Studies on the Breeding Biology And Behaviour of Barbus Pituitora (Mahseer)

C-QU/BIO (84)
FINAL REPORT
(January 1978 — December 1978)

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PRINCIPAL INVESTIGATOR

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ISLAMABAD

LIST OF SCIENTISTS

NAME	DISIGNATION	WORKING HOURS
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GRADUATE STUDENTS

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PAKISTAN SCIENCE FOUNDATION

ANNUAL RESEARCH REPORT

1. Project No: C-QU/BIO (84)

2. Project Title: Studies on the Breeding Biology and Behaviour of Barbus Pituitora (Mahseer)

3. Name of Institution: Department of Biology, Quaid-i-Azam University, Islamabad.

4. Total amount of Grant: Rs. 33,360/-

5. Report Period: January 1978 to December 1978

6. Summery of Progress for this report period : Enclosed.

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PAKISTAN SCIENCE FOUNDATION

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(FISCAL REPORT)

From January, 1978 to December 1978.

1.	Name and address of grantee:	Dr. Qazi Javed Iqbal Department of Biological Sciences, Quaid-i-Azam University, Islamabad
2.	Project No:	C-QU/BIO (84)
3.	Title of the Project:	"Studies on the Breeding Biology and Behaviour of *Barbus Pituitora*.
4.	Amount of Grant:	Rs. 33,360/-

SUMMARY STATUS OF FUNDS

5.	Total Grant fund received during the report period (Jan, 1978 to December 1978)	Rs. 33,360/-
6.	Total Grant funds spent during this report period (Jan. 1978 to Dec. 1978)	Rs. 33,360/-
7.	Balence Grant funds in hand on end of this report period	Nil
8.	Outstanding liabilities	----

PART I

	GRANT FUNDS SPENT DURING THIS REPORT	RECURRING COST
9.	Salaries and benifits of Project Personnels:	Rs. 21360/-
10.	Travel of personnels within country:	Rs. Nil
11.	Supplies and material (detail attached)	Rs. 1200/-
12.	Other Cost	Rs. Nil
13	Total from itom 9-12	Rs. 33,360/-

PART II

GRANT OF FUNDS SPENT DURING THIS PERIOD NON-RECURRING

14.	Capital Assets provided under grant	Nil
15.	Total grant of funds spent during this period (January, 1978 to December, 1978)	Rs. 33,360/-
16.	Signature of the Principal Investigator	[signature]
17.	Designation:	Assistant Professor Department of Biology Quaid-i-Azam University, Islamabad.

18. Dated 31 December, 1978.

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C O N T E N T S

FINAL REPORT

NAME & ADDRESS OF THE INSTITUTION: DEPARTMENT OF BIOLOGICAL SCIENCES QUAID-I-AZAM UNIVERSITY, ISLAMABAD.

PRINCIPAL INVESTIGATOR: DR. QAZI JAVED IQBAL

CO-PRINCIPAL INVESTIGATOR: DR. M.H.QAZI

PROJECT NO: C-QU/BIO (84)

PROJECT TITLE: STUDIES ON THE BREEDING BIOLOGY AND BEHAVIOUR OF *BARBUS PITUITORA* (MAHSEER)

REPORT PERIOD JANUARY, 1978 TO DECEMBER 1978.

VICE-CHANCELLOR
QUAID-I-AZAM UNIVERSITY
ISLAMABAD

(DR. QAZI JAVED IQBAL)
PRINCIPAL INVESTIGATOR

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CO-PRINCIPAL INVESTIGATOR

S U M M A R Y

The present investigations were aimed initially at the primary productivity of the Ramli stream used for supplying running water to experimental ponds employed to study the breeding biology and behaviour of Mahseer (Barbus Pituitora). These investigations are important as Mahseer is an economically important fish but very difficult to breed. It is of utmost importance to know A-biotic and biotic factors operating and controlling a particular fish fauna. Our investigations show that a Temperature of 16°- 34°C and dissolved Oxygen (2.7-7.9 ppl) are important controlling factors in the breeding of this fish. Besides, phyto- and zooplanktan, of the stream are described with reference to those one on which the fish predate upon, such as Cyclops magnus, Diaptomus sp. Daphina sp. Moina brachitata Chydorus ovalis. Other a-biotic factors like pH and phosphate content are described for reference.

Growth rate of the fish under different dietary conditions have been worked out, using length-weight relationships. Two running water ponds and four aquariums were employed in the study. The investigations show that 35% protiens in the fish diet are best suited for adequate growth rate and breeding of B. pituitora.

The length-weight relationships show that W=antilog (-3.7590227 + 2.4026106 log L).

Feeding behaviour is initiated by visual stimuli and oriented by orthrokinases, though telotaxis and dorsal light reaction play importent role. Food orientation is impressed by paulovion classical conditioning.

Diurnal short length and long length migration are supported by protean behaviour which acts as energy conservation machanisms. Both zigzaging pattern and luping is observable.

Sexual Behaviour breeding start in the end of April and lost upto midddle of Sept.

Spawning was induced in the fish by giving injection of preserved pituitary gland in a ratio of 5 mg/Kg of the body weight of the fish. Spawning occured after 7-7½ hrs. of the injection.

INTRODUCTION

Fresh water fishes of Pakistan have a significant economic importance due to their nutritive value especially animal protiens. Taxomomic status of most of these fresh water fishes has been established and catalogued (Ahmad, 1961). Attempts have also been made by the fisheries deptt; to update fresh water fisheries management programe for the proliferation, survival, feed, breeding and economic use of some of these fishes. It need be emphasized here that for successful breeding and propagation of fishes, controlled mechanism involved are to be related to the ecological complexes in which these fishes thrive. In this reagrd little work has been done (Baqai and Zubairi, 1974, Azra and Iqbal, 1975). Another important factor operating on the fish biology is fish feed and food preference and the fish growth in relation to feed and ecological factors such as dissolved oxygen, temperature, phosphates, nitrates and chlorides. Little work is reported on the food habits and feed of carps (Menon, 1955; Hussain; 1955; Vas, 1957; Alikunhi, 1958; Arshad, 1965; Desai, 1968; Ahmad; 1969; Sukmaran, 1969; Hepher, 1969; Szunmiec; 1969, Khandker, 1970; Javed, 1970; Chinkich, et al, 1976). Lastly, investigations are needed to breed the fish artificially in the fish pond, Here also we find scanty reports on the experimental breeding of the carps (Hussain, 1965; Wlodek, 1968; Choudhuri 1968, 1969; Konradt, 1968; Jafri, 1973; 1977; Doha and Dowan, 1967; Qazi, 1965).

The present investigation were aimed at describing environmental factors such as dissolved oxygen and organic phosphate pH and temperature, which play an important role in controling survival growth and successful breeding of the fish.

The investigation also describe food formulation, food prefrence and length weight relationship of the fish. Lastly investigation briefly described experimentation with induced breeding.

PLAN OF WORK

1. Limnological Studies of the Supply Stream.

2. Limnological Studies of the Experimental ponds.

3. Collection of Fish

4. Studies on the Environmental factors controlling survival and breeding of the fish.

5. Food formulation.

6. Studies on the feeding behaviour.

7. Studies on the weight-length relationship.

8. Studies on Energy conservation..

9. Breeding season

10. Induced Breeding.

METHODOLOGY

Primary productivity of the stream and ponds.

