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SOME PRELIMINARY OBSERVATIONS ON CATFISH (*Anarhichas lupus* L. and *A. minor* Olafsen) IN CAPTIVITY

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ABSTRACT

Newly hatched catfish larvae have been startfed on commercial dry pellets with a survival rate of 60 % in the best group during the first 100 days after hatching. The specific growth rate has varied between 2.17 and 3.52 %/day in the first 137 days after hatching. Juvenile spotted catfish had an average specific growth rate of 1.0 %/day over a one year period. The results indicate a decrease in growth above 11°C. The male gonads had a wet weight of about 2 g in May increasing to about 12 g in the spawning season (December/January), while the egg diameter in the female gonad increased from 1.0 mm in May to about 5.5 mm in the spawning season. Behaviour studies have been made on both larvae and adults and indicate that the fishes had their maximum activity around feeding time and spend most of the day laying on the bottom of the tanks. Cannibalism has been observed occasionally and only among juvenile fishes.

INTRODUCTION

Rearing of fish has become an important and constantly growing industry. In Norway and the rest of northern Europe salmonids are most frequently reared, but a lot of research is being done to find other species suited for commercial rearing, and to develop methods to rear them efficiently. Recently two species of wolf fish (*Anarhichas minor* and *A. lupus*) have been considered for rearing (Gjøs ter and Moksness 1986, Pavlov and Novikov 1986). Two reasons were important for the decision to study these species. Firstly they have large eggs and larvae, ready to feed comparatively big particles. The larvae in several ways resemble the salmon larvae, and they were therefore supposed to be easy to rear using the technology developed for salmonids. Secondly the flesh is very tasty, and as only small quanta are landed from the fisheries, it gets a good price.

Studies on the biology of wolf fish are few, and the old literature is partly contradictory. Some basic information is given by e.g. Beese and Kandler (1969), Østvedt (1963), Barasukov (1972) and Jonsson (1982). Spawning of wolf fish has been observed in aquaria (Hognestad 1965). Ringø, Olsen and Bøe (1987) succeeded in rearing larvae of *A. lupus* on a diet containing zooplankton. Pavlov and Nivikov (1986)

diet containing zooplankton. Pavlov and Nivikov (1986) reared *A. lupus marisalbi* on artificial food. Laboratory culture of the Pacific wolf fish *Anarrhichtys ocellatus* has also been successful (Marlive, 1978, 1987).

The present paper gives some information on the experience with rearing of wolf fish in Norway. The feeding and growth of adults and larvae are described and so are various aspects of their behaviour.

MATERIALES AND METHODS

First feeding larvae

An egg-ball was caught near the Faeroe Island by a trawler (10/2-87) and the larvae hatched soon after (10-17/2 1987) in the Fishery Laboratory in Torshavn. Maximum hatching was observed for three days , 12-14/2. Mean hatching date is set to 13/2-87 and defined as age day = 0. 344 of the newly hatched larvae were send Flødevigen Biological Station in two batches the 19/2 and 26/2 and at the laboratory mixed and divided into the two groups: 87-1 and 87-2. The differences between the two groups have mainly been that 87-1 has been startfed on the dry pellet Skretting A/S "Elite Perle", while 87-2 have been startfed on the dry pellet Skretting A/S "Elite Plus" and *Artemia salina* nauplii. The newly hatched *Artemia salina* nauplii were fed the larvae in 87-2 from 9. March (3.75 g eggs/day) to 25. April (5.0 g eggs/day)

Juveniles

During a cruise with R/V "G.O.Sars" from 20 August to 5 September 1985 in the Barent Sea, 35 live spotted catfish juveniles were caught. The juveniles were taken in the upper 60 m with a trawl towed with a speed of 3 nM. The salinity and temperature in the sampling area were around 33 °/oo and 7.5°C respectively (Anon. 1985). The juveniles were transported to the laboratory at Flødevigen Biological Station and dived into three groups: 85-1, 85-2 and 85-3. The experiment started 12 September 1985, defined as day 0. The two groups, 85-1 and 85-2, were kept in tanks of 500 l during the experiment, while 85-3 was transferred from 500 l tank to a 2500 l tank after 431 days. The salinity was stable around 33 °/oo during the whole experimental period, while the temperature varied from 3.9°C in the winter to 13.5°C in the summer with a average of 8.8°C in the whole period

