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Reproduction and larval rearing of the common sea bream (*Pagrus pagrus*), an experimental culture

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SUMMARY - Pagrus pagrus (average weight 30g) collected from the wild matured and spawned, after rearing in tanks for slightly more than two years. They adapted to tank conditions and artificial diets very fast. They grew to an average weight of 300g in one year and to 610g at the end of the second year from collection. Spawning was spontaneous and lasted from the end of February until the end of April, 1995. The water temperature was 17-18°C. Egg diameter ranged from 920-1050µ and larval length from 2.50-3.20mm. Larval feeding, using rotifers, begun on day 4, after the absorbtion of the yolk sack and the opening of the mouth and continued until day 26. The green water method gave the best results for larval rearing. AF grade artemia nauplii were given as from day 22 until day 27. On day 28 the larvae were fed with EG grade artemia nauplii enriched with HUFA. Dry food was given from day 33. Weaning was completed on day 45. The larval growth of *P.pagrus* is fast, however the larvae are very sensitive to stress, irrational nutrition and to handling. At the age of 3 months from hatching the average weight was 2.3g and the average length 4.8cm. It is considered to be a promising species for aquaculture diversification.

Key Words: *Pagrus pagrus*, Reproduction, Rearing, Aquaculture, Cyprus, Species Diversification

RESUME - *"Reproduction et élevage larvaire de la daurade commune (Pagrus pagrus), en tant qu'élevage expérimental". Des individus de Pagrus pagrus (poids moyen 30g), d'origine sauvage, sont parvenus à maturité et à la ponte, après un élevage dans des bassins pendant un peu plus de deux ans. Ils se sont très vite adaptés aux conditions de bassin et au régime alimentaire artificiel. Ils ont grandi jusqu'à un poids moyen de 300g en une année et jusqu'à 610g à la fin de la deuxième année à partir du moment de leur capture. La ponte a été spontanée et a duré de la fin février à la fin avril 1995. La température de l'eau était de 17-18°C. Le diamètre des oeufs allait de 920-1050 µ et la longueur des larves de 2,50-3,20mm. L'alimentation des larves, avec des rotifères, a commencé le 4ème jour, après absorption du sac vitellin et ouverture de la bouche, et a continué jusqu'au 26ème jour. La méthode de l'eau verte a donné les meilleurs résultats en ce qui concerne l'élevage larvaire. Du 22ème au 27ème jour, ils furent alimentés avec des artemia nauplius calibre AF. Le*

28ème jour, le larves furent alimentées avec des artemia nauplius calibre EG enrichies avec de l'HUFA. A partir du 33ème jour, des aliments secs furent distribués. Le sevrage fut achevé le 45ème jour. La croissance larvaire de P. pagrus est rapide, bien que les larves soient très sensibles au stress, à une nutrition irrationnelle et à la manipulation. A l'âge de 3 mois après l'éclosion, le poids moyen était de 2,3g et la longueur moyenne de 4,8cm. Cette espèce est considérée comme prometteuse pour la diversification aquacole.

Mots-clés: *Pagrus pagrus, Reproduction, Elevage, Aquaculture, Chypre, Diversification des espèces.*

INTRODUCTION

The common sea bream, (red porgy) (*Pagrus pagrus*) is one ofthe most highly esteemed fish species in Cyprus, as well as in several other Mediterranean countries. It belongs to the family Sparidae and it is a demersal fish. It is caught mainly with longlines in small quantities by the inshore fishermen. Its retail value is US$24.00/kg for 300-400g fish as compared to US$16.00/kg for gilthead bream. It is appreciated by the consumers for its firm white meat, its taste as well as its pink colouration.

The annual landings of common sea bream in Cyprus ranged between 40-70 tons during the last few years.

The high esteem, the demand and the high value that this species enjoy in the Cyprus market led the Department of Fisheries to investigate its culture potentials, with the final objective its commercial culture on an intensive scale by the private sector, thus contributing to the aquaculture diversification in Cyprus with a new and valuable fish species.

BROODSTOCK FORMATION

Broodstock selection and origin

Efforts to secure broodstock commenced in Cyprus in the late 1980s by collecting large size common sea bream from the wild. Their weight ranged between 500-900g. Although they were transported and placed in fiberglass tanks in good condition, they did not adjust well to artificial diets. The fish behaved nervously and they soon lost condition, exhibiting loss of weight, exophthalmus and then blindness, loss of colouration, skin infections, etc.