Water samples were collected from two stations selected at the stream and were then compared with samples collected from the two experimental ponds, supplied with stream water through 1/2" and 2" diameter pipes at different flow rate. Day and night samples were taken from the ponds. Samples were collected simultaneously upstream downstream and from the ponds. Ponds were of two different dimensions 45'x25' & 6' high & 35' & 5' high, water could either flow independently of each pond or could be run from pond I to pond II.

Oxygen curves were constructed by wrinkler's method as given below:

Estimation of dissolved oxygen by Wrinkler's method

Reagents:- Chemicals used for fixation

1. Manganese sulphate:- 367 gms. of $MnSo_4$ was dissolved in distelled H_2o and diluted to one liter.

2. Alkaline Iodide:- 360 gms. of NaoH was dissolved in distilled & then 150 gms of KI was added to the solute, which was then diluted to one liter. crystals were dissolved by shaking.

3. Sulfuric Acid 50%

Chemicals used for titration:-

1. .01 N sodium thio sulphate:- 2.5 gms of Na_2S2O_3 was weighed and dissolved in one liter of distilled H_2o.

Standerization of sodium thio-sulphate:- Stock solution 1.225 gms= .01 N of $K_2cr_2O_7$ was dissolved in 1000 cc of distilled water chemically equivalent 0.025 N. To 10 c c of $K_2cr_2O_7$ solution of .01 N, was added approx. 2.3 cc. of concentrated H_2So_4 and 5 ml of 15% KI solution so that an equal equality of Iodine was liberated.

Reaction as follows

$K_2cr_2O_7 + 4H_2So4$ $\quad$ $K_2So4 + cr_2(So_4) + 4H_2O + 3\ (O^3)$

$2\ KI + H2O + O$ $\quad$ $2\ KOH + I_2$

$2Na2S2\ O_3 + I_2$ $\quad$ $2\ Na\ I + 2sO_2 + 2O_2$

Procedure:- $Na_2S_2O_3$ was draw in a burrete, and the level marked. 10 ml of prepared $K_2cr_2O_7$ solution was taken in a conical flask, a few drops of Phenophthelin was added as indicator showing blue colour. This was filtrated against $Na_2S_2O_3$ till, the solution became colourless.

Result:-

$$N \text{ of } Na_2S_2O_3 = N \text{ of } K_2cr_2O_7 \times \frac{\text{vol of } K_2cr_2O_7}{\text{vol of } Na_2S_2O_7}$$

2. Starch Solution:- 2%

Procedure:- Fixation of water samples:- 250 ml brown bottle was filled with water, so that no air bubble was trapped in. 2 ml of M_nSO_4 was added to it followed by 2 ml of alkaline solution. After shaking, a dense cloud of precipetation appeared at the bottom. The pracipetate was allowed to settle down. After half an hour 2 ml of H_2So_4 was added. The pracipetate dissolved and the sample became yellow. This colour is due to the formation of iodine.

Titration

The burrette was filled with sodium thio-sulphate, the initial reading was noted. 20 ml of fixed sample was drawn by pippet in a titration flask, 5-6 drops of starch solution were added as indicator, the solution became blue, then titrated against sodium thio-sulphate drop by drop, till the sample became colourless. Final reading was noted. Difference of the two readings gave the amount of sodium-thio sulphate consumed.

Results: $Nxv \ X \ \frac{B}{B-2} \ X \ 5.6 \ X \ \frac{1000}{5}$

Estimation of Inorganic Phosphate

Fiske & Subbarow Method (1925)

Reagents:-

1. Standard phosphate Solution:- 0.351 gms of pure dry mono-potassium phosphate was dissolved in water and transfered quantitatively to a 1-liter volumetric flask. 10 ml of 10 N sulfuric acid was added, and diluted to the mark with water, and mixed. This solution contained 0.4 mg of phosphourus in 5 ml. This made the solution stable indefinitely.

2. Molybdate Solution:- 25 gms of reagent grade ammonium molydbate was dissolved in approximatly 200 ml of water. To a 1-liter volumetric flask containing 300 ml of 10 N sulphuric acid, the molybdate solution was added and diluted with washing to a 1 liter and mixed to render it stable in definately.

3. Aminonaphtholsulfonic Acid Reagent:- To 195 ml 15% sodium-bisulfite solution contained in a glass-stoppered cylinder, 0.5 gms of 1,2,4-aminonaphtholsulfonic acid was added and then 5 ml of 20% sodium sulfite. This was shaken until the powder was dissolved. The solution was transfered to a brown glass bottle and stored in the coold incubator This solution was useable for about four weeks.

Procedure:-

Standard was prepared by taking 3 ml of stock standard, adding to it 12 ml of distilled water, so that it became 5 times dilute. From this 6 different concentrations were prepared as follow:-

S_1	=	0.5 ml	of	5	time	dilute	solution	+	4.5	ml	distilled	water.
S_2	=	1.0 "	"	"	"	"	"	"	4.0	"	"	"
S_3	=	1.5 "	"	"	"	"	"	"	3.5	"	"	"
S_4	=	2.0 "	"	"	"	"	"	"	3.0	"	"	"
S_5	=	2.5 "	"	"	"	"	"	"	2.5	"	"	"
S_6	=	3.0 "	"	"	"	"	"	"	2.0	"	"	"

To each standard i.e. S_1 S_2........S_6, 0.4 ml ANSA and 1 ml Molybdate solution was added.

Samples were prepared as:

T_1 = 5 ml of pure sample + 0.4 ml ANSA + 1 ml molybdate solution.

T2 = 2.5 ml of sample + 2.5 ml distilled water + 0.4 ml ANSA + 1 ml molybdate solution.

The solution was left for 10-15 minutes and than transfered a portion of the coloured solution into a container and readings were taken with photometer at 660. The photometer was set at zero density with a blank, prepared by treating 5 ml of distilled water with 1 ml of molybdate solution and 0.4 ml of ANSA reagent. Densities of standard and samples were noted from photometer.

Results:-

$$\frac{\text{Density of Sample}}{\text{Density of standard}} \times \frac{\text{Standard's concentration}}{\text{Volume of sample}} \times 100$$

"= mg pi/100 ml of sample.

Temperature was noted using electronic thermister and pH. with a portable pH meter.

Observations were made over a period of six months. Approximate variables of dissolved Oxygen and temperature were also monitered using equariums (4) 5'x3' & 4' high placed alongside the ponds and by supplying oxygen with air pump and different levels of warm water with heated water flow into the aquariums at different flow intensites (Fig.1).

COLLECTION OF FISH

Fishes were collected from Hassan Abdal fish farm Bara K h Stream, Chattar Bagh Stream and Outlet stream of Rawal Dam. Fishes were brought in fish containers.

Measurement of Fishes

Length: Fishes were measured from tip of the snout to the tip of the gill and from tip of the gill to the tip of tail fin and then from the tip of the tail fin to the tail fin end.

Weight. A container was half filled with water and weighed as (a), then the fish was put into it and again weighed as (b). The actual weight (W), was worked out as b-a =W.