Adult fishes

Adult striped catfish were caught by nets at the southern coast of Norway during April/May 1986 and transferred to the Flødevigen Biological Station. They were kept in tanks of 5 m^3. All of the dead adult fish were examined for the wet weights of their gonads and in addition the eggs in the female gonad were measured for egg-diameter.

Behaviour

The behaviour of the juvenile and adult fishes was observed directly in the tanks and in a small outdoor basin. The early larvae were observed through a video-camera, having the larvae in a small glassjar.

Specific growth rate, SGR, was calculated according to the formulae:
SGR = (Ln Wt2 - Ln Wt1) / (t2-t1), where Wt1 and Wt2 are wet weights of fishes at days t1 and t2.

RESULTS AND DISCUSSION

Startfeeding

The two groups of newly hatched catfish larvae were successfully startfed with dry pellets. The 87-2 group had a considerably higher survival rate (60 %) compared to 87-1 (12 %) during the first 100 days after hatching (Fig. 1 and 2).The higher survival rate observed in 87-2 might have been caused by by the newly hatched *A. salina* larvae fed this group. A possible period of mass mortality caused by starvation was observed in both groups 20 to 40 days after hatching. The specific growth rate in the two groups is shown in Table 1. In the two groups the SGR varied between 2.16 and 3.52 %/day.

Table 1. The specific growth rate (SGR) in the two 87-1 and 87-2 groups during May and June 1987. Average wet weight = Wt, numbers of fish measured = N and the numbers of days after hatching = day.

Group	Day	N	Wt (g)	Period	SGR
87-1	74	20	0.273	0 - 74	2.16
87-1	102	20	0.655	74-102	3.13
87-1	137	19	2.246	102-137	3.52
87-2	74	87	0.402	0 - 74	2.69
87-2	102	87	1.008	74-102	3.29
87-2	137	78	3.057	102-137	3.17

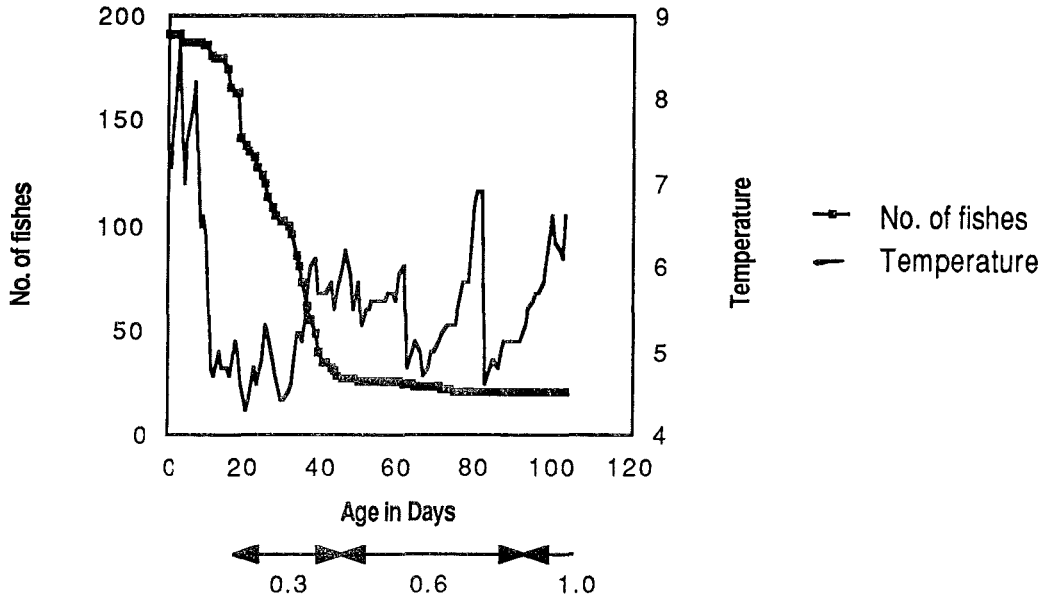

Figure 1. Temperature (°C) and number of survivals during startfeeding in group 87-1. Period fed with the dry pellet Skretting "Elite Perle" and its particle size are indicated.

