SOME BIOLOGICAL ASPECTS OF PORCUS BAYAD IN TIGA DAM LAKE, KANO STATE.

By

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DECLARATION.

I declare that this work is wholly the author's and has not been part of any presentation for any other qualification.

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DEDICATION

TO ALLAH,

My

"BELOVED" CHILDREN

(TALATU, NAFISAT AND ABDULJELLAAL)

AND MOTHER (FATIMAT)

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ABSTRACT

Investigation in to aspects of the biology of Porcus bavad (ptaff) in Tiga dam lake were conducted between August, 1986 and July 1987. Samples were obtained from commercial fish landings in Tiga, Rurum and Bagauda beside the dam twice or thrice monthly, during the period of investigation,

A total of 510 Specimens were examined of which 336 (65.9%) had fed and 174 (34.0%) had empty stomachs. The fish was Piscivorous, however those below 30cm standard length were predominantly omnivourous feeding on fishes, insects and plants while the larger ones above 30cm were typically piscivorous feeding on Alestes sp_t synodontis sp and Tilapia sp.

The length - weight regression analysis indicated positive allometrie growth. The standard length of the specimens ranged from 12.0cm to 57.2cm for males, while that of the females ranged from 11.8cm to 55.0cm. The weight of both sexes ranged from 81.Og to 1716.Og. Size distribution studies showed that the females were smaller than the males.

The mean condition factor determined were found to be high for most part of the period of investigation. Out of a total of 510 specimens examined, 311 were males and 199 were females. The fish showed a well defined peak in the breeding activity from May to August. The mean fecundity estimate was 4,726 + 690.

CHAPTER ONE

INTRODUCTION

This studies focus on some aspects of the biology of Porcus bayad (Family: Bagridae) in Tiga dam Lake, Kano State. The genus known as Bagrus is now known as Porcus (Daget and Durand, 1981). The family Bagridae is one of the seven Siluroid fish families found in Africa. They are also found in Asia. Sixteen genera and one hundred and two species have been described (Lowe-McConnel, 1975). In the Northern part of Nigeria; five genera and twelve species were found. (Reed et al, 1967). These are:-

1. Genus Bagrus: Three Species
   a). B. bayad (Ptaff)
   b). B. filamentosus (Pellegrin)
   c). B. docmac (Forskal)
2. Genus Chrysichthys: Three species
   C. auratus (Ptaff)
   C. nigrodigitatus (Lacepede)
   C. furcatus (Gunther)
3. Genus Clarotes: Two species
   a). C. laticeps (Ruppel)
   b). C. macrocephalus (Daget)
4. Genus Parauchenoglanis
5. Genus Auchenoglanis: Two species
   a). A. biscutatus (Geoffry)
   b). A. occidentalis (cuvier)

Reed et al., (1967) recorded B. filamentosus for the Niger and Benue complex of rivers but was not specific as to whether the fish was found in the Niger.

Much work has been done on the biology of some other freshwater fishes of Africa and Nigeria in particular, but little relates to P. bayad which are important commercial cat fishes. Ajayi (1970) reported the Bagridae in Lake Kainji as being represented by four genera. Chrysichthys, Bagrus, Auchenoglanis and Clarotes. Other genera like Notoglanidium which had been reported in the other parts of Nigeria do not inhabit the lake.

The Bagridae were about the fifth in abundance in Kainji Lake. They occupy the same position of importance in terms of weight and number of fishes and therefore occupy its commercial position inspite of change from riverine to lacustrine environment. (Imevbore and Bakare, 1970). Seasonal variations in Bagridae abundance are tied to seasonal flooding which has caused significant reduction in its population (Imevbore and Bakare, 1970). Prior to the change from river to lake, Motwani (1970) found that the Bagridae formed up to 35.1 per cent and 59.4 per cent by number and weight in the river section now submerged. However B. docmac was just 0.6 per cent.

All the Bagridae were growing well in Kainji except C. auratus showing stunted growth (Ajayi, 1970). Sexual dimorphism existed in C. auratus. Egg count

showed that fecundity was generally low (Ajayi, 1970). Ajayi, (1970) found chrysichthys spp to be omnivorous relying heavily on detritus, crustacea and insect larvae, while Bagrus spp were primarily predatory on fish. Auchenoglanis spp on the other hand were m molluscivorous.

A comparism of the distribution and abundance of chrysichthys spp in Lake Volta and Kainji illustrates without doubt the relative influence of enviromental factors on the biology of a fish species. Both C. nigrodigitatus in Volta Lake and C. auratus in Lake Kainji utilised the same food items is identical proportions (Reynolds, 1968). Corbet (1961) investigated the food of non-cichlid fishes in the Lake Victoria Basin and reported that B.bayad fed on fishes and plant materials mostly in the form of seeds and other plant parts, while B. docmac fed particularly on fish and insect larvae.

Tweddle (1975) in his work on B. meridionalis in Lake Malawi discoverd that the young B. meridionalis fed mainly on insects while the adults were typically piscivorous. B. meridionalis was observed to show a well defined peak in the breeding activity between January and March in Lake Malawi.

However, little or nothing has been done on the

biology of P. bayad in Tiga dam Lake, Kano State.

The objectives of this studies are therefore:-

i) To provide information on the food and feeding habits of P. bayad.

ii) To establish the length-weight relationship of both males and females.

iii) To determine the condition factor.

iv) To determine the average length at first maturity.

v) To determine its fecundity.

CHAPTER TWO

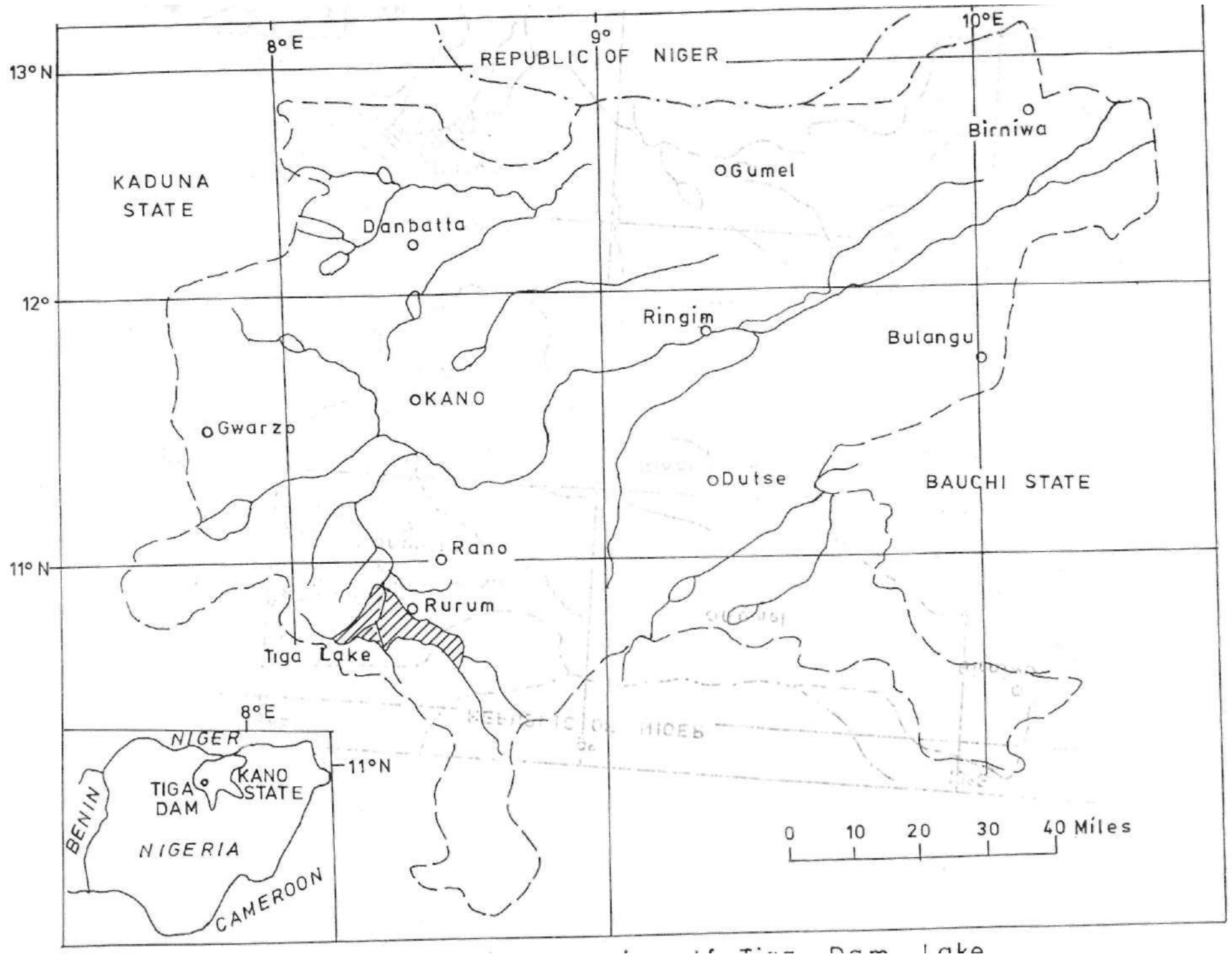
MATERIALS AND METHODS

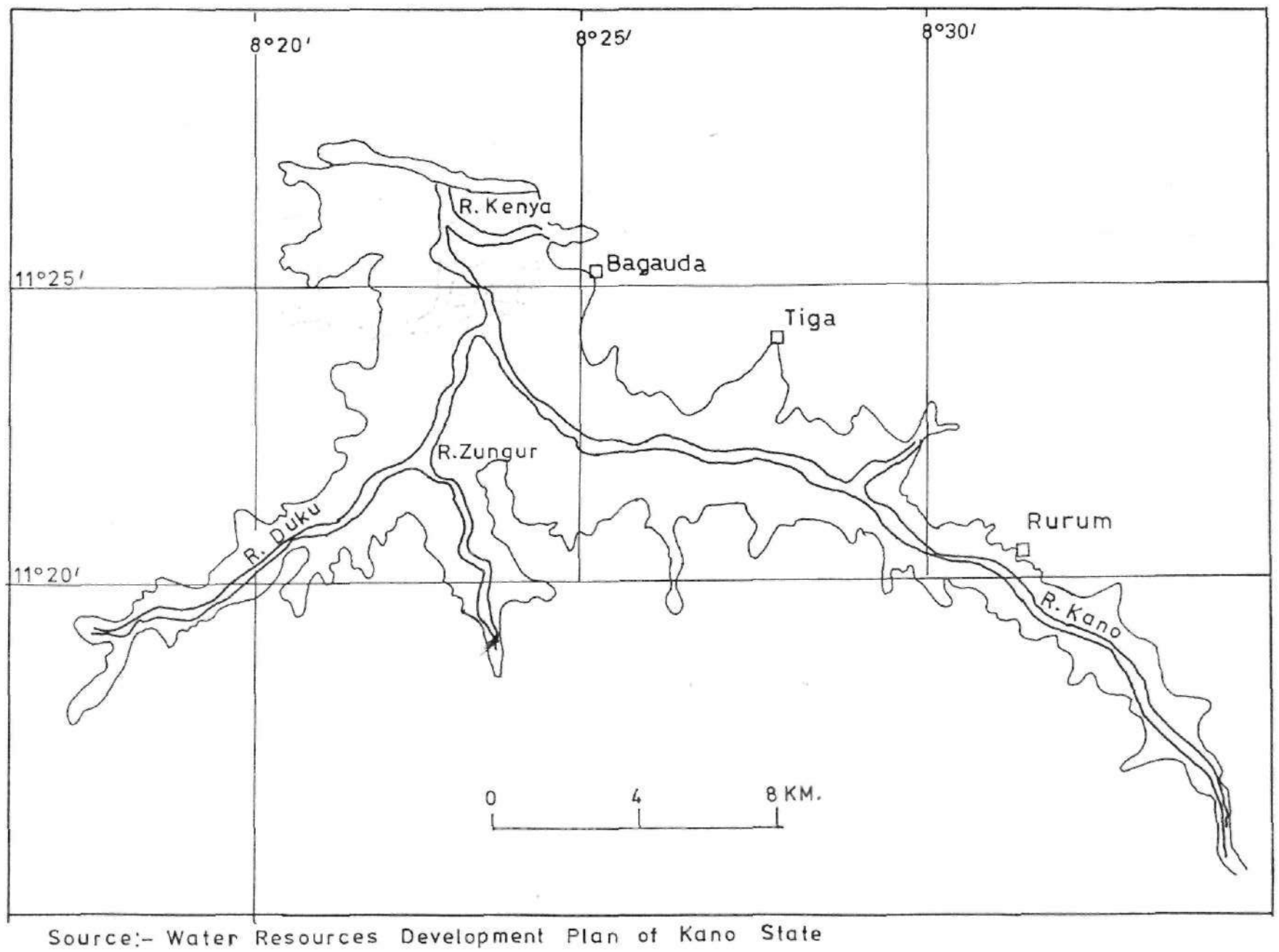
2.1. STUDY AREA AND SOURCE

Dam construction by various governments is a multipurpose venture geared primarily towards the generation of hydro-electricity, irrigation of agricultural lands, urban water supply, fisheries, improved navigation and recreational facilities. Notable among such dams in Kano State are the following: Birnin Kudu, Bagauda, Karaye, Keffin Gana, Dambo and Tiga. Others under construction within the state are located in Gari, Marke and Tamar, yet a lot more are being proposed.

The largest of such man made dams is in Tiga, this was constructed by Water Resource Engineering Construction Agency (WRECCA), primarily for irrigation, hydroelectric power generation and urban water supply. It is situated South east of Kano State of Nigeria (Fig. 1a, b). The area lies between latitude $12^{o}N$ and longitude $8\frac{1}{2}^{o}E$.

It has a tropical continental climate (Hore, 1970) with a distinctly marked rainy and dry season. The rainy season last from the month of May to September or early October. The dry season last from October to March or April (Walter, 1967). Because of the ferrisol and sandy substratum, there is intensive


8° E
9°
10°E
13° N
REPUBLIC OF NIGER
KADUNA STATE
Birniwa
Gumel
Danbatta
12°
Ringim
Bulangu
KANO
Gwarzo
Dutse
BAUCHI STATE
Rano
11° N
Rurum
Tiga Lake
8°E
NIGER
11°N
TIGA DAM
KANO STATE
BENIN
NIGERIA
CAMEROON
0 10 20 30 40 Miles



Source:- Water Resources Development Plan of Kano State

Fig. 1b: Map of Tiga Dam Lake showing Sample Sites.

seepage of water to the underground layers. However, fishery activities in the dam has made it the main source of fish in Kano State and its neighbourhood.

The fish samples were bought from the fish retailers beside the lake in Rurum, Tiga and Bagauda junction. Sampling trips were made twice or thrice each month from August, 1986 to July 1987. The samples were transported in Yankari cool boxes to the laboratory where they were kept in the freezer until needed for analysis. The freezing minimises posthumous digestion. The fishermen interviewed on method of capture, said that surface set gill nets, cast nets and foul hook long lines were mostly used for catching the fish.

2.2. FISH IDENTIFICATION AND DESCRIPTION.

The fish (Fig.2) was identified using keys prepared by Lewis (1974) and was further confirmed by Professor A. A. Olatunde, Department of Biological Sciences, Ahmadu Bello University, Zaria. A brief redescription of *P. bayad* is given below.

Head is relatively long and slender, about two times as long as its wide. Dorsal fin with about eleven branched rays, the first ray is prolonged into a short filament. Flattened head with nostrils widely separated, four mandibular barbels, inner ones short, a pair of maxillary barbels extend to half the total length but not beyond pelvic fins. A long adipose

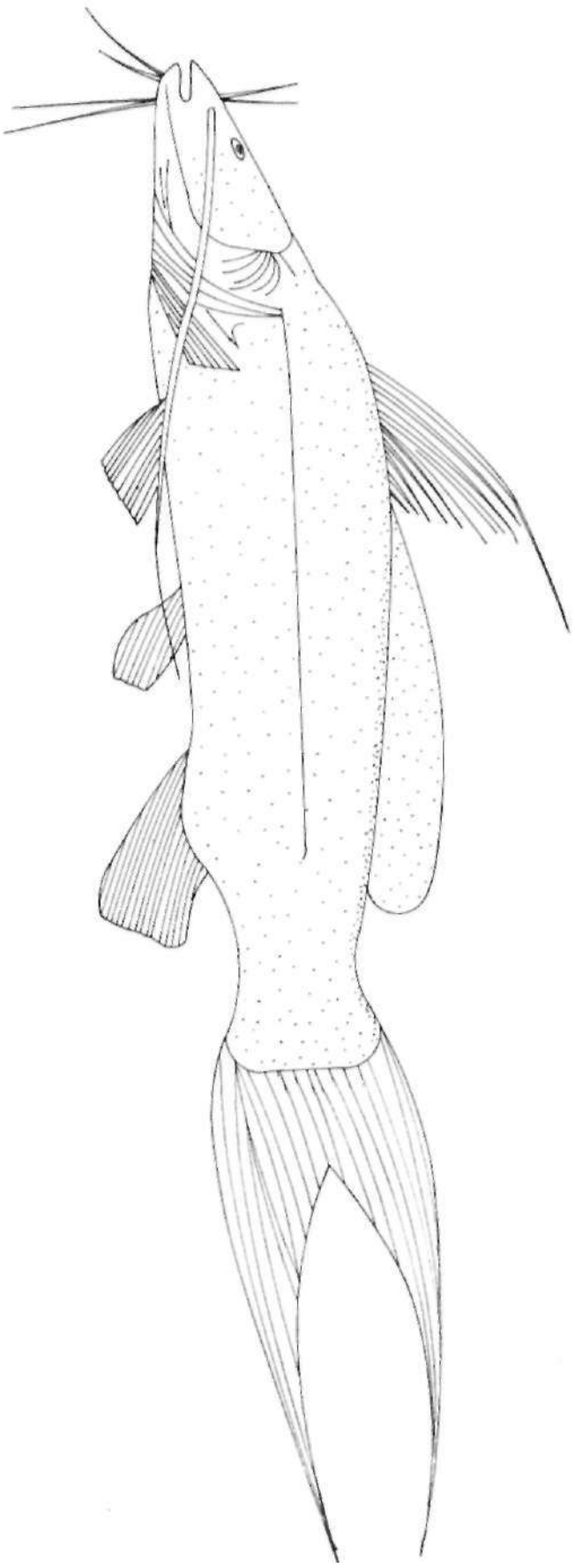


Fig. 2: P. bayad

fin just behind dorsal fin. Mandibular and maxillary teeth present colour greenish or greyish, tinted with yellow, ventral surface whitish, body slightly iridescent soon after capture.

