Fishery Technology
1996, Vol. 33(1) pp : 10 - 15

Observations on the Growth Performance of *Labeo dussumieri* (Val.) in Mono and Mixed Culture Experiments

B. Madhusoodana Kurup
Department of Industrial Fisheries
Cochin University of Science & Technology
Cochin-682 016, India

Growth performance and production potential of an indigenous carp of Kerala, *Labeo dussumieri* (Val.) has been studied by culturing it alone and also in combination with Indian major carps. In monoculture trials, *L. dussumieri* attained a mean weight of 392 and 356 g at stocking densities of 3000 and 4000 ha^{-1}, respectively within a period of 10 months. In composite culture trials when *L. dussumieri* (Thooli) was reared along with Catla, Rohu and Mrigal in the ratio 1:1:1:0.5, and the average weight attained by Catla, Rohu, Mrigal and Thooli within a period of ten months were 671, 602, 474 and 322 g, respectively at a stocking density of 6000 ha^{-1} whereas at a higher density of 8000 ha^{-1}, the average weights registered were in the order of 557, 506, 397 and 283 g, respectively. These would work out to a gross production of 2698 and 3043 kg ha^{-1} at stocking densities of 6000 and 8000 ha^{-1}, respectively. The growth attained by *L. dussumieri* was apparently poor in the experiments when ratio of the above four species was maintained at 1:1:1:1. Physico-chemical and biotic parameters of the ponds were also studied.

Key words : Monoculture, composite culture, growth performance, *Labeo dussumieri*

Labeo dussumieri (Val.), commonly known as *Thooli* in Central Kerala, is the only species of the genus *Labeo* Cuv. indigenous to Kerala waters (Kurup & Kuriakose, 1990) and its regional availability is well restricted in four rivers of Central Kerala where this species is being preferred as an important delicacy. No attempt has so far been made to study the growth rate of this species in captivity. In order to assess the culture potential of *L. dussumieri*, information on growth performance, compatibility with other cultivable species, habitat preference and feeding habit are very essential. Therefore, *L. dussumieri* was reared in combination with other carps as well as alone and the present account embodies the results of the culture experiments carried out during 1988-90 period. The growth and production performance of the Indian major carps in composite culture experiments have been already reported, notable among them being those of Lakshmanan *et al.* (1971), Sinha *et al.* (1973), Chaudhuri *et al.* (1975) Chakrabarty *et al.* (1976), Das *et al.* (1977), Murty *et al.* (1978), Das *et al.* (1982), Lakshmanan *et al.* (1985) and Das & Ray (1989).

Materials and Methods

The mono and mixed culture experiments were carried out in four newly constructed earthern ponds having water spread areas ranging from 0.01 to 0.02 ha, at the ICAR project site of College of Fisheries, Cochin. The preparation and manuring of these rain fed, weed free ponds were done 15 days prior to stocking. Eradication of predatory and weed fishes was done by poisoning with Mahua oil

cake (*Bassia latifolia*) @ 250 ppm. Lime was applied @ 150 kg ha^{-1} $year^{-1}$ in two equal installments while cow dung was used @ 8000 kg ha^{-1} $year^{-1}$ in four equal installments. Urea and Massuriephos were applied @ 200 kg^{-1} ha^{-1} $year^{-1}$ in two installments. Physico-chemical parameters of water were determined following standard procedures (APHA, 1985; Strickland & Parsons, 1972). Plankton and benthos samples were collected at fortnightly intervals, the former by filtering of 50 litres of pond water through a no. 20 bolting silk, while the latter with the help of a van Veen grab. The stocking materials were produced from the parental stock by resorting to induced breeding techniques (Kurup *et al.*, 1983a). Details of species stocked, stocking ratio and stocking density, size of fingerlings, etc. are given in Table 3. The fishes were fed with a mixture of rice bran and oil cake at 1:1 ratio at 4% of body weight on alternate days. About 15% of each species were sampled every month randomly by cast netting and their individual length in mm and weight up to an accuracy of 0.1 g were recorded. On termination of the experiments, the ponds were dewatered and the fishes were fully harvested by repeated seining. Statistical analysis of the data were done following Snedecor & Cochran (1967).

