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ADDITIONAL EXPERIMENTS ON THE GROWTH OF JUVENILES AND FINGERLINGS OF THE EUROPEAN SEA BASS (*DICENTRARCHUS LABRAX* L.)

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ABSTRACT

Laboratory experiments were conducted with juvenile *Dicentrarchus labrax* L. in order to determine their ability to grow and develop in fresh water on small zooplankton and zoobenthos. Fish of 0.036g. weight were able to grow on small Cladocera and Copepods. Juveniles of 25–29mm total length were able to feed on fry of *Sarotherodon* sp. *D. labrax* of 0.77g weight, fed *Sarotherodon* sp. showed an individual growth rate of 0.06–0.11 g/day and a food conversion rate of 8.18 when raised to the size of 3.57g.

INTRODUCTION

In Israel, polyculture is the most common method of fish farming. *Sarotherodon* sp. in their second year of life, are sometimes used in such mixed cultures and are grown to a weight of 500–600g. Wild spawning which results in overcrowding does occur, however. To overcome this problem, the fish are sexed and only the males stocked. The procedure is not foolproof and some females are introduced along with the males. A possible solution to the spawning which takes place is the introduction of predatory fish which will feed upon the fry. In fresh water, lakes and reservoirs, the European sea bass, *Dicentrarchus labrax* L., is known to consume some of the undersriable, small fish and thereby ensure better growth of the fish stocked.

D. labrax, a marine predator, is a member of the *Serranidae*, a marine family in which are included a number of euryhaline species. *D. labrax* can live and grow in fresh water but it will not reproduce. This limitation is advantageous when introducing these fish into fresh water: proliferation of other fry is controlled and at the same time *D. labrax* itself, will not multiply. Since 1969, this species has been considered a likely candidate for aquaculture. Artificial spawning, rearing of larvae, and experimental growth studies in salt and brackish water ponds, cages, and lagoons, have been conducted recently (Barnabe, 1976; Girin, 1978). The adaptability of juvenile *D. labrax* (0.026g) to brackish water (S = 12ppt) was studied by Chervinski (1979). The growth of fingerlings of 1.0g weight in fresh water has been examined by Chervinski and Lahav (1979) under laboratory conditions.

The suitability of *D. labrax* of 200g and greater weight, to serve as predators of *Sarotherodon* sp. in ponds had already been investigated (Chervinski, 1975). The earliest age at which these fish could be introduced into fresh water and the overall efficiency of including *D. labrax* in polyculture is however, unknown.

The aim of the present work was to test whether juvenile *D. labrax* of size smaller than 1.0g could survive transfer to fresh water and whether they could grow on fresh water zooplankton and zoobenthos. We also wished to determine at which size this species is first able to prey upon *Sarotherodon* sp.

MATERIALS AND METHODS

Two hundred juvenile *D. labrax* of average weight of 0.036g and of average total length of 16.3±1.594mm (average ± standard error) were flown in from France on March 15, 1979, and maintained in a communal tank of sea water (S = 39 ppt).

Growth experiments, after adaptation to fresh water, were conducted at the Fisheries Station Genosar. Observations were made in plastic containers of 100 l. capacity, containing 80 l. fresh, filtered water from lake Kinneret (S = 0.3 ppt). The flow rate was 1.0 – 2.0 l./minute per container.

On March 18, 1979, trials were begun in testing the adaptability of the 0.036g juveniles to fresh water. For this purpose, six groups of twenty fish, each were transferred from the communal tank to six plastic containers filled with 80 l sea water (S = 39 ppt). Fresh water was added to each container at a rate allowing total replacement of the sea water within twenty-four hours. The fish were than maintained in the same water for an additional seven days, removed and counted. Throughout the experiment, the fish were fed small Cladocera and Copepods.

The zooplankton and zoobenthos used in the experiments were grown in a concrete tank of 50m^3 capacity containing fresh water and fertilized with chicken manure. Under these conditions, there was an abundance of Cladocera, Copepods and Chironomids. The Copepods and the Cladocera were caught with the aid of a scoop net of very fine mesh (50 micron pore size); the Chironomids were seined and collected from the mud of the tank bottom. Both the zooplankton and the Chironomids were filtered through three sediment nets of 1190, 710 and 250 micron pore size. *Sarotherodon* sp. fry were caught in commercial ponds in which wild spawning had taken place.