2.3. LABORATORY MEASUREMENTS

2.3.1. LENGTH AND WEIGHT MEASUREMENTS

Each specimen was measured for total and standard lengths using a measuring board, measurements were made to the nearest 0.01 cm. The resh weight of specimen and the gonadal weights were determined to the nearest 0.01 g, using a spring balance and a mettler electronic balance (Model 1200).

i). Total length (cm):- This was measured from the tip of the snout to the longest lobe or filament of the caudal fin. The margins of both lobes were pressed together before measurement.

ii). Standard length (cm):- This was measured from the tip of the snout to the point or attachment of caudal rays of the hypural bone.

iii). Body weight:- This is the whole fresh weight of specimen after the excess water had been blotted. This was measured on the spring balance and mettler electronic balance (Model 1200).

2.3.2. ASSESSMENT OF STOMACH FULLNESS AND CONTENTS.

The abdomen was carefully cut opened length wise from the anus towards the head region. The stomach of

each specimen was removed and its fullness estimated using the technique of Olatunde (1978a) as in Table 1.

The stomach were kept in labelled specimen bottles containing 10% formalin until needed for further an analysis. The preserved stomach was cut opened and the contents were poured into the petri-dish separated into various taxonomic groups, e.g. plant materials, Insects, detritus and fish. Point were then awarded to individual dietary items based on the size and abundance of the food items.

The sum of the points given to the individual dietary items were equal to the points awarded to the stomach fullness. All Points gained by each food item were summed up and scaled down to percentages, percentage contribution made by each food item for each month was calculated. The frequency of occurrence method was also used along with the points method. In this, the number of fish in which each food item occurred was expressed as a percentage of the total number of fish with food in the stomach.

TABLE I

CLASSIFICATION OF STOMACH FULLNESS

Stomach Size	Description	Points
Full Stomach	The stomach bulges considerably with food.	10
¾full Stomach	The stomach is almost full but doesn't bulge	7.5
½full Stomach	Food occupies above 50% of the stomach volume	5.0
¼full Stomach	Stomach wall very flabby sometimes looked as if empty.	2.5
Empty Stomach	No visible food in the stomach even when dissected and examined.	0

2.3.3. SEX DETERMINATION AND CLASSIFICATION OF GONADS

The abdomen of each fish was cut opened and the gonads were observed with naked eyes except those in stage 1 which were observed under a microscope (x10) to determine the sex. The immature testes were difficult to recognise in small specimens. In the mature females, eggs were clearly observed in the ovary, while in the males the testes were lobed, whitish and non-granular in appearance. The female gonad was "Y" shaped, with smooth wall and occasionally yellowish with tiny blood vessels around it. After the sex had been determined, the gonadal maturity stages were determined using the maturity scale modified after Nikolsky (1963) and Olatunde (1978b) as in Table 2. Sex ratio was determined and chi-square test of significance was carried out to determined deviation from expected ratio 1:1, See appendix 5.

2.3.4. FECUNDITY ESTIMATION

The fecundity was estimated by subsampling technique using the dry gravimetric method modified after Simpson (1951). Gilson fluid was prepared by mixing 100ml 60% alcohol, 880ml distiled water, 15ml 80% nitric acid, 18ml glacial acetic acid and 20g mercuric chloride. The fluid has the triple advantage of preserving the eggs, hardening the eggs and breaking

TABLE 2

SCALE FOR IDENTIFYING MATURITY STAGES OF GONADS IN P BAYAD

Maturity Stage	Gonad Condition	Female	Male
I	Virgin	Ovary very small. Usually Sex can only be determined after careful observation under the dissecting microscope in small specimens	Testes very small, usually not very easily identified in some small specimens
II	Immature or developing	Sex easily discernible. Ovary is small in size. Eggs not distinguishable to the naked eyes.	Testes clearly visible to the naked eyes, but very thin, lobed and translucent.
III	Matured or developed	Eggs visible to the naked eyes. The ovaries form up to 5% of the body	The size of the testes increased. The testes became white and swollen with conspicous finger-like out growth in the outer wall.
IV	Fully matured.	The ovary weight increased remarkably in relation to the body weight. The eggs were not shed with slight presure on the abdomen. The gonads have achieved maximum weights.	The testes were whitish anterioly and orange-rose posterioly. The testes do not shed milt on slight pressure on the abdomen.

Table 2. Contd.

V	Running or spawning	The eggs were shed from the ovary with slight pressure on the abdomen	Milt was shed on slight pressure on the abdomen the milt has a milky-white coloration and it is sticky on touching.
VI	Spent and recovering (spawned)	Eggs have been shed ovaries became flaccid, look like empty sacs. A few eggs may occasionally be present in the ovaries. Eventually all eggs remaining w were absorbed and ovary condition returned to stage II. The ovary blood vessels became prominent and redish.	The milt have been shed completely. The testes became facid like empty sacs and returned to thin walls. Testes now returned to stage II and remained whitish.

down the ovarian tissues to release the individual eggs (Ricker, 1968). Enough of the Gilson fluid was taken for each egg sac. The ovarian walls were punctured and eggs were allowed to remain in the fluid. The puncturing allows for easy penetration of the fluid. The eggs were regularly shaken to avoid clumping together. The Gilson fluid was decanted after preservation for three months.

The eggs were washed several times to remove the ovarian tissues and unwanted materials. Care was taken not to lose any egg during the washing processes. After this procedure, eggs were poured into Whatman filter paper in a funnel to drain the excess water.

Eggs were later transferred into a petri-dish already laid with two filter paper, excess moisture was absorbed by the filter paper. Clumps were carefully broken and spread in a single layer on Whatman filter paper. The eggs were air dried for about 24 hours in room temperature 25^{o}C).

Fecundity was determined by weighing all eggs using a mettler electronic balance (Model 1200). Three sub-samples of two hundred eggs were weighed. The ratio of the total weight of eggs to the mean weight of subsamples were then multiplied by two hundred to get the fecundity estimate. Counting and weighing were done in the same room to avoid moisture content variations in the eggs.

The formula for fecundity estimate is,

$$F = \frac{Sn \times WtT}{Swt}$$

where, F = fecundity (Estimated total number of eggs)

Sn = Subsample number of eggs (Average number of eggs in Subsamples).

Swt = Subsample weight of eggs (Average weight of Subsampled eggs).

WtT = Total weight of the eggs in the ovary.

The 95% confidence limit was calculated using the formula, $\bar{x} \pm 1.96\ s/\sqrt{N}$. Regression analysis was performed to determine the relationship between fecundity and standard length and weight of the fish.

2.3.5. LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR.

The length-weight relationship was calculated using the formula of Lecren (1951)

$$W = aL^b \quad \ldots\ldots\ldots\ldots\ldots(1)$$

The empirical data were transformed into natural log so, the equation (1) above was also transformed as,

$$\text{Log } W = \text{Log } a + b \log L \quad \ldots\ldots\ldots(2)$$

where W = fresh weight of the fish(g)

L = standard length (cm)

a = constant.

b = an exponent.

The condition factor "K" was calculated using the formula of Worthington and Richardo, (1930).

$$K = \frac{W(100)}{L^3}$$

where, K = condition factor.

W = weight of fish (g)

L = standard length (cm)

The "K" values were calculated for each fish.

CHAPTER THREE

RESULTS

3.1. FOOD AND FEEDING HABITS

3.1.1. THE COMPOSITION OF THE STOMACH CONTENTS

The categories into which food items were grouped are given below.

(a) ALGAE.

These included the filamentous chlorophyta (green algae) and cyanophyta (blue-green algae). Examples were Anabaena sp., Oscillatoria sp. and Spirogyra sp..

(b) PLANT REMAINS.

These were made up of leaves and fragments of wood including twigs and tree barks.

(c) SEEDS.

The most commonly found seeds belong to the family Graminae. These were probably moved in by either the wind or rains from the neighbouring farmlands. eg. Maize, Rice, Wheat, Guinea corn.

(d) CRUSTACEA.

This group included ostracods, shrimps,copepods and prawn (decapod).

(e) INSECTA.

This included all the insects, both the terrestrial and aquatic types. They were either adults or larval forms.

i) Insect remains: These were made up of various insect parts that were partially digested. These were not identified further.

ii) Ephemeroptera:- Only the nymphs were found.

iii) Diptera:- This included chironomidae, both the larval and pupal forms were found— chironomous sp., chaoboridae family both the larval and pupal forms were found.

iv) Trichoptera:- Only the larval forms were present. Most common among them was Hydropsyche sp.

v) Odonata:- The nymphs were found.

vi) Hemiptera:- Both terrestrial and aquatic adult forms and larval forms were found in the stomach. eg. Family Corixidae (water boatman), Notonectidae (Back swimmers).

f) MOLLUSCA.

Empty shells of both gastropods and lamellibranchs were seen in the stomachs.

g) ANNELIDA

Only the oligochaetes were found and mostly family lumbricidae.

h) FISH

i) Fish remains:- These were mainly the identifiable, partly digested fish parts like the skulls, spines, vertebrae, musculature, fins and visceral parts.

ii) Scales:- These probably belonged to the prey that had perviously been digested or picked up directly. The scales remain undigested for quite sometime.

iii) Fish eggs:- These equally may belong to the prey consumed or eaten directly.

iv) Whole fish:- The whole fish were intact and easily identifiable. However at or most of the time fish may be devoid of barbels, fins and its original colour may be lost. The prey fishes were Alestes sp, Tilapia sp. and Synodontis sp.

(i) Bottom deposits.

i) Inorganic: Muds fine sand and gravel of small size, these were probably picked up accidentally with other good items.

ii) Organic matter: These included fine materials usually of dead vegetables and animals origin. They were all mited up and called detritus.

(k) Others/Digested food: Unidentified fine organic matter of plant and animal origin.

3.1.2. The food items consumed

Table 3 shows the list of food items found in the stomachs of P. bayad and the relative importance of each. The percentage total points indicated that fish constituted 64.9% of the total food consumed. This was followed by the insects (29.2%). However, the crustaceans, the annelida, plant materials, mollusca and bottom deposits (0.28% - 4.12%) were also consumed but of secondary importance. Out of the total fish consumed, Synodontis sp was most frequent with 36.4% frequency of occurence, followed by

TABLE 3.

PERCENTAGE COMPOSITION AND RELATIVE IMPORTANCE OF DIETARY ITEMS IN THE STOMACH OF BAGRUS BAYAD.

Number of stomachs with food = 336 (65.9%)

Number of stomachs without food = 174 (34.0%)

Total number of stomach examined = 510.

Dietary items	% Frequency of occurrence	% Total points
Insect remains/parts	5.95	1.34
Adult insects		
Orthoptera	11.73	4.46
Coleoptera	7.10	2.26
Hemiptera	2.90	2.0
Immature insects		
Ephemeroptera nymph	10.71	1.73
Chironomid larvae/pupae	14.88	2.31
Chaoborus larvae/pupae	13.39	2.49
Trichoptera larvae	3.87	0.52
Dragonfly nymph	7.44	1.44
Damselfly nymph	2.08	0.45
Hemiptera nymph	0.60	0.05
Total insects		20.20

Fish		
Fish eggs	18.45	3.70
Fish Scales	20.54	4.07
Fish parts/remains	15.48	10.84
Tilapia sp	32.14	12.58
Synodontis sp	36.42	18.16
Alestes sp	33.14	15.60
Total fish		64.85
Copepoda	5.65	0.12
Clam shrimp	0.89	0.14
Ostracoda	13.99	0.32
Total Crustacea		0.28
Total Annelida	11.61	0.28
Algae	9.52	0.35
Plant remains	24.11	0.87
Seeds	18.75	1.65
Total plants		2.87
Total Mollusca	8.33	1.69
Mud/Sand/Pebbles	18.75	3.88
Digested food	21.73	4.12

Alestes sp (33.1%) and Tilapia sp. (32.1%). The fish eggs, scales and parts were equally important.

Second in importance were the insects. Among the insects chironomid larvae/pupae were the most frequent (14.9%). Chaoborus larvae/pupae followed closely with 13.4% frequency of occurence. The adult Orthoptera was most frequently consumed among the adult insects. Other like adult hemiptera, coleoptera ephemeropteran nymphs and dragonfly nymphs were also observed in the diet. Apart from the above major food consumed, P bayad fed less frequently on crustacean groups. e.g. clam shrimps and copepods. The Annelida, mollusca, mainly made up of empty shells and some bottom deposits were also observed. Plant materials were consumed, the most frequent was plant remains (24.1%) followed by seeds (19.8%) and the least frequent was algae (9.5%).

3.1.3. FOOD ITEMS CONSUMED BY DIFFERENT LENGTH GROUPS

Figure 3. shows the dietary items consumed by different lengths groups of P. bayad. Those with standard lengths below 30cm fed mainly on insects and plant materials most frequently. The percentage frequency of occurrence for insects was 68.3% and plant material was 56.3%. Others consumed less frequently were crustacea, fish, Annelida and Mollusca.

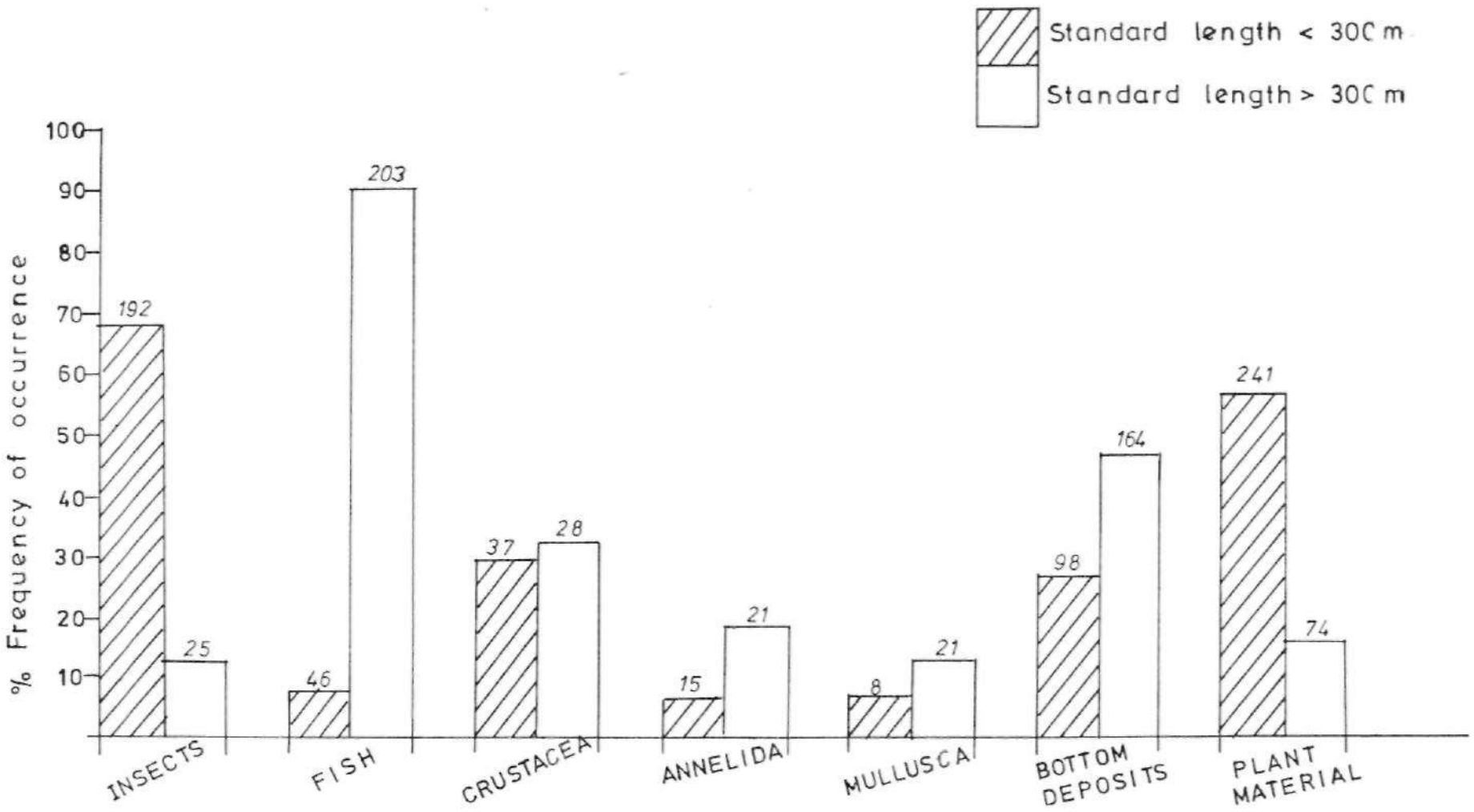


Fig. 3: Variation in dietary items selected by different length groups of P. bayad

Those with standard lengths above 30cm were typically piscivorous. Fish occured most frequently in the stomachs examined. Others less frequent is the diet included the crustaceans, insects, annelids and molluscs. The percentage frequency of occurrence of food items for fish below 30cm standard length showed that it was omnivorous.

3.1.4. MONTHLY FEEDING INDEX.

The number of P. bayad with food and those with empty stonachs were recorded for each month throughout the period of investigation. These were later converted to percentages Figure 4 shows the monthly feeding index. The percentage of fish feeding was 80% in August, this decreased steadily to about 43% in February. There was s gradual rise in the percentage of fish feeding from March to attain a peak in May when 90% of the fish had full stomachs.

3.1.5. MONTHLY VARIATION IN THE FOOD ITEMS CONSUMED

Figure 5 shows variation in the food items consumed each month. P. bayad consumed large proportion of fish throughout the period of investigation. The highest percentage total points was got from fish preys which included Synodontis, Tilapia and Alestes species. Less fish was consumed in January. The consumption of insects was irregular but they were important diets in August, October and January but least consumed in December. Plant materials were evenly consumed throughout the period of investigation.