Results and Discussion

The variations noticed in respect of water quality parameters of the stocking ponds during 1988-89 and 1989-90 periods are shown in Table 1. As there was no source of water supply readily available in the vicinity of the grow out ponds, a steep decline in water column of these ponds was noticed during the summer months. The fluctuation pattern of abiotic parameters were almost identical in all the ponds. However, a steady improvement in nutrient concentration during 1989-90, is worth mentioning. The characteristics of the pond soil were as follows: pH 6.0 - 6.8, organic carbon 0.42 - 1.92%, Calcium carbonate 1.27 - 5.43%, The soil contained 28-37% sand, 38-48% silt and 27-30% clay.

The primary productivity values of the ponds were very poor during 1988-89 periods while in 1989-90 a gradual improvement was seen. In general high

Table 1. Ranges of major environmental and biological parameters in different ponds

	1988-89				1989-90			
Pond No.	M1	M2	S1	S2	M1	M2	S1	S2
Water level, cm	70-140	80-160	90-205	115-220	80-190	65-200	110-190	90-200
Water temperature, °C	28.7-29.8	27.1-31.4	26.9-31.5	27.0-31.7	28.4-32.3	28.5-32.6	28.7-32.7	28.5-32.5
Water, pH	7.3-8.1	7.4-8.0	7.3-8.1	7.4-8.3	7.6-8.9	7.9-9.0	7.5-8.8	7.4-8.3
Dissolved oxygen, mg l^{-1}	1.6-12.4 7-10.9	2.1-10.9 4.8-9.7	4.0-10.8	4.6-11.1	2.8-12.4	1.9-10.6	1.8-9.2	2.16-10.6
Total alkalinity, ppm	179-204	85-180.7	141-450	139-391	215-240	95-320	104-370	117-340
Nitrate, ng l^{-1}	0.08-0.2	0.07-0.22	0.09-0.19	0.02-0.14	0.18-0.42	0.20-0.46	0.12-0.3	0.14-0.36
Phosphate, ng l^{-1}	0.18-1.9	0.27-2.4	0.1-1.4	0.2-2.1	0.28-4.1	1.8-3.2	0.3-2.49	0.27-3.4
Turbidity, ntu	9-19	7.5-14.5	4-14.5	1.5-31.5	12-48	16-54	8-24	8.18
Primary productivity gC m^{-2} day^{-1}	0.05-1.3	0.19-1.1	0.34-1.97	0.1-1.4	0.8-4.8	1.4-5.2	0.9-5.4	1.2-3.4
Plankton ml 50 l^{-1}	0.4-1.0	0.04-0.7	0.2-2.1	0.2-1.8	0.8-2.2	0.6-1.8	0.3-1.0	0.2-1.4
Benthos No. m^{-2}	32-41.4	32.5-52.4	21-31	7-39	28-96	32-84	12-46	16-48

Table 2. Growth pattern of *Labeo dussumieri* in monoculture

	Pond No. & Area	Stocking rate, Nos ha^{-1}	No. stocked	Average weight, g Initial	Final	Survival %	Increment in weight %	Period of rearing, months
1988-89	M1 0.01 ha	3000	32	1.15	197.4	93.74	196.2	7
	M2 0.02 ha	4000	81	1.15	139.8	86.7	138.7	6
1989-90	M1 0.01 ha	3000	32	4.9	392.0	43.75	387.1	10
	M2 0.02 ha	4000	81	4.9	356.0	46.91	351.1	10

values could be observed during February-March months, whereas extreme low values were recorded in the months of June and July. The phytoplankters were predominantly represented by *Chlamydamonas, Euglena, Volvox, Peridinium, Closterium, Oscillatoria, Navicula* and *Scenedesmus* while *Moina, Daphnia, Cyclops, Filinia, Phelodina, Diaptomus, Brachionus Keratella,* rhizopods and copepods were the most dominant zooplankters. The density of benthic population was also high during 1989-90 compared to 1988-89 and invariably insect larvae accounted for sizeable fraction, comprising of *Chironomus,* Dragon fly nymphs and *Cybister.* Besides, bivalves,

Table 3. Growth, survival, production of fish and contribution of each species in mixed culture