Three series of feeding experiments were carried out.

In the first series, there were three experimental groups each of which included fish of 0.05g initial weight. The first group, the control, consisted of three containers each stocked with fifteen fish which were fed a daily ration of 1g trout pellets (44% protein). A second group of three containers were also stocked with fifteen fish per container. Their daily ration was 15g zooplankton (Cladocera and Copepods) of size smaller than 0.25mm. The third group consisted of six containers stocked with but five fish each. Each vessel was daily supplied with 20g small zooplankton (Cladocera and Copepods of 0.25–0.71mm size). The zooplankton multiplied in these containers and the newly hatched larvae were observed to be consumed by the fish. The experiment was continued for 28 days (March 25 – April 22). The temperature ranged between 16–22°C with an average of 19.8°C.

In the second series, the initial weight of the fish was 0.9g. The trials were conducted in two sets of three containers each. In both groups, five fish were stocked in each container. The first group was supplied with a daily ration of 14g small zooplankton (0.25–0.71mm length). The second group was fed an equivalent daily weight of Chironomids. This experiment also lasted 28 days (May 13 – June 10, 1979).

The third series of experiments was carried out in three containers each stocked with five fish. The experiment was repeated three times. The fish were allowed to feed ad lib on small fry (0.04 – 0.10g.) of *Sarotherodon* sp. In the third trial, the amount of fry consumed was calculated by subtracting the amount remaining from that given. Upon termination of the experiment, the average conversion rate (amount of fry consumed/ increase in fish weight), was reckoned.

RESULTS

The results of the adaptation experiment indicated that juvenile *D. labrax* could adjust to a gradual change from sea water to fresh water. The survival rate after seven days maintenance in the fresh water was 77.5% (Fig. 1).

The results of the feeding experiment are presented in Table 1. The individual weight gain of fish fed trout pellets was 8%/day while those fed small Cladocera and Copepods grew at a rate of 16%/day. The most favorable rate, 36%/day, was achieved in the containers stocked with only five fish, fed small zooplankton.

Table 2 shows the results of the second series of experiments. The individual growth rate of the fish fed small zooplankton was 2.2%/day, that of the fish fed Chironomids was 3.3%/day. In order to find the amount of Chironomids consumed, on ten different occasions during the experiment, the Chironomids remaining after twenty-four hours were removed and weighed. By subtracting their weight from the weight of the Chironimids provided, it was calculated that the average daily consumption per container was 7.1g.

Fig 1. Percent survival of *D. labrax* upon adaptation to fresh water.