Length-Weight relationship

The length-weight relationship was expressed as follows: $W= a L^b$, Where W is weight, L is length and a and b emperically derived constants determined by standard regression analysis. This was further expressed in Logarthmic form; Log W=log a + b Log L (Grover, 1976).

Each fish was tagged before release and bi-monthly length-weight meassurements were taken to observe growth-food relationship.

Plankton fauna on which the fish were observed to predate was noted and identified.

Observations on protean Behaviour were made at the inlet stream of Rawal Dam. Observation on the maturity of male and female fish were made by (a) squezing out spematazea and ova from the fish (b) by disecting the fish and then scanning the testes and ovary under a Binocular microcope.

The breeding behaviour of the fish was observed in the experimatal ponds.

Induced spawning was effected by injecting pituitary in the male and female fish as given below.

The pit. gland of the several fishes were taken out by dissecting the fish. It was then placed in a polythene bag and preserved in cooled incubator at $-10^{\circ}C$.

The fishes of known weight and length were given injections of pituitary to affect spawning behaviour in April. Experiments on induced breeding were carried on in aquariums.

OBSERVATIONS & RESULTS

Limnological Studies

pH: Hydrogen ion concentration ranged between 7.2-8.6, which is slightly alkaline in nature.

Phosphate: Inorganic phosphates were maximum .03-.04 mg/ml in June-July, while in winter, the concentration was low being .003-.001 mg/ml.

Oxygen: Dissolved oxygen was minimum in June, ranging between 4.5-4.7/ppl and was maximum in January ranging between 6.8-7.9/ppl.

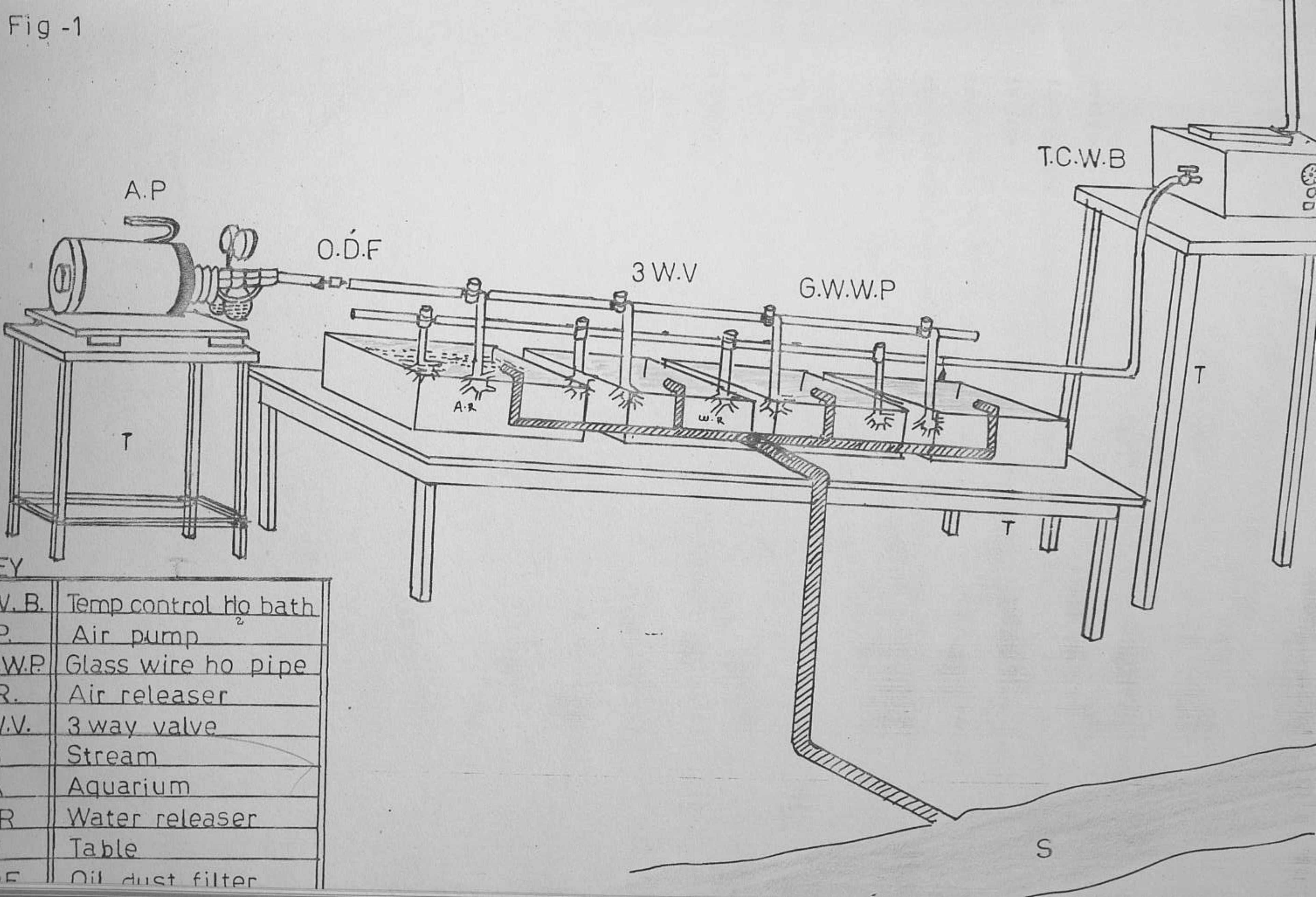
When water flow into the ponds was controlled and brought to a minimum, the dissolved oxygen content went down to a minimum and toxicity caused 100% mortality to the fish.

Experimental observations were made, using aquaria placed alongside the ponds (fig. I). Results indicated that a low concentration of oxygen (2.7/ppl) caused mortality to fish.

Temperature: Minimum temperature ranged between 13-15°C in Jan., and max. ranged between 20-36°C in June. Experiments on temperature effects were conducted in the aquaria (Fig. I) The results show that temperature is also an important factor in the breeding and survival of the fish and that a temperature ranging between 16-34°C is favourable for the fish.

Zooplanktons such as *Cyclops magnus, Diaptomus sp. Daphina sp. Moina brachitata Chydorus ovalis* are usually predated upon by the fish *Barbus pituitora*.

Fig -1



EY

W. B.	Temp control H_2O bath
P.	Air pump
W.W.P.	Glass wire ho pipe
R.	Air releaser
W.V.	3 way valve
S	Stream
A	Aquarium
R	Water releaser
T	Table
DF	Oil dust filter

CONCLUSIONS

Limnological studies indicate that dissolved oxygen is a critical factor in the survival and successful breeding of the fish Barbus pituitora and that the fish may only be bred and propagated in ponds, lakes or streams having a safe range of dissolved oxygen level as indicated in the results. It is also shown that temperature also effects successful maintenance and breeding of the fish.

Table No. I

Formulation of feed containing different level of protein.

