ASPECTS ON THE ECOLOGY OF *LABEO CAPENSIS* AND *LABEO UMBRATUS* IN THE VAAL RIVER

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INTRODUCTION

In the period 1969 to 1971 a research project on the ecology of angling species in the Vaal River was undertaken by the Nature Conservation Division of the Transvaal Provincial Administration. A paper on aspects on the ecology of the yellowfish species appears in this same number (Mulder 1973) and the present paper includes a report on similar studies on the mudfish species *Labeo capensis* (A. Smith) and *Labeo umbratus* (A. Smith). Although the mudfish is not a popular angling fish, knowledge on its ecology is important because of its tendency to overpopulate most of the dams in the highveld regions of Transvaal.

DISTRIBUTION

Both species were found from the origin of the Vaal River to its confluence with the Orange River. *Labeo capensis* was numerically the dominant species in most localities throughout the year and did not seem to be confined to certain habitat types. *Labeo umbratus*, on the other hand, was found in large numbers where lentic conditions prevailed. Examples of these habitats included the Vaal Dam, Bloemhof Dam and the stretch of water above the Vaalharts irrigation weir. In areas where the water was reasonably fast-flowing and clear, it was virtually absent except during spawning migrations.

LENGTH/MASS RELATIONSHIP

As in the case of the yellowfish species no significant difference in the mean mass of males and females was noted (Tables 1 and 2). Length/mass relationships were computed using the formula:

$$W = \log C + n (\log L)$$

The results appear in Tables 3 and 4. For comparative purposes and to determine whether maturity does result in a change in body form, the values were computed for two length groups.

The obvious difference for both species in the values of n does indicate a change in body shape for the two length groups. The seasonal change in the values of n for the different seasons cannot, however, be used as an indication of condition as the values of c do vary (Le Cren 1951).

AGE AND GROWTH

Distinct annuli on the dorso-lateral scales of both species simplified age determination. As for the yellowfish the body/scale relationship was computed by using the distance from the focus to the latero-dorsal margin of the scales (16× magnification). Annuli were more easily distinguished on this line and measurements could be done more accurately. The formula of Schaeffer (1965) was employed for the back calculations and the results are summarized in Tables 5 and 6. Obvious from the tables is the faster growth-rate of *Labeo umbratus* compared to that of *Labeo capensis* as well as the difference in longevity of the two species.

Growth-curves were computed for both species (Von Bertalanffy 1938).

For *Labeo capensis* it was:

$$L_t = 49{,}1\ (1-e^{-0{,}230\ (t-0{,}38)}$$

The hypothetical maximum length computed as 49,1 is smaller than that actually found during the survey (maximum 50 cm). This, however, must be ascribed to the paucity of specimens sampled in the nine-year age group.

For *Labeo umbratus* the curve was computed as:

$$L_t = 60{,}8\ (1-e^{-0{,}276\ (t-0{,}44)}$$

TABLE 1

STATISTICAL EVALUATION OF DIFFERENCES IN MEAN MASS FOR MALES AND FEMALES OF *Labeo capensis*

Length intervals (cm)	*FEMALES*			*MALES*			
	N	$\bar{x}$	*Sx*	*N*	$\bar{x}$	*Sx*	*t,05*
30–33	30	522,1	76,7	37	505,4	110,4	0,7020
34–37	90	765,8	102,2	50	769,9	94,7	0,2333
38–41	102	1066,8	141,6	38	1029,0	133,1	1,4264

TABLE 2

STATISTICAL EVALUATION OF DIFFERENCES IN MEAN MASS FOR MALES AND FEMALES OF *Labeo umbratus*

Length intervals (cm)	*FEMALES*			*MALES*			
	N	$\bar{x}$	*Sx*	*N*	$\bar{x}$	*Sx*	*t,05*
31-35	31	473,7	248,2	32	459,7	290,9	0,2052
36–40	50	771,6	357,4	56	742,8	470,1	0,3517
41–45	55	1156,3	199,5	28	1182,8	164,9	0,6038

TABLE 3

Labeo capensis: VALUES OF LOG C AND CONSTANT n IN THE LENGTH/MASS RELATIONSHIP W=LOG C + n (LOG L) FOR THE SEASONAL SURVEYS

