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CARIDINA SPP. (CRUSTACEA: DECAPODA: ATYIDAE) AS SUITABLE FOOD ORGANISMS FOR THE FRY AND FINGERLINGS OF FOOD FISH AND ORNAMENTAL FISH

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ABSTRACT

Caridina spp., which are common tropical freshwater shrimps growing to about 30 mm, were found to be suitable for feeding fry and fingerlings of several food fish species, as well as two ornamental fish species. These shrimps are also suitable, in wet or dry form, as a cheap, high protein ingredient in supplementary feeds in fish culture. They can easily be collected from the wild or can be cultured easily in high density in small ponds. Fry of Channa striatus, Oreochromis mossambicus and Tor khudree were tested on shrimp larvae and plankton. Fry of C. striatus grew better on shrimp larvae, whereas those of O. mossambicus grew better on plankton. Fry of T. khudree grew equally well on both diets. Fingerlings of Cyprinus carpio, O. mossambicus and T. khudree were tested on shrimps and a formulated ration containing 45% protein. The growth rate of O. mossambicus fingerlings was better on the formulated ration whereas those of the fingerlings of the other two species were similar on both diets. Fingerlings of C. striatus were tested on shrimps, aquatic oligochaetes and trash fish. Their growth rate was highest on shrimps and lowest on trash fish. Ornamental fish species, Belontia signata and Etroplus maculatus lived equally well on shrimps, mosquito larvae and aquatic

oligochaetes. Feed conversion ratios of 6.04, 6.36, 6.98 and 7.48 were obtained for Caridina spp. when they were fed to the fingerlings of C. striatus, T. khudree, C. carpio and O. mossambicus respectively.

INTRODUCTION

A critical stage in fish farming is the rearing of fry and fingerlings. Fry and fingerlings of most cultivable species such as carps and tilapias, and those of carnivorous species such as eels and snakeheads feed on zooplankton and other small animals, especially small crustacea.

Atyid shrimps are usually small, mainly freshwater animals feeding on detritus and decaying organic matter. Among atyids, Caridina spp. are widely distributed in the tropics from East Africa to Far East (Bouvier, 1925). They are common in the littoral zones of most freshwater bodies, both standing and flowing. They grow to about 30 mm in a probable life-span of one year, and produce several broods within this period (Hart, 1980; K.H.G.M. de Silva and P.K. de Silva, unpublished data). The egg usually hatches as a planktonic zoea larva, which metamorphoses into a benthic post-zoea and later develops into a juvenile. Thus, the stages of life cycle of Caridina spp. appear to provide food organisms of suitable size for fry and fingerlings in fish farming. They can easily be collected in large numbers from the littoral region of water bodies, especially lakes, irrigation reservoirs and lagoons, in which they are found among the vegetation and debris. They can also be cultured easily in high density on decaying leaves of many plants. Such cultures require minimum care and cost very little.

The potential of atyid shrimps, especially that of Caridina spp. for feeding fry and fingerlings and ornamental fish has not hitherto been studied. The present work investigates this possibility.

MATERIALS AND METHODS

Nine species of Caridina occur in Sri Lanka. These species were collected and reared in small tanks in pond water in the laboratory. Breeding and larval development as well as the ranges of tolerance to various ecological factors were studied in each species. On the basis of these studies, C.

fernandoi and C. nilotica (=C. simoni) were selected as most suitable for experimentation with fish species.

Species that have a coastal distribution such as C. gracilirostris, C. propinqua, C. typus and C. zeylanica showed a requirement of brackish water for larval development, and therefore, are not suitable for pure freshwater culture. The species that are found at higher elevations only such as C. singhalensis and C. pristis are also not suitable because of their limited distribution and relatively low upper limit of temperature tolerance. C. costai also appears to have a restricted distribution. On the other hand, C. fernandoi and C. nilotica are widely distributed from sea level to an elevation of about 700 m and have a wider temperature tolerance and a freshwater larval development.

Four species of food fishes and two species of indigenous ornamental fishes were selected for the study. Fry and fingerlings of the striped snakehead (Channa striatus), tilapia (Oreochromis mossambicus), and mahsier (Tor khudree) were collected from the wild; those of the common carp (Cyprinus carpio) were obtained from the Inland Fisheries Research Station at Ginigathhena. The ornamental fishes comb-tail (Belontia signata) and orange chromide (Etroplus maculatus) were collected from the wild.

Individuals of each species used for different treatments in each experiment were selected from the same brood, except for those of B. signata and E. maculatus. Each of the latter species was collected from a single location on a single day.

The fry were acclimated to laboratory conditions for four days prior to experimentation. The fingerlings of C. striatus and O. mossambicus were reared in the laboratory from the fry stage, while those of C. carpio and T. khudree were kept under laboratory conditions for one week prior to experimentation. B. signata and E. maculatus were kept in the laboratory for two weeks prior to experimentation.