In 1992 the efforts for securing broodstock were focused in collecting young fish of common sea bream. During that year in the daily catches of the local fishermen there was an unusually large number of young fish of this species. The first fish were collected by trawling with the trawler of the Department of Fisheries and subsequently by specially employed commercial trawlers. They were caught in November-December, in depths of about 30m and their weight ranged from 20-50g.

Almost all fish reached the trawler's deck with an overinflated swim bladder. By exercising gentle pressure on the sides of the fish with both hands their swim bladder lost its excess air, allowing the fish to swim normally. Other methods of deflating the swim bladder, like the use of a syringe, did not prove so practical and successful.

The fish were transported to the Department's Experimental Marine Aquaculture Station at Meneou where they were treated immediately with a bactericide to avoid secondary infections from injuries, mainly from the loss of scales during handling. About 150 fish of an average weight of 30g were secured successfully by this method and were placed in a round fiberglass tank for rearing.

Broodstock rearing

The young common bream adapted to culture conditions amazingly fast. Their swimming behaviour was normal. They were kept in a round 40m^3 capacity tank (diameter 8m and height 1m) having a water exchange of about 30%/h. The fish started accepting artificial diets soon, about 10 days from collection, despite the fact that their natural food consists of living organisms that can be found in the substrate like molluscs, decapode crustaceans, echinoderms, worms and fishes (Marzouk and Kartas, 1987). Gradually they became quite accustomed to dry pellets, catching their food usually at the middle of the water column and also from the bottom of the pond.

The fish growth rate was followed regularly through a monthly sampling. The fish were anaesthetized and were sampled for length and weight. Their growth over a period of about two years is shown in Fig. 1. They grew to an average weight of 300g during the first year and to 610g at the end of the second year from collection. The water temperature during rearing is shown in Fig. 2. It ranged from 14.5°C in winter to 28°C in summer. The fish fed more actively and had faster growth during the summer months and slowed down significantly during the winter months.

During their rearing the fish lost their bright pink colour and exhibited only a pinkish appearance with vivid blue spots at their sides that were more distinct and numerous in smaller fish.

Maturation and spawning

The common sea bream is a protogynous hermaphrodite (Alekseev, 1983). It has the reproduction characteristics of a sequential spawner.

During 1994 and 1995, in an effort to study its maturation and spawning, several specimens from the fish market were sampled and were dissected in order to check their gonadal maturity. A total of 18 fish were sampled, all during the months of February, March and April. Their length ranged from 22-27cm and their weight from 160-340g. All of them had a small ribbon like gonad, an indication that at this size the fish do not mature. Their sex determination by macro examination was not possible.

At the Meneou Station common sea bream spawning began, for the first time, at the end of February, 1995 and continued until the end of April. The broodstock had an average length of 33cm, average weight of 650g and was three years old.

It was not advisable to biopsy the stock for sex ratios or other details regarding maturation and spawning, in order to avoid stress and interruption of spawning. When spawning commenced the water temperature was 17°C. In North Carolina, USA, spawning of wild stocks of *P.pagrus* is reported (Manooch 1976) to take place within the same period, with peak spawning in March and April.

The nutrition of the broodstock consisted of commercial dry pellets of the same type used for gilthead seabream, supplemented with squid and small fish.

Spawning was spontaneous, no induction of any kind or any other intervention in the maturation and spawning procedure was undertaken. The fish spawned early in the morning. The good quality eggs floated and were collected in egg collectors daily.

According to fecundity estimations (Manooch, 1976) a common sea bream of about 51.6cm is expected to give 488.600 eggs. It was not possible to estimate the fecundity of the broodstock at Meneou Station because it seemed that only a small number, out of the 80 fish kept in the tank, were spawning.

Egg diameter ranged from 920μ to 1050μ. A single lipid droplet with a diameter of 220-250μ was present. Occasionally eggs with two lipid droplets were found.

LARVAL REARING

Egg hatching and larval rearing was carried out in 3.5m^3 cylindroconical fiberglass tanks. The water temperature was about 18±1°C. An open water circulation system was maintained. The water exchange was very low at the beginning and was increasedgradually. Salinity was about 39%o. All larval rearing tanks had fluorescent light, which was later on switched off, surface oil skimmer and light aeration.