	CENTIMETRE GROUPS					
	7–25 Centimetre			*25 Centimetre and larger*		
Season	*Log c*	*n*	*N*	*Log c*	*n*	*N*
Winter 69	—1,8283	2,9824	846	—2,4071	3,4097	265
Spring 69	—1,8638	3,0232	1394	—2,0564	3,1916	489
Summer 70	—1,8001	2,9927	850	—2,1022	3,1999	327
Autumn 70	—1,7532	2,9282	791	—2,3456	3,3579	140

TABLE 4

Labeo umbratus: VALUES OF LOG C AND CONSTANT n IN THE LENGTH/MASS RELATIONSHIP W=LOG C + n (LOG L) FOR THE SEASONAL SURVEYS

	CENTIMETRE GROUPS					
	7–25 Centimetre			*25 Centimetre and larger*		
Season	*Log c*	*n*	*N*	*Log c*	*n*	*N*
Winter 69	—1,7940	2,9179	282	—2,4163	3,3714	214
Spring 69	—1,8067	2,9389	255	—2,0195	3,1160	68
Summer 70	—1,7543	2,9074	241	—2,0063	3,0935	108
Autumn 70	—1,7534	2,8814	351	—1,9287	3,0300	168

REPRODUCTION

The female/male ratio for mature fish was determined as 3,4 for *Labeo capensis* and 1,1 for *Labeo umbratus*. For *Labeo capensis* this can be partially explained by the difference in life-span of the sexes (Figure 1).

The lengths at which it was found that the sexes reach maturity are given in Table 9 together with similar determinations by other authors. Corresponding ages were determined as four years for males and five years for females for *Labeo capensis* and three and four years respec-

TABLE 5

MEAN EMPIRICAL AND MEAN BACK CALCULATED LENGTHS FOR THE AGE GROUPS OF *Labeo capensis*

		YEAR CLASSES												
	N	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
	24	(9,2)												
	22	8,6	(14,4)											
	20	8,8	14,4	(19,7)										
*	25	8,8	14,4	20,4	(26,0)									
FEMALES	12	9,0	14,4	20,7	26,4	(32,1)								
FEMALES	27	9,4	15,0	21,0	26,9	32,5	(37,7)							
FEMALES	30	8,5	13,6	19,0	24,3	29,5	34,4	(39,1)						
FEMALES	15	8,0	12,8	18,0	22,7	27,5	36,1	36,1	(40,4)					
FEMALES	4	7,8	11,6	15,9	20,4	24,7	33,1	33,1	37,5	(41,6)				
MALES	8	9,1	14,6	20,3	26,0	(31,7)								
MALES	6	9,6	15,7	20,8	25,8	31,0	(35,5)							
MALES	5	8,5	13,2	18,1	23,5	28,0	32,2	(37,3)						
MALES	1	8,0	12,7	17,0	22,5	28,3	32,1	36,6	(40,7)					
	Σ199													

* Sexes not discernible.
( ) Empirical lengths calculated from fish that had completed growth for season.

tively for *Labeo umbratus*. Early maturity is an important factor which can contribute to the success of the species in the Vaal River.

During the surveys all gonads were weighed to compute coefficients of ripeness (Nakai and Usami 1962). The formula employed was:

$$\text{Coefficient} = \frac{\text{gonad weight (gm)} \times 10^4}{\text{Length of fish (cm)}^3}$$

These coefficients were of little value in the study of the reproductive cycle and the method of Nikolsky (1963) was used. The latter method involves the usual examination of each gonad and the classification thereof in one of six stages.

The findings of Groenewald (1957) and Göldner (1967) that fecundity increases with increasing length were underlined in the present study (Tables 10 and 11).

Monthly surveys revealed that the ovaries of both *Labeo capensis* and *Labeo umbratus* are well developed by the end of winter (a few ripe-running females were found in August of the

TABLE 6

MEAN EMPIRICAL AND MEAN BACK CALCULATED LENGTHS FOR THE AGE GROUPS OF *Labeo umbratus*

	N	YEAR CLASSES 1	2	3	4	5	6	7	8
	44	(11,0)							
*	37	11,0	(21,0)						
Females	16	11,7	21,2	(32,0)					
	14	10,5	19,6	29,3	(38,5)				
	15	10,5	19,3	27,3	33,1	(43,8)			
	2	10,2	18,2	26,0	34,1	40,4	(47,3)		
Males	12	10,6	20,1	(30,6)					
	11	10,5	20,0	29,2	(38,1)				
	2	9,7	17,9	25,9	34,2	(42,1)			
	1	8,8	14,3	21,1	29,9	38,2	(45,5)		
	Σ154								

* Sexes not discernible.
( ) Empirical lengths calculated from fish that had completed growth for season.

