NOTES

Biological Notes on Blue Suckers in the Mississippi River¹

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Abstract

The total length (L, mm)-weight (W, g) relationship for 153 blue suckers (Cycleptus elongatus) collected from areas of swift current in Pool 20, Mississippi River, was $\log_{10}W = -6.69 +$ 3.59($\log_{10}L$). Condition factors (K = $10^5W/L$) were 0.74-1.1; they increased with increasing fish size, and varied among months (March-October) and between years (1977-1978). Fin rays had more discernible annuli than scales after age VII. The largest blue sucker collected was age X (scales) or XIII (fin rays) and 817 mm long. Males generally reached sexual maturity at age IV, females at age VI. Males had nuptial tubercles during April, but no ripe females were found. For six females aged VI-IX (617-736 mm), the fecundity (Y, number of 1mm diameter eggs)-length relationship was Y = -375,100 + 771.5L. Blue suckers at primarily Tricoptera and Diptera larvae and pupae, and lesser numbers of Ephemeroptera larvae and amphipods.

The blue sucker *Cycleptus elongatus* is an uncommon and little-known species inhabiting the major river systems of the United States. Blue suckers were once commercially important. In 1894 and 1899, over 900,000 kg of blue suckers were caught in Pool 20, a 33.6-km section of the Mississippi River that borders the states of Illinois, Iowa, and Missouri and extends from Keokuk, Iowa, downstream to Canton, Missouri (Coker 1930). After Locks and Dam 19 were constructed at Keokuk, Iowa, in 1910, the catch in Pool 20 was less than 320,000 kg. The major cause of this decline was the reduction of current velocity below the dam (Pflieger 1975) and the resulting loss of a series of rapids that had been a prime habitat for the fish (Coker 1930). The present study was conducted to contribute information on the natural history of the blue sucker.

Methods

Sampling was done by electroshocking over areas of rocky substrate below Dam 19, around bridge abutments, and over wing dams in the upper 4.8 km of Pool 20. One hundred blue suckers were captured during March–September 1977, most of them from July onward. An additional 53 were caught in 1978, 17 in April and 36 in August. The water temperature was recorded during each trip to the field.

Each fish was measured and weighed. The fork length (FL)-total length (TL) conversion (based on 1978 captures) was FL = 0.91(TL). For age determination, scales were removed from the second and third rows above the lateral line below the origin of the dorsal fin, and the first four pectoral rays from the left fin were removed as close to the body as possible with wire cutters. Scale annuli, read at 31× magnification, had one to several circuli cut by a complete circulus in both posterolateral quadrants. In addition, circuli were sometimes crowded in the anterior and lateral quadrants just behind the cut-over. False annuli were characterized by cutting-over in only one of the posterolateral quadrants or by crowding not accompanied by cutting-over. Scale measurements were made along the dorsal-ventral axis through the centrum, because Spoor (1938) and Buchholz (1957) found that this length varies less among adjacent scales than the anterior radius. Transverse fin-ray sections were ground to 0.5 mm, polished, cleared in xylene, and examined at 30× magnification. The annuli were defined as less optically dense zones in transmitted light (Beamish and Harvey 1969).

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	Mean total length at capture (mm) ± SD	Number of fish	Annulus									
Age			1	2	3	4	5	6	7	8	9	10
II	413 ± 16	3	207	329								
III	473 ± 20	17	207	312	406							
IV	510 ± 23	53	187	301	405	483						
v	557 ± 18	33	181	284	387	472	529					
VI	605 ± 21	19	183	289	387	461	532	580				
VII	655 ± 24	8	189	290	388	482	545	590	630			
VIII	679 ± 25	4	198	299	411	476	542	591	635	672		
IX	726 ± 14	2	195	293	422	456	525	595	637	675	715	
Х	817	I	121	242	367	456	549	600	664	721	765	798
Weighted average			189	296	397	47 1	533	585	635	680	732	798

TABLE 1.—Calculated mean total lengths (mm) at scale-annulus formation of 140 blue suckers, 1977 and 1978.

To determine the fecundity of six nonbreeding females, a portion of an ovary was removed and weighed on an analytical balance. The eggs therein were counted and extrapolated to both weighed ovaries.

Contents of digestive tracts were removed up to the first caudal loop of the intestine (suckers do not have well-defined stomachs), preserved in 10% formalin, and identified to order.

Results and Discussion

Length, Weight, and Condition

The length-weight relationship of 153 blue suckers (least-squares regression) was $log_{10}W$ = -6.69 + 3.59($log_{10}L$), where W = weight in grams and L = total length in millimeters; r = 0.96. For 30 males and 19 females, the slopes were 3.51 and 4.00, respectively, but the difference between them was not significant (*t*-test; P < 0.05). The overall slope was similar to those determined by Fogle (1963b) (3.42; N = 5) and by Swingle (1972) (3.19; N = 6).