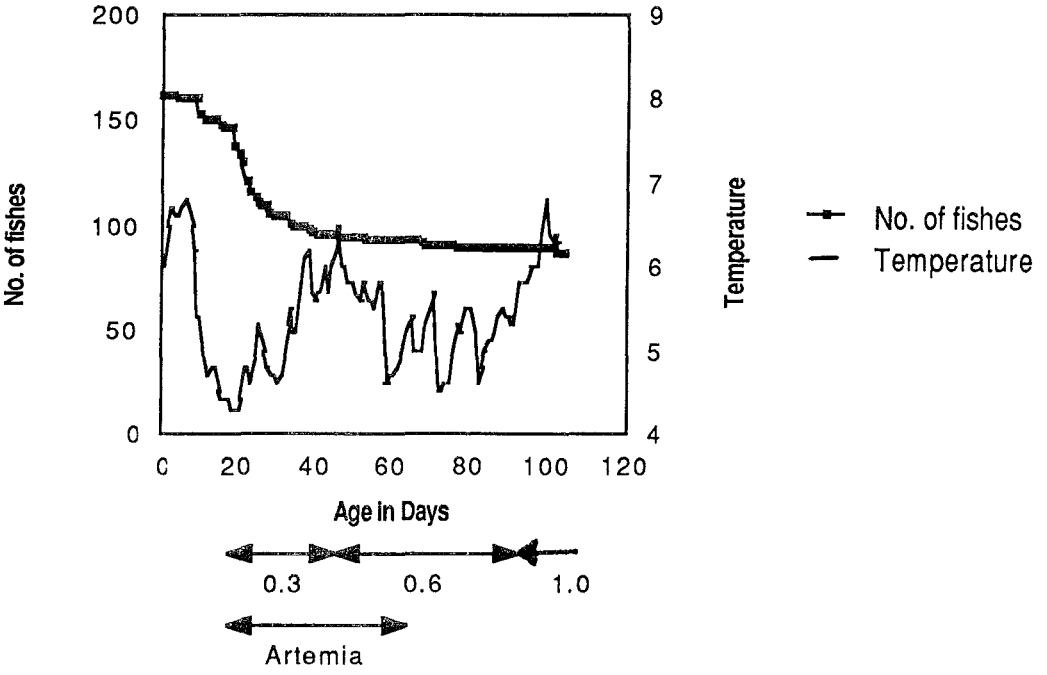

Figure 2. Temperature (°C) and numbers of survivals during startfeeding in group 87-1. Period fed the dry pellet Skretting "Elite Plus" and *Artemia salina* nauplii are indicated. The particle size of the dry pellets is also indicated.

Growth in juvenile fishes

The average wet weight of the three groups of spotted catfish, 85-1, 85-2 and 85-3 is shown in Fig. 3 and 4. The 85-3 group had a considerably better growth compared with the other two groups (Fig. 3). A variation in growth over time was observed in the 85-3 group (Fig. 4) probably due

to experiment with different food types given the group resulting in no food uptake in periods.Slow growth might also have been caused by unfavorable temperature condition, like temperature over 11°C as indicated in Fig. 4. The 85-3 group had an SGR of 1.0 %/day in the time period from 12. September 1985 to 2. February 1987 with a min and max value of 0.0 and 3.4 %/day respectively. The average initial wet weight of the fishes were 11 g.