Fish were weighed individually at the beginning and at regular intervals during experimentation to the nearest milligram after a starvation period of 12 hours and after removing as much excess water as possible with blotting paper. Individuals of B. signata and E. maculatus and fingerlings of C. carpio, C. striatus, O. mossambicus and T. khudree were anaesthetized in a solution of 1:20,000 benzocaine (BDH Ltd.

England) (50 mg dm^{-3}) prior to weighing to facilitate handling. The initial weight difference between the heaviest and lightest individuals of any species used in any treatment was less than 0.5 times the initial weight of the lightest individual.

Experiment 1. Fry Culture.

Three species of fish, namely, *C. striatus*, *O. mossambicus* and *T. khudree* were used. Six groups of five fry each in the size range 15-20 mm were selected from each species. Each group was kept in 10 dm^3 of water in a glass trough, 35 cm diameter and 15 cm height. The three replicates of the control contained pond water with an initial zooplankton density of 1.2 ml in 100 dm^3 of water. This was the highest plankton density observed in plankton cultures fertilized with cattle manure. Those of the test contained pond water filtered through a phytoplankton net. 150 ovigerous *Caridina fernandoi* in an advanced stage of egg development (eggs containing larvae with clearly visible eyes) were placed in each test tank and were provided with decaying leaves of *Ficus religiosa* as food. This number was chosen arbitrarily so that even if a third of the gravid shrimps hatch their eggs per day it would provide about 50 x 300 larvae (or 3,000 larvae per fish per day) as the fecundity of *C. fernandoi* is about 300 (Table 4). The same amount of decaying leaves was kept in the controls as well. The pond water in the controls was renewed twice weekly and the plankton density was brought to the original level. The test tanks were examined daily and the shrimps that had their eggs hatched were replaced by an equal number of suitable ovigerous ones. The exuviae of the moulted shrimps were also removed. Water was removed twice weekly through a zooplankton net to retain any larval stages present, the tanks were filled with filtered pond water and the correct number of shrimps was introduced. Fry were weighed weekly and the experiment was terminated after four weeks.

Experiment 2. Fingerling Culture.

Ten fingerlings each of *C. carpio*, *O. mossambicus* and *T. khudree* of 45-55 mm standard length and 15 fingerlings of *C. striatus* of 50-60 mm standard length were kept individually in plastic containers (21 cm and 27 cm top and bottom diameters and 26 cm height), each in 10 dm^3 of water. A continuous flow of water was maintained at a rate of about 5 dm^3 per hour through each tank. Fingerlings of *C. striatus* were assigned into 3 groups of 5 each. Each individual of the first group was initially offered 50 weighed Caridina fernandoi of the 10-15mm size class (roughly equivalent to the initial body weight of the fingerling) and this number was increased to 100 in the second month. The number consumed was replaced daily with weighed fresh ones. Individuals of the other two groups were given trash fish and aquatic oligochaetes respectively at a rate of 50% body weight once daily in the evening and the unconsumed feed were removed in the morning. The fingerlings of each of the other three species were assigned to two groups of five each and each group was given either shrimps (as described for snakehead fingerlings) or a pelleted formulated ration (45% fish meal, 20% soybean meal, 20% rice bran, 15% coconut cake, 0.1% vitamin premix) containing about 45% protein at a rate of about 10% body weight twice daily. Weights of fingerlings and unconsumed shrimps were measured fortnightly for eight weeks.

Experiment 3. Ornamental Fish Culture

Eighteen specimens each of B. signata of 45-50 mm standard length, and E. maculatus of 40-45 mm standard length were kept in plastic containers (those described in fingerling culture), two per container, in 10 dm^3 of pond water. Specimens of each species were assigned to three equal groups and each group was given either mosquito larvae, aquatic oligochaetes, or shrimps (C. nilotica) once daily at a rate of about 10% body weight for four weeks. Individuals were weighed and water renewed at weekly intervals. The fish in each container were identified by a notch on either the left or right ventral fin.

RESULTS

The temperature, pH, dissolved oxygen concentration and electrical conductivity in water in the experimental tanks varied during the experimental period between 24° and 26°C, 7.2 and 7.8, 82% saturation and 112% saturation, and 55 and 90 $\mu S\ cm^{-1}$ at 25°C, respectively. These parameters were measured every day between 0730 and 0830 hrs.

The growth rates of fish in different replicates of any treatment did not show significant difference ($P < 0.05$), and therefore, the results from the replicates were pooled together for analysis.

Fry of the snakehead (C. striatus) appeared to grow better on shrimp larvae than on plankton, whereas those of the tilapia (O. mossambicus) appeared to grow better on plankton than on shrimp larvae(Fig. 1). Comparison of the means (Table 1) by Student's t-test also indicated significant difference ($P < 0.05$) between growth rates on plankton and on shrimp larvae for both fish species. On the other hand, growth rates of fry of mahsier (T. khudree) appear to be rather similar on plankton and on shrimp larvae (Fig. 1). The difference in the growth rates (Table 1), in fact was found to be not significant at 5% level.

