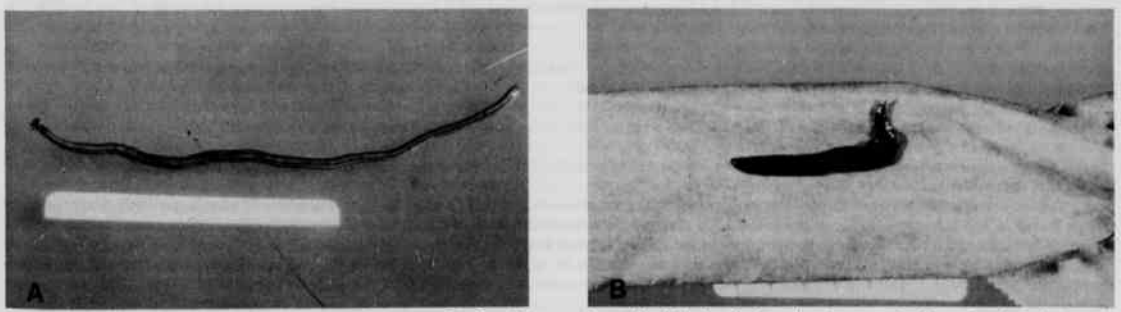

Figure 1. (a) A fully differentiated *Bipalium kewense* showing the spade-like head and the longitudinal, dark linear stripes. (B) *Geoplana* sp. found in the central Arkansas (Little Rock) area. The anterior end of this land planarian is more slender and pointed than the posterior end. Both figures are approximately life-size.

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ADDITIONAL RECORDS AND UPDATES ON THE ARKANSAS FLORA

During 1979 and 1980 the Arkansas Natural Heritage Inventory Program conducted field surveys to assess vascular plant rarity in the state. Five taxa were discovered new to the flora of Arkansas:

Psoralea digitata T. & G. var. *digitata*. MILLER COUNTY; scattered in a sandy churchyard northwest of Doddridge about 4.0 Km north of Hwy. 160 and Hwy. 237 junction. Davis and Kral 2689, 25 June 1980. Shinners (Field and Laboratory 19:14-25, 1951) cites a Nuttall voucher of this taxon from "sandhills of the Red River, Arkansas Territory." Since it is impossible that this voucher was collected in either Oklahoma or Arkansas, it should be treated as a new record in Arkansas.

Tradescantia reverchonii Bush. MILLER COUNTY; sparse on very sandy soils northwest of Doddridge about 1.1 Km south of the junction of Hwy. 237 and Hwy. 134, T18S R28W, Sec. 17, E ½ NW ¼. Davis and Tucker 2580, 17 June 1980.

Aletris aurea Walt. MILLER COUNTY; local in a moist, mowed pine-barren about 2.4 Km north of Fouke on west side of Hwy. 71, T17S R27W, Sec. 9, SW ¼ NW ¼. Davis and Tucker 2547.

Xyris baldwiniana R. & S. CALHOUN COUNTY; small remnant of savannah in railroad and gravel road rights-of-way, 2.1 Km north of Hwy. 172 along road paralleling railroad east of Hwy. 67. Davis and Roberts 2606.

Rhynchospora rariflora (Michx.) Ell. CALHOUN COUNTY; same location as above cited *Xyris*. Roberts and Davis 1500.

The *Rhynchospora rariflora* voucher is deposited in Vanderbilt University and the remaining vouchers are filed in Arkansas Tech University.

Four species which had previously been reported to Arkansas were confirmed with vouchers. Demaree (Taxodium 1:1-88, 1943) reported *Rhynchospora cephalantha* Gray, but the location of the voucher was unkknown until located in February, 1980 at Vanderbilt University. This voucher is annotated by Robert Kral. *Carex latebracteata* Waterfall has been vouched from Polk, Garland and Howard counties, and specimens are deposited in Vanderbilt University Herbarium (Davis and Tucker 2124; Davis, Pell and Smith 2146; Davis and Shepherd 2159). *Anthaenantia rufa* (Ell.) Schult. was confirmed from both Bradley and Drew counties (Davis and Pell 1896; Davis and Shepherd 2820b). This species was reported without voucher by Moore (Proc. Ark. Acad. Sci. 15:9-25, 1961). After having been considered extirpated, five stems of *Cypripedium reginae* Walter were discovered in Stone County (Davis and Foster 2414). The previous two species are deposited in Arkansas Tech University Herbarium.

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OBSERVATIONS ON THE OCCURRENCE OF CHALKY DEPOSITS ON FOREWINGS OF *ONCOMETOPIA ORBONA* (F.) (HOMOPTERA: CICADELLIDAE)

Many homopterans produce a chalky or waxy, white material. Metcalfe (1969) mentioned that the most distinctive feature of the nymphs of the delphacid *Saccharosydne saccharivora* (Westw.) was the white wax rods formed on the head, tail, and lateral abdomen. He added that among adults the white wax was present only on females.