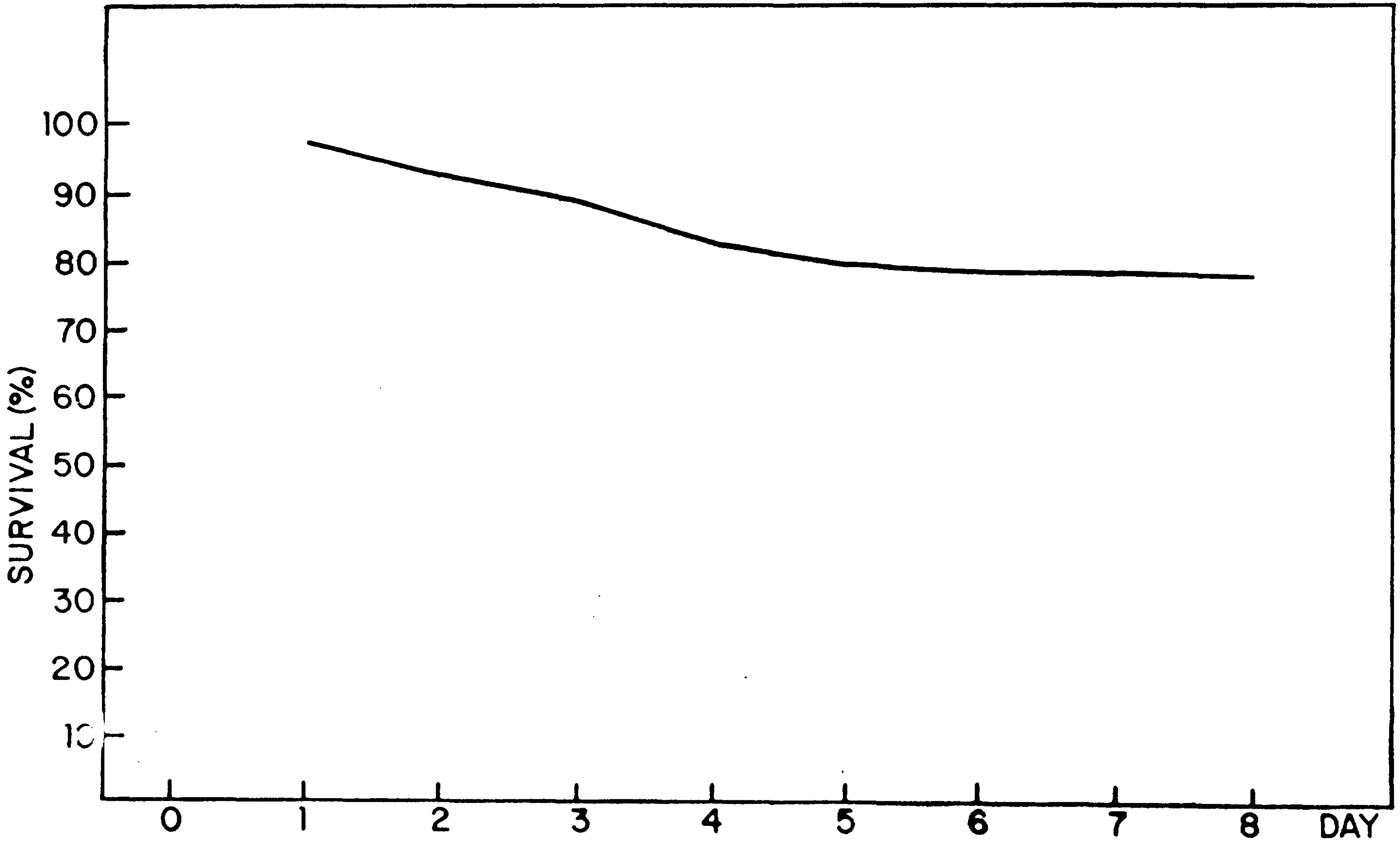

Table 1. Growth of sea bass in plastic containers upon being fed pellets and zooplankton (March 25 – April 22, 1979 = 28 days). Three containers in each trial.

Feed	Number of fish		Mean weight(g)		Percent	Increment	
	stocked	harvested	initial	final	mortality	g/fish/day	%/fish/day
Trout starter	15	13.3	0.050	0.150	11.3	0.004	8
Small zooplankton <25mm	15	12.7	0.050	0.270	15.3	0.008	16
Zooplankton 0.25–0.71mm	5	4.3	0.050	0.540	11.7	0.018	36

Table 2. Growth of sea bass in plastic containers upon being fed zooplankton and chironomids. (May 13 – June 10, 1979 = 28 days). Three containers in each trial, five fish per container.

Feed	Mean weight(g).		Individual growth increment	
	initial	final	g/day	%/day
Zooplankton	0.9±0.122	1.4±0.264	0.02	2.2
Chironomids	0.9±0.100	1.8±0.264	0.03	3.3

Fig 2. Size relationship between predator *(D. labrax)* and prey *(Sarotherodon* sp.)