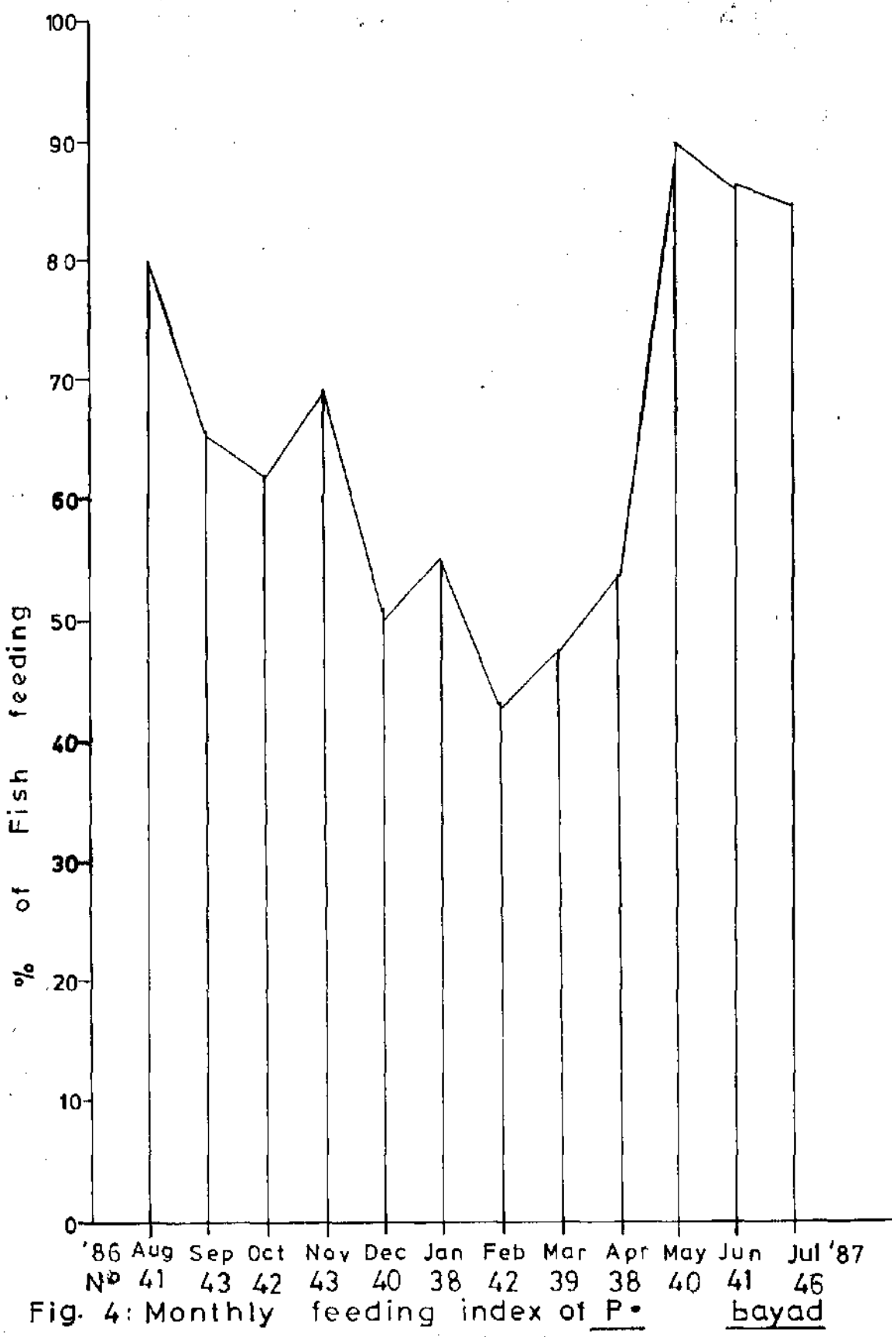


Fig. 4: Monthly feeding index of P. bayad

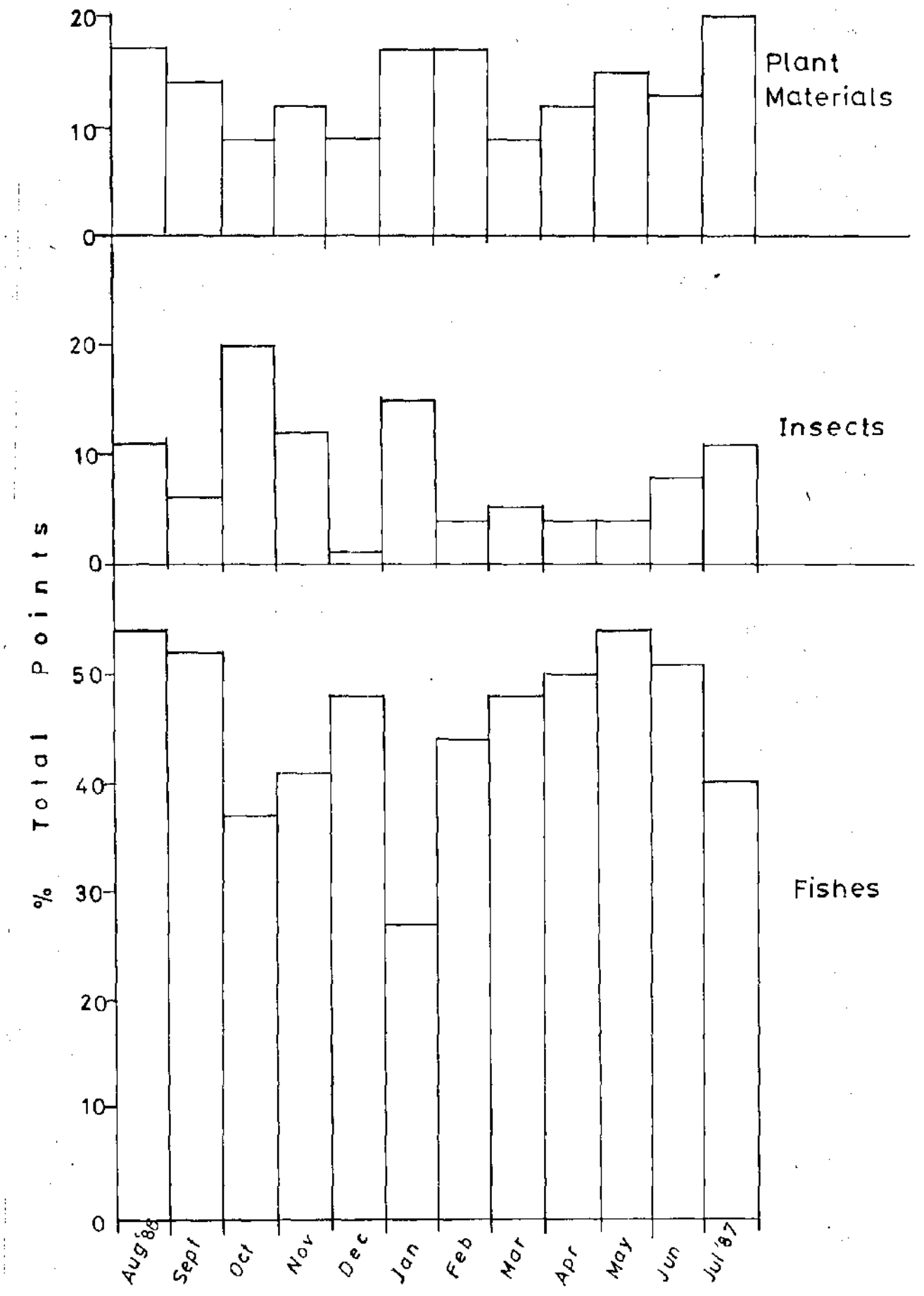


Fig. 5: Monthly Variation in the diets of P. bayad

3.2. LENGTH - WEIGHT RELATIONSHIP

The graphs showing the length-weight relationship were drawn for males, females and both combined (Figures 6,7,8). The graphs showed that the weight was directly proportional to the standard lengths in the three graphs. It therefore shows that as weight increases the standard length increases.

The correlation coefficient were very high (0.86-0.87) in both males and females of P. bayad. The correlation between the lengths and weights were found to be highly significant ($P > 0.001$). The regression coefficient "b" was calculated in the range of 4.79 and 4.87. This showed that the growth was allometric i.e weight increased faster than the cube of the length, a non symetrical growth.

3.3. LENGTH FREQUENCY DISTRIBUTIONS.

The length frequency distributions were plotted graphically as shown in Figure 9. The number of both males and females found within the length groups of 10-20cm and 30-40cm were few. Generally there were more males in 20-30cm and 40-45cm standard length groups than females. The result should, however, be taken with caution since the fish samples were bought.

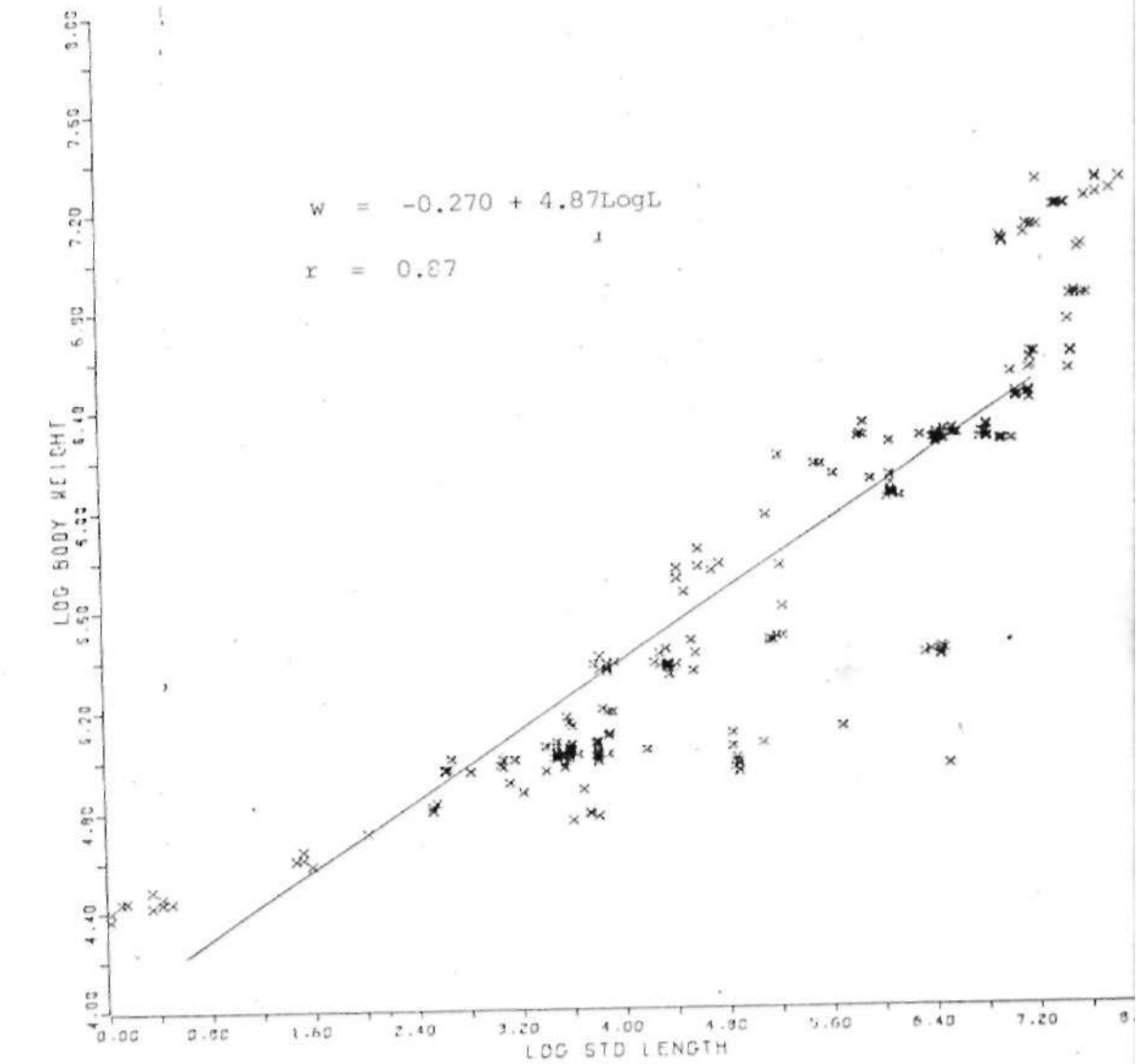


FIG.6 LENGTH-WEIGHT RELATIONSHIP(LOG-LOG) OF *P. KAYAD* (MALE)

w = -0.105 + 4.79LogL

r = 0.87

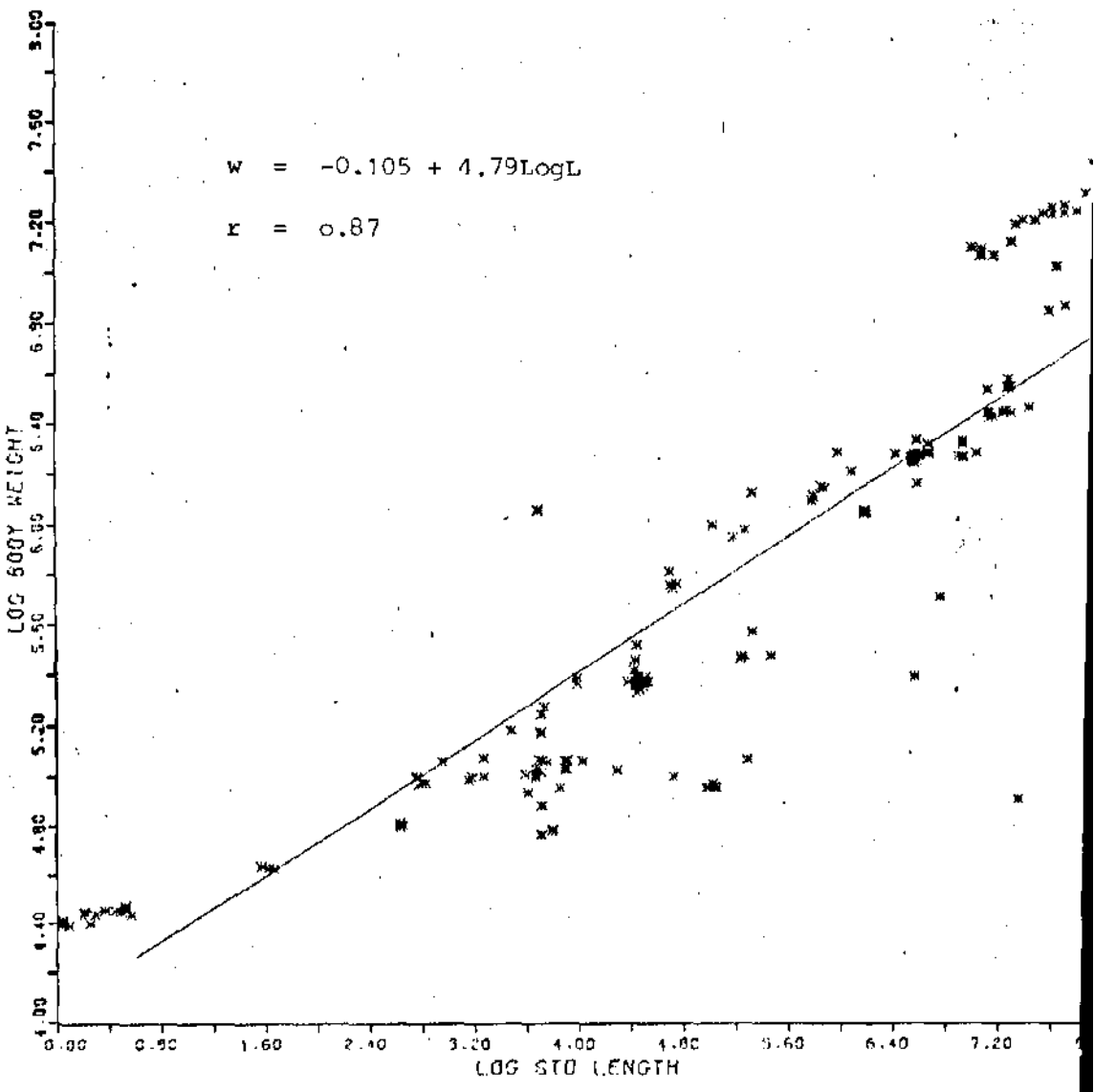


FIG 7 LENGTH-WEIGHT RELATIONSHIP(LOG-LOG) OF *P. BRYRD* (FEMALE)