Ingradients	0% Protein	25% Protein	30% Protein	35.0 gms.
Casein	0.0 gms	25.0 gms.	30.0 gms	35.0 gms.
Starch	20.0 "	10.0 "	15.0 "	10.0 "
Cellulose	30.0 "	25.0 "	18.0 "	19.0 "
Minerals	4.0 "	2.0 "	2.0 "	2.0 "
Vitamins	2.0 "	4.0 "	4.0 "	4.0 "
Oil	25.0 "	19.0 "	16.0 "	15.0 "
Glucose	20.0 "	15.0 "	15.0 "	15.0 "
	100.0 = 385 calories value	100.0 = 371 calories value	100.0= 384 calories value	100.0= 375 calories value

FEEDING BEHAVIOUR

Observations and Feeding Behaviour.

Feeding Behaviour is initiated by visual stimuli of the food and orientation as by telotaxis and orthokinesis, through dersal light reaction play important role in the intisity of orientation Feed orientation may be impressed by Pavlovian canditioning.

Feed Relationships.

Results:- Four dietery experiments were conducted on the fish, aloggwith a control groups. Each group was of four fishes, each fish was measured weighed, tagged and then released into the experimental acquariums. Results are shown in tables 2-10. For comparison see graphs of weight relationship and length relationship(see graph 1-4).

The fish food was prepared is given in table I.

The results indicate that 35% protein in the deit are best suited for adequate growth of the fish.

Observation:-

On feeding behaviour show that stimulation orientation machanism play a supporting factor in artificial feeding of the fish and that the fish may be conditioned to feed an farmulated feed.

Conclusions :-

It may be concluded from the experiments on A-biotic and biotic factors favourable as shown in liminological section, a diet containing 35% porteins is best suited for the benificial breeding and propogation of the fish Barbus pituitora

Table No II

Consult

Initial weight and length of the Mahseer (<u>Barbus</u> <u>pituitora</u>) before treating with any specific diet.

No of Species Barbus pituitora	Total weight of the Species <u>Barbus</u> pituitora (gms) W	Length from mouth to the end of gill cover (mm)	Length from end of gill cover upto end of body (mm)	Length of tail fin (mm)	Total length from mouth upto tail end (mm)	Total Increasing length of the species <u>B. pituitora</u> (mm)	Total Increasing weigth of the <u>B. pituitora</u> (gms) W
1.	4.0	10	50	15	75	x	x
2.	4.0	10	50	15	75	x	x
3.	4.0	10	50	15	75	x	x
4.	4.0	10	50	15	75	x	x

Table No.III Group A.

Result of the feeding Experiments with Mahseer (Barbus. pituitora) group A.

No of Species Barbus pituitora	Total weight of the Species Barbus pituitora (gms) W	Length from mouth the end of gill cover (mm)	Length from end of gill cover upto end of body (mm)	Length of tail fin (mm)	Total length from mouth upto tail end (mm)	Toral Increasing length of the species B. pituitora (mm)	Total Increasing weight of the B. pituitora (gms)w
.	4.8	10	54	15	79	4	0.8
.	4.8	10	54	15	79	4	0.8
.	4.8	10	54	15	79	4	0.8
	4.8	10	54	15	79	4	0.8

hseer (Barbus pituitora) were fed experimental diet containing (0% protein) r fifteen days at 25-27°C of water temperature.

mortality occurred during the experimental period.

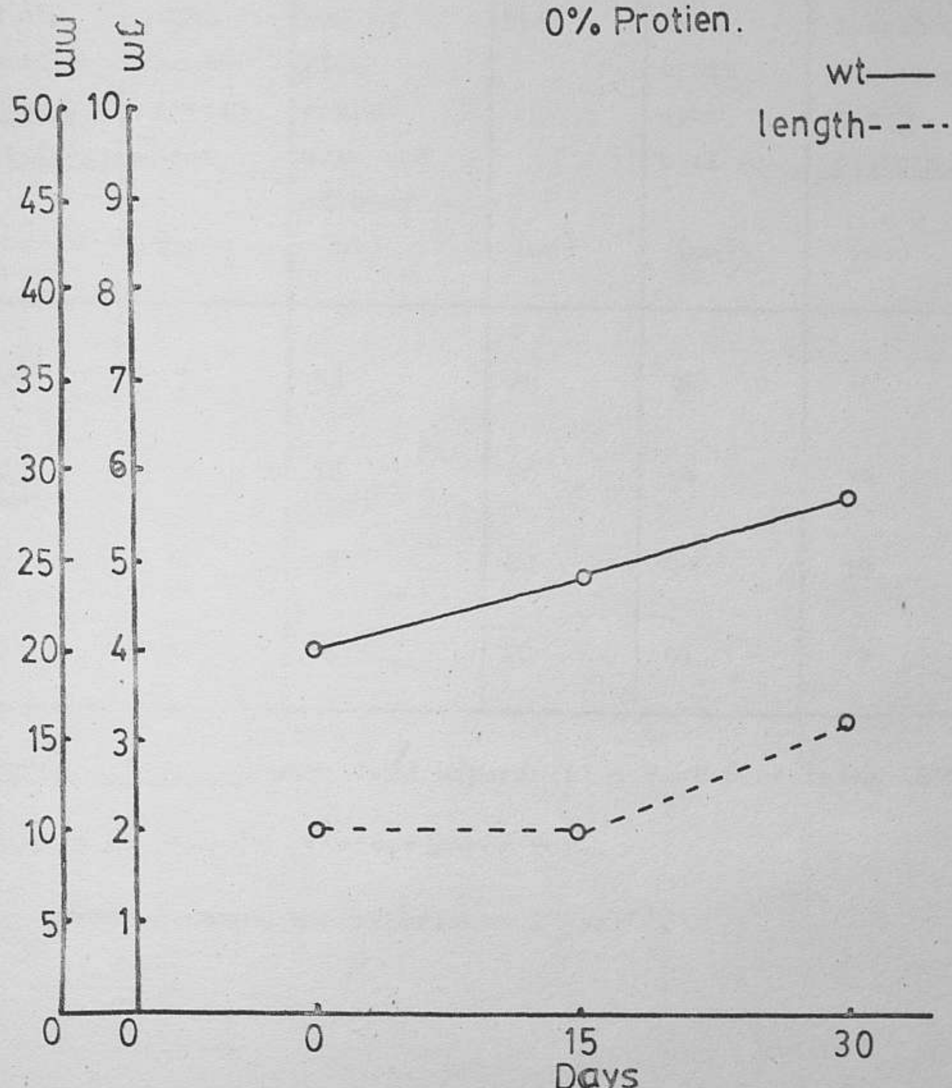
Table No. IV (Group A)

Result of the feeding experiment with Mahseer (Barbus pituitora) group A.

No of Species Barbus pituitora	Total weight of the Species Barbus pituitora (gms) W	Length from mouth to the end of gill cover (mm)	Length from end of gill cover upto end of body (mm)	Length of tail fin (mm)	Total length from mouth upto tail end (mm)	Total Increasing length of the species B. pituitora (mm)	Total Increasing weight of the B. pituitora (gms)w
1.	5.7	16	58	20	94	19	1.7
2.	5.7	16	58	20	94	19	1.7
3.	5.7	16	58	20	94	19	1.7
4.	5.7	16	58	20	94	19	1.7

Mahseer (Barbus pituitora) were fed experimental diet containing (0% protein) for thirty day at 25-27°C of water temperature.

No mortality occurred during the experimental period.


