Asian Fisheries Science **13**(2000): 191-199
Asian Fisheries Society, Manila, Philippines

https://doi.org/10.33997/j.afs.2000.13.2.010

Preliminary Studies on the Performance and Feeding Behavior of Silver Pomfret (*Pampus argenteus* Euphrasen) Fingerlings Fed with Commercial Feed and Reared in Fiberglass Tanks

E.M. CRUZ, S. ALMATAR, K. ABDUL ELAH and A. AL-YAQOUT

Mariculture and Fisheries Department
Food Resources Division
Kuwait Institute for Scientific Research
P.O. Box 1638, 22017
Salmiya, Kuwait

Abstract

This preliminary study was conducted to determine the performance and feeding behavior of silver pomfret fingerlings (*Pampus argenteus* Euphrasen) fed with commercial feed and reared in fiberglass tanks. Silver pomfret fingerlings with an average weight of 15.2 g were stocked in six 1-ton fiberglass tanks (water volume = 700 l) at the rate of 20 fish per tank. The fish previously fed with moist feed made into paste, were gradually trained to feed on the test diet by replacing 25% of the paste with the test diet (Turbot feed, Ecostart 16 by Biomar of France) at weekly intervals. When the fish were already accustomed to the test diet, the feeding experiment started.

Three tanks were assigned for each form (dry and moist) of feed treatment. Moist pellets were prepared by grinding the dry pellets, adding 25% water and repelletizing using a manual meat grinder. The experiment was carried out for 82 days.

At the end of the study, significant differences between the two feed groups were observed. Fish fed with dry pellets were bigger ($P < 0.03$); had better daily growth rate ($P < 0.03$) and higher specific growth rate ($P < 0.03$); and gave better feed conversion ratio ($P < 0.01$) than the fish fed with moist pellets. However, survival rate of the fish fed with wet pellets was higher ($P < 0.03$) than that of the fish fed with dry pellets. Results of this preliminary study indicate that silver pomfret fingerlings accept dry pellets and perform better than those fed with moist pellets.

Introduction

Silver pomfret (*Pampus argenteus* Euphrasen) is the most expensive fish in Kuwait. It is considered as one of the fishes of highest quality not only by Kuwaitis but also by other nationals in the Gulf. In 1996, the total landings of silver pomfret was 2,475 metric tons of which about 65% was

imported (MOP/CSO 1997). In 1998, the total landing of silver pomfret declined to 1,715 mt and importation increased to more than 70% (MOP/CSO 1999). The decline in the supply of locally caught silver pomfret had resulted to an increase in the importation of fish from Iran and Pakistan. The high demand, the low supply and the preference for freshly caught fish are factors that create a favorable environment for the culture of silver pomfret in Kuwait.

Although silver pomfret is also considered as a valuable fish worldwide with wide geographic distribution from East China Sea to Southeast Asia, Indian Ocean and Arabian Gulf, very little has been done on culturing this species. Among the natural food materials of silver pomfret in the open waters are copepods, tunicates, medusae, jelly fish, fish larvae and eggs, and gelatinous substances (Suyehiro 1942; Chopra 1960; Kuthalingam 1967; Rao 1967; Pati 1980; Mohamed and Ali 1994). As jelly fish and copepods are the major food items of silver pomfret in the Arabian Gulf and Bay of Bengal (Mohamed and Ali 1994; Pati 1980), Pati (1984) considered the abundance of copepods as one of the conditions for the successful pond culture of silver pomfret while Salman et al. (1992) assumed that an abundant supply of jelly fish would help in the successful culture of silver pomfret in ponds. The failure of their initial attempt was due to the lack of abundant jellyfish.

Favorable factors such as the availability of silver pomfret broodstock, successful artificial fertilization (Almatar et al. 1999), hatching and nursery (Al-Abdul-Elah et al. 1999) and the abundant number of fry in Kuwaiti waters (Anon 1983) are conducive to the development of aquaculture for this species in Kuwait. Hence, this preliminary study is the first attempt ever to observe the growth performance, feed conversion, mortality and feeding behavior of silver pomfret fingerlings fed with artificial diet (pelleted feed) reared under controlled conditions in fiberglass tanks.