Year, Pond No. and Area	Rate of Stocking per ha	Species and their ratio	Average weight initial, g	final, g	Survival %	Increment in weight g	Total Production kg ha^{-1} 10 months^{-1} Gross	Net	Contribution by weight %
1988-89	6000	C 1 (20)*	0.84	308	70.2	307.46			16.36 (3)+
S1		R 1 (20)	0.10	449	90.2	449.20			30.74 (2)
0.01 ha		M 1 (20)	0.14	623	80.4	623.36			38.00 (1)
		T 1 (20)	0.48	207	95.1	206.52	2024	2022.8	14.90 (4)
1988-89	8000	C 1 (26)	0.84	296	84.6	295.16			24.47 (3)
S2		R 1 (26)	0.10	250	92.3	349.90			30.19 (2)
0.01 ha		M 1 (26)	0.14	402	13.0	401.86			27.48 (1)
		T 1 (26)	0.48	199	96.1	198.52	2140	2138.8	17.88 (4)
1989-90	6000	C 1 (23)	0.15	671	82.6	670.85			36.20 (1)
S1		R 1 (23)	0.18	602	78.0	601.82			30.90 (2)
0.01 ha		M 0.5 (12)	0.13	474	83.3	473.87			13.50 (4)
		T 1 (23)	0.38	322	91.3	321.62	2698	2696.62	19.30 (3)
1989-90	8000	C 1 (32)	0.15	557	75.0	556.85			33.70 (2)
S2		R 1 (32)	0.18	506	87.5	505.82			35.70 (1)
0.01 ha		M 0.5 (16)	0.13	397	75.0	396.87			12.00 (4)
		T 1 (32)	0.94	283	84.3	282.06	3043	3039.71	18.60 (3)

* Number stocked in parenthesis; C-Catla, R-Rohu, M-Mrigal, T-Thooli (*Labeo dussumieri*); + Numbers in paranthesis indicate ranking

gastropods, ostracods and oligochaetes also contributed to the benthic community of the stocking ponds.

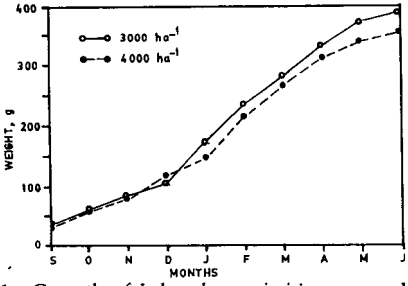

Fig. 1. Growth of *Labeo dussumieri* in monoculture at stocking rates of 3000 and 4000 nos. ha^{-1} during 1989-90

Results of growth performance of *L. dussumieri* in mono as well as composite culture experiments are summarized in Tables 2 and 3. When *L. dussumieri* was cultured alone for a period of 10 months it attained an average weight of 392 and 356 g under a stocking density of 3000 and 4000 nos. ha^{-1}, respectively (Table 2, Fig. 1). However, the retrieval percentage was only of the order of 43.76 and 46.71. Mixed culture trials were carried out at two different stocking ratios viz., 1:1:1:1 and 1:1:1:0.5 of catla, rohu, mrigal and thooli (Table 3) under two different stocking densities of 6000 and 8000 ha^{-1}. The results reveal that at the stocking ratio 1:1:1:0.5, catla, rohu, mrigal and thooli attained the highest average weight of 671, 602, 474 and 322 g, respectively within a period of 10 months. But at the stocking density of 8000 ha^{-1} the respective absolute weights registered were 557, 506, 397 and 283 g, respectively. The corresponding weight attained by *L. dussumieri* was only of the order of 207 and 199 g when the stocking ratio was maintained at 1:1:1:1. The average weight attained by catla, rohu, mrigal and thooli in each trial were subjected to statistical analysis and the results reveal that in all trials *F* values were found to be significantly different at 5 and 1% levels. A pairwise comparison of various species applying *t* - test also revealed similar trend. It may, therefore, be inferred that catla, rohu, mrigal and thooli differed significantly from each other in growth performance at two stocking densities and also at two different stocking ratios as given above. In order to ascertain whether there existed any difference in growth of *L. dussumieri* when the stocking ratio of mrigal was halved, *t* - test was employed and the results showed that the growth attained by the above species showed significant difference at 5% and 1% levels in both lower stocking density of 6000 nos. ha^{-1} (t = 5.39; df = 18) as well as in higher stocking density of 8000 nos. ha^{-1} (t = 3.87; df = 18). The growth in weight of catla, rohu, mrigal and thooli at two different stocking densities during 1989-90 is depicted in Figs. 2&3.