0% Protien.
wt——
length- - -
mm
gm
50
45
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35
30
25
20
15
10
5
0
10
9
8
7
6
5
4
3
2
1
0
0
15
30
Days

Table No. V (Group B)

Result of the feeding experiment with Mahseer (Barbus pituitora) group B.

No. of species Barbus pituitora.	Total weight of the Species Barbus. pituitora (gms) W	Length from mouth to the end of gill cover (mm)	Length from end of gill cover upto end of body (mm)	Length of tail fin (mm)	Total length from mouth upto tail end (mm)	Total Increasing length of the species B. pituitora (mm)	Total Increasing weight of the B. pituitora. (gms) w
	6.0	16	58	20	94	19	2.0
	6.0	16	58	20	94	19	2.0
	6.0	16	58	20	94	19	2.0
	6.0	16	58	20	94	19	2.0

Mahseer (Barbus pituitora) were fed experimental diet containing (25% protein) for fifteen days at 25-27°C of water temperature.

No mortality occurred during the experimental period.

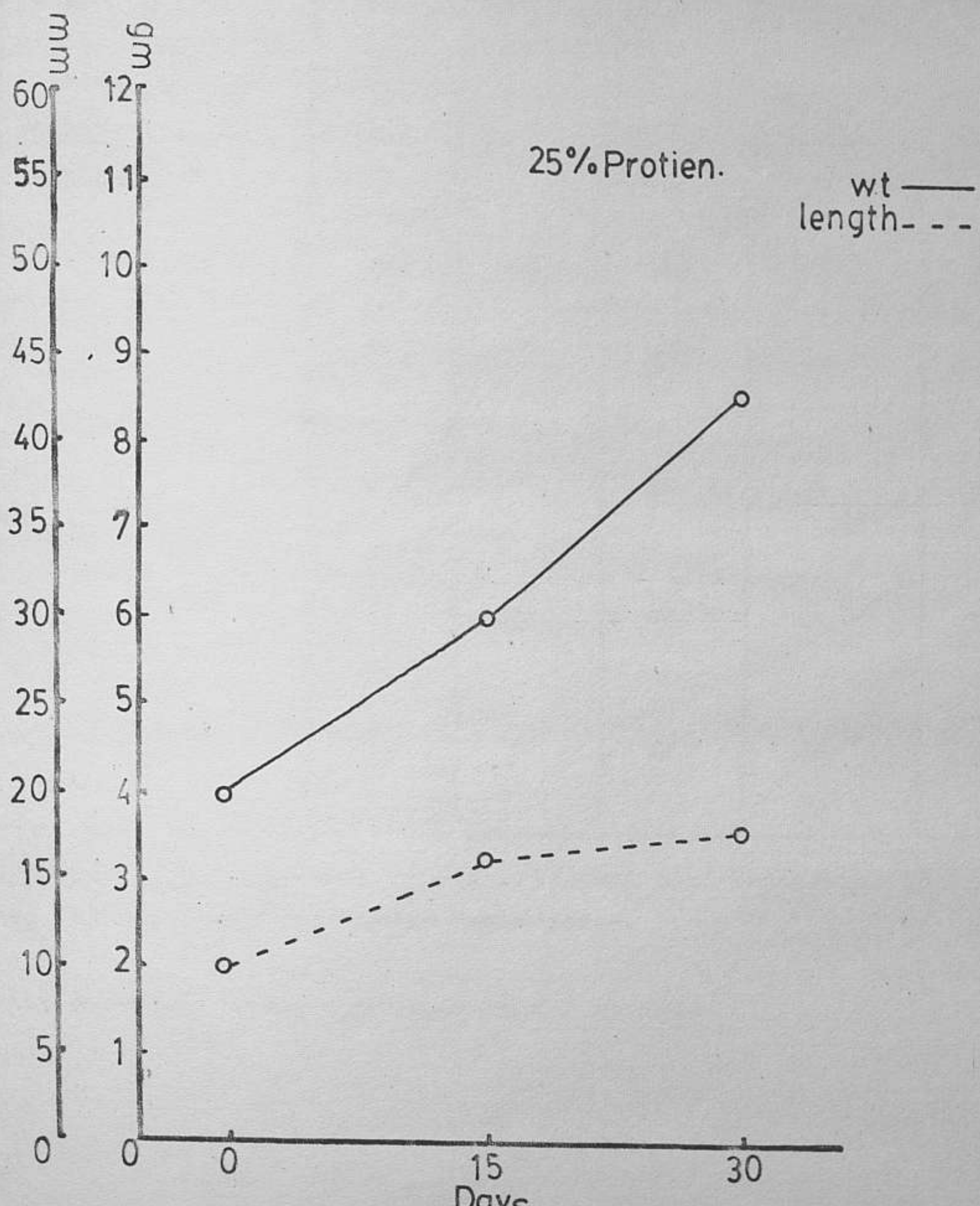
Table No VI (Group B)

Result of thefeeding experiment with Mahseer (Barbus pituitora) group B.

f ies us. itor	Total weight of the Species Barbus pituitora (gms) W	Length from mouth the end of gill cover (mm)	Length from end of gill cover upto end of body (mm)	Length of tail fin (mm)	Total length from mouth upto tail end (mm)	Total Increasing length of the species B. pituitora. (mm)	Total Increasing weight of the B. pituitora. (gms) W
	8.4	18	60	21	99	24	4.4
	8.4	18	60	21	99	24	4.4
	8.4	18	60	21	99	24	4.4
	8.4	18	60	21	99	24	4.4

Mahseer (Barbus pituitora) were fed experimental diet containing (25% protein) for thirty days at 25-27°C of water temperature.

No mortality occurred during the experimental period,



25% Protien.
wt
length
mm
gm
Days
0
15
30
60
55
50
45
40
35
30
25
20
15
10
5
0
12
11
10
9
8
7
6
5
4
3
2
1
0

Table No.VII(Group C)

Result of the feeding experiment with Mahseer (Barbus. pituitora) group C.

o. of pecies rbus. ituitora	Total weight of the Species Barbus. pituitora (gms) W	Length from mouth to the end of gill cover (mm)	Length from end of gill cover upto end of body (mm)	Length of tail fin (mm)	Total length from mouth upto tail end (mm)	Total Increasing length of the species B. pituitora. (mm)	Total Increasing weight of the B. pituitora. (gms) w
	7.1	18	60	21	99	24	3.1
	7.1	18	60	21	99	24	3.1
	7.1	18	60	21	99	24	3.1
	7.1	18	60	21	99	24	3.1

Mahseer (Barbus. pituitora) were fed experimental diet containing (30% protein) for fifteen days at 25-27°C of water temperature.

No mortality occurred during the experimental period.

Table NoVI[illegible] (Group C)

Result of the feeding experiment with Mahseer (Barbus. potuitora)

group C.

of ies us. itora.	Total Weight of the Species Barbus. pituitora. (gms) W	Length from mouth to the end of gill cover (mm)	Length from end of gill cover upto end of body (mm)	Length of tail fin (mm)	Total length from mouth upto tail end (mm)	Total Increasing length of the species B. pituitora. (mm)	Total Increasing weight of the B. pituitora. (gms) w
	10.5	20	71	22	113	38	6.5
	10.5	20	71	22	113	38	6.5
	10.5	20	71	22	113	38	6.5
	10.4	20	71	22	113	38	6.4

Mahseer (Barbus. pituitora) were fed experimental diet containing (30% protein) for thirty days at 25-27°C of water temperature.