1969/70 season). The main spawning takes place in the early spring yet several minor spawnings were evident thereafter until January.

The possible spawning behaviour of *Labeo capensis* was observed in October 1970. Rain in the area had caused the river to rise considerably and at the actual locality the grass on the banks had been inundated. Several small channels had been opened parallel to the main stream. In one of these channels fish were seen migrating upstream just before sundown and also moving about in the grass on the edges. A gill net was strung across such a channel to investigate. It was found that *Labeo capensis* moved upstream in pairs (male and female) and in these channels the female was apparently forced into the grass.

All fish were in a ripe-running condition and the activity was thought to be the actual spawning behaviour. In the main stream the same behaviour was noticed. Fertilized ova were collected amongst the gravel and grass on the stream-bed and transferred to glass jars. The ova hatched after 30 hours and the larvae were actively moving in a horizontal plane within five hours. In contrast to this *Barbus holubi* larvae are active after four to six days only (Mulder 1973). Fryer and Whitehead (1959) reported spawning of *Labeo victorianus*, under similar conditions in the early hours of the morning and found that hatching occurred after 45 hours at 23°C. In our case the temperature was recorded as 22°C and it might just be that the actual spawning took place in the early morning and that the activity was not the spawning at all.

Table 7

LENGTH FREQUENCIES BY AGE GROUP OF *Labeo capensis*

	YEAR CLASSES								
Length (cm)	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
6	2								
7	4								
8	4								
9	6								
10	4	1							
11	2	1							
12	1	1							
13	1	4							
14		6							
15		6	1						
16		1	1						
17		2	2						
18			2						
19			4						
20			3	1					
21			2	1					
22			2	2					
23			2	2					
24			1	4					
25				4					
26				1					
27				2					
28				4	3				
29					3				
30				2	4				
31				2	2	2			
32					1	1	1		
33					1	2			
34					2	1	3		
35					1	5	3		
36					1	2	2		
37					1	5	3	3	
38					1	4	4	3	
39						2	7	3	
40						7	2	2	2
41						2	1	2	
42							3		1
44							2	1	1
45							2	1	
50								1	

TABLE 8

LENGTH FREQUENCIES BY AGE GROUPS OF *Labeo umbratus*

	YEAR CLASSES					
Length (cm)	*1*	*2*	*3*	*4*	*5*	*6*
7	4					
8	3					
9	12					
10	8					
11	4					
12	2					
13	5					
14	1					
15	2					
16	3					
17		4				
18		7				
19		3				
20		5				
21		5				
22		5				
23		3				
24		3				
25		1	1			
26		1	4			
27			1			
28			2			
29			4			
30			2			
31			3			
32			1	1		
33			3	3		
34			1			
35			1	2		
36			1	3	1	
37			3	3		
38			1	2		
39				3		
40				3	2	
41				1	2	
42				2		
43				1	3	
44				1	2	
45					5	1
47						2
49					1	

TABLE 9

LENGTHS AT WHICH SIX VAAL RIVER FISH SPECIES REACH MATURITY

SPECIES	*Vaal River 1969–1971*		*Baberspan 1965–1966*		*Vaal River 1956*	
	♀	♂	♀	♂	♀	♂
B. kimberleyensis	46,0	35,0	—	—	—	—
B. holubi	34,0	28,0	25,0	20,0	24,0	20,0
L. capensis	31,0	26,0	32,0	26,0	24,0	22,0
L. umbratus	30,0	22,0	34,0	32,0	32,5	32,5
C. carpio	35,0	30,0	39,0	31,0*	48,8	31,3
C. gariepinus	46,0	44,0	48,0	43,0*	45,0	45,0

* From coefficient of ripeness data (Göldner 1967).

