

Variation in *Io*, Fifty Years Later

LOUIS LUTZ, Lincoln Memorial University, Harrogate, Tenn., and
A. O. WEESE, University of Oklahoma, Norman

The opportunity to re-examine a carefully surveyed animal population after the passage of fifty years seldom presents itself. During the years 1899, 1900, and 1901, Charles C. Adams collected snails of the genus *Io* from exactly designated stations in the Tennessee River and its tributaries, to which this genus is limited, and analyzed the populations from each locality. Many of the habitats from which collections were made at that time have been altered greatly or obliterated by the extensive operations of the Tennessee Valley Authority, but much of the upper reaches of the Powell and Clinch Rivers has remained relatively unaltered and it is with eleven stations on these two rivers that the present study is concerned. All collecting stations were identified with those designated by Adams (2), a matter which sometimes presented difficulties. For example, Lytton's Mill and McDonald's Mill are no longer in existence and the localities had to be determined by consultation with "old-timers". For purposes of comparison the same station numbers as those employed by Adams are used.

The stations were as follows, beginning with the localities nearest the source of each river and proceeding down-stream:

POWELL RIVER

1. Olinger to two miles above Dryden, Va.
2. Lytton's Mill, near Pennington Gap, Va.
3. Holiday Shoals, near the state line, ten miles from Rose Hill, Va.
4. McHenry's Ford and Bryant Shoals, Tenn.
5. Green's Ford (Cedar Fork Grove), Claiborne Co. and Powell River P. O. (Hopewell), Campbell Co., Tenn.

CLINCH RIVER

6. One mile above Cleveland, Va.
7. St. Paul to Dungannon, Va.
8. Fort Blackmore, Va.
9. McDonald's Mill, near Clinchport, Va.
10. Four miles above Kyle's Ford, Tenn.
11. Between Kyle's Ford and Sneedville, Tenn.

In the analysis of his collections Adams recorded data as to shell width, "shell index" (ratio of aperture length to shell width), spine height, and "spine index" (ratio of spine height to distance between spines) and on the basis of these and other considerations defined five "forms" of *I. fluviatilis* Say within the populations of the river systems here considered. These "forms" and their general distribution in 1899 were as follows:

- powellensis*, Stations 1, 2, 5.
- lyttonensis*, Stations 1, 2, 3, 4, 5
- clinchenensis*, Stations 6, 7
- paulensis*, Stations 7, 8, 9
- brevis*, Stations 10, 11

Of these *powellensis* and *clinchenensis*, from the headwaters of the Powell and Clinch respectively, are smooth forms. The remainder exhibit various degrees of spinosity. The present report is concerned chiefly with the relative distribution of spinose and smooth shells without reference to other differences.

SUMMARY OF COLLECTIONS AT THE DIFFERENT STATIONS

POWELL RIVER

1. Adams found abundant shells below a mill dam at this station, but only one above. No living shells were collected in the vicinity of the ruins of the dam in 1950, and from another locality four miles below only ten shells were found after careful search. None of the 1950 shells were spined, while 28 of 699 in the 1899 collection had low spines. In 1948 water in this portion of the Powell was rated in Class III (requiring advanced treatment methods for use as a course of water supply).
2. The recent population was also too meagre for adequate comparison with that of 1899. The 18 specimens fell well within the range of the Adams collection of 192 in size and shape and the same proportion was spinose except that the mean spine height was less.
3. This was the first station at which animals were apparently as abundant in 1950 as on the earlier date. The shells were somewhat smaller (younger) and although Adams found few spineless shells (8 of 136) 36% of the recent collection were without spines and the mean height of spines was less.
4. This station seems still to provide a favorable habitat for *Io* in spite of the fact that the backwaters from Norris Reservoir occasionally reach this point. The shells of both collections were relatively large. Spines were considerably higher in 1899 and the proportion of spinose shells was about the same.
5. As in Station 4 the 1950 shells were somewhat larger than those collected in 1899. The largest shell of any collected from the Clinch-Powell system was in the 1950 sample. Over 30% however, were spineless in 1950 compared to 10% on the earlier date and spines averaged much smaller. This station is also affected by the waters of Norris Reservoir.

CLINCH RIVER

6. All of the shells of the 1899 collection were spineless, but of the 22 taken in 1950, eight had spines 0.8 mm or more in height. The shells were smaller and less globose in shape. Most of them were empty, indicating unfavorable conditions also shown by the presence of sewage.
7. The proportion of spinose shells at this station was greater and the average spine height was somewhat increased in the 1950 collection. Other shell measurements were very much alike.
8. While shells from this area were the smallest of the Adams collections from the Powell and the Clinch, the few collected in 1950 approximated the size of those from other localities. The differences in spinosity were not significant.
9. The 1950 shells were all small and 90% were spinose, but spines were not as high as in 1899, when smooth shells were almost entirely absent.
10. Numbers were small in 1950 but all specimens taken were spinose. The mean spine height was then greatest of any collection for the two years, although it did not differ significantly from those for the populations at Station 11.
11. The two collections were very similar in all respects in spite of the fact that the 1899 collection was spread over a distance of at least one hundred miles along the course of the river, about half of which is now in Norris Reservoir or below the dam. The largest spines were from these groups, and almost all were spinose.

TABLE I.
Comparison of 1899 and 1950 Collections as to Spinosity

STATION	NUMBER		PERCENTAGE SPINOSE		MEAN HEIGHT OF SPINES (SPINOSE SHELLS ONLY)	
	1899	1950	1899	1950	1899	1950
1	699	10	4	0	1.11	—
2	192	18	45	45	1.03	0.8
3	136	331	94	64	1.55	1.32
4	196	130	79	76	1.57	1.12
5	444	111	90	68	1.84	1.33
6	182	22	0	48	—	1.07
7	226	192	27	51	1.00	1.25
8	208	44	75	83	1.38	1.26
9	184	213	99	90	1.94	1.56
10	288	50	95	100	1.71	2.03
11	98	149	100	98	2.01	1.94

Progressive increases in the proportion of spinose shells and in the length of spines from the headwaters downstream occur now as they did in 1899. The exceptions were, in 1899, a higher percentage of spinosity at Station 3, and a lower spine height at Station 10. In 1950 the spine height at Station 3 was also "out of step" and the percentage of spinosity at Station 5 was less than that at Station 4. There seems to have been a decrease in abundance of snails near the headwaters of each river, and in the Powell River, a decrease in the height of spines. On the whole, except for the downward shift of the upper limit of the range of the species on these two rivers the population characters have remained remarkably constant.

LITERATURE CITED

1. ADAMS, CHARLES C. 1900. Variation in *Io*. Proc. Am. Assn. Adv. Sci. 9:208-225.
2. ADAMS, CHARLES C. 1915. The variations and ecological distribution of the snails of the genus *Io*. Memoirs Nat. Acad. Sci. 12(2):1-184.