The plankton in the tanks contained copepods (especially cyclopoids), cladocerans and nauplius larvae, in that order of abundance. The relative abundance of the three groups varied but adult copepods always dominated and the naupli were always least abundant.

At the end of the experimental period, the tanks contained only a few shrimp larvae indicating that most of them were consumed by the fish fry.

Growth of the fingerlings of C. carpio, T. khudree, O. mossambicus and C. striatus during the two month period is shown in Fig. 2. In both months, the growth rate of O. mossambicus fingerlings (Table 2) was significantly higher ($P > 0.05$) on the standard ration than on shrimp larvae. The growth of the fingerlings of C. carpio appears to be better on the formulated ration on both months (Table 2). However, comparison of the means by Student's t-test indicated that although the difference in the growth rates was significant at 5% level in the first month, the difference was not significant at this level in the second month. The growth of the fingerlings of T. khudree appeared to be better on the formulated ration than on the shrimps (Fig. 2), but comparison of the means showed no significant difference at 5% level in either month.

Fingerlings of C. striatus grew best on the shrimps (Fig. 2). The growth rate on the shrimps (Table 2) was significantly higher than that on the aquatic oligochaetes in both months ($P > 0.05$). The growth rate on the aquatic oligochaetes, on the other hand, was significantly higher ($P > 0.05$) than that on trash fish. The growth on trash fish was especially low in the first month, although this increased somewhat in the second month (Table 2).

Growth rates of B. signata and E. maculatus were very low on all three treatments (Fig. 3, Table 3). No significant difference was observed ($P < 0.05$) between the growth rates in the three treatments in either species (Table 3).

Feed conversion ratio (FCR, which is the ratio of feed consumed, by weight, to the weight gained) was calculated for individual fingerlings and the mean for each fish species was obtained. FCR of shrimps was found to be 6.04 ± 0.122, 6.36 ± 0.131, 6.98 ± 0.171 and 7.48 ± 0.137 for the fingerlings of C. striatus, T. khudree, C. carpio and O mossambicus , respectively. These values were found to be significantly different from each other at 5% level.

DISCUSSION

Data on the embryonic and larval development, fecundity, etc. of Caridina fernandoi and C. nilotica (Table 4) indicate that the shrimps can breed at a high rate. They can easily be cultured at high density in small tanks and pools. Well oxygenated clear water is more suitable for such cultures. Shrimps can also be collected abundantly from suitable freshwater bodies. Hart (1981) showed that in the littoral region of Lake Sibaya, South Africa, C. nilotica can be as abundant as 10,000 individuals per square metre (20 g m^{-2} dry weight) and that the mean production is 24 g m^{-2} $year^{-1}$ dry weight (which works out to be 1,200 kg ha^{-1} $year^{-1}$ wet weight, assuming wet weight to be five times the dry weight) at an annual mean standing stock level of 2.7 g m^{-2} dry weight. This is very high for any benthic organism. C. nilotica is very widely distributed from East Africa to Far East. (Sri Lankan species has been considered as C. simoni, a separate species from C. nilotica, by some authors (see for instance, Johnson, 1963). According to this view, C. nilotica is confined to Africa and C. simoni is widely distributed in southern and south-east Asia). Although C. fernandoi is confined to Sri Lanka, other similar species are present in almost all countries in the Indo-West Pacific region.

Although data are not available on the proximate composition of Caridina spp., Bardach, Ryther & McLarney (1972) give a composition of 66% protein, 7% fat and 5% carbohydrate for small shrimps (species unspecified). They also give a composition of 42% protein and 31% carbohydrates for Daphnia, which is the commonly used zooplankton in fry culture in Japan, and 65% protein, 15% fat and 14% carbohydrate for the aquatic oligochaete Tubifex, which is also commonly used in fry and fingerling culture. Thus, if the proximate composition of Caridina spp. is similar to that given for small shrimps, they are a better protein source than Daphnia and compare well with aquatic oligochaetes. Huet (1972) points out that shrimps (although he is not referring to Caridina spp.) are one of the most important feeds in fish and that they give good quality fish.

Fry and fingerlings of the snakehead C. striatus, grew well on shrimp larvae and shrimps respectively. In nature, fry of C. striatus feed on zooplankton and especially on planktonic crustacea (Alikunhi, 1953), while fingerlings feed on aquatic insects, insect larvae, shrimps etc. The optimum protein level for juveniles (30-37 g weight) of C. striatus has been estimated to be about 46% (Wee, 1983). Although the optimum protein level for fry and fingerlings of C. striatus is not known, judging from the data on other species such as the common carp (see later), this level could be expected to be higher than 46%. Thus, shrimps supply a very adequate protein source and the present data on the growth rates indicate that shrimp larvae are a better feed than zooplankton for fry and that shrimps are a better feed than aquatic oligochaetes for fingerlings of C. striatus.