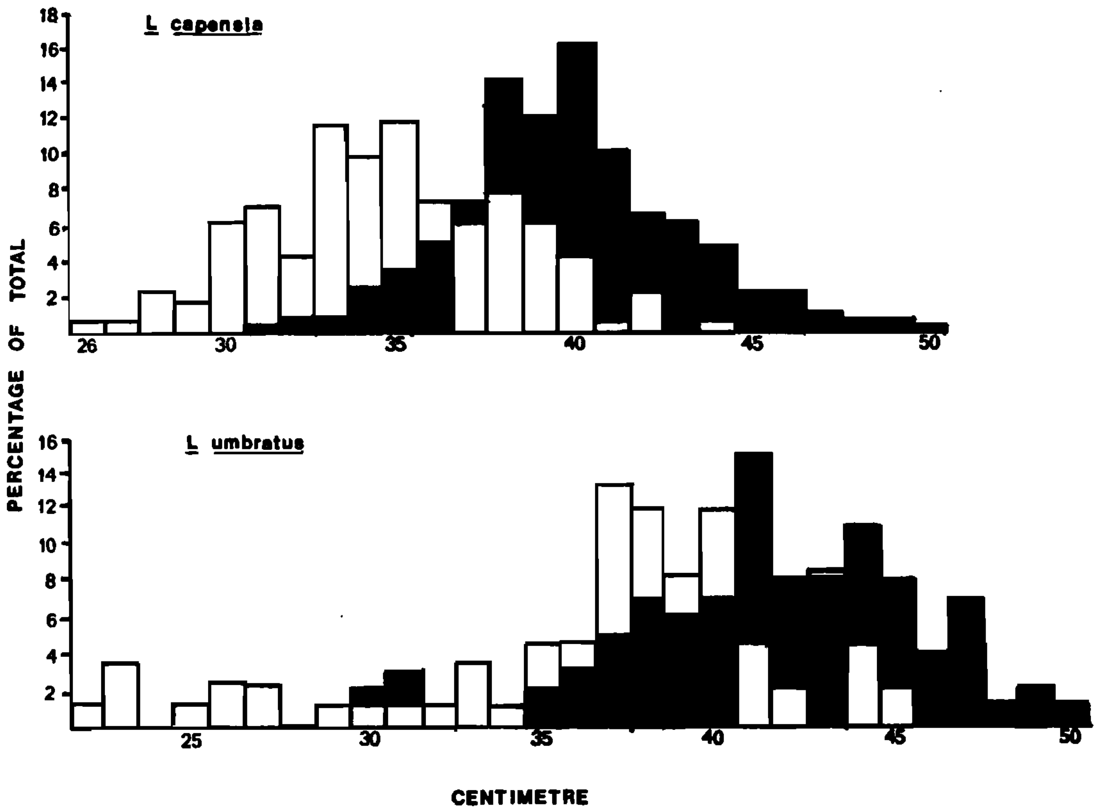

FIGURE 1

Percentage frequencies of mature males and females of *Labeo capensis* and *Labeo umbratus*: Data for sexes computed separately.

TABLE 10

FECUNDITY, OVA DIAMETER AND COEFFICIENT OF RIPENESS FOR *Labeo capensis*

Length	*Fecundity*	*Diameter*	*C.R.*
30,4	29 000	0,4 – 0,6	4,6
35,9	31 000	0,4 – 0,6	3,9
38,7	101 000	0,7 – 1,0	9,5
39,6	107 000	0,5 – 0,7	6,0
41,7	150 000	0,7 – 1,1	17,7
43,5	152 000	0,9 – 1,2	19,6
45,3	225 000	0,9 – 1,1	13,9
46,0	209 000	0,0 – 1,2	16,6
47,0	174 000	0,7 – 1,0	15,6
47,5	214 000	0,9 – 1,3	19,1

TABLE 11

FECUNDITY, OVA DIAMETER AND COEFFICIENT OF RIPENESS FOR *Labeo umbratus*

Length	*Fecundity*	*Diameter*	*C.R.*
31,5	63 000	0,8 – 1,0	9,9
33,8	86 000	0,7 – 0,9	8,3
35,3	67 000	0,7 – 0,8	9,1
36,3	94 000	0,7 – 1,0	6,3
37,7	118 000	0,8 – 1,1	9,9
39,3	116 000	1,0 – 1,4	21,8
40,5	119 000	0,7 – 0,9	7,8
45,5	232 000	0,7 – 1,1	12,0
46,9	228 000	0,9 – 1,2	16,7
48,5	282 000	1,1 – 1,5	29,5
49,0	277 000	0,8 – 1,3	20,9

FEEDING HABITS

This parameter was not investigated in the present study but existing literature does show that both species are detritus feeders (Groenewald 1957; Jubb 1967; Enslin, 1966; Kruger 1972).

SUMMARY

The present study revealed that *Labeo capensis* was numerically the dominant species in the Vaal River. In contrast, *Labeo umbratus* was confined to lentic habitat types. The success of the latter species in most highveld impoundments can be ascribed to its fast growth-rate, early maturity and fecundity.

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