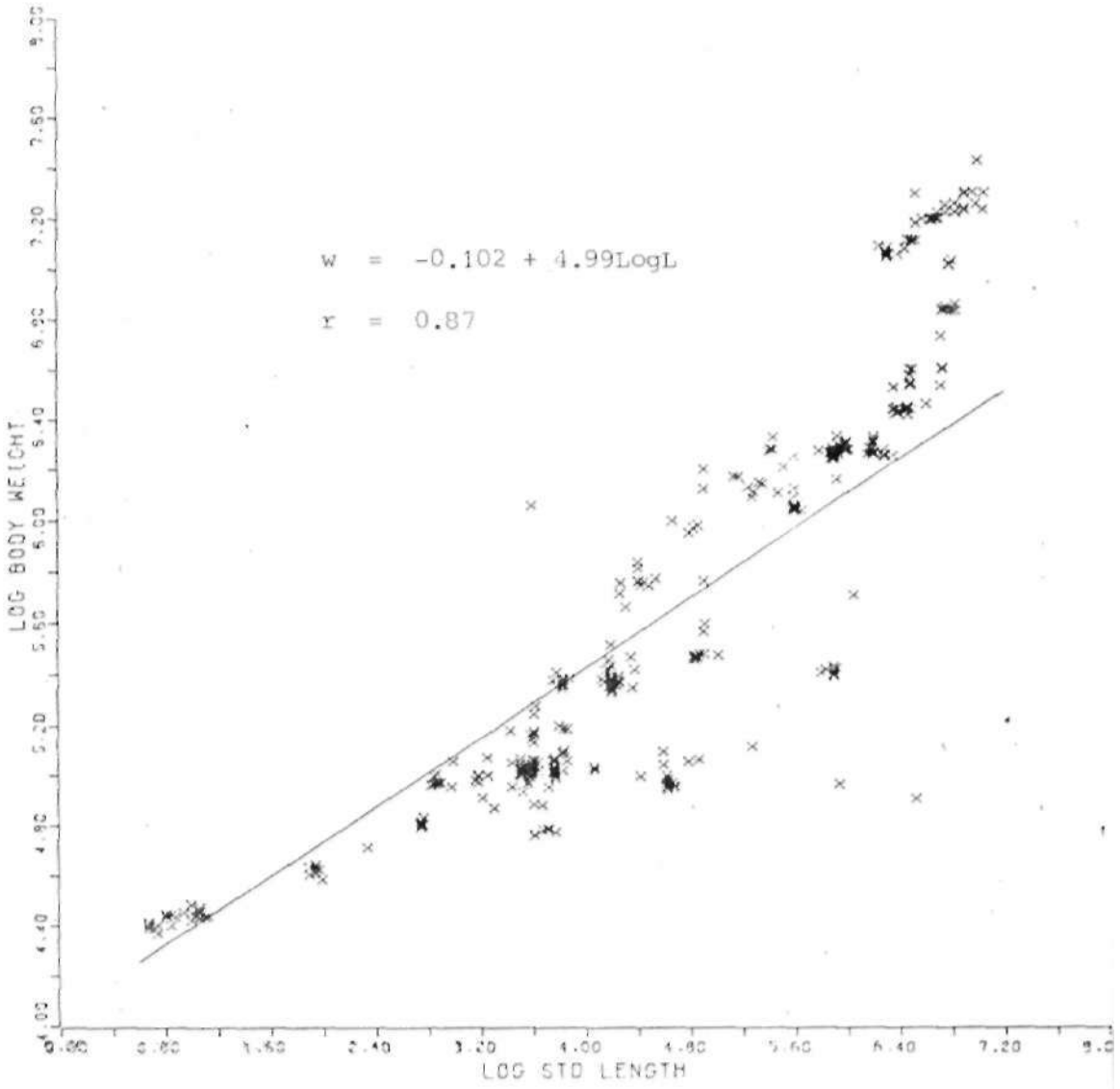


FIG. 8 LENGTH-WEIGHT RELATIONSHIP(LOG-LOG) OF P. BAYAD (MALE AND FEMALE COMBINED

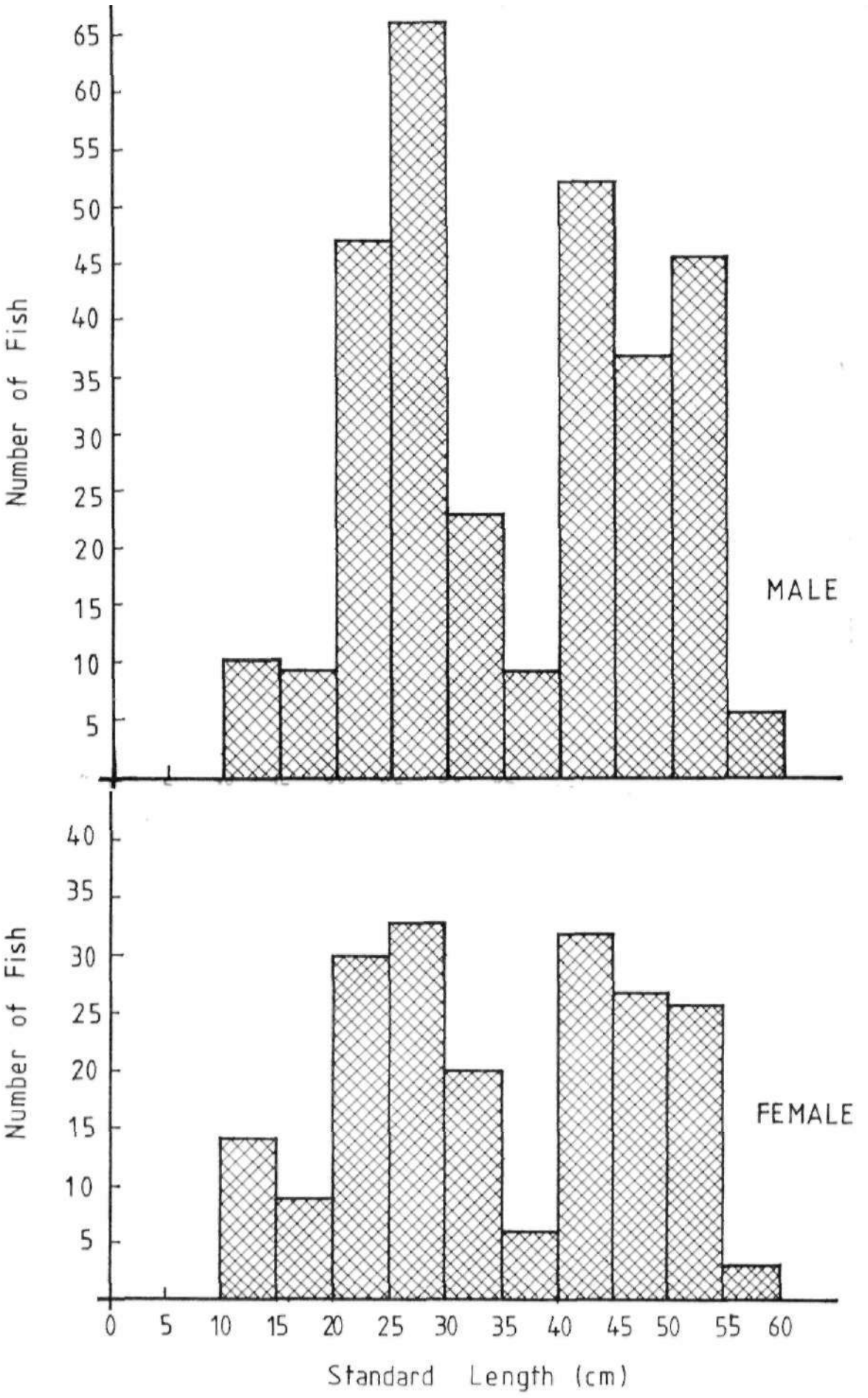


Fig. 9: Seasonal length frequency distribution of males and female P. bayad.

3.4. CONDITION FACTOR .

The mean monthly variation in condition factors were analysed and are shown in Figure 10. The periods which fell below 1.0 were regarded as low condition periods. For P. bayad, the highest period was in the month of August. The condition decreased from August to the lowest periods in February and March. From April the condition went above 1.0 to another peak in July. The peak periods coincided with periods of high rainfall when food organisms are abundant.
The fish were in good condition for most part of the study period.

3.5. SEX RATIO, REPRODUCTIVE CYCLE AND FECUNDITY

3.5.1 SIZE AND SEXUAL DIMORPHISM.

The males of P. bayad were generalyy larger and we weigh more than the females of the same standard length. The males possessed genital organs which were attached to the roof of the abdominal lining. The male genitals have finger-like out growths. In the females the left and right ovaries were oblong and transluscent. In the mature females the ovaries were light yellow.

3.5.2 SEX RATIO.

The sex of 510 specimens were determined, out of these 311 were males and 199 were females. This gave a ratio of 1.5 males to 1 female. Table 5 (a and b)shows th

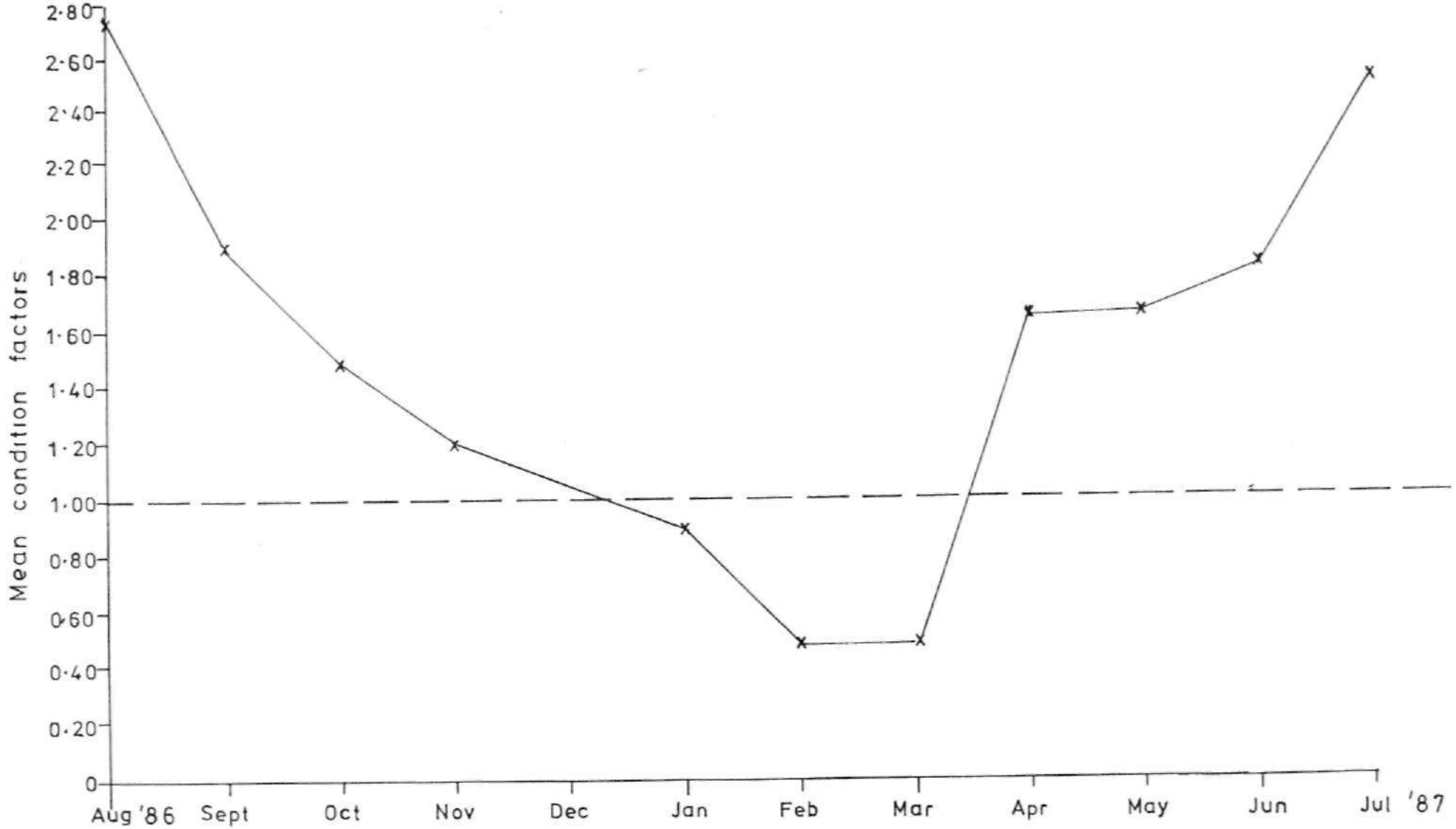


Fig. 10: Monthly variation in mean condition factor of P. bayad

TABLE 5 (a) MONTHLY VARIATION IN SEX RATIO OF P. bayad

MONTHS.	86 AUG.	86 SEPT.	86 OCT.	86 NOV.	86 DEC.	87 JAN.	87 FEB.	87 MAR.	87 APRIL	87 MAY	87 JUN.	87 JULY
Males	26	28	25	25	23	23	27	25	25	26	28	30
Females	15	15	17	18	12	15	15	14	12	15	18	22
Total No. Examined.	41	43	42	43	40	38	42	39	42	41	46	52
Sex ratio	1.6:1	1.5:1	1.7:1	1.7:1	1.5:1	1.7:1	1.6:1	1.6:1	1.5:1	1.6:1	1.6:1	1.7:1

TABLE 5 (b) CHI-SQUARE ANALYSIS OF MONTHLY SEX RATIO.

MONTHS	86 AUG	86 SEPT.	86 OCT.	86 NOV.	86 DEC.	87 JAN.	87 FEB.	87 MAR.	87 APRIL	87 MAY	87 JUN.	87 JULY
MALES X_1^2	4.65	6.32	2.56	1.96	5.26	2.78	5.33	4.84	6.76	4.61	3.51	2.13
FEMALES X_1^2	8.06	10.0	3.76	2.72	10.83	4.26	9.60	8.64	14.08	8.03	5.55	2.91

monthly sex ration and chi-square analysis. Since none of of the calculated x^2 values was more than the critical value of 19.7 at 0.05 level of significance, the observe sex ratios do not differ from the expected ratio 1:1.

3.5.3. REPRODUCTIVE CYCLE:

Figure 11. shows the cycle of maturation and depletion of the female gonads. In August and September specimens with stages 1 - VI gonad development were observed. But from october to March only the virgin, immature and matured stages were observed. The fully matured spawning and spent stage were completely absent in these months. April to July marked the periods when the percentage of virgins were below 20%, however the immature, matured, fully matured stages were above 40% in these months. Spawning probably started in July. The period of maturity of P. bayad tends to synchronise with the begining of the rains.

Figure 12. Shows the monthly variation in the percentage of matured P. bayad. In August percentage of matured female was 72% and 34% in males. The percentage matured in males rose to 50% in September and decreased to below 10% from October to April, similarly the matured females decreased from August to October when less than 5% matured. The matured females were not observed from November to April. The percentage matured P. bayad rose to a peak in May and droped low in

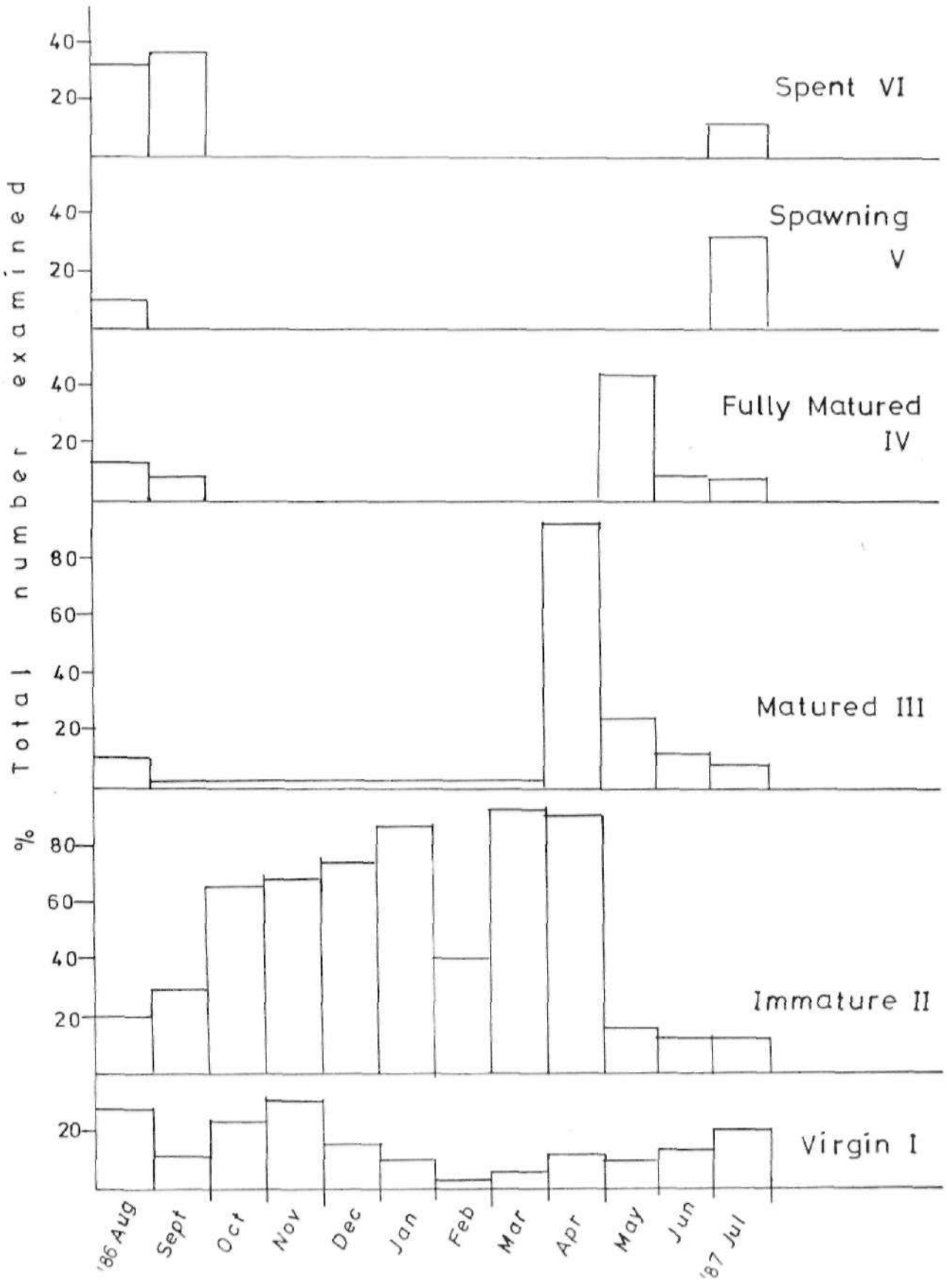


Fig. 11: Cycle of maturation and depletion of female gonads in P. bayad.