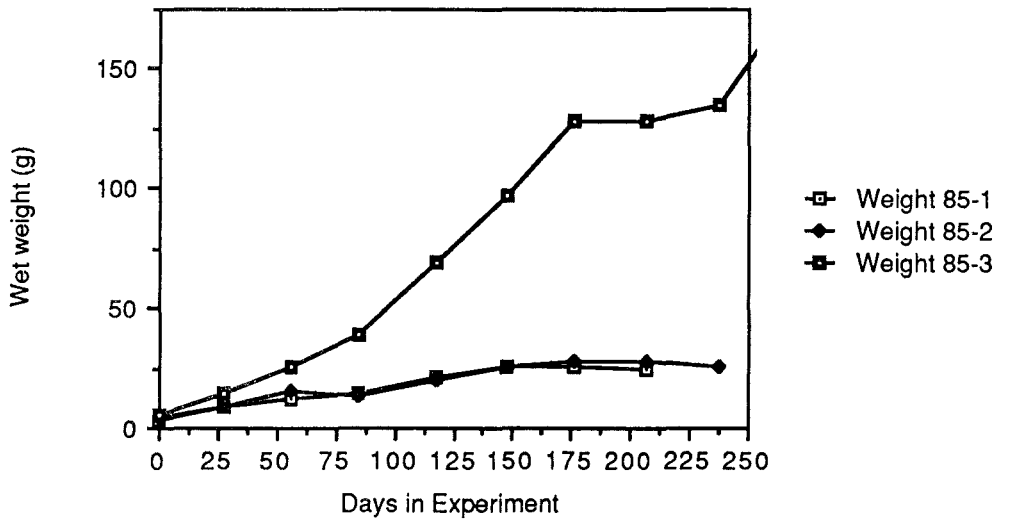

Figure 3. Average wet weight (g) of the fishes in the three groups of spotted catfish.

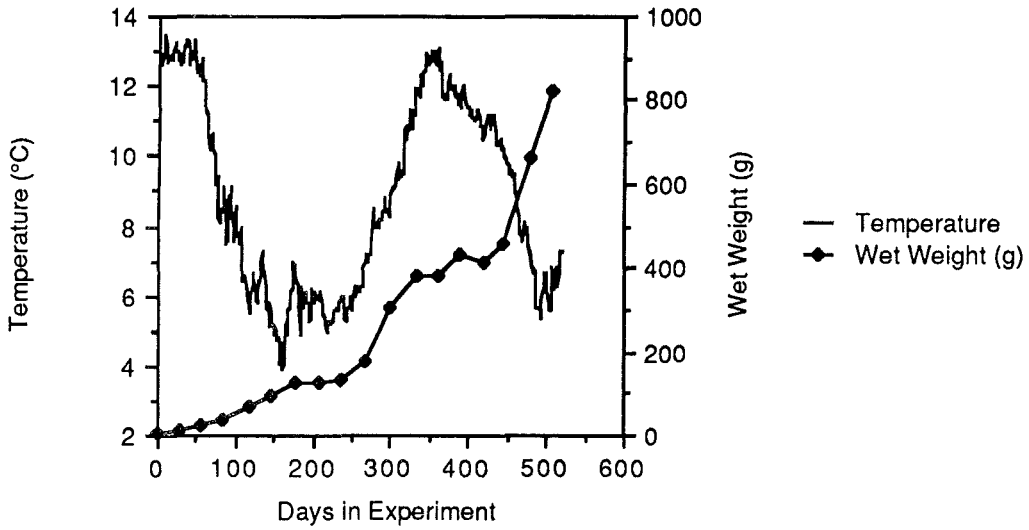

Figure 4. Temperature and average wet weight (g) of fishes in 85-3.

Maturation of gonads

The wet weight of the male gonads shows an increase from about 2 g in May to about 12 g in the spawning season (December/January, (Fig.5). Several males were stripped during the spawning season giving good quality sperm. The gonads of the female increased in weight from about 50 g in May to about 500 g in October (Fig. 6). The weight of the female gonads increased with increasing length of the fish. The egg diameter increased from about 1 mm in May to about 5.5 mm in the spawning season (Fig. 7)

During the spawning season in December 1986 and January 1987 three female striped catfish had spawned in a small outdoor concrete basin. None of the eggs were obtained from this spawning, probably because they were eaten by other catfishes in the same basin. One female and one male catfish were stripped and the eggs and sperm mixed. None of the eggs were fertilized probably due to low quality sperm. The stripping of both the female and the male was without problems. The egg diameter of the stripped eggs were between 5.5 and 5.8 mm.