The hatching period at a water temperature of 16-17°C lasted 48 hours. Larval length immediately after hatching ranged from 2.50mm to 3.20mm. Hatchability varied during the various trials, the highest being 80%. The initial larval density used was 30/l.

Several diets and culture methods and techniques were tried out in order to find the optimum culture conditions for the species. The green water method gave the best results.

Feeding began on day 4 after the absorbtion of the yolk sack and the opening of the mouth. Mixed rotifers, about 70% large and 30% small type, were given regularly, twice a day, from day 4 up to day 26. The first meal of the day was early in the morning, with rotifers enriched with phytoplankton and the second in the afternoon with rotifers enriched with HUFA. The phytoplankton species used were mainly *Chlorella sp.* and sometimes *Nanochloris sp.* Rotifers were grown on yeast and on phytoplankton, mainly *Chlorella sp.* and *Tetraselmis suesica*. The fish larvae fed on rotifers very actively. On day 5 about 50% of the larvae had a full stomach. A rotifer population of 2-3/ml was maintained in the tank. Twice a day, morning and afternoon, phytoplankton was added to the larval tank in order to maintain green water. On day 10, 75% of the larvae were found to have developed the swim bladder. On day 22

freshly hatched nauplii of AF grade artemia were given, gradually decreasing the quantity of rotifers. From day 28 the larvae were fed with EG grade artemia nauplii and metanauplii enriched with HUFA. Dry food was given from day 33 and weaning was completed on day 45. They reacted very positively to dry food which indicated that they could be weaned earlier. The feeding regime is shown in Fig. 3.

As regards the larvae behaviour it was observed that after day 8 the majority of the larvae were swimming on the upper 10-15cm of the water column of the tank, mainly around the periphery of the tank. As they grew up they tended to swim lower into the tank, not being very strong swimmers. The common sea bream larvae, very early in their life, exhibited a territorial dominance behaviour and later they became aggressive causing to mortalities.

The larval growth of *P.pagrus* was found to be quite fast with large variations in larval size. They adapted well to the various types of feeding. They were very fragile at handling and very sensitive to stress from water disturbances, illumination and irrational feeding etc.

During the period when the larvae were feeding on rotifers, there were cases of overfeeding and distended stomachs and intestine resulting to mortalities. This could be attributed to injuries by the rotifer exoskeleton, followed by secondary bacterial infections. The same problem of distended stomachs and intestine resulting to mortalities, appeared again later on at the age of 35-40 days, when weaning was taking place. In the latter case it was found that all the distended stomachs and intestines contained a large number of exoskeletons of copepods.

At that age the fish larvae were able to prey on the copepods that have established flourishing populations on the sides of the larval tank. In an attempt to handle this problem some preventive treatment with sulpha drugs was applied. Another larval rearing problem faced at the age of 38-45 days, which also caused mortalities, was the swollen abdominal cavities which containeda colourless liquid.

A very high proportion, about 70% of the larval population, after day 10 were found to have stones and/or sand in their urinary bladder. This did not seem to be a cause of mortality being rather a stress factor.

The fish were transferred to nursery tanks at the age of 45 days. The growth in the nursery tank was very fast. At the age of 3 months the average weight of the young fish was 2.3g and the average length 4.8cm. This compares extremely favourably with the growth of *Sparus auratus*, for example, which needs about 4 months to reach the average weight of 2g.

DISCUSSION AND CONCLUSION

The culture of *P.pagrus* presents several advantages which could play an important role in the culture of this species on a commercial scale by the private sector. Eventhough its ongrowing in cages has not been studied yet, the indications from the up to now hatchery results and from the broodstock rearing are very promising.

It was not clear whether the changes of food during the various stages was the original cause of the abnormal feeding habits (both in quantity and quality of food) and subsequent mortalities or the mortalities could be attributed to physiological changes in the metabolism of the larvae occurring at that age. This topic needs further study, since it seemed to present one of the constraints for the mass production of common sea bream in hatcheries. It was evident that transition from one type of food to another has to be done carefully, avoiding excess feeding. Also avoidance of the building up of copepod populations during the weaning period may alleviate the problem.