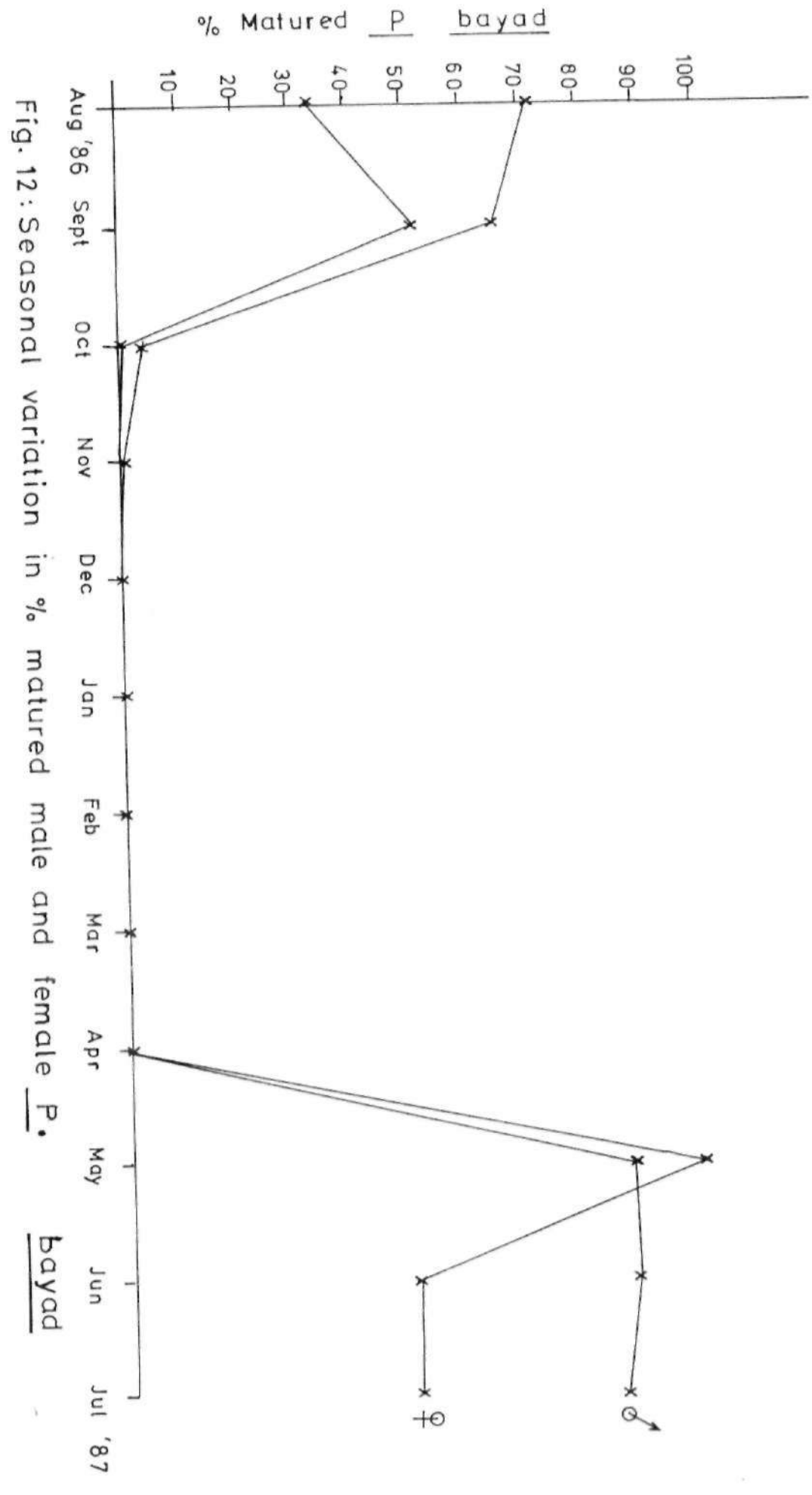


Fig. 12: Seasonal variation in % matured male and female P. bayad

June and July to between 50% and 75%.

3.5.4. AVERAGE LENGTH AT MATURITY.

The percentage matured P. bayad were plotted against standard length as shown in Figure 13. The average length at maturity was estimated from the length corresponding to 50% matured P. bayad . The average length at maturity of male is 42cm and female is 26cm. In both male and female the percentage maturing increased to its peak at 58cm standard length. The number of individuals maturing droped sharply beyond 58cm standard length.

3.5.5. MONTHLY VARIATION IN GONADAL WEIGHT.

The mean monthly gonadal weight for the males and females were plotted against the months. Figure 14 shws that the female gonads weigh more than the females. In August and September the gonal weights were low indicating little gonadal development. This reduces further till November. November to March shows no change in gonad weight meaning no development. From April the weight increase to a peak in both male and female gonadal weight. In July, the male gonads weighed less than 2g while the female gonad was as high as 12.5g during the period of investigation.

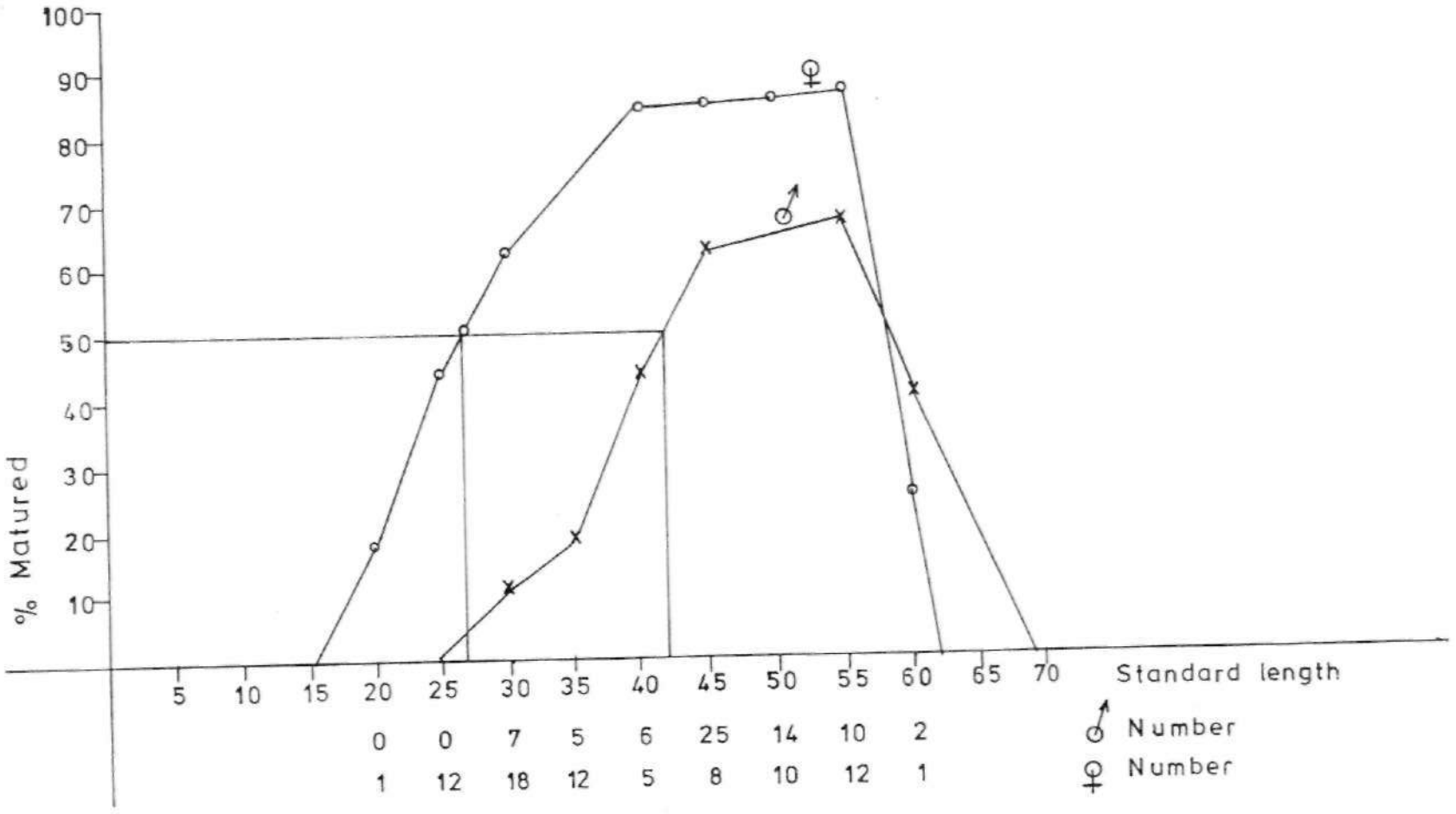


Fig. 13: Relationship between standard length and percentage maturity in P. bayad.

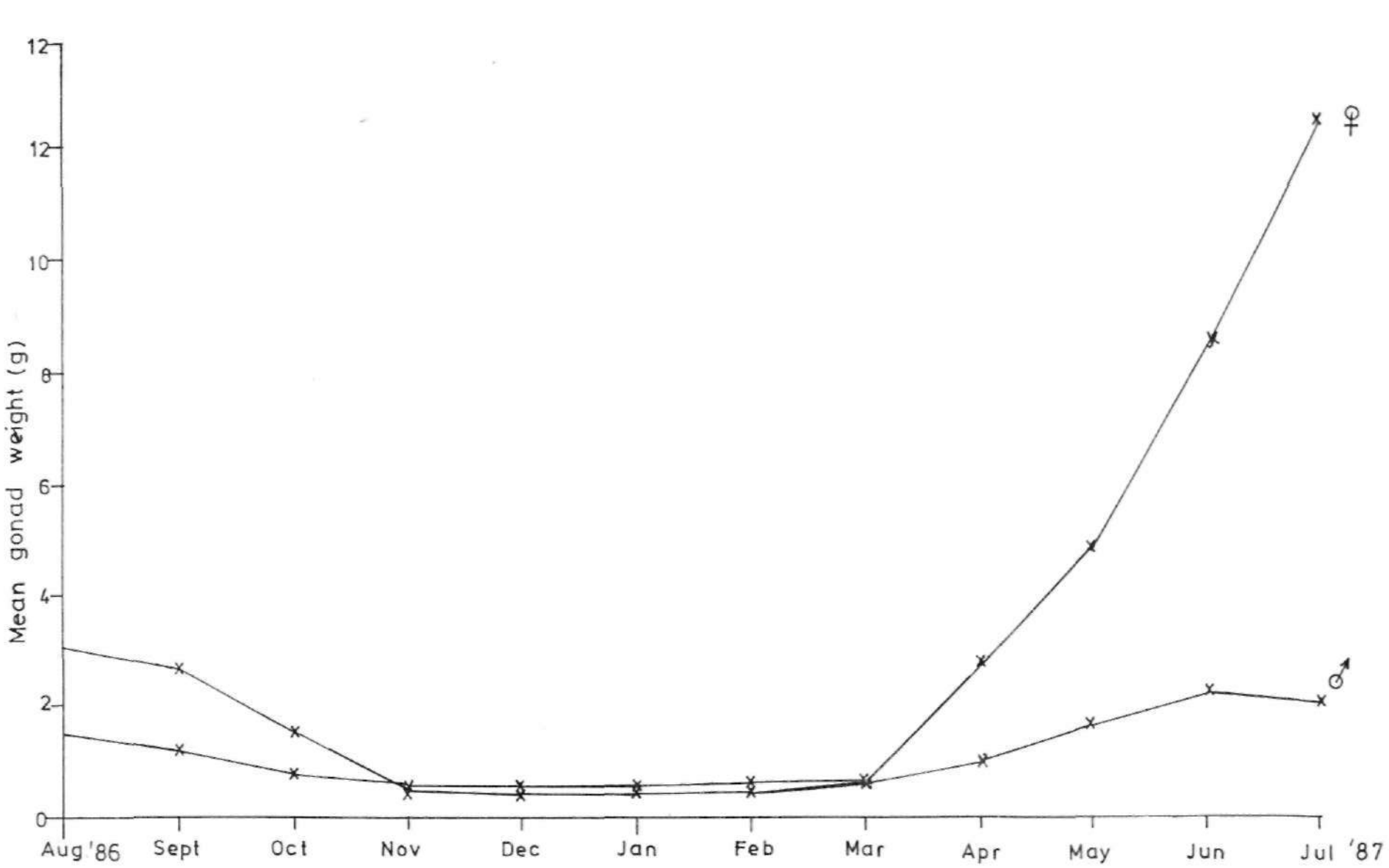


Fig. 14: Seasonal variation in gonad weight of male and female P. bayad

3.5.6. FECUNDITY

Fecundity was estimated using matured gonads in stage IV. The females in this stage were not very common, however, a total of 15 specimens were used for the fecundity estimation. Eggs were observed in those whose standard length ranged from 26cm to 68cm. The egg number ranged from 2677 to 7375 with a mean value of 4,726 + 690. The fish is therefore not highly fecund if compared to other tropical catfishes (Olatunde, 1977 and Willoughby; 1974). The number of eggs were plotted against the standard, body and gonad weight (Figures 15, 16, 17). The number of eggs increased from standard length of 26cm to a maximum at 70cm. Beyond this length changes in egg number doesn't occur. The egg number is increased with increase body weight but the egg number remain unchanged from body weight of 1000g. The egg number is directly proportional to the gonad weight meaning that more eggs are found in the gonads as the gonad weight increased.