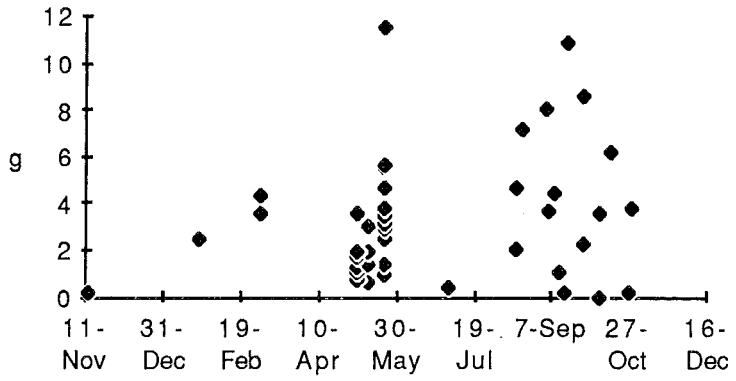

Figure 5. The changes of the wet weight (g) of the male gonad from May to December.

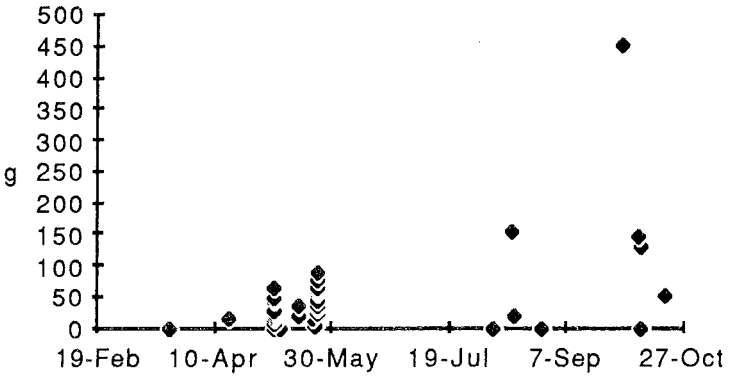

Figure 6. The changes in wet weight (g) of the female gonad from May to October.

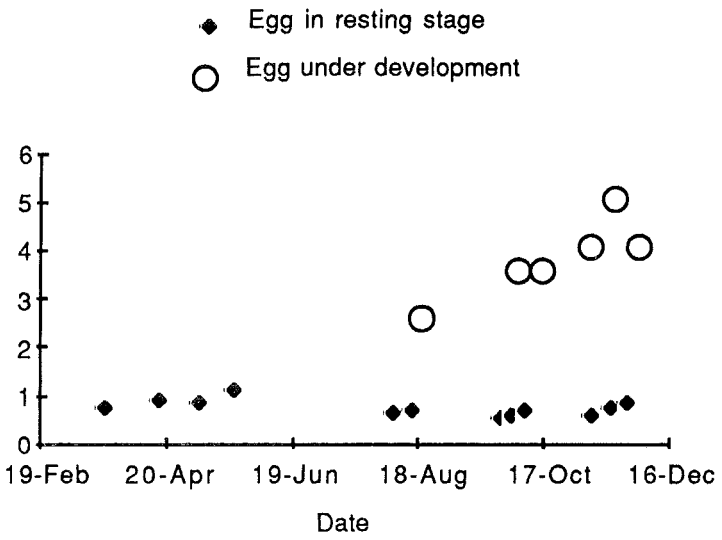

Figure 7. Changes in egg-diameter in the female gonad from May to December.

Behaviour

Observations on behaviour have been made on both adult fish, juveniles and larvae.

Variation in behaviour with age.