The work being undertaken for the rearing of this fish was not conclusive as regards the colour of the final product (table size fish). This aspect of the culture of common sea bream may need further work before this species is produced on commercial basis. It has to be examined whether it is possible for this fish to acquire pink colour and how it can keep its attractive pink colouration after fishing, in order to avoid the marketing problems which are now faced because of the dark colour of the relative species Japanese red sea bream, *P. major.*

Several parameters of the culture of *P. pagrus* need further work, even though it seems that similar biotechnology with that applied for *Sparus auratus*, adapted to the biological and physical requirements of this particular species, can be employed. Work on several aspects of its mass production in hatcheries and culture in cages is underway in several countries of the Mediterranean. It is anticipated that the problems will soon be overcome and that *P. pagrus* could be considered as one of the most promising new species. Its culture on commercial basis will enhance the diversification of aquaculture and it is expected to allow a better utilization of physical as well as human resources of fish hatcheries, since it is a late winter- spring spawner.

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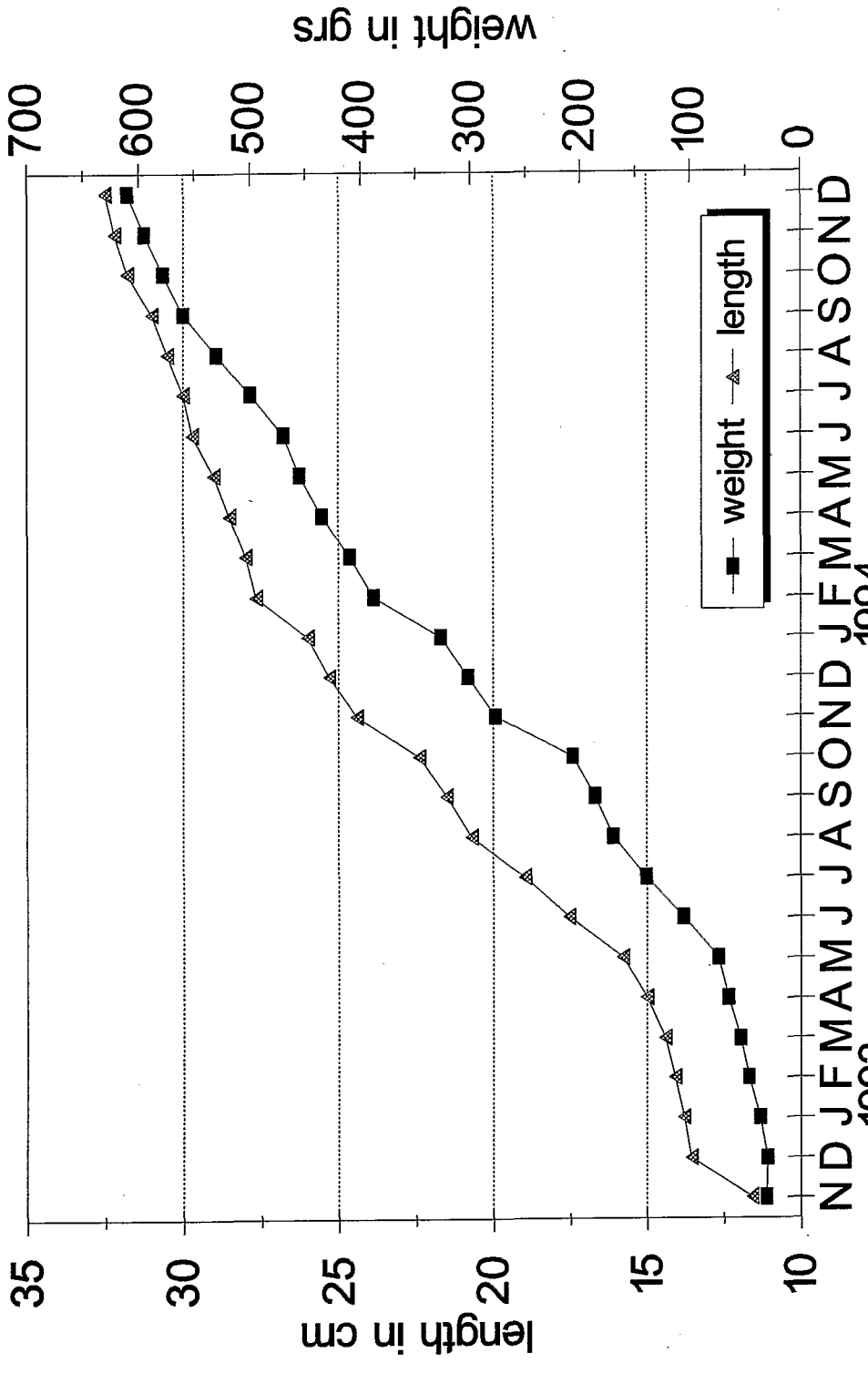