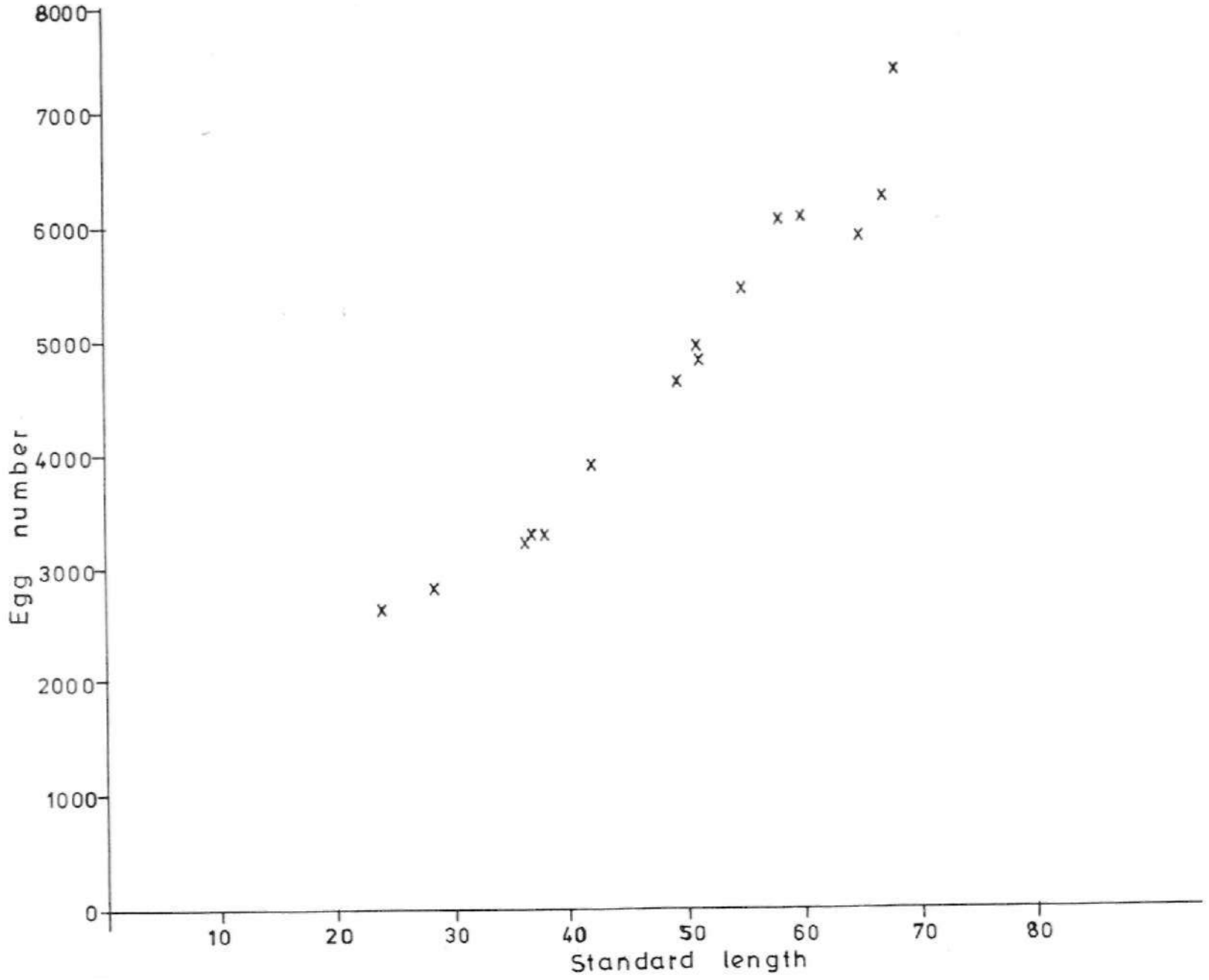


Fig. 15 Relationship of egg number to standard length of P. bayad

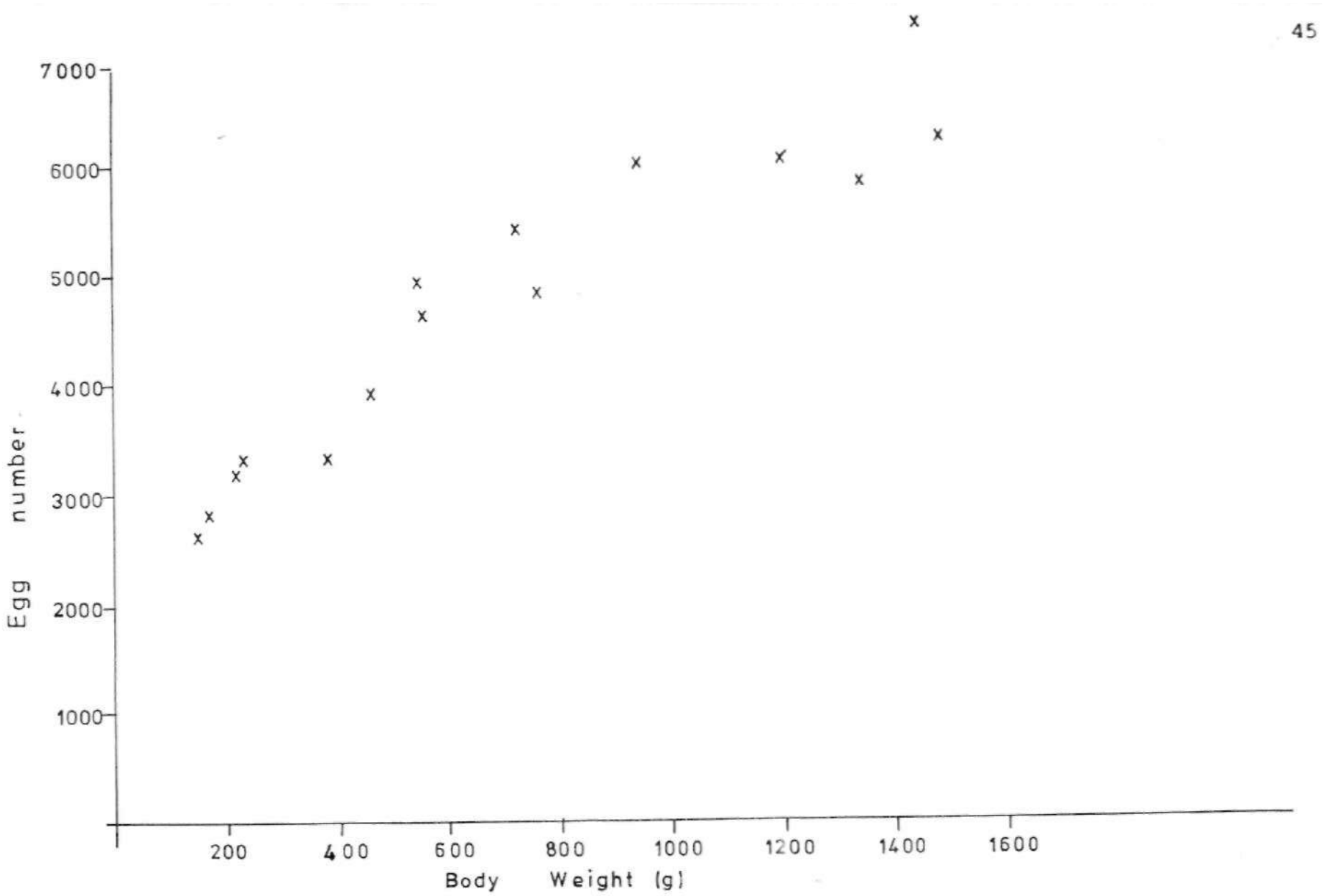


Fig. 16: Relationship of egg number to body weight of P. bayad

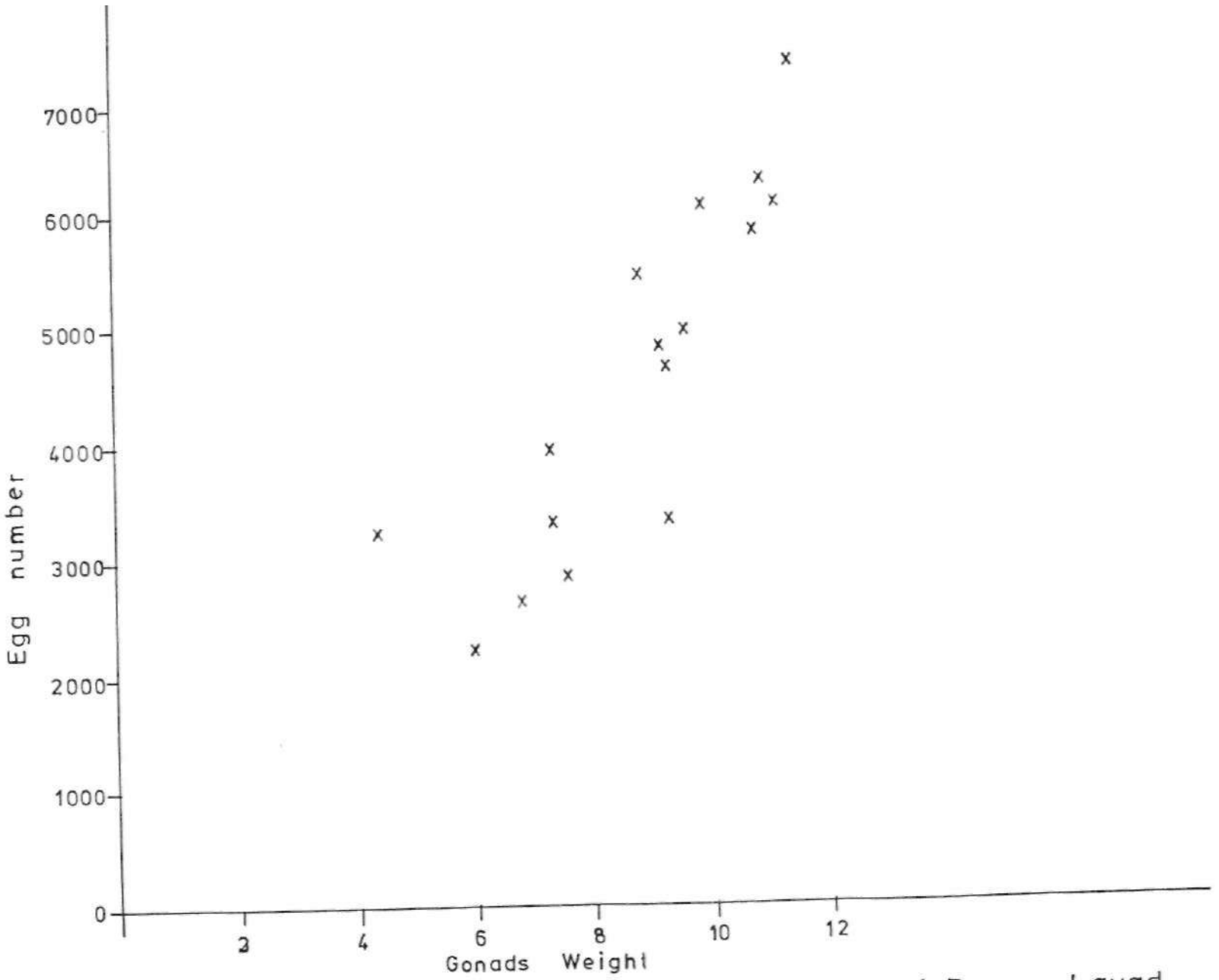


Fig. 17: Relationship of egg number to gonad weight of P. bayad

CHAPTER FOUR

DISCUSSION

Hynes (1950) made a review of the various methods used in the stomach content analysis and advocated the use of more than one technique to avoid a biased assessment of the diets.

In this study, two methods were used for the stomach analysis and were found to be adequate. They were the frequency of occurrence method and the points method. The frequency of occurrence method, have been used often in the stomach analysis of some freshwater fishes (Olatunde, 1977; Fagade, 1979 and Nwadiaro, 1982). The points method has also been used in conjuction with the numerical and volumetric methods (Fagade, 1971).

The frequency of occurrence method requires no special apparatus or skill. However, this method is often biased by the accumulation of certain food items resistant to digestion (Olatunde, 1977). The most frequent food item may not necessarily be the most important. It also provides little information on the biochemical and energy value of the different food items in the diet. The points method has the disadvantage of being subjective. Most fishery biologist prefer this method because, it is easy and rapid (Olatunde, 1977).

P. bayad was piscivorous in Tiga dam lake prefering fish diets such as Synodontis, Alestes and Tilapia species. Insects were of secondary importance. P. bayad exhibited a great diversity of feeding habits with respect to size. The main food items of those whose standard lengths fell below 30cm coincided with those food items that were of secondary importance to fish with standard lengths above 30cm. When the lengths were below 30cm, the fish tended to feed more on insects and plant materials. The preference at this length for insects might be due to their inability to catch the fish preys as a result of small gape. Above 30cm, P. bayad became typically piscivorous. Olatunde (1977) observed that at the early stage of life, the food items selected by Schilbe mystus were small but as the predator increased in size a similar size increase in prey organisms occurred.

The consumption of mud/sand materials in P. bayad could be accidental. Changes in the food composition and feeding habits of fish in relation to the size, age and season are biological phenomena which are common to many species of the fish in the tropics and temperate areas (Olatunde, 1977). The result of Tweddle (1975), on B. meridionalis in Lake Malawi showed that those below 20cm standard length were mainly insectvorous while those above were piscivorous. Corbet (1961) gave the food of B. docmac in Lake Victoria as lithophilic insects for those below 20cm while those above 20cm fed on fishes.

Imevbore, and Bakare (1970) worked on Lake Kainji and observed that B.bayad fed on fishes which he could not identify, however, food items like Alestes sp, Prawns and vegetable materials were equally found in the stomache.

Welman (1948) gave the food of B. docmac in Nigerian as prawns, insect larvae and mud. Similarly, Irvine (1947) reported the food of B. docmac as fish eggs, fry, adult fish, snails, bivalves and insect larvae. Sandon and El-Tayib (1953) reported the food of B. docmac and B.bayad as Alestes, Synodontis species, grains and plant materials while in Lake Edward B. docmac was reported feeding on Haplochromis, chironomid and chaoborid larvae (Reed et al. 1967).

The variations in the monthly feeding index and the dietary composition could be influenced by food availability and abundance, as well as a number of factors such as climatic and physico-chemical parameters (Olatunde, 1977). Macdonald (1956) noted that the lunar rhythms of emergence of Chaoboridae and Chironomidae in Lake Victoria affected the relative numbers of these organisms taken by Mormyrus Kunnume. Okedi (1971) similarly noticed, the effect of season on the feeding index of the fish. He observed thatthe quality of chironomids and Povilla adusta nymphs in the stomach of mormyrids correlated with certain lunar phases.

In this work, one third of the fish examined had empty stomachs and this was probably due to various reasons such as those suggested by Olatunde (1977)

i). Digestion of food before or after the fish were caught.

ii). Regurgitation of food items while struggling in the fishing gear.

iii). Poor physiological state preventing feeding,

iv). Gravid or spawning thus feeding less.

v). Lagler et al. (1962) reported that many predatory fishes appear to regurgitate their food with ease because of the striated muscles extending from oesophagus to the stomach. More over, carnivores digest their food faster than herbivores. Competition for same food items may as well result in empty stomachs.

The analysis of the length-weight relationship showed that the growth of B.bayad was allometric. This means that the fish does not grow symmetrically (Tesch, 1968). Variations in the value of "b" could be due to several factors such as maturity level, season, time of capture, stomach fullness and other factors that might influence the weight (Lagler, 1952). Similarly, Vasnetsov (1953) was of the view that though samples are often pooled together for calculations, their development passes through several stages each of which may have their own length-weight relationship.

Fish growth could either be allometric or isometric. Fagade (1979) observed isometric growth in T. melanotheron and T. guineensis in Lagos lagoon. Similarly, Reynold et al. (1969) noticed allometric growth in Alestes baremose, Citharinus citharus and Synodontis gambiensis. Olatunde (1977) equally observed an isometric growth in Schilbe mystus in Lake Kainji

Chi-square analysis of the sex ratio at 95% confidence limits indicated that there was no deviation from the expected ratio of 1:1, however, sex ratio in favour of males were observed in B. bayad, in Lake Kainji (Imevbore and Bakare 1970). Mathur (1964) and Fagade (1979) observed high sex ratio in favour of females in Hilsa ilisha and T. melanotheron respectively.

The length at which the male and female B. bayad mature differs. Females matured at lower standard lengths than males. This difference might be due to the fact that males grow faster than females. Imevbore and Bakare (1970) observed a similar trend in B bayad in Lake Kainji, where the smallest matured female was 26.3cm in standard length and the male was 41.5cm. Two common parameters which can be used to define a sexually matured fish, are its age and size assuming that the physiological conditions of the fish are directly related to one of both of these factors (Mortimer, 1960).

A high percentage of B. bayad were observed to have fully developed gonads between May and August. This period marks the peak of the rains. The fish therefore breeds during the rainy season when the water level is high. Tropical fishes are found to breed at different times of the year (Bank et al; 1965). Some breed at the start of the rainy season, some at the peak, and others at the end of the rains. (Bank et al; (1965) noticed that B. bayad B. docmac and Auchenoglanis occidentalis in River Niger had matured ovaries in July to September periods. Motwani and Kanwai (1970) got matured Bagrus spp between May and August flood, while Imevbore and Bakare (1970) observed gravid B. bayad in River Niger from May to August. All these indicated that most of the tropical fishes spawn during the rainy season.

The condition factor is a measure of fish response to growth in water. It expresses the condition of the fish. The value is affected by genetic differences, sex, maturity stages, season, fullness of the stomach and age of the fish (Nikolsky, 1963). The condition of B bayad was good throughout the period of investigation except from January to March. This meant that the fish fed well throughout the year and less during the period of low condition.

The number of eggs of P. bayad ranged from 2677 to 7,375, with an average value of 4726 + 690. The fish, therefore had low fecundity when compared with other tropical catfishes (Olatunde, 1977 and Willoughby, 1974). Scatter graphs of egg number against standard length, body and gonad weights indicated three trends of relationship. Egg number was directly proportional to gonad weight, increased with increase in body weight up to 1000g and dropped beyond this weight, while the egg number increased with increase in standard length upto 65cm and above which egg number remained unchanged. This trend was observed by many workers. Olatunde (1977) observed increase in egg number with increase in length and body weight of Siluranodon auritus inhabiting Lake Kainji. Lowe (1955) recorded a fecundity varing from 1,000 for an 80mm specimen to 7,061 for a 190mm specimen of T Zilli. Increase were recorded by Dennison and Bulkley (1972) in Ictalcurus melas. However, Fagade (1979) did not observe the highest fecundity in the largest T. guineensis.

A number of factors determine the fecundity of a fish, but these factors are found to vary from one species to another. Olatunde (1977) found the following to have some effects on the number of eggs to be produced by the individual fish.

i). Egg laying habits and care of the young. For example viviparous species and species excercising parental care produce less number of eggs than those species which broadcast their eggs and leave them unattended.

ii). Egg sizes/size of fish: In some fishes, those with large eggs produce fewer eggs than those with smaller eggs. The fecundity is related to fish size. The egg number increase with increase in fish size.

Variations have been found in the same species of fish located in different lattitudes. Nikolsky, (1963) observed that Pike had varied egg number in different geographical areas. Food supply equally affect the egg number produced. Well fed fish have higher fecundity than starving fish. Scott (1956) and Bagenal (1969) studied independently egg size and number in Salmon giardnerrii and found that only egg sizes were genetically controlled while egg number only varied with environment and physiological factors.

SUMMARY AND CONCLUSION.

Some biological aspects of P. bayad were studied in Tiga dam between August, 1986 and July, 1987. A total of 510 specimens were examined, 311 were males and 199 were females. Male were generally larger than females.

The length-weight relationship showed that as the fish grew in length, the weight also increased. The length-weight regression analysis showed that P. bayad exhibited an allometric growth. The mean condition factor showed that the fish were in good condition for most part of the period of investigation.

Diverse feeding habits were exhibited by P. bayad in Tiga dam lake. The smaller fish below 30cm standard length were mainly omnivorous while the larger ones above 30cm were typically piscivorous. The feeding index pattern varied seasonally with low index in the dry season and high index in the rainy season. The mean fecundity increased with the increase in body and gonad weights and the standard length.

The result of this work will serve as a pivot on which other research on P. bayad can be carried out, more especially on details of its fecundity, and feeding habits.

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APPENDIX 1. THE LENGTHS, WEIGHTS, SEX, GONAD CONDITION AND "K" VALUE OF P. BAYAD FROM AUGUST 1986 TO JULY 1987.

AUGUST, 86	TOTAL LENGTH (cm)	STANDARD LENGTH (cm)	TOTAL WEIGHT (g)	GONAD WEIGHT (g)	STOMACH SIZE	SEX	GONAD CONDITION	"K"
	32.0	25.6	160.2	1.31	full	M	II	0.95
	31.0	25.3	120.4	1.24	full	M	II	0.74
	35.6	25.7	212.6	1.86	¾full	M	II	1.25
	36.5	28.5	215.6	1.90	Empty	M	II	0.93
	37.5	29.0	305.6	1.23	½full	M	II	1.25
	48.1	43.5	533.3	1.26	½full	M	VI	0.65
	41.0	34	321.0	2.37	½full	M	III	0.82
	24.20	21.0	142.6	0.51	¾full	M	I	1.54
	68.3	57.2	1443.3	4.2	Empty	M	V	0.77
	33.0	25.8	182.0	1.83	¾full	M	II	1.06
	32.0	24.4	176.4	1.80	½full	M	II	1.21
	28.8	23.6	156.9	1.48	½full	M	I	1.20
	34.3	29.8	226.7	2.28	¾full	M	III	0.86
	37.2	29.3	289.6	2.39	½full	M	III	1.15

Appendix 1 Contd.

38.6	33.3	394.3	2.50	¾full	M	III	1.07
41.6	36.3	482.0	2.60	½full	M	IV	1.01
42.4	37.0	463.0	3. 0	½full	M	V	0.91
37.4	30.6	315.2	0.98	½full	M	I	1.10
24.5	20.2	143.8	0.52	¾full	M	I	1.74
44.1	39.2	453.2	4. 6	¾full	M	V	0.75
50.2	38.6	541.6	9.69	½full	M	V	0.94
33.0	26.2	180.0	2.60	¾full	M	III	1.00
32.4	24.5	172.6	1.63	Empty	M	II	1.17
19.3	16.2	104.3	0.93	Empty	M	I	2.45
29.5	24.2	152.0	0.98	½full	M	I	1.07
47.2	43.3	532.8	1.43	¾full	M	VI	0.66
35.6	26.0	214.3	1.06	¼full	M	III	1.22
35.5	26.3	219.2	1.25	full	M	II	1.20
48.4	44.6	538.6	1.22	Empty	M	VI	0.61
14.60	12.40	84.60	0.78	¾full	F	I	4.44
48.50	43.70	536.3	8.45	¾full	F	V	0.81
52.3	48.0	540.1	10.34	½full	F	V	0.49

Appendix 1 Continued

36.5	28.4	226.8	8.31	Empty	F	V	0.99
59.8	47.6	1221.1	26. 2	½full	F	V	7.13
64.8	51.6	1361.2	31. 2	¼full	F	V	1.00
69.2	57.4	1716.3	35. 8	¼full	E	V	0.91
32.4	24.7	196.5	8.63	¾full	F	III	1.30
28.6	23.5	178.8	7.62	¾full	F	IV	1.38
38.9	33.6	398.9	9.34	full	F	IV	1.05
41.0	32.9	405.8	24. 4	¾full	F	V	1.24
49.0	44.0	530.8	21.28	¾full	M	VI	0.62
24.6	20.3	144.0	0.46	½full	M	I	1.73
26.2	22.1	145.0	0.49	½full	M	I	1.34
33.2	26.4	164.0	0.54	full	M	II	0.93
28.4	24.0	149.0	0.46	Empty	M	I	1.08
32.0	24.6	158.6	0.52	Empty	M	II	1.07
50.0	38.8	538.0	8.45	¾full	M	V	0.92
52.0	47.0	534.0	2.74	¾full	M	VI	0.51
15.8	13.0	84.6	0.31	full	M	I	3.85
19.4	16.2	100.4	0.36	½full	M	I	2.45

Appendix 1. Contd.