Materials and Methods

Acclimation of hatchery produced silver pomfret fingerlings to the new environment started on 20 October 1998. Fish with an average weight of 15.2 $\pm$ 6.56 g were randomly stocked in six 1-ton fiberglass tanks (water volume = 700 l) at the rate of 20 fish per tank. Seawater (34 ppt) from a deep well flowed through the tanks at the rate of 2 l·min. Packed column was installed at the water inlet and an air stone was installed inside each tank to aerate the water.

Initially, the fish were fed with moist feed that the fish were previously eating. The moist feed that was made into paste was composed of 50% minced fresh shrimp, 49% encapsulated marine larvae diet, 1% fish oil, 20 g mineral premix per kg feed and 100 g vitamin mix per kg feed. The paste was spread on a small plastic mesh suspended at the middle of the water column. After two weeks, 25% of the paste was replaced with the test feed (Turbot feed, Ecostart 15 by Biomar of France) at weekly interval to gradually train the fish to the test diet. The test diet formulated specifically for

turbot contains 52% crude protein, 15% crude lipids, 10.0% ash and 0.4% fiber as indicated in the tag by the manufacturer. Proximate analysis on the test diet for moisture, crude protein, crude lipids and ash was conducted.

The experiment comparing the performance of silver pomfret fingerlings fed with dry and moist pellets started on 30 November 1998. Three tanks were assigned for each type of feed treatment (dry and moist). Moist pellets were prepared by grinding the dry pellets, adding 25% water and re-pelletized using a meat grinder. Moist pellets were prepared on a weekly basis. The moist pellets were stored in a freezer. The daily ration was taken out of the freezer in the afternoon and then fed the next day.

The mean initial individual weights of fish in both feed groups were almost the same (25.80 vs 25.82 g). During the experiment, feeding habits of the fish were observed. To encourage the fish to eat more, feeding frequency was increased from 2 times a day to 3 times a day, then from 3 times a day to 4 times a day and finally to 5 times a day. The fish were hand-fed to satiation at each feeding which was done at two hours interval starting at 0800 h. Fish were fed six days a week. Pellets were dropped in a designated area where the uneaten pellets were collected in a tray measuring 22 x 18 x 2 cm located about 30 cm below the water surface. The amount of feed at satiation rate was taken two days after fish sampling was recorded. The amount of feed consumed per feeding was likewise observed on three occasions. Data on daily feed consumption in both groups were expressed in an equal basis, i.e. as dry pellet containing 10.08% moisture.

Fish were weighed every two weeks. At each sampling period, water level was reduced to approximately 100 l and 1 g of MS222 was added to anesthetize the fish. Daily recording of temperature was done and dissolved oxygen (DO) concentration was taken once a week.

The experiment was terminated after 82 days. The fish were weighed individually and deformed fish were counted. The specific growth rate (SGR) was calculated using the method of Luczkovich and Olla (1983): SGR = 100 (ln final weight - ln initial weight)/culture days. The feed conversion ratios (FCR) were calculated as feed given per kilogram wet weight gain.

Data obtained on the final weight, daily gain in weight, specific growth rate, feed conversion ratio and survival rate were statistically analyzed using the SPSSPC+ statistical software package (SPSS 1996).

Results and Discussion

Water quality and feed analysis

The mean water temperature for the month of November was 26.2ºC (range 24.0 - 27.0ºC), 25.8ºC (range 23.5 - 26.5ºC) for the month of January and 25.0ºC (range 22.5-26.0ºC) for the month of February. Weekly DO concentration was always above 5.2 mg l^{-1}. The water temperature and DO were within the optimum levels for the growth and development of other species.

Proximate analysis on the test diet indicates that it contain 10.08% moisture, 51.0% crude protein, 14.46% crude lipids and 8.13% ash.

Survival

The mean survival rate of the fish fed with moist pellets (100.00%) was significantly higher ($P < 0.03$) than that of the fish fed with dry pellets (85%). Mortality occurred during the first month of the experiment. No pathological organisms were identified on the dead fish. However, air bubbles were present in the stomach and no feeds were found in the stomach and intestines. As this fish feeds on jellyfish in the wild (Pati 1980; Mohamed and Ali 1994), it is possible that the fish mistake the bubbles for jellyfish. Gulping on air bubbles resulted in the fish floating on the surface, sometimes with the belly up.