Figure 1: Growth of Pagrus pagrus (Broodstock) at Meneou Experimental Marine Aquaculture Station for the Years 1992-94

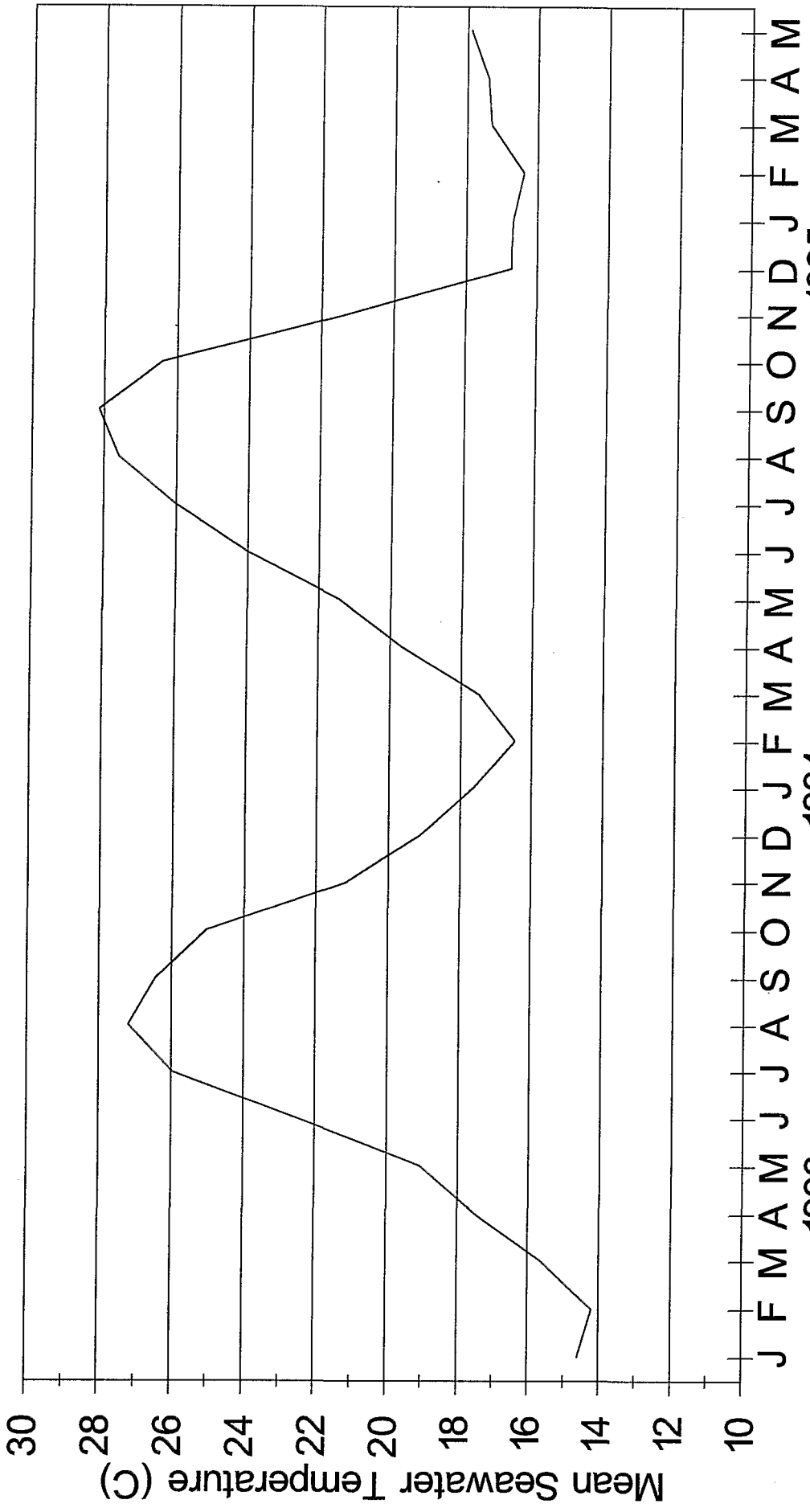

Fig.2: Meneou Exp. Marine Aquaculture
Station - Mean Seawater Temp. at 07:30