14.7	12.2	85.0	0.31	Empty	M	I	4.68
15.9	13.2	84.8	0.32	¾full	M	I	3.69
36.6	28.2	216.0	1.95	Empty	M	II	0.96
48.7	44.6	539.0	1.15	¾full	M	VI	0.61
29.4	24.0	151.6	0.92	¼full	M	I	1.10
51.2	47.0	530.0	2.12	¾full	M	VI	0.51
19.0	16.2	101.0	0.95	Empty	M	I	2.38
64.4	51.0	1250.0	2.02	½full	M	VI	0.94
58.0	55.0	940.0	1.96	¾full	M	VI	0.56
30.6	25.0	120.0	1.20	½full	F	II	0.77
36.6	28.5	220.0	2.92	full	F	VI	0.95
48.6	43.8	531.5	6.38	Empty	F	V	0.63
51.0	47.0	531.8	2.14	Empty	F	VI	0.51
24.2	20.5	145.0	2.96	¾full	F	III	1.68
26.5	22.5	149.0	2.42	¾full	F	II	1.31
65.0	51.0	1336.0	2.85	full	F	VI	1.01
67.0	54.0	1391.0	2.94	¼full	F	VI	0.88
60.0	55.0	1401.0	2.92	¾full	F	VI	0.84

Appendix 1. Contd,

	14.8	12.2	85.0	0.908	¾full	F	I	4.68
	15.8	13.1	84.6	0.909	½full	F	I	3.76
	48.6	44.6	538.0	2.00	full	F	VI	0.61
	32.5	24.6	178.0	3.89	full	F	III	1.20
	51.4	47.0	531.0	2.20	½full	F	VI	0.51
	42.2	34.0	460.0	7.32	full	F	IV	1.17
SEPTEMBER, 86	30.0	24.5	151.7	1.62	Empty	M	II	1.03
	32.0	25.5	158.8	1.24	Empty	M	II	0.96
	36.5	28.5	215.6	1.83	full	M	II	0.93
	37.5	29.0	305.5	1.03	full	M	II	1.25
	48.5	43.5	529.7	1.14	¾full	M	VI	0.64
	51.2	47.0	532.6	1.30	Empty	M	VI	0.51
	40.0	30.0	320.5	1.94	½full	M	III	1.19
	35.5	26.0	218.0	1.26	full	M	II	1.24
	48.0	43.4	530.4	2.84	¾full	M	IV	0.65
	24.6	20.2	143.0	0.30	Empty	M	I	1.73
	26.2	22.0	146.0	0.33	Empty	M	I	1.37

Appendix 1. Contd.

26.4	22.5	149.3	0.32	½full	M	I	1.31
30.2	24.3	150.4	0.81	Empty	M	II	1.05
33.6	26.0	163.2	0.49	¼full	M	II	0.93
48.5	43.6	530.5	1.18	¾full	M	VI	0.64
48.8	44.9	540.1	1.26	full	M	VI	0.61
29.5	24.0	151.7	0.39	¼full	M	I	1.10
29.5	24.1	151.0	0.38	Empty	M	I	1.09
32.0	24.5	155.6	0.44	¼full	M	II	1.06
35.5	26.0	212.8	1.04	¼full	M	III	1.21
47.4	42.4	537.3	1.24	½full	M	IV	0.71
48.2	43.2	531.0	1.25	¼full	M	VI	0.66
48.6	43.4	536.0	1.28	½full	M	VI	0.66
48.6	43.6	530.0	1.27	¾full	M	II	0.64
40.2	31.0	324.2	1.21	¼full	M	III	1.09
32.0	25.6	159.0	1.22	Empty	M	III	0.95
33.6	26.0	164.0	1.20	¼full	M	VI	0.93
30.5	24.6	117.6	2.22	Empty	F	VI	0.79
35.5	26.0	213.9	2.82	Empty	F	VI	1.22

Appendix 1. Contd.

40.0	30.0	319.4	2.09	½full	F	VI	1.18
49.0	44.0	534.5	2.23	¼full	F	VI	0.63
51.0	47.0	531.6	6.47	Empty	F	IV	0.51
48.5	43.5	531.8	2.84	full	F	VI	0.65
24.6	20.4	144.4	2.36	Empty	F	II	1.70
32.0	25.5	158.4	2.42	Empty	F	II	0.96
44.2	39.6	501.9	2.26	¾full	F	VI	0.81
48.6	43.6	538.2	2.34	full	F	VI	0.65
28.5	24.0	149.6	2.38	¼full	F	II	1.08
32.0	24.5	159.2	1.46	½full	F	VI	1.08
32.8	24.8	157.6	1.86	Empty	F	VI	1.03
47.2	42.4	536.7	1.37	½full	F	II	0.70
36.0	26.0	219.0	4.38	full	F	II	1.25
29.5	24.0	153.7	1902	Empty	M	I	1.11
35.5	26.0	212.9	1.25	½full	M	II	1.21
35.5	25.5	218.0	1.22	½full	M	II	1.31
50.2	46.5	530.6	1.26	Empty	M	II	0.53

OCTOBER

Appendix 1 Contd.

51.4	47.0	532.5	2.32	Empty	M	IV	0.51
21.6	17.9	112.0	0.142	¼full	M	I	0.73
31.2	27.6	154.6	0.34	full	M	II	0.74
38.8	29.6	236.2	0.53	Empty	M	II	0.91
39.0	33.8	241.6	0.54	Empty	M	II	0.63
42.2	34.1	272.0	0.63	¼full	M	II	0.69
51.2	47.0	530.0	2.21	¾full	M	II	0.51
30.8	24.6	158.0	0.38	full	M	II	1.06
33.2	26.1	165.2	0.44	¼full	M	II	0.93
46.4	40.6	428.8	1.04	Empty	M	II	0.64
48.5	44.0	526.3	0.84	¾full	M	II	0.37
48.8	44.8	542.0	0.85	full	M	II	0.60
50.3	46.9	543.2	0.74	½full	M	II	0.53
50.6	46.9	540.0	0.75	Empty	M	II	0.52
26.4	22.8	131.0	0.32	full	M	I	1.11
26.8	23.6	142.7	0.33	½full	M	I	1.09
27.9	31.7	149.4	0.48	¼full	M	I	0.47
29.0	33.0	158.0	0.41	Empty	M	I	0.44

Appendix 1. Contd.

32.5	24.6	157.6	2.26	Empty	F	II	1.06
36.5	28.5	216.5	1.86	¼full	F	II	0.94
48.5	43.5	532.2	3.48	½full	F	II	0.65
48.0	43.4	530.2	1.42	¼full	F	II	0.65
19.0	16.0	103.6	0.14	Empty	F	I	2.53
31.0	27.6	152.6	1.56	Empty	F	II	0.73
32.0	25.6	158.8	1.61	Empty	F	II	0.95
42.1	34.0	264.0	3.68	½full	F	II	0.67
30.5	24.6	132.6	1.26	Empty	F	II	0.89
46.2	40.4	428.8	1.26	Empty	F	II	0.65
48.1	43.8	478.2	1.34	Empty	F	II	0.57
48.8	44.7	538.4	1.42	¼full	F	II	0.60
14.2	11.9	81.0	0.08	full	F	I	1.92
27.4	30.1	148.6	1.03	¼full	F	I	0.54
29.8	33.7	159.4	1.02	Empty	F	II	0.42
41.5	45.3	304.3	1.09	full	F	II	0.33
15.9	13.0	869.9	0.09	¼full	F	I	3.96

Appendix 1. Contd.

NOVEMBER	49.5	38.5	536.0	0.68	full	M	II	0.94
	64.5	50.6	1250.0	0.77	½full	M	II	0.96
	64.0	50.0	1210.0	0.73	¼full	M	II	0.97
	30.5	24.6	117.0	0.26	½full	M	I	0.79
	30.2	24.3	150.0	0.26	¼full	M	I	1.05
	31.0	24.8	152.0	0.28	Empty	M	I	1.00
	48.5	43.5	532.0	0.68	½full	M	II	0.65
	35.5	26.0	218.0	0.48	full	M	II	1.24
	29.6	24.0	153.0	0.40	Empty	M	I	1.11
	29.5	24.2	153.5	0.39	full	M	I	1.08
	64.0	50.2	1253.0	0.77	¾full	M	II	0.99
	68.0	55.0	1400.0	0.82	full	M	II	0.84
	69.2	56.0	1502.0	0.83	½full	M	II	0.86
	14.6	12.0	87.0	0.080	¼full	M	I	4.75
	15.8	13.0	86.6	0.086	full	M	I	1.20
	29.0	24.0	150.3	0.32	½full	M	II	1.09
	46.2	40.3	426.9	0.646	Empty	M	II	0.59
	48.0	44.7	539.5	0.65	Empty	M	II	0.60

Appendix 1. Contd.

50.6	46.8	542.0	0.652	full	M	II	0.53
68.4	56.0	1514.6	0.836	¼full	M	II	0.86
35.5	26.3	218.0	0. 49	Empty	M	I	1.24
30.2	24.6	153.0	0. 28	Empty	M	II	1.03
64.0	50.2	1251.0	0.776	Empty	M	II	0.99
37.0	28.6	215.8	0. 48	½full	M	II	0.92
51.3	46.6	543.0	0.650	Empty	M	II	0.54
66.0	52.5	1359.5	0. 78	¼full	F	II	0.94
39.5	30.0	336.0	0. 51	¼full	F	II	1.24
65.0	51.0	1338.0	0.775	full	F	II	1.01
49.6	38.8	540.0	0.694	¼full	F	II	0.92
49.0	44.0	531.5	0.690	¾full	F	II	0.62
51.2	47.1	534.0	0. 60	Empty	F	II	0.51
23.2	19.8	123.2	0. 12	½full	F	I	1.59
70.0	56.8	1514.0	0.832	½full	F	II	0.83
19.5	16.2	102.8	0. 12	¾full	F	I	2.42
15.5	12.9	85.4	0. 09	½full	F	I	1.23
26.3	22.1	148.4	0. 21	Empty	F	II	1.37

Appendix 1. Contd.

	36.5	28.5	216.4	0. 48	¼full	F	II	0.93
	14.2	12.3	81.8	0. 09	½full	F	I	4.39
	26.4	22.0	146.6	0. 25	Empty	F	I	1.38
	15.4	12.9	85.8	0. 08	¼full	F	II	3.99
	48.2	43.6	538.6	0.642	¾full	F	II	0.65
	68.1	56.2	1409.2	0.810	Empty	F	II	0.80
DECEMBER	32.3	25.6	153.0	0. 40	Empty	M	I	0.91
	36.0	26.0	210.0	0. 49	Empty	M	II	1.19
	48.5	43.6	526.2	0. 64	¼full	M	II	0.63
	49.0	44.2	528.4	0. 65	¾full	M	II	0.62
	51.1	48.0	530.0	0. 59	¾full	M	II	0.48
	15.8	13.0	84.4	0.088	Empty	M	II	4.99
	60.0	48.2	1190.0	0.720	Empty	M	II	1.06
	64.0	50.4	1208.0	0.730	full	M	II	0.97
	66.3	52.8	1360.0	0.790	Empty	M	II	0.92
	69.7	58.1	1508.0	0.800	¼full	M	II	0.77
	30.0	23.9	150.0	0. 25	Empty	M	I	1.10
	46.4	40.5	431.0	0.630	½full	M	II	0.65

Appendix 1. Contd.

46.0	40.2	420.3	0.630	Empty	M	II	0.65
29.5	24.0	150.0	0.310	¼full	M	II	1.09
39.0	33.8	242.0	0.496	¼full	M	II	0.63
27.8	21.6	146.5	0.280	Empty	M	II	0.46
51.2	47.0	52.1	0.641	¼full	M	II	0.51
38.8	42.5	224.5	0.492	¼full	M	II	0.29
15.4	12.8	83.5	0.085	¼full	M	I	3.98
55.4	50.3	748.7	0.653	½full	M	II	0.59
54.3	50.0	633.0	0.654	¼full	M	II	0.50
57.3	53.4	857.4	0.723	full	M	II	0.56
59.6	54.6	1153.0	0.748	Empty	M	II	0.71
40.3	30.1	314.0	0.500	½full	F	II	1.15
48.5	43.6	528.0	0. 66	Empty	F	II	0.64
14.4	11.8	82.7	0.082	Empty	F	II	4.99
16.0	13.3	88.1	0.091	Empty	F	I	4.01
64.6	50.7	1246.3	0.780	¾full	F	II	0.96
68.1	58.7	1412.3	0.820	½full	F	II	0.72
15.0	12.8	86.4	0. 09	Empty	F	I	4.10

Appendix 1. Contd.

	36.8	28.6	212.0	0.460	Empty	F	II	0.65
	48.0	43.4	528.2	0.632	Empty	F	II	0.65
	37.8	28.9	221.0	0. 47	½full	F	II	0.92
	56.0	52.0	648.0	0.680	¾full	F	II	0.46
	51.1	47.0	530.0	0. 64	Empty	F	II	0.51
	64.5	50.6	1252.0	0.770	Empty	F	II	0.97
	14.0	11.8	83.0	0.087	¼full	F	I	4.05
	53.0	49.0	636.0	0.653	Empty	F	II	0.54
	58.0	53.6	950.0	0.684	½full	F	II	0.62
	59.0	54.4	1134.0	0.736	Empty	F	II	0.70
JANUARY, 87	60.0	48.3	116.9	0.840	¼full	M	II	1.04
	29.5	24.3	14. 6	0.320	½full	M	II	1.02
	37.8	28.9	217.3	0.440	Empty	M	II	0.90
	37.7	28.8	214.2	0.430	½full	M	II	0.90
	14.0	12.0	79.2	0.210	¼full	M	I	0.460
	54.6	50.2	622.0	0.660	¼full	M	II	0.46
	27.8	31.6	143.8	0.310	¾full	M	II	0.49
		43.4	523.0	0.629	Empty	M	II	0.64

Appendix 1. Contd.

46.5	40.6	426.0	0.590	½full	M	II	0.64
39.2	34.1	242.0	0.342	¼full	M	II	0.61
15.6	12.8	89 .1	0.160	Empty	M	I	4.25
23.1	19.9	126	0.100	Empty	M	II	1.60
32.4	25.5	151	0.310	¼full	M	II	0.42
55.2	50.6	749	0.620	Empty	M	II	0.58
58.0	53.6	944	0.640	½full	M	II	0.55
52.3	49.2	627.6	0.680	½full	M	II	0.53
59.0	54.3	1136	0.685	¼full	M	II	0.01
55.0	50.3	732	0.614	¼full	M	II	0.58
32.4	25.6	150	0.400	Empty	M	II	0.41
51.2	48.0	526	0.582	Empty	M	II	0.16
23.0	19.8	124	0.110	¾full	M	I	1.60
66.	52.6	1356	0.760	Empty	M	II	0.93
29.5	24.4	148.0	1. 10	Empty	F	II	1.02
14.2	11.8	81.0	0. 26	Empty	F	I	0.49
27.7	32.0	145.0	0. 36	½full	F	II	0.44
48.0	43.5	525.0	0. 71	Empty	F	II	0.64

Appendix 1. Contd.

	46.4	40.5	429.0	0.618	Empty	F	II	0.65
	39.0	33.6	240.0	0. 34	¼full	F	II	0.63
	36.8	28.6	210.0	0. 33	Empty	F	II	0.89
	36.6	29.0	216.0	0. 32	¼full	F	II	0.26
	15.2	12.6	86 .2	0.186	¼full	F	I	4.31
	53.1	48.8	694.2	0.710	Empty	F	II	0.60
	54.8	50.4	702.1	0.690	¾full	F	II	0.55
	54.6	50.2	640	0.680	Empty	F	II	0.51
	32.3	25.5	154	0.460	Empty	F	II	0.93
	48.5	43.6	520.1	0.680	Empty	F	II	0.63
	36.5	28.5	216.6	0.500	½full	F	II	0.94
	60.	48.3	1180	0.810	¼full	F	II	1.05
FEBRUARY	66.0	52.6	1353	0.782	Empty	M	II	0.93
	60.2	48.3	1178	0.620	Empty	M	II	1.05
	36.5	28.5	213.2	0. 34	Empty	M	II	0.92
	51.2	48.0	523	0. 46	¼full	M	II	0.47
	32.3	25.6	148.5	0.210	Empty	M	II	0.89
	60.0	48.3	1165	0.710	½full	M	II	1.03

Appendix 1. Contd.

29.5	24.3	144.5	0.120	Empty	M	I	1.01
29.5	24.4	148	0.180	½full	M	II	1.02
54.6	50.2	619	0.710	full	M	II	0.49
39.0	33.6	238	0.280	Empty	M	II	0.63
48.0	43.5	223.1	0.613	Empty	M	II	0.27
29.5	24.3	144.1	0.340	¾full	M	II	1.01
32.4	25.6	148.3	0.330	½full	M	II	0.40
54.6	50.2	638.1	0.580	Empty	M	II	0.51
58.0	53.6	747.0	0.650	½full	M	II	0.49
23.0	19.8	122.0	0.090	Empty	M	II	1.57
52.3	49.3	625.2	0.590	Empty	M	II	0.52
60.3	48.3	1177	0. 72	¾full	M	II	1.04
53.6	48.8	691.2	0.580	Empty	M	II	0.60
55.2	50.6	747	0. 59	Empty	M	II	0.58
58.0	53.6	942	0.610	¾full	M	II	0.61
54.6	50.2	638.0	0.550	½full	M	II	0.50
55.0	50.3	730.1	0.560	½full	M	II	0.57
32.4	25.6	150.2	0.260	Empty	M	II	0.90

Appendix 1. Contd.

36.8	28.6	208.2	0.310	Empty	M	II	0.89
39.0	33.6	238.1	0.340	full	M	II	0.63
46.5	40.6	424.1	0.390	Empty	M	II	0.63
27.5	31.8	143.0	0.370	½full	F	II	0.44
23.1	19.8	122.0	0.160	¾full	F	II	1.57
48.5	43.6	519.5	0.690	¾full	F	II	0.63
32.4	25.5	152	0.430	Empty	F	II	0.42
37.8	28.9	215.2	0.460	Empty	F	II	0.89
37.7	28.8	212.2	0.490	Empty	F	II	0.89
27.8	32.1	143.0	0.380	full	F	II	0.43
27.7	32.2	143.2	0.366	Empty	F	II	0.43
36.8	28.6	209.2	0.530	Empty	F	II	1.25
23.0	19.8	122.1	0.300	¾full	F	II	1.57
54.8	50.4	700.0	0.830	Empty	F	II	0.56
52.3	49.2	625.2	0.760	Empty	F	II	0.52
59.0	54.3	1133.0	0.840	Empty	F	II	0.13
48.5	43.6	519.1	0.660	full	F	II	0.63
48.1	43.3	520.2	0.630	Empty	F	II	0.64

Appendix 1. Contd.