Fingerlings of C. striatus did not grow well on trash fish, contrary to expectations, although the trash fish were given finely chopped. Apparently, trash fish, although quite suitable for on-growing stages is not suitable for fingerlings, at least when they are small. This may be due to difficulty in ingestion or digestion /or both, of fish muscle by the fingerlings.

The optimum protein level for fry and fingerlings of T. khudree is not known, but could be expected to be somewhat similar to that of fry and fingerlings of the common carp, as both species are closely related cyprinids. Similar growth rates of fry on zooplankton and shrimp larvae, and fingerlings on formulated feed and shrimps indicate that shrimp larvae and shrimps (Caridina spp.) can be used for successful culture of fry and fingerlings of the species.

The optimum protein level for the common carp (Cyprinus carpio) has been estimated as 35-38% (Ogino & Saito 1970; Sin, 1973; Jauncey, 1982), and this level for its fingerlings has been estimated as 45% (Sen et al, 1978). A protein level of 43-47% has been recommended by NAC (1977) for fry and fingerlings of C. carpio. The lower growth rate of the fingerlings of C. carpio on shrimps in the first month was probably due to the difficulty for the smaller fingerlings to capture shrimps. This was indicated by the observation that the number of shrimps caught by the fingerlings in the first month was lower than that caught in the second month. Shrimps contain the required level of protein and the similarity of growth rates of the fingerlings on the formulated ration and on shrimps in the second month indicate that shrimps are a suitable feed at least for larger fingerlings of C. carpio.

The growth rates of fry of O. mossambicus on zooplankton reported here are comparable but higher than the growth rates of 0.027-0.030 day^{-1} at 20°C obtained by Gophen (1980) for somewhat larger fry (1.12-1.14 g weight) of another species of tilapia, namely, Sarotherodon galilaeus, fed on zooplankton. S. galilaeus, in any case, is reported to have a slower growth rate and is not favoured for pond culture (Trewavas, 1982). Gophen (1980) showed that the growth rate of fry of S. galilaeus was much lower when zooplankton was dominated by cyclopoid copepods than when it was dominated by cladocerans. He attributes the difference in growth rate to the difficulty in capturing copepods compared to cladocerans. The lower growth rate of O. mossambicus fry on Caridina larvae compared to that on zooplankton, reported here, may also have been due to difficulties experienced by tilapia fry in capturing shrimp larvae. Similarly, lower growth rates of fingerlings on shrimps compared to those on the formulated ration may also have been due to difficulties experienced by tilapia fingerlings in capturing shrimps.

A protein level of 45-50% for the fry of < 1 g and a protein level of 37-42% for the fingerlings of 1-10g have been estimated as the optimum levels in the diet of O. mossambicus (Balarin & Haller, 1982). These requirements are adequately met by the shrimps.

The feed conversion ratio (FCR) of Caridina fernandoi varied from fish species to fish species, but the values obtained (6.04-7.48) compare well with those reported for fresh fish (6-8) and fresh meat (5-8) as well as other unspecified shrimp species (4-6) (Huet, 1972).

In fry culture experiments reported here the possibility of fry obtaining some nourishment from the decaying leaves (supplied as feed for ovigerous shrimps) and other detritus (e.g. faeces of shrimps) present in the tanks cannot be ruled out, especially in the case of tilapia. However, the level of nourishment obtained from such sources must be quite low and relatively unimportant compared to that obtained from the shrimp larvae and would not have caused serious error in the determination of growth rates.

The low rates of growth observed in the ornamental fish species probably indicate that the amount of feed given (10% body weight daily) was inadequate. The feeding rate was deliberately kept low because, in ornamental fish culture, maintenance of healthy fish is more important than obtaining a high growth rate. The results of the experiment demonstrated that the aquatic oligochaetes and mosquito larvae, two commonly used live feed items in ornamental fish culture, can be replaced by Caridina spp., which, unlike some adult mosquitoes, carry no dangerous diseases and are not micropredators on man, and are also much easier to keep in culture in small aquarium tanks than aquatic oligochaetes.