No mortality occurred during the experimental period.

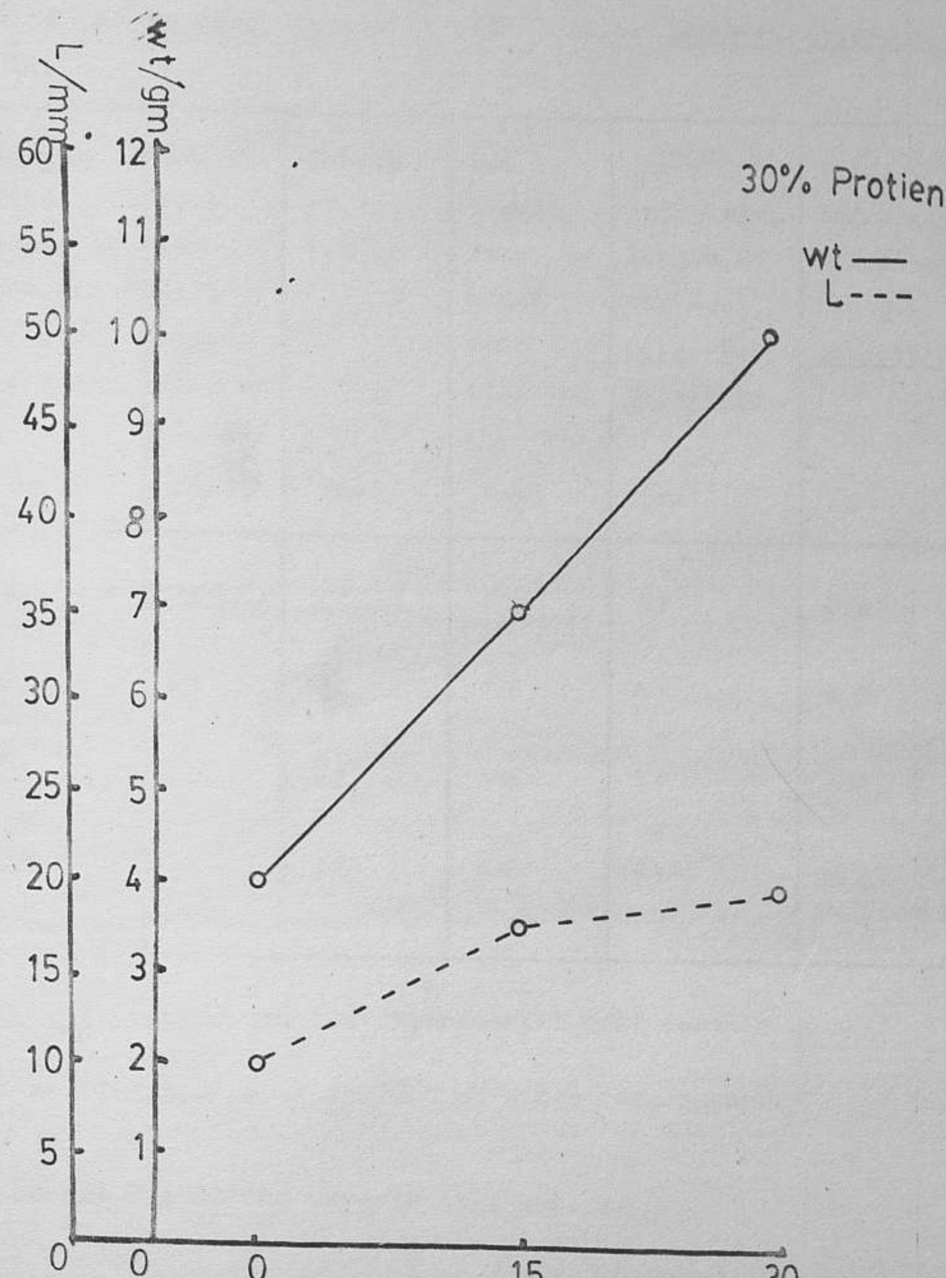

L/mm
wt/gm
60
55
50
45
40
35
30
25
20
15
10
5
0
12
11
10
9
8
7
6
5
4
3
2
1
0
0
15
30
Days
30% Protien
wt
L

Table No. IIX (Group D)

Result of the feeding experiment with Mahseer (Barbus. pituitora) group D.

No. of Species Barbus. pituitora	Total weight of the Species Barbus. pituitora (gms) w	Length from mouth to the end of gill cover (mm)	Length from end of gill cover uotp end of body (mm)	Length of tail fin (mm)	Total length from mouth upto tail end (mm)	Total Increasing length of the species B. pituitora. (mm)	Total Increasing weight of the B. pituitora (gms) w
1.	12.2	21	73	22	116	41	8.2
2.	12.2	21	73	22	116	41	8.2
3.	12.2	21	73	22	116	41	8.2
4.	12.2	21	73	22	116	41	8.2

Mahseer (Barbus. pituitora) were fed experimental diet containing (35% protein) for fifteen days at 25-27°C of water temperature.

No mortality occurred during the experimental period.

Table No.X (Group D)

Result of lthe feeding experiment with Mahseer (<u>Barbus. pituitora</u>) group D.