MARCH, 87	23.4	19.8	122.3	0.182	Empty	M	I	1.64
	32.4	25.6	147.2	0.320	½full	M	II	0.40
	36.8	28.6	208.0	0.360	¼full	M	II	0.27
	48.6	43.5	222.5	0.620	¼full	M	II	0.02
	54.6	50.2	637.0	0.660	Empty	M	II	0.01
	52.3	49.2	623.2	0.650	Empty	M	II	0.02
	55.8	50.4	700.0	0.620	½full	M	II	0.55
	48.3	43.4	520.0	0.600	Empty	M	II	0.03
	27.5	31.8	142.1	0.186	¼full	M	I	0.44
	60.2	48.3	1164.0	0.890	Empty	M	II	0.03
	58.0	53.4	698.0	0.68	½full	M	II	0.46
	32.6	25.6	151.0	0.340	¼full	M	II	0.41
	65.9	52.3	1352	0.800	½full	M	II	0.02
	39.0	33.4	236.4	0.310	Empty	M	II	0.63
	58.0	53.6	745.0	0.640	Empty	M	II	0.48
	60.4	48.4	1175	0.830	Empty	M	II	1.04
	54.7	50.2	637.2	0.800	¼full	M	II	0.50
	54.6	50.2	637.0	0.550	Empty	M	II	0.50

Appendix 1. Contd.

48.0	43.6	223.0	0.480	½full	M	II	0.14
27.6	31.8	140.6	0.180	¼full	M	II	0.44
46.5	41.0	423.0	0.440	Empty	M	II	0.61
38.0	29.7	211	0.310	Empty	M	II	0.81
48.0	43.5	520.3	0.470	¾full	M	II	0.63
32.6	26.0	152.0	0.380	¼full	M	II	0.86
23.6	19.8	121.0	0.380	Empty	F	II	1.63
36.8	28.5	207.0	0.470	Empty	F	II	0.28
52.3	48.9	622.0	0.840	½full	F	II	0.02
46.5	40.6	423.0	0.740	Empty	F	II	0.05
29.5	24.4	148.0	0.480	Empty	F	II	1.02
37.6	28.4	212.0	0.490	¼full	F	II	0.29
46.6	40.4	422	0.76	¾full	F	II	0.64
36.8	28.6	212.1	0.49	Empty	F	II	0,28
27.0	31.7	142.2	0.640	Empty	F	II	0.09
48.0	43.6	221.1	0.690	½full	F	II	0.27
54.6	50.2	634.1	0.880	¼full	F	II	0.50
23.4	19.8	121.4	0.392	Empty	F	II	1.63

Appendix 1. Contd.

	61.3	49.3	1181	1. 63	¼full	F	II	0.99
	40.0	35.0	240.3	0.665	Empty	F	II	0.56
APRIL	39.0	33.4	239.5	0.920	½full	M	II	0.64
	36.7	28.6	216.6	0.960	Empty	M	II	0.93
	66.3	53.1	1358.0	1. 44	Empty	M	II	0.91
	58.0	53.6	748	1. 28	½full	M	II	0.49
	48.2	43.6	226.2	1. 23	Empty	M	II	0.27
	46.4	40.4	428	1. 06	½full	M	II	0.65
	29.6	24.5	153	0.380	Empty	M	I	0.55
	28.0	31.8	144.6	0.370	¾full	M	I	0.45
	54.7	50.2	639.6	1. 26	Empty	M	II	0.51
	59.0	48.4	1177	1. 43	¾full	M	II	1.04
	29.6	24.5	149.5	0.200	½full	M	I	1.02
	58.2	54.0	942.0	1. 37	½full	M	II	0.60
	52.3	49.2	626.0	1. 28	Empty	M	II	0.53
	32.4	25.6	151.2	0.930	Empty	M	II	0.90
	32.3	25.5	151.0	0.890	½full	M	II	0.91

Appendix 1. Contd.

53.1	48.8	632.4	3.01	¼full	F	II	0.28
55.2	50.4	704.2	2.86	Empty	F	II	1.82
48.5	43.6	519.3	2.84	½full	F	II	0.63
64.8	52.6	1356.0	3.52	Empty	F	II	0.93
60.2	48.3	1161.0	3.32	Empty	F	II	1.05
46.8	40.4	424.0	2.66	Empty	F	II	1.56
54.6	50.0	634.2	2.87	Empty	F	II	0.51
53.0	48.9	633.0	2.61	Empty	F	II	0.54
25.0	24.1	139.6	2.07	Empty	F	II	1.00
58.6	54.6	944.6	1.68	full	M	III	0.58
53.3	49.4	628.0	1.93	¼full	M	III	0.52
34.6	25.6	153.1	1.74	½full	M	III	0.91
34.2	25.6	152.8	1.62	Empty	M	III	0.91
52.4	48.2	529.0	1.86	½full	M	III	0.47
36.6	28.5	217.8	1.78	½full	M	III	0.94
47.4	40.4	431	1.94	¼full	M	III	1.06
29.6	24.5	156.5	0.63	Empty	M	II	0.92

MAY,

Appendix 1. Contd.

32.6	25.6	155.1	1.82	¼full	M	III	1.06
63.3	53.4	1362.2	2.38	¼full	M	III	0.92
46.6	40.4	426.6	1.64	full	M	III	0.65
29.6	24.5	151.1	1.26	¼full	M	II	1.03
59.0	48.4	1181.2	1.93	¼full	M	III	1.04
54.7	50.2	642.6	2.12	Empty	M	III	0.51
28.0	31.8	146.8	1.10	Empty	M	II	0.46
29.5	24.6	155.1	1.10	½full	M	III	1.04
46.4	40.4	431.1	1.52	½full	M	III	0.65
48.2	43.6	229.3	1.90	¾full	M	III	0.28
58.0	53.6	751.4	2.04	½full	M	III	0.49
66.3	53.2	1361.4	2.49	¾full	M	III	0.90
36.7	28.6	218.4	1.81	¼full	M	III	0.93
46.4	40.4	432.0	1.13	¾full	M	III	0.66
52.3	49.2	639.0	1.28	½full	M	III	0.54
55.2	50.4	707.1	1.39	½full	M	III	0.55
28.0	31.5	156.0	1.07	¾full	M	II	0.50
36.7	28.6	218.0	1.48	¾full	M	III	0.93

Appendix 1. Contd.

53.4	48.8	635.0	6.12	¼full	F	III	0.55
56.2	50.6	706.4	5.63	½full	F	III	0.55
48.8	43.8	521.3	5.25	full	F	III	0.62
66.7	52.6	1360.0	6.45	½full	F	III	0.93
60.5	48.3	1185.0	6.33	½full	F	III	0.65
54.6	50.0	637.0	5.81	¼full	F	III	0.51
29.6	24.6	151.0	4.44	½full	F	II	1.01
54.6	50.0	638.1	6.00	full	F	III	0.51
46.6	40.4	427.8	5.68	½full	F	III	0.65
37.6	28.4	216.3	4.96	½full	F	III	0.94
29.6	24.4	153.2	4.59	¼full	F	III	1.06
36.8	28.5	214.1	4.27	Empty	F	III	0.92
23.2	19.8	123.8	2.17	½full	F	III	1.59
32.4	33.4	239.5	3.87	full	F	III	0.12
39.2	33.4	240.6	3.14	½full	F	III	0.12
29.4	24.5	430	2.61	½full	F	III	2.92
36.8	28.5	213.8	4.03	Empty	F	III	0.92

Appendix 1. Contd.

	JUNE 86	36.6	28.2	226.6	1.69	¾full	M	II	1.01
		48.7	44.6	552.3	1.96	½full	M	III	0.62
		29.4	24.0	156.8	1.21	¼full	M	II	1.13
		51.2	47.0	560.0	3.29	½full	M	IV	0.54
		42.2	34.3	498.0	2.68	Empty	M	IV	1.29
		64.4	51.0	1500.0	3.32	½full	M	IV	1.13
		26.2	22.1	149.4	1.28	¾full	M	II	1.38
		33.0	26.0	180.0	2.61	¼full	M	III	1.02
		28.4	24.0	159.4	1.52	½full	M	II	1.15
		32.0	24.6	170.2	1.62	½full	M	II	1.14
		50.2	38.8	566.4	3.20	¼full	M	IV	0.91
		52.0	47	556.0	3.36	½full	M	IV	0.54
		68.0	56.0	1418.0	3.68	¼full	M	IV	0.81
		24.6	20.4	150.8	0.69	full	M	I	1.18
		49.0	44.0	550.4	2.84	¾full	M	III	0.65
		41.0	30.0	344.2	2.21	¾full	M	II	1.27
		48.1	43.5	543.4	2.60	¾full	M	III	0.66
		37.5	29.0	318.6	2.14	full	M	II	1.31

Appendix 1. Contd.

36.5	28.5	230.4	2 .06	full	M	II	1.00
35.6	25.7	224.6	1 .03	½full	M	I	1.32
30.6	25.0	132.3	0 .94	full	M	I	0.85
32.0	25.6	118.8	1 .01	full	M	I	0.71
58.2	54.0	954.8	3 .01	¼full	M	IV	0.61
46.6	40.4	444.6	2 .47	½full	M	III	0.67
59.0	48.2	1198.2	3.22	½full	M	IV	1.07
46.4	40.4	460.0	2 .84	¼full	M	IV	0.70
28.0	31.5	164.4	1 .10	full	M	I	0.53
41.5	36.0	483.4	2 .81	Empty	M	III	1.04
48.6	44.6	559.4	9 .32	¾full	F	IV	0.63
32.5	24.6	190.1	7 .82	¾full	F	III	0.68
51.4	47.0	569.0	9 .64	Empty	F	IV	0.55
58.2	55.0	970.0	9 .96	Empty	F	IV	0.58
26.5	22.5	160.0	7 .41	¾full	F	III	1.40
65.0	51.0	1360.0	10.84	Empty	F	IV	1.03
67.0	54.0	1430.0	10.92	½full	F	IV	0.91
68.0	55.0	1446.0	11.48	½full	F	IV	0.87

Appendix 1. Contd.

	24. 2	20. 3	148. 4	0.94	full	F	I	1.77
	51. 0	47. 0	560. 2	9.28	½full	F	IV	0.54
	48. 6	43. 8	569. 6	9.05	¾full	F	III	0.68
	36. 6	28. 5	250. 2	7.24	½full	F	III	1.08
	31. 0	25. 3	142. 3	7.37	¾full	F	III	0.88
	60. 0	48. 4	1212. 0	11.19	¼full	F	IV	0.11
	55. 2	50. 4	726. 4	8.82	¼full	F	IV	0.57
	66. 3	53. 2	1394. 3	11.36	¼full	F	IV	0.93
	29. 6	24. 6	176. 2	3.06	¾full	F	II	1.18
	37. 6	28. 4	236. 0	7.30	½full	F	IV	1.03
JULY, 87.	18.85	16.40	98.20	0.88	full	M	I	2.23
	29.20	24.00	152. 0	0.91	¾full	M	I	1.10
	14.70	12.30	85 . 2	0.42	¼full	M	I	4.58
	30.90	25.20	120. 6	1.04	Empty	M	II	0.75
	45.80	40.40	524. 2	2.12	¾full	M	V	0.80
	47.40	43.70	528.80	2.22	½full	M	V	0.63
	48.40	43.90	538. 2	2.36	¾full	M	V	0.64

Appendix 1. Contd.

35.8	28. 0	218.7	0.94	½full	M	II	1.00
41.3	33. 0	386.8	3.62	Empty	F	VI	1.08
18.0	16.30	102.3	0.91	full	F	I	2.36
42.6	37. 4	455.1	26. 3	¾full	F	V	0.85
24.2	21. 1	158.0	6.48	½full	F	IV	1.68
32.1	26. 2	158.3	2.36	¼full	F	II	0.88
43.6	37. 8	472.3	24. 5	½full	F	V	0.87
43.9	38. 0	469.8	27. 4	¾full	F	V	0.86
43.4	37. 3	446.1	3. 2	½full	F	VI	0.86
51.3	46. 7	533.4	3. 1	½full	F	VI	0.52
40.1	30. 3	320.0	2.32	Empty	F	VI	1.15
24.2	20. 6	145.0	3.20	½full	F	III	1.66
42.6	37. 4	455.1	26. 3	¾full	F	V	0.85
18.0	16.30	102.3	0.91	full	F	I	2.36
41.3	33. 0	3868	3.62	Empty	F	VI	1.08
41.0	32. 0	405.8	24. 4	¾full	F	V	1.24
38.9	33. 6	398.9	9.34	full	F	IV	1.05
26.6	23. 5	178.8	7.62	¾full	F	IV	1.38

Appendix 1. Contd.

32.4	24. 7	196.5	8.63	¾full	F	III	1.30
69.2	57. 4	1716.3	35. 8	¼full	F	V	0.91
64.8	51. 6	1361.2	31. 2	¼full	F	V	1.00
59.8	47. 6	1221.2	26..2	¼full	F	V	1.13
36.5	28. 4	226.8	8.31	Empty	F	V	0.99
52.3	48. 0	540.1	10.34	½full	F	V	0.49
98.5	43. 7	536.3	8.45	¼full	F	V	0.81
14.60	12.40	84.6	0.78	¾full	F	V	4.44

APPENDIX 2. MONTHLY PERCENTAGE BY POINTS COMPOSITION OF DIETARY ITEMS

	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APRIL.	MAY	JUNE.	JULY
Tadpoles	-	4.41	4.13	3.77	6.15	5.88	3.14	4.12	0.88	1.32	-	2.86
Scales	1.51	1.67	1.59	0.87	2.56	2.35	2.75	2.94	3.52	3.96	3.83	4.19
Digested food	2.37	3.82	2.22	6.38	2.56	7.65	1.57	2.94	1.10	1.10	0.42	4.00
Adult Insects	10.54	6.18	19.05	12.17	1.03	12.94	2.35	3.53	3.74	4.18	10.54	6.18
Algae	3.23	2.35	6.98	1.45	1.85	6.47	4. 8	0.59	0.88	0.88	2.29	2.86
Insect parts	0.86	-	1.27	-	-	2.35	0.39	1.18	-	-	1.04	7.62
Plant remains	8.39	5.29	1.90	8.12	4.62	8.24	7.84	4.71	10.33	9.89	9.17	8.76
Eathworm	0.43	2.06	3.81	3.77	5.13	3.53	2.75	2.94	1.10	1.10	0.63	0.76
Prawn	2.58	1.76	2.22	2.03	3.59	2. 9	2.75	2.94	3.10	3.08	2.92	2.10
Ephemeroptera nymph	0.65	059	2.03	0.58	2.05	2.35	1.96	0.59	1.76	1.76	1.67	1.33
Chaoborus larvae/pupae	1.42	0.29	1.52	1.45	0.41	6.47	3.14	2.35	1.85	1.85	1.88	2.29
Trichoptera nymph	0.22	0.88	0.63	0.87	0.51	0.59	0.78	-	-	-	-	0.76
Dragonfly nymph	0.43	1.17	2.22	0.87	0.51	0.59	2.75	2.35	0.85	0.77	1.25	0.57

Appendix 2. Contd.

Damselfly nymph	0.22	0.88	1.59	0.87	0.51	-	-	-	00.43	-	-	-
Fish eggs	1.51	0.29	0.63	0.87	2.05	2.35	1.18	6.24	5.11	7.03	6.25	3.62
Fish parts	-	2.06	1.90	1.16	1.03	1.18	0.39	2.94	4.26	13.19	9.58	10.67
Alestes Sp.	16.13	12.35	13.97	11.01	15.38	10.59	13.73	17.06	16.77	10.11	11.46	3.05
Tilapia SP.	10.54	22.06	9.84	9.28	10.26	6.47	9.80	11.18	11.49	2.64	11.25	11.05
Synodontis Sp.	24.09	15.29	10.79	18.84	18.97	5.88	19.22	10.59	11.91	21.10	13.13	11.81
Shells	0.43	3.23	1.90	2.32	1.03	0.59	4.71	1.76	0.43	-	-	0.57
Shrimp	-	-	-	-	-	1.18	-	-	-	0.22	-	-
Mud/Sand	3.44	3.51	2.22	5.51	4.62	0.59	3.92	2.35	1.70	3.52	3.75	3.62
Seeds	5.81	6.58	0.60	2.03	2.05	2.35	4.70	3.53	0.85	4.18	1.67	8.38
Hemiptera lavae	-	0.59	-	-	-	-	-	-	-	-	-	-

APPENDIX 3.

VARIATION IN DIETARY ITEMS SELECTED BY DIFFERENT LENGTH GROUPS

Standard Length	30 cm	Standard Length	30 cm
Insects	68.3%	12.1%	
Fish	8.5%	90.3%	
Crustacea	28.6%	32.3%	
Annelida	6.4%	18.1%	
Mollusca	6.2%	12.8%	
Bottom Deposits	23.7%	46.4%	
Plant materials	56.3%	14.6%	

APPENDIX 4.

MONTH	CONDITION FACTOR		MEAN BODY WEIGHT		MEAN GONAD WEIGHT	
	MEAN					
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
AUG.	1.45	1.37	305	514	1.45	3.00
SEPT.	0.95	0.95	313	321	1.10	2.63
OCT.	0.78	1.06	333	263	0.83	1.45
NOV.	1.27	1.46	574	535	0.52	0.46
DEC.	1.00	1.58	568	585	0.54	0.52
JAN.	0.86	0.93	477	387	0.47	0.55
FEB.	0.72	0.73	531	365	0.46	0.53
MAR.	0.48	0.59	526	325	0.53	0.68
APRIL	0.75	0.99	437	492	0.99	2.68
MAY	0.75	0.86	484	476	1.65	4.79
JUNE	0.99	0.86	465	604	2.23	8.50
JULY	1.21	1.25	326	478	2.01	12.48

APPENDIX 6

CHI-SQUARE TEST

The chi-square test of significance was computed on the basis of Ho hypothesis. Under the hypothesis the computed value of X^2 given by the formula is > than some critical value (eg. as $x^2 0.95$ or $x^2 0.99$), the observed frequency then differ significantly from ex expected frequencies and would reject Ho at corresponding level of significance.

The chi-square formula is

$$X^2 = \frac{(0j - ej)2}{ej}$$

where x^2 = chi - square

= Summation of values

0j = observed values

ej = expected values.

The critical value of $X^2(0.95)$ for K - 1 = 12 - 1 = 11 degrees of freedom is 19.7. If x^2 > 19.7 the observed distribution differs significantly at 0.05 level of significance.