For a small scale farm (less than one hectare pond space), sufficient quantities of fresh atyid shrimps for fry and fingerling culture can be collected from the natural habitat or can be cultured easily in a small pond or in a pen in a nearby freshwater body, such as a lake. Suitable species can even be cultured on a commercial scale in pens in lakes, irrigation reservoirs, and brackish water tolerant species even in lagoons. Dried Caridina spp. can be used as a high protein ingredient in fresh or dry supplementary feeds. Huet (1972) points out that dried shrimp (species unspecified) is an excellent supplementary feed which can be mixed either with fresh feed or with dry feed. The most costly item in fish farming at intensive or semi-intensive scale is the fish feed. Feed cost may range from 40-60% of the total operating cost (Gerhardsen, 1979) depending on the level of feeding, but may go as high as 75% in some instances such as catfish farming (Rabanal & Shang, 1979). Usually, more than 50% of the feed cost is due to expensive fish meal. Therefore, an alternative cheap, high protein source is required in order to cut down the cost of feed. Atyid shrimps such as Caridina spp. appears to be such a source which deserves careful investigation. Further work in this direction may well lead to the exploitation of this cheap source of high protein by the commercial fish farmer.

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TABLE 1

GROWTH RATES OF FRY OF THREE SPECIES OF FISH, WHICH FED FOR ONE MONTH ON PLANKTON OR SHRIMPS LARVAE. THREE REPLICATES, EACH CONTAINING 5 FRY, WERE STUDIED FOR EACH TREATMENT.

Species	Treatment	Initial wt(mg) (mean ± S.E. of 15 fry)	Final wt(mg) (mean ± S.E. of 15 fry)	Monthly Growth Rate (mean ± S.E. of three replicates)
Channa striatus	Plankton	102 ± 4.3	198 ± 8.2	0.92 ± 0.022*
	Shrimp larvae	108 ± 3.3	233 ± 9.4	1.20 ± 0.065*
Oreochromis mossambicus	Plankton	162 ± 7.2	398 ± 14.1	1.55 ± 0.063*
	Shrimp larvae	174 ± 10.3	362 ± 12.3	1.07 ± 0.027*
Tor khudree	Plankton	198 ± 12.0	350 ± 14.3	0.80 ± 0.049
	Shrimp larvae	206 ± 9.3	339 ± 17.4	0.62 ± 0.028

Significantly different (P> 0.05) growth rates of each species are indicated by *.

TABLE 2

GROWTH RATES OF FINGERLINGS OF FOUR SPECIES OF FISH ON DIFFERENT FEEDS. FIVE FINGERLINGS WERE USED AS REPLICATES FOR EACH TREATMENT. MEAN ± S.E. OF EACH VARIABLE OF THE FIVE REPLICATES ARE GIVEN.

Species	Treatment	Initial Wt(g)	Final Wt(g)	Monthly Growth Rate 1st Month	Monthly Growth Rate 2nd Month
Cyprinus carpio	Std. ration	2.113±0.1506	8.981±0.7096	1.09±0.033*	1.03±0.068
	Shrimps	2.294±0.1697	8.121±0.6254	0.82±0.053*	0.95±0.053
Oreochromis mossambicus	Std. ration	2.704±0.1704	15.713±1.2304	1.56±0.030*	1.27±0.042*
	Shrimps	2.817±0.1873	13.098±1.1537	1.22±0.063*	1.10±0.046*
Tor khudree	Std. ration	2.557±0.1841	9.187±0.7671	0.92±0.042	0.87±0.046
	Shrimps	2.481±0.1792	10.231±1.0126	1.08±0.055	0.98±0.057
Channa striatus	Trash fish	2.316±0.0987	4.807±0.5744	0.21±0.020*	0.71±0.067*
	Oligochaetes	2.143±0.0962	8.379±1.2236	1.04±0.048*	0.92±0.014*
	Shrimps	2.250±0.0902	10.285±0.7724	1.24±0.058*	1.04±0.024*

Significantly different ($P > 0.05$) mean growth rates of each species for each month are indicated by *.

TABLE 3

GROWTH RATES OF *Belontia signata* AND *Etroplus maculatus* ON THREE DIFFERENT FEEDS.
THREE REPLICATES, EACH WITH TWO INDIVIDUALS, WERE STUDIED FOR EACH TREATMENT.
DIFFERENCES BETWEEN REPLICATES WERE NOT SIGNIFICANT (P <0.05).
MEAN GROWTH RATES OF DIFFERENT TREATMENTS FOR EACH SPECIES WERE ALSO NOT SIGNIFICANT (P < 0.05).