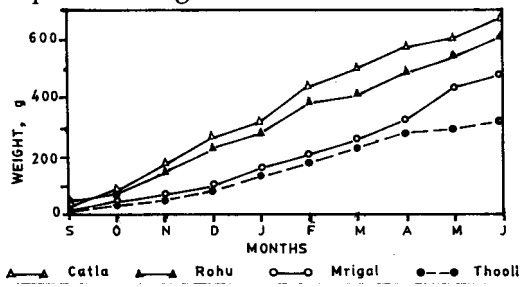

Fig. 2. Growth of *Labeo dussumieri* in mixed culture at stocking rates of 6000 nos ha^{-1}, during 1989-90

The growth and net production were calculated in the mixed farming experiments and the results are shown in Table 3. Highest net production of 3039.7 kg^{-1} ha^{-1} in 10 months was obtained at a stocking density of 8000 nos. ha^{-1}. Although catla has been reported as the fastest growing Indian carp, in the present study, its contribution towards total production was not satisfactory (Table 3) and it ranked only next to rohu and mrigal. The contribution by thooli was apparently lowest in all the trials carried out during the present study.

The basic considerations to be examined for assessing culture potential of a fish

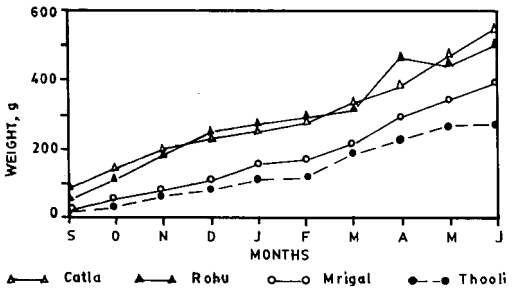

Fig. 3. Growth of *Labeo dussumieri* in mixed culture at stocking rate of 8000 nos. ha^{-1}, during 1989-90

are growth rate, compatibility with other species in respect of food, space and feeding behavior and efficiency in uptake of supplementary feed. While examining the above aspects of *L. dussumieri* it could be seen that in captivity the maximum weight attained was 392 and 322 g, respectively in mono and mixed culture systems. In the mixed farming experiments, *L. dussumieri* attained only average weights of 322 and 283 g at stocking densities of 6000 and 8000 nos. ha^{-1}, respectively against 602 and 506 g attained by *L. rohita* and therefore, it appears that the growth rate of former species is only about half of the latter. Ricker (1971) reported that growth rate of fish is profoundly influenced by the type of feed consumed by the fish and its food conversion efficiency. *L. rohita* is omnivorous in feeding habit (Das & Moitra, 1956) in contrast to the herbivorous and illiophagic feeding habit of *L. dussumieri* (Kurup, 1993a). Unlike *L. rohita, L. dussumieri* is a bottom dweller and the preference for supplementary feed was found unsatisfactory, mud always forming a sizeable portion of the gut content (Kurup, 1993a). The growth attained by *L. calbasu* was reported as 312 - 466.7 g year^{-1} at stocking densities ranging from 5000 to 6250 nos. ha^{-1} (Lakshmanan *et al.*, 1971) and 266.6 g in 6 months (Chakrabarty *et al.*, 1976). Therefore it woud appear that the growth rates of *L. dussumieri* and *L. calbasu* are almost comparable. *L. dussumieri* attained a weight of 392 g in monoculture trial within a period of 10 months against the annual growth of 215 g in Pampa river (Kurup, 1993b) indicating its faster growth in captive conditions.

In composite fish farming wherein a number of compatible species are reared together, it is necessary to initially group species with almost identical or overlapping feeding habits and thereafter decide the best ratio among each group (Lakshmanan *et al.*, 1971). In the present study also a significant difference in the growth rate of *L. dussumieri* could be achieved in mixed culture when stocking ratio of mrigal was halved. Both these species are herbivirous and illiophagic (Kamal, 1967; Kurup, 1993a) and also inhabit the bottom niche of culture ponds. Therefore, these two species are likely to complete for food and space in captive conditions when they are allowed to coexist in the some niche. In the present study the growth of *L. dussumieri* was found adversely affected in culture trials wherein the ratio between mrigal and thooli was maintained at 1:1 (Table 3). On the contrary, a reduction in the stocking ratio of mrigal resulted in attaining significant improvement in the growth rate of *L. dussumieri.* It would thus appear that *Cirrhinus mrigala* and *L. dussumieri* are not compatible species for mixed farming. Similar findings with respect to catla and silver carp; and mrigal and common carp have already been reported (Alikunhi & Sukumaran, 1964).