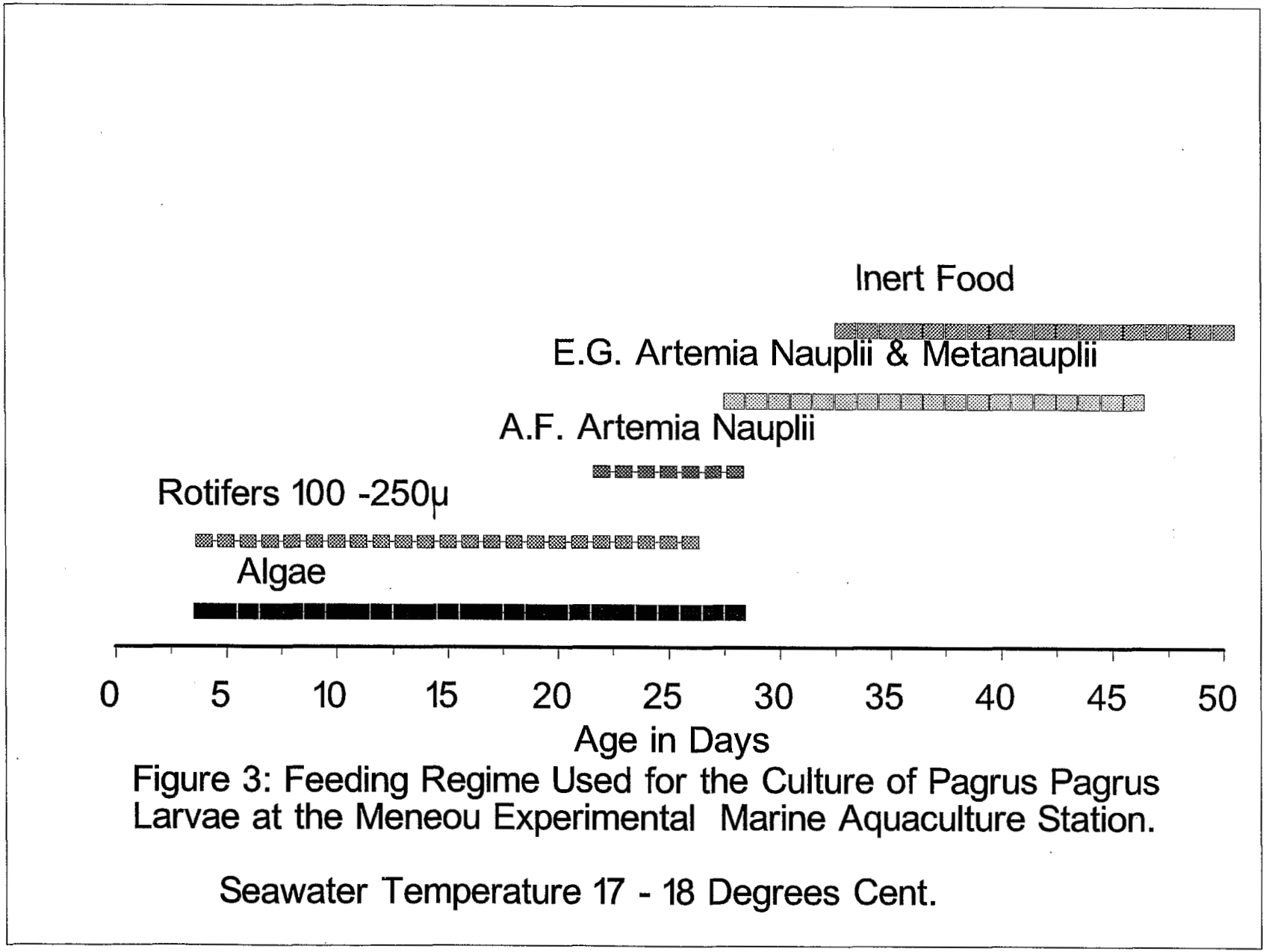

Figure 3: Feeding Regime Used for the Culture of Pagrus Pagrus Larvae at the Meneou Experimental Marine Aquaculture Station.

Seawater Temperature 17 - 18 Degrees Cent.