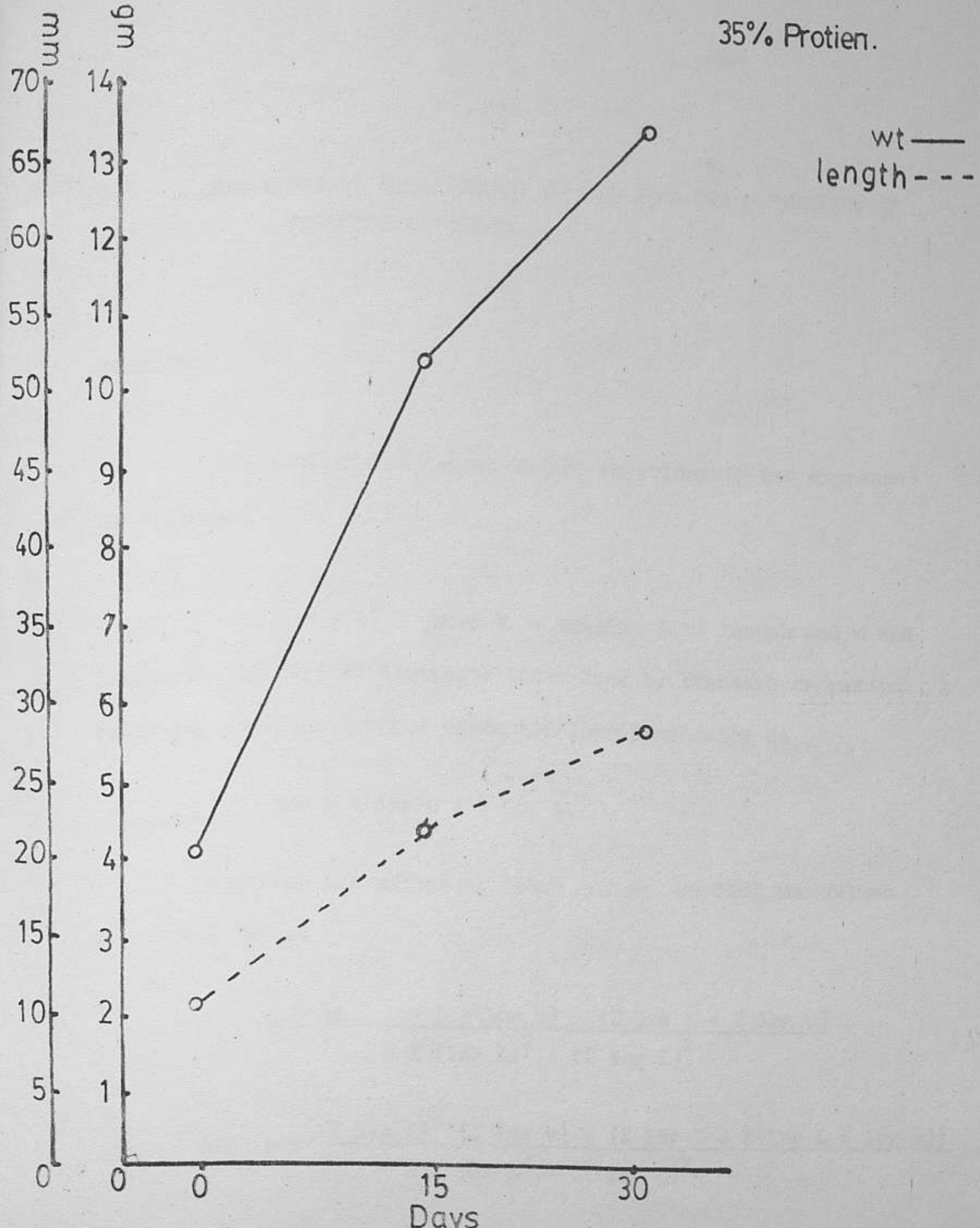
No. of Species <u>Barbus. pituitora</u>	Total weight of the Species <u>Barbus. pituitora</u> (gms) W	Length from mouth to the end of gill cover (mm)	Length from end of gill cover upto end of body (mm)	Length of tail fin (mm)	Total length from mouth upto tail end (mm)	Total Increasing length of the species <u>B. pituitora</u> (mm)	Total Increasing weight of the <u>B. pituitora</u>. (gms) w
1.	25.2	28	90	29	147	72	21.2
2.	25.2	28	90	29	147	72	21.2
3.	25.2	28	90	29	147	72	21.2
4.	25.2	28	90	29	147	72	21.2

Mahseer (<u>Barbus. pituitora</u>) were fed experimental diet containing (35% protein) for thirty days at 25-27°C of water temperature.

No mortality occurred during the experimental period.

GRAPH NO. 4

WEIGHT LENTH RELATIONSHIP OF THE FISH(BARBUS- PITUITORA) FED ON 35% PROTEIN.


35% Protien.
wt ——
length - - -
mm
gm
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
0
15
30
Days

LENGTH-WEIGHT RELATIONSHIP OF THE FISH FOR ESTIMATION OF PRODUCTIVITY LEVEL.

RESULTS:

The analysis of length-weight relationship was expressed as follows:

$W = a\ L^{b}$, where W is weight, L is length and a and b emperically derived constants determined by standard regression analysis. This was further expressed logrithamically as

$$\log W = \log a + b \log L.$$

Applying the method of least square, we find the values of 'a' and 'b' as

$$b = \frac{(n\ \Sigma \log L * \log w) - (\Sigma \log L * \Sigma \log w)}{n\ \Sigma\ (\log L)^{2} - (\Sigma \log L)^{2}}$$

$$\log\ a = \frac{(\Sigma \log L)^{2}\ (\Sigma \log w) - [\Sigma \log L * \Sigma(\log L * \log w)]}{n\ \Sigma \log L^{2} - (\Sigma \log L)^{2}}$$

Now putting the values from table in the equation for finding the values of b and log a.

$$b = \frac{(n\ \Sigma\ (\log L * \log w) - (\Sigma \log l * \Sigma \log w)}{n\ \Sigma\ (\log L)^2 - (\Sigma \log L)^2}$$

$$= \frac{(23 * 91.301445) - (39.158889 * 52.934678)}{23 * 122.32554 - (52.934678)^2}$$

$$= \frac{27.0701}{11.4073} = 2.4026106$$

$$b = 2.4026106$$

For $$\log a = \frac{(n\ \Sigma \log L * \log w) - (\Sigma \log L * \log w)}{n\ \Sigma\ (\log L)^2 - (\Sigma \log L)^2}$$

$$\log a = \frac{[\Sigma(\log L)^2\ (\Sigma \log w)] - [(\Sigma \log L * \Sigma(\log L * \log w)]}{n\ \Sigma\ (\log L)^2 - (\Sigma \log L)^2}$$

$$= \frac{(122.32554 * 39.158889) - (52.934678 * 91.301445)}{(23 * 122.32554) - (52.934678)^2}$$

$$= -\frac{42.8803}{11.4073} = -3.7590227$$

$$b = 2.4026106$$

$$\log a = -3.7590227$$

so equation becomes

$$\log w = -3.7590227 + 2.4026106 \log L$$

$$w = \text{antilog}\ (-3.7590227 + 2.4026106 \log L)$$

consult Table 11.

CONCLUSION:

The emperically derived results show that any experiments to be conducted on food, feeding behaviour and propogation of the fish should be deduced using length-weight relationships, so that comparable results may be obtained.

LENGTH-WEIGHT RELATIONSHIPS. TABLE NO. XI

No. of species	W gram	L m.m.	Logw	LogL	LogL*logw	$\log L^2$
1.	7.0	99	.84509	1.995635	1.6864911	3.982559
2.	11.0	113	1.041392	2.053078	2.138059	4.21512292
3.	15.0	121	1.176091	2.082785	2.4497520	4.3379933
4.	18.0	132	1.255272	2.120573	2.6618959	4.4968298
5.	25.0	147	1.39794	2.167317	3.0297791	4.6972629
6.	28.0	152	1.447158	2.18184	3.1574497	4.7604257
7.	35.0	165	1.544068	2.21748	3.4239399	4.9172175
8.	40.0	177	1.602059	2.2479732	3.6013856	5.0533835
9.	46.0	184	1.662757	2.264817	3.7658403	5.129396
10.	50.0	189	1.69897	2.2364618	3.7996815	5.0017613
11.	62.0	213	1.79239	2.328379	4.1733632	5.4213487
12.	66.5	212	1.82282	2.326335	4.2444899	5.4118345
13.	72.0	225	1.857332	2.35218	4.36878815	5.53227507
14.	75.6	230	1.87852	2.36172	4.4365382	5.5777213
15.	79.5	239	1.900367	2.378397	4.5198271	5.6567722
16.	82.0	245	1.913813	2.389166	4.5724169	5.7081141
17.	88.0	254	1.94448	2.404833	4.6761496	5.7832217
18.	93.5	261	1.970811	2.4166405	4.7627416	5.8401513
19.	105.0	280	2.021189	2.4477158	4.9461688	5.9885822
20.	113.0	288	2.05307	2.459392	5.0493039	6.048609
21.	114.5	296	2.058805	2.4712917	5.0879077	6.1072826
22.	132.5	317	2.122215	2.501059	5.3077849	6.2552961
23.	142.0	339	2.15228	2.530199	5.4456967	6.4019069
			39.158889	52.934678	91.301445	122.32554

OBSERVATION ON PROTEAN BEHAVIOUR

The fish show two type of diurnal movements; Short-length movements in slow water. These donnot exceed more than 60 yards up-stream and down-stream lures. Long-length movements during which the fish and the school travel up-stream in the morning (6.00-6.30 am) travelling several hundred yards and then travel back to the lake at approx. 11.30 am to 12.00 noon.