Condition factors, $K = W(10^5)/L^3$, where W =grams and L = total length in millimeters, increased with age and total length, ranging from 0.74 to 1.10. Condition factors in 1978 were higher than those in 1977 for fish with comparable total lengths. Average K values varied seasonally during 1977: 0.80 in March (N = 6); 0.75 in April (N = 7); 0.83 in May (N = 4); 0.87 in June (N = 6); 0.90 in July (N = 15); 0.89 in August (N = 29); 0.87 in September (N = 33). For fish of similar length, K values from the present study were higher than those reported by Fogle (1963a) and Sprague (1960), approximately equal to those reported by Jenkins (1953), and lower than those reported by Swingle (1972).

Growth

The linear body-scale relationship of 140 blue suckers (least-squares regression) was L = 216.1 + 64.3S, where L = total length in millimeters and S = scale radius in millimeters; r = 0.86. Separate regressions for each sex did not differ significantly (P < 0.05). The constant, 216.1, may indicate that the growth rate changed after the fish reached a certain length; however, no young of the year or age-I fish were caught for verification.

The average increment of growth declined in each year of life (Table 1). After annulus 1, males were slightly, but not significantly, longer than females at each annulus. Elrod and Hassler (1971) also reported that males and females had similar lengths at each annulus. One of the age IX fish for which the sex was determined was a male and the other a female, which indicates that the sexes may have equal longevities.

Until age VII, ages determined from scales and rays showed good agreement (Fig. 1). However, in 11 of 17 fish collected prior to June, a new annulus was present on the periphery of the ray but not on the scale. A new annulus was formed in the scales of all fish collected after May. At age VII and beyond, more discrepancies arose between the ages determined by scales and rays, the differences ranging from 1 to 3 years. However, the rays varied more in shape and had no well-defined centrum from which to measure annuli. Because



FIGURE 1.—Relationship between ages determined from scales and from fin rays of 140 blue suckers. Numbers by points are sample sizes.

only 12% of the fish showed discrepancies, back calculations were based on scales.

Reproduction

The youngest mature male and female were age IV and 503 mm total length, and age VI and 573 mm long, respectively. Seven fish longer than 500 mm and 16 of 21 age IV fish were immature. All fish longer than 573 mm were mature.

No ripe females were collected during the study, and a late April-early May spawning season can be inferred only from male characteristics. Free-flowing milt could be manually expressed from three of seven fish on 29 April 1977 (water temperature, 16.4 C) and from 15 of 17 males during 27-29 April 1978 (13.4 C). No ripe males were collected during March or May (and thereafter) 1977. During April, all males possessed nuptial tubercles over most of the body but concentrated on the head and dorsal and caudal fins. Mature males, from which sperm could be expressed, had tubercles on the scales of the sides and back as well as on the head and fins. Immatures had tubercles confined to head and fins. Males became more intensely blue in April, after which the color returned to normal and the nuptial tubercles regressed completely in the immature fish, but the mature males retained small nodules around the eyes through September 1977 and August 1978. Forbes and Richardson (1908) observed the color change and tubercles on the heads of male blue suckers.

The diameters of 50 eggs from each of six nonbreeding, gravid females (age VI, 617 mm, to age IX, 736 mm) collected in August 1978 were measured under a dissecting microscope at 7× magnification. Two definite egg sizes (mean \pm SD) of 1.0 \pm 0.03 mm and 0.4 \pm 0.01 mm were evident. The larger eggs were opaque and white; the smaller eggs were transparent and were not included in the egg counts. The relationship of the eggs produced to total length determined by least-squares regression was Y = -375,100 + 771.5L, where Y = number of eggs and L = total length in millimeters; r = 0.94.

Food Habits

Food occurred in 46 of 80 digestive tracts examined. Trichoptera (caddis fly) larvae and pupae were found in 97% of those 46 tracts, making up 79% of the total numbers, 48% of the volume, and 19% of the weight of the food items. Diptera (midge) larvae and pupae were second in importance: 97% occurrence, 20% of numbers, 1% of volume, 0.6% of weight. Ephemeroptera (mayfly) larvae and amphipods occurred in 11% and 5% of the digestive tracts containing food, respectively, but were insignificant in terms of total numbers, volume, and weight. Debris (principally sand) occurred in all 46 tracts and contributed 42% of the volume and 76% of the weight of the gut contents; detritus (unidentified fragments) was also found in all 46 tracts, and composed 9% of the volume and 4% of the weight of the gut contents. We found no other published information about the food habits of blue suckers.

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