1. Larval stage.
Larvae are mostly pelagic, but they can also be laying at the bottom. Sometimes they are laying on their sides. They swim in two different ways. Usually they swim by curling the body from the anus and backwards, combined with movements of the pectoral fins. They also swim with the pectoral fins only. Then they are keeping the body in a vertical position with the tail curled upwards.

2. Pelagic stage.
In this stage too, like in the larval stage, the fish spend most time in the open water. They are swimming for shorter or longer periods, and at intervals they rest. During these brakes they takes a position which is characteristic for this stage, although it is sometimes observed in larvae too. They sink towards the bottom with the body in a vertical position and the tail curled upwards. Sometimes they reach the bottom before they start swimming again. Fish in this stage takes food pelagically, and does not show much interest for food at the bottom.

It is difficult to draw a border between the larval stage and the pelagic stage. The pelagic stage lasts till the larvae are about 50 mm long.

3. First bottom stage.
Fish in this stage spend more time at the bottom than in the free water. Still they frequently swim, particularly when they are hungry. This stage differs from the following stages as the larvae distribute over the bottom with large distance between them. They are not laying close together as

older fish usually do. They are also aggressive towards other fishes coming too close. When fed they first come up to take food falling through the water, but as food starts accumulating at the bottom, they apparently prefer to feed there.

This stage lasts from the fish is 5 till it is 10 cm long.

4. Second bottom stage.
Fish in this stage spend most of their time at the bottom. They differ from the previous stage by aggregating at the bottom, and by being less aggressive. Fish in the early part of this stage can however also be aggressive particularly during feeding.

Fish in this stage prefer to take food from the bottom, but sometimes they take food before it reaches the bottom too. The stage starts when the fish is about 10 cm long, and lasts for the rest of their life.

Activity

Larvae and juveniles of wolf fish are more active than older wolf fish, but less active than most other fish larvae. The larvae hatch at a rather advanced level of development, and from hatching they vary between swimming and rest at the bottom. Apparently they are more active in light than in darkness, and preliminary observations indicate that larvae held in aquaria with light walls are more active than larvae held in aquaria with dark walls. Swimming speed was measured in larvae 2 to 5 weeks old, (Table 2).

Table 2. Swimming speed of wolf fish larvae in cm/second. Each figure is based on 8 - 10 measurements.

	Group 87 - 1		Group 87 - 2	
Age	Mean	SD	Mean	SD
2 weeks	2.3	0.73	3.2	0.99
3 weeks	3.8	1.21	3.2	0.75
5 weeks	3.2	1.08	4.3	0.98

Adult wolf fish kept in aquaria are not very active. Most of the time they spend quietly at the bottom, usually in an aggregation with other wolf fish. Fig. 8 show the proportion of active (i.e. swimming) fishes in an aquarium with many fishes (A, 14 fishes) and one with few fishes (B, 4 fishes). The proportion of swimming fish was always low, and lowest in the group with high fish density.

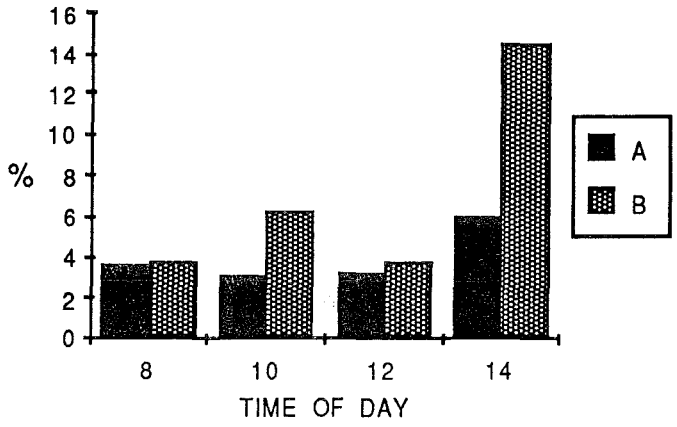

Fig 8. Swimming activity in two groups of adult fish (66.5 - 98 cm.). The figure shows percentage of fish swimming in group A (14 fish) and group B (4 fish).