Species	Treatment	Initial Wt(g) (mean ± S.E. of 6 individuals)	Final Wt(g) (mean ± S.E. of 6 individuals)	Monthly Growth Rate (mean ± S.E.)
Belontia signata	Mosquito larvae	5.373 ± 0.3841	6.629 ± 0.4131	0.17 ± 0.010
	Oligochaetes	4.339 ± 0.5010	5.143 ± 0.8090	0.19 ± 0.020
	Shrimps	4.617 ± 0.3562	5.410 ± 0.2625	0.18 ± 0.032
Etroplus maculatus	Mosquito larvae	3.641 ± 0.1095	4.247 ± 0.0752	0.17 ± 0.016
	Oligochaetes	3.426 ± 0.2267	4.025 ± 0.3352	0.15 ± 0.036
	Shrimps	3.783 ± 0.2177	4.474 ± 0.1825	0.18 ± 0.027

TABLE 4

DATA ON FECUNDITY, EMBRYONIC AND LARVAL DEVELOPMENT OF *Caridina fernandoi* AND *C. nilotica* (FROM Glaister, 1976; Hart, 1980; AND UNPUBLISHED DATA OF K.H.G.M. De Silva AND P.K. De Silva)

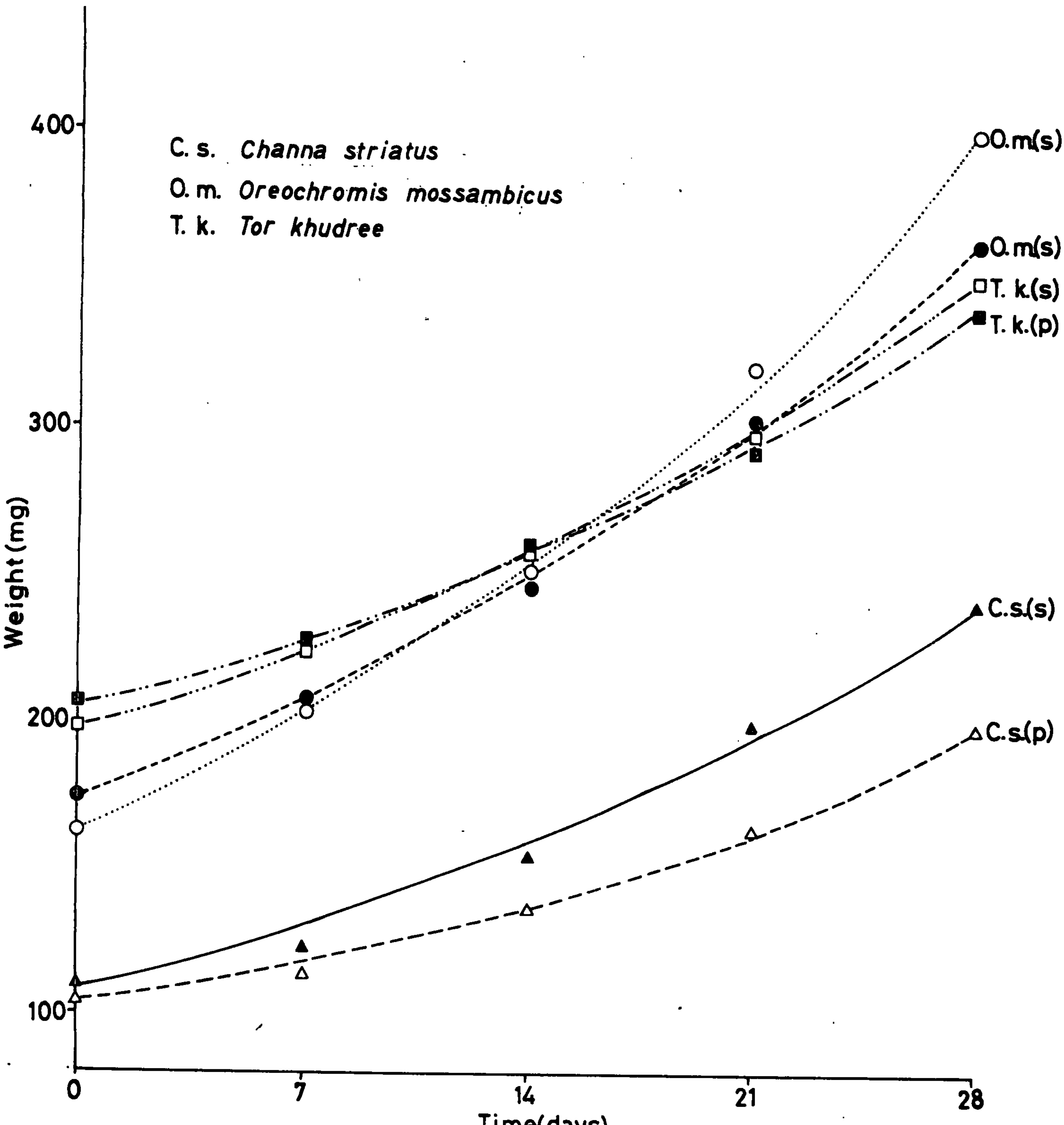
	C. fernandoi	*C. nilotica*
No, of eggs per clutch	about 300	about 100
No, of broods developed by a single female	more than 10	upto 24
Time interval between two consecutive broods	20 - 40 days	1 - 5 days
Age at 1st brood	4 months	2 - 4 months
Period of embryonic development	18 days at 25°C	14 days at 30°C
No. of pelagic larval stages	4	4
Period of larval development upto benthic stage	about 7 days	about 14 days
Size of larva at hatching	about 1.5 mm	1.7 - 2.05 mm