Growth, feed conversion and feeding behavior

Results on the growth performance of silver pomfret fingerlings are summarized in Table 1. After 82 days, mean individual final weight and growth (daily weight gain and specific growth rate) of fish fed with dry pellets were significantly higher ($P < 0.03$) than the fish fed with moist pellets. Mean individual final weight of fish fed with dry pellets was 54.26 g (110.31% increase in their initial weight) while the fish fed with moist pellets attained a final mean weight per fish of 45.52 g which corresponds to

Table 1. Effects of feeding dry and moist pellets on performance of silver pomfret fingerlings.

	Pellet	
	Dry	Moist
Initial data		
Mean weight, g fish^{-1}	25.80 ± 13.79	25.82 ± 9.11
Total weight, g tank^{-1}	516.00	499.00
Number of fish tank^{-1}	20.00	19.33
Final data		
Mean weight, g fish^{-1}	54.26 ± 25.11*	45.52 ± 17.24
Total weight, g tank^{-1}	922.50	880.00
Number of fish tank^{-1}	17.00	19.33
Gain in weight, g fish^{-1}	28.46*	19.70
Weight increase, % initial wt.	110.31	75.29
Daily weight gain, g fish^{-1}	0.34*	0.24
Specific growth rate, %/d	0.91*	0.69
Total weight gain, g tank^{-1}	406.50	381.00
Total feed consumed, g tank^{-1}	731.33	1001.74
Feed conversion ratio	1.80^{+}	2.63
Survival rate, %	85.00	100.00*

*Significantly different from the other treatment ($P < 0.03$).
$^{+}$Significantly different from the other treatment ($P < 0.01$).

only 76.29% increase in their initial weight. Size variability at harvest as expressed in coefficient of variation (CV) was higher in fish fed with dry pellets (CV = 49.96%) as compared to the fish fed with moist pellets (CV = 39.39%). The higher size variation of the fish fed with dry pellets could not be entirely attributed to the test diet since the variation already existed at the start of the experiment where the CV for the fish fed with dry pellets was 52.06% and 34.89% for the fish fed with moist pellets.

The mean individual daily gain in weight and the specific growth rate of fish fed with dry pellets were 0.34 g and 0.91%, respectively and 0.24 g and 0.69%, respectively for fish fed with moist pellets. As no research has been done so far on this species, growth data could only be compared with other cultured species. The growth rates of silver pomfret fingerlings obtained in this study were lower than the values reported for other warmwater species with similar size and temperature range. Red sea bream (*Chrysophrys major* Temminck and Schlegel) grew from 22.9 g to 38.0 g in 30 days, resulting in a SGR of 1.70% (Fujii and Yone 1976). Morris and Davies (1995) obtained a SGR of 1.16 for gilthead seabream (*Sparus aurata* L.) fingerlings which grew from 21.68 g to 55.85 g. Common carp (*Cyprinus carpio* L.) fingerlings reared from 22.9 g to 38.1 g had a SGR of 1.70% (Furuichi and Yone 1980). Granoth and Porath (1983) reported a daily growth of 0.55 – 0.64 g for tilapia hybrids *Sarotherodon niloticus* x *S. aureus* which grew from 24 g to 40 g. It is apparent that the optimum growth for silver pomfret fingerlings was not achieved in this study. The feed given did not provide the necessary nutrients for its optimum growth since it was formulated for turbot. It is therefore recommended that other available commercial feeds formulated for other species and locally formulated diets be tried.

The feed conversion ratio of the fish fed with dry pellets (1.80) was significantly lower ($P < 0.01$) than the fish fed with moist pellets (2.63). The poor feed conversion ratio of the fish fed with moist pellets could be attributed to the loss of nutrients due to dissolution into the water. The fish, instead of swallowing the feed at once, exerted all the efforts to break the pellets into small pieces before swallowing it. In the process, a great portion of the feed was dissolved in water. This would account for the high feed allocation but poor intake leading to slow growth and poor feed conversion ratio.

The feed conversion ratio obtained in the fish fed with dry pellets were comparable to those reported for other species. Morris and Davies (1995) obtained a FCR of 1.81 with gilthead seabream, 1.72 for African catfish *Clarias lazera* C. and V. (Hogendoorn et al. 1983), 1.3-1.8 for eel *Anguilla anguilla* L. (Seymour 1989), 2.31 for tilapia hybrid (Granoth and Porath 1983), and 1.38 - 2.1 for Nile tilapia *Oreochromis niloticus* L. (Dabrowska et al. 1989; Balogun and Fagbenro 1995; Belal et al. 1995; and Dato-Cajegas and Yakupitiyage 1996).