The production values registered in 1988-89 periods were very low while an improvement in growth performance of the various species stocked as well as their contribution to production in 1989-90 were noteworthy. The low rate of production registered in 1988-89 period could be attributed to poor conditioning of grow out ponds as they were newly constructed and

were earlier not used for farming. Further more, in this study, the weight attained by catla, rohu and mrigal were not satisfactory and therefore, not comparable with other available reports (Alikunhi *et al.*, 1971; Chakraborty *et al.*, 1976; Sinha *et al.*, 1973; Murty *et al.*, 1978; Das *et al.*, 1982). However, production registered in 1989-90 in the present study under simple management could be considered as satisfactory and can favourably be compared with Lakshmanan *et al.* (1971). Further improvements of the production rates would be possible by resorting to judicious management of the stocking ratio as suggested by Alikunhi (1957).

The author is grateful to Dr. M.J. Sebastian, Dean, College of Fisheries, Kerala Agricultural University, Panangad for providing the necessary facilities. This work was done as part of ICAR ad hoc project and the financial assistance received from Indian Council of Agricultural Research is gratefully acknowledged.

References

Alikunhi, K.H. (1957) *Fm. Bull. Indian Counc. Agric. Res.* **20**, 144

Alikunhi, K.H. & Sukumaran, K.K. (1964) *Proc. Indian Acad. Sci.* (B), **60**, 71

Alikunhi, K.H., Sukumaran, K.K. & Parameswaran, S. (1971) *Jour. Ind. Fish. Assoc.* **1**(1), 26

APHA (1985) *Standard Methods for Testing Water and Waste water* American Public Health Association, Washington DC, USA

Chakraborty, R.D., Murty, D.S., Sen, P.R., Nandy, A.C. & Chakraborty, D.P. (1976) *J. Inland Fish. Soc.* **8**, 179

Chaudhuri, H., Chakrabarty, R.D. Rao, N.G.S. & Jena, S. (1975) *Aquaculture* **6**, 343

Das, S.M. & Moitra, S.K. (1956) *Proc. Nat. Acad. Sci.* (B), **26**(4), 213

Das, P. Sinha, M., Kumar, D., Chakraborty, D.P. & Guha Ray M.K. (1977) *J. Inland Fish. Soc. India* **9**, 105

Das, P., Kumar, D., Bhaumik, U., Roy, B. & Chakraborty, D.P. (1982) *J. Inland Fish. Soc. India* **14**, 18

Das, I. & Ray, A.K. (1989) *J. Inland Fish. Soc. India* **21**, 1

Kamal, M.Y. (1967) *Indian J. Fish* **14**(1&2), 24

Kurup, B.M. (1993a) *Indian J. Fish* (in press)

Kurup, B.M. (1993b) *Indian J. Fish* (in press)

Kurup, B.M. & Kuriakose, Binu. (1990) *Fishing Chimes*, **10**, 39

Kurup, B.M., Nair C.M. & Kuriakose, Binu. (1993) *J. Aqua. Trop.* **8**, 255

Lakshmanan, M.A.V., Sukumaran, K.K., Murty, D.S., Chakraborty, D.P. & Philipose, M.T. (1971) *J. Inland Fish. Soc. India*, **3**, 1

Lakshmanan, M.A.V., Rao, P.L.N., Selvaraj, C. & Rai, S.P. (1985) *J. Inland Fish. Soc. India*, **17**(1&2), 48

Murty, D.S., Saha G.N., Selvaraj, C., Reddy, P.V.G.K. & Dey, R.K. (1978) *J. Inland Fish. Soc. India*, **10**, 39

Ricker, W.E. (1971) *Methods of Fish Production in Freshwater*, IBP Handbook No. 3, 2nd edn., Blackwell scientific Publications Ltd., Osney Mead, Oxford, UK

Sinha, V.R.P., Vijaya Gupta, M., Banerjee, M.K. & Kumar, D. (1973) *J. Inland Fish. Soc. India.* **5**, 201

Snedecor, G.W. & Cochran, W.G. (1967) *Statistical Methods.* Oxford & IBH Publishing Co. New Delhi

Strickland, J.D. & Parsons, T.R. (1972) *Bull. Fish. Res. Bd. Canada*, **125**, 1