PROTEAN MOVEMENTS

The fish show single erratic movements by zig-zagging or looping in the stream. This protean behaviour is shown during down-stream and up-stteam journey, fish od not travel parallel to water flow but show protean behaviour by zig-zagging so that when they travel down-stream the water flow is at 120^{0} to the right or left of the front region of the fish. Similarly, while travelling up-stream, the water flow hits the tail at 60°. This zig-zagging protean behaviour is used as a postural device by the fish to offer least resistance in water and at the same time, movements at an angle to watef flow facilitate swift journey using least possible energy. Whereas, when showing movement-pause the fish always orientate parallel to water flow.

CONCLUSION

The fish Barbus pituitora uses protean behaviour as a means of energy conservation during up-stream a down-stream for energy.

INDUCED BREEDING

Two males weighing 1½ kg and one female weighing 1½ kg were used in the induced spawning experiment.

The preserved pituitary (male and female) of the fishes was homogenized and diluted with a drop of distilled water. The sample wa then centrifuged. Intramuscular injection of lthe female pitunitary was then given to the female fish at a ratio of 3 mg/kg of the body weight After four hours another injection was given at a ratio of 5 mg/kg. T female was then freed into he hapae net. The net was spread in the mi aquarium water, so that it did not touch the bottom.

Same process of injectionig male pituitary was simultanesuly r with the two males, which were also released in to the same net. After time the female showed splashing movements in water. After seven and h hours the female secreted the spawn and the male discharged mid over the eggs.

Hatching of the eggs occurred after fourteen hours or the fert ation. Two nets were used, one was large and the other one small. The larger hapa contained the smaller one inside it. When the eggs hatche the larvae came out of the mashes of smaller one and went to the larger n mesh, through which the fingerlings could not pass down.

After the completion of this procedure, all the fingerlings were transfered to the pond. The cage was not poured at once in the pond because the abrupt change of temperature may effect fingerlings. The cage was gradually poured so that fingerlings could aclamatize the temperature.

GENERAL DISCUSSION

Present studies were conducted to study the possibility of sucessful breeding and propagation of the fish Mahseer Barbus p... so that it may be utilized as an economic corp.

A-biotic factors play an imp portant role in the productivit... a given. Initial studies on the stream supplying water to experi... tanks, and later experimental studies canducted in the aquariums indicate that temperature and Oxygen are cantrolling factors in t... sucessful propagation and survival of the fish in fish tanks. Similarly, pH also phays an impertant role in the survival of the f...

It is important to know a balanced diet if one intends to use ... fish for economic purposes. Previously, studies have been made an ... carps with respect to their dietary energy. But these were mainly concerned on the utilization of carbohydrates (P.Jeyachandran ... H. ti..,.1969; Chinkichi et.al., 1976). Present studies indicate that for economic growth of the fish a deit consisting 35% protion is mo... effecients as shown in length-weight relationship Viz W=antilog (-3 7590227+2,4026106 log L).

Failure of the major carps to breed in captivity, is inpart due to the refrectiveness to induced spawning, though successful studies have been made in some carps (Doha and Dewan 1.. Qazi 1965; Mitra, 1969; Chaudhri 196.; Singh, 1969; Jafri, 1977.

Present studies indicate a break through by sucessfully inducing spawning with hormone injection.

Occurance of protean behaviour in prey organisms has been reviewed and discussed by Humphries and Driver (1967), and Humpries and Driver (1970). No evidence is available on the eco-behavioural aspects of protean displays involved in other behavioural patterns e.. forfor courtship displays (Iqbal, personal observation). Present stud.. indicate that protean displays are used as postural device for energy conservation. Such postural eratic devices are comparable to sudden jet blasts employed for propulsion.

1. NEED FOR ADDITIONAL RESEARCH:

Further studies are recommended on the feeding behaviour and dietary formulation. These studies will be made on weight length relationships, so that a model for economic breeding of the fish may be formulated.

2. Studies on the sexual behaviour are also recommended as only initial observations were made during the present study.

3. Studies on the growth rate of the fish are also recommended for economic purposes.

4. Lastly detailed studies on the breeding biology, using modern induced breeding techniques should be made.

It is recommended that the above mentioned studies should be conducted for a period of three years.

Note:- An extension scheme is being submitted under separate cover.

LIST OF PUBLICATIONS:

Papers under preparations.

i) Environmental factors controlling the survival and breeding of the fish <u>Barbus pituitora</u>.(Mahseer)

ii) Feeding behaviour of the fish <u>Barbus pituitora</u>.

iii) Length weight relationship of the fish <u>Barbus pituitora</u>

iv) Protean behaviour exhibited by the fish <u>Barbus pituitora</u> as a postural device for energy conservation.

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HEAD WISE EXPENDITURE DURING THE PERIOD

JANUARY 1978 TO DECEMBER 1978

RECURRING

Heads	Provision	Expenditure	Out Standing Liabilities
1. Chemicals & Glassware	4000/-	4000/-	-
2. Conveyance	1000/-	1000/-	-
3. Films	4000/-	4000/-	-
4. Books & Journals	1000/-	1000/-	-
TOTAL	10,000/-	10,000/-	-

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DETAILS OF FISCAL REPORT

Pay and allowance paid to Research Officer during the period January 1978 to December 1978.

Name of Research Officer Mr. Fazle Subhan

Period	Pay	M.A.	C.A.	L.C.A.	H.R.	Net Payment
January	900/-	100/-	60/-	90./-	630/-	1780/-
Febuary	900/-	100/-	60/-	90/-	630/-	1780/-
March	900/-	100/-	60/-	90/-	630/-	1780/-
April	900/-	100/-	60/-	90/-	630/-	1780/-
May	900/-	100/-	60/-	90/-	630/-	1780/-
Jine	900/-	100/-	60/-	90/-	630/-	1780/-
July	900/-	100/-	60/-	90/-	630/-	1780/-
August	900/-	100/-	60/-	90/-	630/-	1780/-
September	900/-	100/-	60/-	90/-	630/-	1780/-
October	900/-	100/-	60/-	90/-	630/-	1780/-
November	900/-	100/-	60/-	90/-	630/-	1780/-
December	900/-	100/-	60/-	90/-	630/-	1780/-
TOTAL	10800/-	1200/-	720/-	1080/-	7560/-	21,360/-

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