The mean daily rations of silver pomfret fingerlings at different size groups fed to satiation five times a day are shown in Table 2. The mean daily ration for both feed groups was expressed on equal terms based on dry

pellets, the water added to the moist pellets was deducted. The mean daily ration for the fish fed with dry pellets was 1.66% while it was 2.30% for the fish fed with moist pellets. The mean daily rations obtained in this study were lower than those reported for other species. The average daily ration for gilthead sea bream was 3.59% for fish weighing 25.9 g and 3.09% for fish weighing 53.3 g (Petridis and Rogdakis 1996). For Nile tilapia, the average daily ration was from 8.66 to 6.09% for fish weighing from 25.80 to 54.26 g (De Silva et al. 1986). As can be seen in Table 2, changes in the feeding rates were not consistent and therefore did not reflect the normal changes reported for most species where feed ration expressed in percent declined with the increase in fish size (Pandian 1970; and Birkett 1972). The low feeding rates obtained in this study may be the reason for the low growth rate of silver pomfret fingerlings in comparison with other species.

As fish were observed to consume less feed at certain times of the day, feed consumption in each feeding was observed in three occasions towards the end of the experiment. Table 3 presents the percent feed consumption per feeding time. Although the fish were fed at regular intervals, i.e. every two hours, the fish consumed more feeds towards the end of the day (25% for the dry pellet group and 33.58% for the moist pellet group at the fifth feeding at around 1600 h). This finding agrees with the observation of Noeske and Spieler (1984) who stated that there is increasing evidence that most fish species have a preferred feeding time. In rainbow trout (*Oncorhynchus mykiss* Walbaum) and channel catfish (*Ictalurus punctatus* Rafinesque), better growth and feed conversion efficiency were obtained when they were fed at certain time of the day (Sundararaj et al. 1982; Noeske-Halim et al. 1985; Reddy et al. 1994; and Boujard et al. 1995). Hence, silver pomfret should be fed based on its natural feeding rhythms similar to those recommended by Azzaydi et al. (1999) for European sea bass (*Dicentrarchus labrax* L.) rather than the conventional equal amount in each feeding time.

Table 2. Feeding rates of silver pomfret fingerlings fed with dry and moist pellets.

Mean weight per fish, g	Mean feeding rate, %
Dry Pellet	
26.41	1.73
30.33	1.49
31.98	1.88
35.98	1.57
43.06	1.78
47.96	1.54
Mean	1.67
Range	1.49-1.88
Moist Pellet	
25.82	2.73
29.31	2.16
31.44	2.63
33.82	1.96
39.83	2.08
42.20	2.26
Mean	2.30
Range	1.96-2.73

It was observed that the fish ate only the feed that it could consume at the time of feeding. Despite the presence of the uneaten feed at the bottom of the tank, the fish ignored the feed and ate only the new feed that was given in the next feeding. At 20 fish per tank, jostling and competition for food were not observed. Based on the feeding behavior of this species, the recommended feeding strategy is to provide more feeds towards the end of the day and to increase the feeding frequency to six times a day at two hours interval.

Table 3. Amount of feed consumed by silver pomfret fingerlings per feeding in percent of the total ration for the day.

Pellet	Feeding Period				
	First %	Second %	Third %	Fourth %	Fifth %
Dry					
10-02-99	14.99	20.85	22.97	15.95	25.24
14-02-99	29.08	9.92	17.73	24.62	18.65
16-02-99	21.07	13.50	17.21	16.49	31.71
Total	65.14	44.27	57.91	57.06	75.60
Mean	21.71	14.76	19.30	19.02	25.20
Moist					
10-02-99	12.51	11.23	18.01	24.91	33.34
14-02-99	14.59	12.63	23.30	21.01	28.47
16-02-99	14.75	10.32	15.97	20.02	38.94
Total	41.85	34.18	57.29	65.94	100.74
Mean	13.95	11.39	19.10	21.98	33.58

The fish fed on the entire column of the tank including the bottom of the tank. Smaller fish tended to feed on the upper column while bigger fish preferred to feed below the smaller fish and only the big fish fed at the bottom of the tank. Hence, there is a need to install the feed catching tray when the fish are small. For the fish fed with moist pellets, although some fish would swallow the entire pellet, most of the fish would try to break it into small pieces before swallowing. Fish were observed to feed/gulp on air bubbles coming from the air stone.