Three groups with small fish (A, 9 - 13 cm; B, 14 - 18 cm; C, 15 - 38 cm) also showed low swimming activity (Fig. 9).

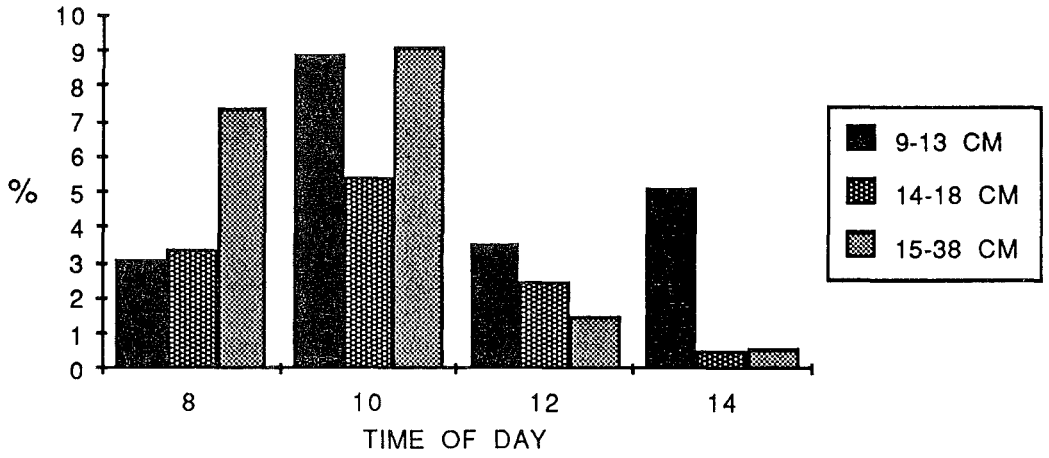

Fig. 9. Swimming activity in three groups of young wolf fish. The figure show percentage of fish swimming in the three size groups.

The young fish were most active around 10 o'clock when they were fed, while the adults were most active in the afternoon.

Activity was also studied in an outdoor basin (Fig. 10). Observations were made twice a day during a one month period (Fig. 11).

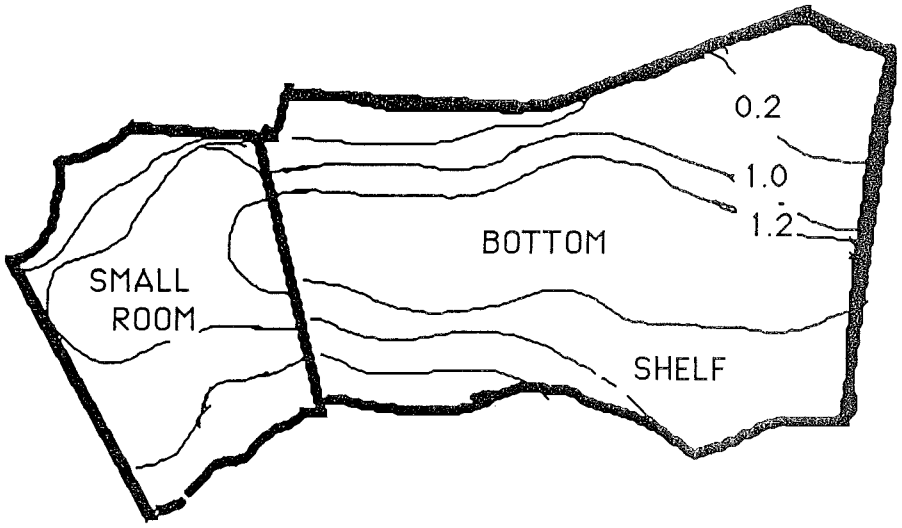

Fig. 10. The small outdoor concrete basin used for observation of behaviour.