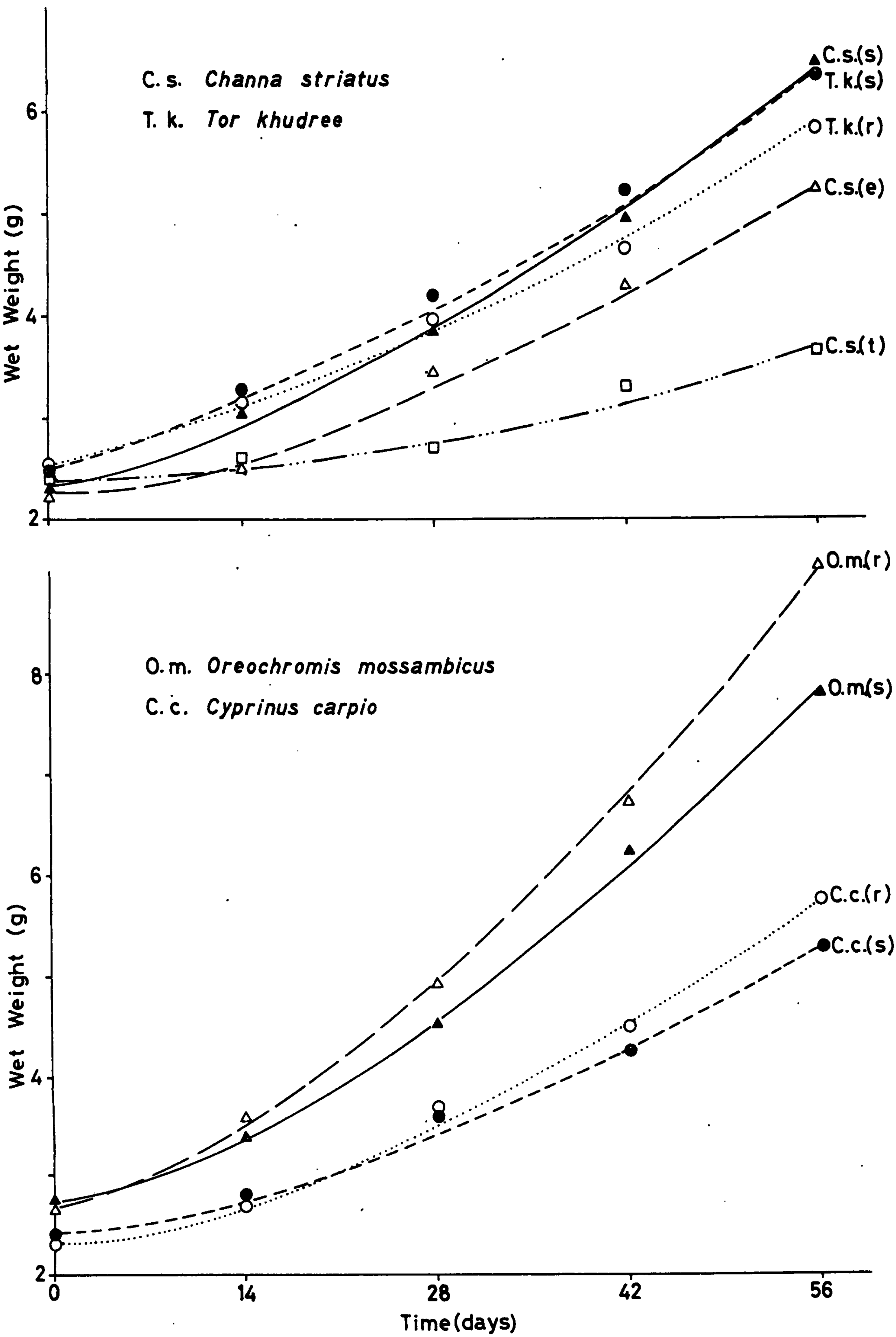
LEGENDS FOR FIGURES

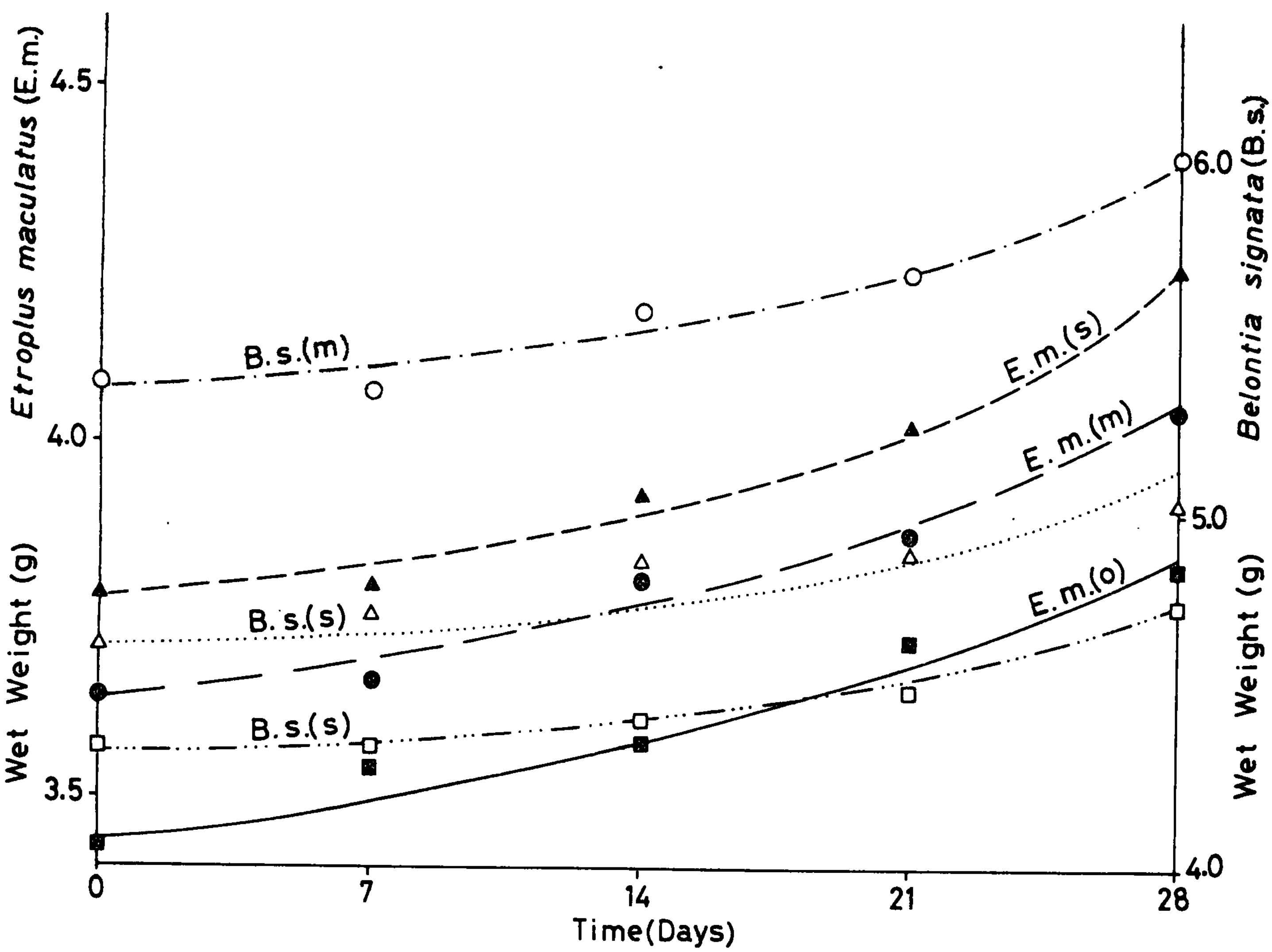
FIGURE 1: Growth curves of the fry of *Channa striatus*, *Oreochromis mossambicus* and *Tor khudree*, which were fed with plankton (p) and shrimp (s).

FIGURE 2: Growth curves of the fingerlings of *Channa striatus*, *Cyprinus carpio*, *Oreochromis mossambicus* and *Tor khudree*, which were fed with different feeds. e - aquatic oligochaetes;; r - formulated ration; s - shrimps; t - trash fish.

FIGURE 3: Growth curves of *Belontia signata* and *Etroplus maculatus*, which were fed with aquatic oligochaetes (o), mosquito larvae (m), and shrimps (s).


C. s. Channa striatus
O. m. Oreochromis mossambicus
T. k. Tor khudree
O.m(s)
O.m(s)
T. k.(s)
T. k.(p)
C.s.(s)
C.s.(p)
400
300
200
100
Weight (mg)
0
7
14
21
28
Time(days)


C.s. Channa striatus
T.k. Tor khudree
C.s.(s)
T.k.(s)
T.k.(r)
C.s.(e)
C.s.(t)
Wet Weight (g)
O.m. Oreochromis mossambicus
C.c. Cyprinus carpio
O.m(r)
O.m(s)
C.c.(r)
C.c.(s)
Wet Weight (g)
Time (days)
0
14
28
42
56



Etroplus maculatus (E.m.)
Wet Weight (g)
Belontia signata (B.s.)
Wet Weight (g)
4.5
4.0
3.5
6.0
5.0
4.0
B.s.(m)
E.m.(s)
E.m.(m)
B.s.(s)
B.s.(s)
E.m.(o)
0
7
14
21
28
Time(Days)