During the experiment, fish abnormalities were observed. Abnormalities observed were exposed gills and blind fish. More abnormalities were observed in the fish fed with moist pellets than in fish fed with dry pellets. There were more fish that had exposed gills in the fish fed with moist pellets (12.07 %) than in the fish fed with dry pellets (4.17%). There were likewise more fish with one eye blind (10.34%) in the fish fed with moist pellets compared to those fish fed with dry pellets (4.17%).

Based on the results of this study, better performance could be obtained if silver pomfret fingerlings are fed with dry pellets and fed based on the natural feeding rhythm, i.e., providing more feeds towards the end of the day and fed at least five times a day.

Acknowledgment

The authors are grateful to Lamiya Al-Musalam, T. Nelson, and Musaad Al-Roumi for their assistance during the conduct of this study. We wish to thank Mr. Mohammed Ridha for the statistical analysis of the data and to Dr. Rosalyn Duremdez-Fernandez for doing the post-mortem examinations of the dead fish.

References

Al-Abdul-Elah, K., S. Almatar, T. Abu Rezq and T. Nelson. 1999. Culture potential of the silver pomfret (*Pampus argenteus*) in Kuwait. II. Development of hatchery techniques. Book of Abstract. Annual International Conference and Exposition of the World Aquaculture Society. 26 April – 2 May 1999. Sydney Australia. p. 13.

Almatar, S., K. Al-Abdul-Elah, T. Abu Rezq, A. Yousef, L. Al-Musalam and S. El-Dakour. 1999. Culture potential of the silver pomfret (*Pampus argenteus*) in Kuwait. I. Egg collections from wild stock. Book of Abstract. Annual International Conference and Exposition of the World Aquaculture Society. 26 April – 2 May 1999. Sydney Australia. p. 21.

Anon. 1983. Aquatic biology investigation. Studies for Subiya area, Kuwait Bay and the development of electrical networks contract No. MEW/CP/PGP – 1113 – 80/81. Final report, Vol. I. Government of Kuwait. Ministry of Electricity and Water, Safat, Kuwait. Dames & Moore, Environmental Consultants, Seattle, Washington, USA.

Azzaydi, M., F.J. Martinez, F.J. Zamora, F.J. Sanchez-Vasquez and J.A. Madrid. 1999. Effect of meal size modulation on growth performance and feeding rhythms in European sea bass (*Dicentrarchus labrax* L.). Aquaculture 170:253-266.

Balogun, A.M. and O.A. Fagbenro. 1995. Use of macademia presscake as a protein feedstuff in practical diets for tilapia, *Oreochromis niloticus* (L.). Aquaculture Research 26:371-377.

Belal, I.E.H., A. Al-Owaifeir and M. Al-Dosari. 1995. Replacing fish meal with chicken offal silage in commercial *Oreochromis niloticus* (L.) feed. Aquaculture Research 26:855-858.

Birkett, L. 1972. Some relationships between food intake and growth of young fish. Symposium of the Zoological Society, London 29:259-269.

Boujard, T., A. Gelineau and G. Corraze. 1995. Time of single daily meal influences growth performance in rainbow trout (*Oncorhynchus mykiss*). Aquaculture Research 26:341-349.

Chopra, S. 1960. A note on the sudden outburst of ctenophores and medusae in the waters off Bombay. Current Science 29:392-393.

Dato-Cajegas, C.R. and A. Yakupitiyage. 1996. The need for dietary mineral supplementation for Nile tilapia, *Oreochromis niloticus*, culture in a semi-intensive system. Aquaculture 144:227-237.

Dabrowska, H., K.D. Günther and K. Meyer-Burgdorff. 1989. Availability of various magnesium compounds to tilapia (*Oreochromis niloticus).* Aquaculture 76:269-276.

De Silva, S.S., R.M. Gunasekera and C. Keembiyahetti. 1986. Optimum ration and feeding frequency in *Oreochromis niloticus* young. The First Asian Fisheries Forum (eds. J.L. Maclean, L.B. Dizon and L.V. Hosillos). pp. 559-564. Asian Fisheries Society, Manila, Philippines.

Fujii, M. and Y. Yone. 1976. Studies of red sea bream – XIII Effect of dietary linolenic acid and Ω3 polyunsaturated fatty acids on growth and efficiency. Bulletin of the Japanese Society of Scientific Fisheries 42:583-588.