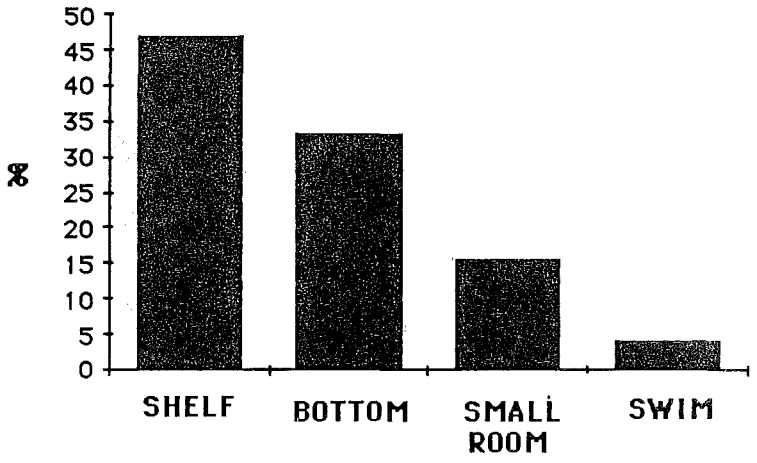

Fig. 11. Percentage distribution of wolf fish in an outdoor basin (see Fig. 10).

The fish spent most of the time on a shelf at 1 to 1.3 m depth (Fig. 11). From 0 to 13 % of the fishes were active during the observations. There were a trend with fewer fishes laying on the shelf and more fishes swimming during the period (Fig. 12). The figure for one day is the mean of two observations.

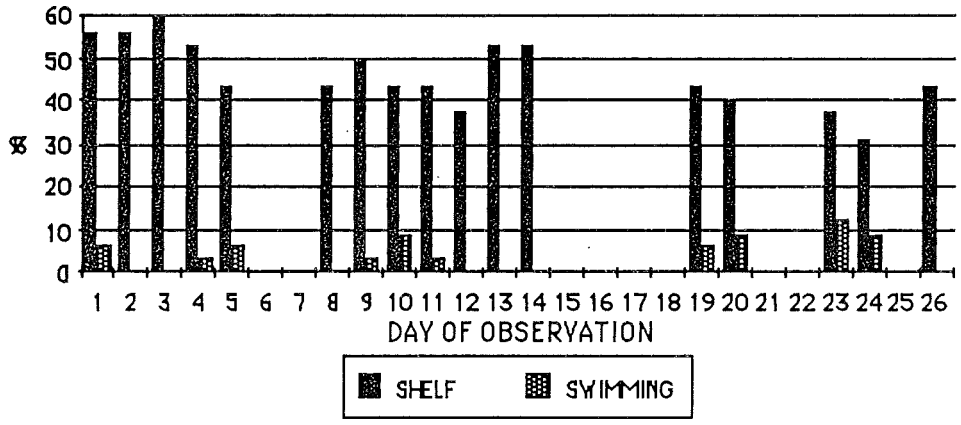

Fig. 12. Percentage distribution of wolf fish laying on a shelf
and swimming in the basin shown in Fig. 10 during a period of
26 days.

Aggression

Wolf fish kept in captivity are generally little aggressive. Often they are laying close together, and are using a small fraction of the available space. Even when fed aggression is seldom observed among adult fish. Sometimes one fish bite another, but apparently it is by mistake, not for fighting.

Cannibalism.

With few exceptions, cannibalism is only observed among young fishes. When small wolf fish (< 10 cm.) attack each other, they take bits from the abdominal region or from the tail. It has not been observed how older fish attach their prey, but as now remains has been found, they probably take the whole fish. Among wolf fish larger than about 30 cm, no cannibalism has been observed. In an experiment with 56 wolf fish, 4 to 9 cm. long 6 fish were eaten by other fish during the period 8 September to 6 October. Two of these fishes (4.3 and 4.8 cm. long) were found partly eaten. One fish died for other reasons during the same period. During the period 6. October to November no cannibalism was observed in this group.

Deceases

So far one ectoparasitt has been observed on the fishes. This parasite, *Platibella anarica*, has caused reduced food uptake. Mortality has been redused by formalin treatment over a two days periode.

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