Furuichi, M. and Y. Yone. 1980. Effect of dietary dextrin levels on the growth and feed efficiency, the chemical composition of liver and dorsal muscle, and the absorption of dietary protein and dextrin in fishes. Bulletin of the Japanese Society of Scientific Fisheries 46:225-229.

Granoth, G. and D. Porath. 1983. An attempt to optimize feed utilization in a flow-through aquaculture. Proceedings of the First International Symposium in Aquaculture (comps. L. Fishelson and Z. Yaron). Tel Aviv University, Tel Aviv.

Hogendoorn, H., A.J. Jansen, W.J. Koops, M.A.M. Machiels, P.H. van Ewijk and P. van Hees. 1983. Growth and production of the African catfish *Clarias lazera* (C. and V.) 2. Effects of body weight, temperature and feeding level in intensive tank culture. Aquaculture 34:265-285.

Kuthalingam, M.D.K. 1967. Observations on the fishery and biology of the silver pomfret *Pampus argenteus* (Euphrasen) for the Bay of Bengal. Indian Journal of Fisheries 10(A):59-74.

Luczkovich, J.J. and B.L. Olla. 1983. Feeding behavior, prey consumption, and growth of juvenile hake. Transaction of the American Fisheries Society 112:629-637.

MOP/CSO (Ministry of Planning/Central Statistics Office) (1997) Annual statistical abstract. 1996. State of Kuwait. Central Statistical Office, Ministry of Planning, Kuwait.

MOP/CSO (Ministry of Planning/Central Statistics Office). 1999. Annual statistical abstract. 1998. State of Kuwait. Central Statistical Office, Ministry of Planning, Kuwait.

Mohamed, A.R. and T.S. Ali. 1994. Feed habit of silver pomfret *Pampus argenteus* (Euphrasen) in the Northwestern Arabian Gulf. Journal of Agricultural Research 4:38-44.

Morris, P.C. and S.J. Davies. 1995. The requirement of the gilthead seabream (*Sparus aurata* L.) for nicotinic acid. Animal Science 61:437-443.

Noeske, T.A. and R.E. Spieler. 1984. Circadian feeding time affects growth of fish. Transaction of the American Fisheries Society 113:540-544.

Noeske-Halim, T.A., R.E. Spieler, N.C. Parker and M.A. Suttle. 1985. Feeding time differentially affects fattening and growth of channel catfish. Journal of Nutrition 115:1228-1232.

Pati, S. 1980. Food and Feeding of silver pomfret *Pampus argenteus* (Euphrasen) from Bay of Bengal. Indian Journal of Fisheries 27:244-256.

Pati, S. 1984. Possibilities of aquaculture of silver pomfret, *Pampus argenteus* (Euphrasen) along the Balasore coast. Proceedings of the Symposium on Coastal Aquaculture. pp. 782-786.

Pandian, T.J. 1970. Intake and conversion in the fish *Limanda limanda* exposed to different temperature. Marine Biology 5:1-17.

Petridis, D. and I. Rogdakis. 1996. The development of growth and feeding equations for sea bream, *Sparus aurata* L., culture. Aquaculture Research 27:413-419.

Rao, K.S. 1967. Food and feeding habits of fishes from trawl catches in the Bay of Bengal with observations on diurnal variation in the nature of the feed. Indian Journal of Fisheries 11:277-314.

Reddy, P.K., J.J. Leatherland, M.N. Khan and T. Boujard. 1994. Effect of daily meal time on the growth of rainbow trout fed different ration levels. Aquaculture International 2:1-15.

Salman, A.N., S.A. Kitten and F.M. Kamil. 1992. Raising of silver pomfret (*Pampus argenteus* Euphrasen) in the earthen tidal pond of Khor Al-Zubair lagoons. Journal of Agricultural Research 2:105-121.

Seymour, E.A. 1989. Devising optimum feeding regimes and temperatures for the warmwater culture of eel, *Anguilla anguilla* L. Aquaculture and Fisheries Management 20:129-142.

Sundararaj, B., P. Nath and F. Halberg. 1982. Circadian meal timing in relation to lighting schedule optimizes catfish body weight gain. Journal of Nutrition 112:1085-1097.

Suyehiro, Y. 1942. A study on the digestive system and feeding habits of fish. Japan Journal of Zoology 10:1-303.

SPSS. 1996. SPSS Base Windows User's Guide. SPSS Inc. Chicago, USA.

Manuscript recieved 16 December 1999; Accepted 01 March 2000.