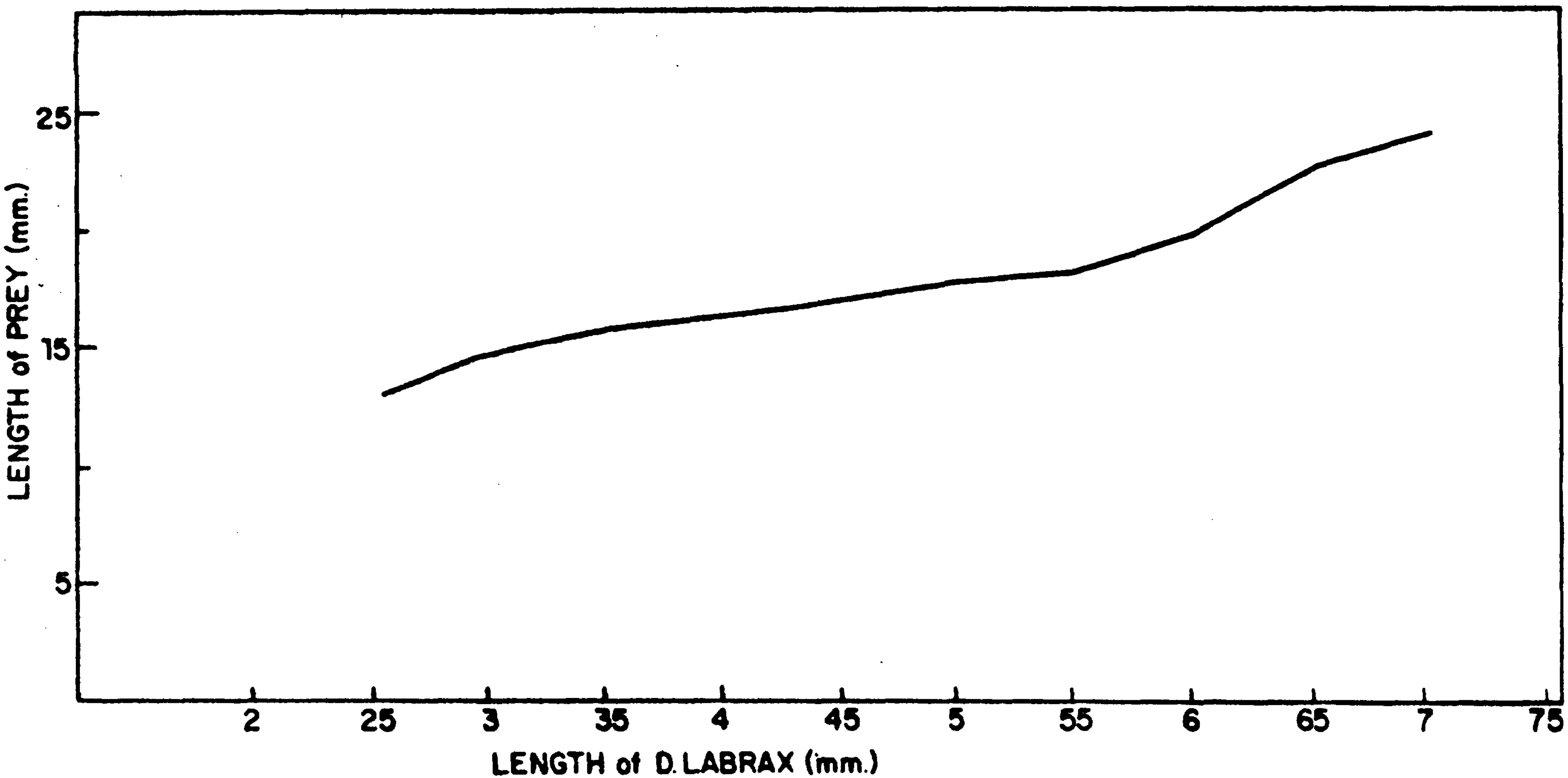

Table 3 shows the results of the third experiment. It can be seen that when the initial weight of the *D. labrax* fingerling was 0.77g, the individual growth rate was 7.8%/day. For fish of 1.87g initial weight, the rate was 4.8%/day. In the third trial, the average weight of *Sarotherodon* sp. fry consumed by *D. labrax* was found to be 92.1g/container over a period of twenty-one days. Each fish consumed an average of 0.9g/day and the mean growth rate was 0.11g/day (0.8%/day). In this case, the food conversion rate was 8.18.

Table 3. Growth of sea bass in plastic containers upon being fed *Sarotherodon* sp. fry. (Five fish per container, three containers at each date).

Feed	Mean weight ±S.E.		Individual growth increm.		Duration of experiment days	Conversion rate
	initial	final	g/day	%/day		
Sar. fry	0.77 ±0.209	1.87 ±0.255	0.06	7.8	19	
Sar. fry	1.87 ±0.255	3.77 ±0.323	0.09	4.8	21	
Sar. fry	1.30 ±0.173	3.57 ±1.051	0.11	8.5	21	8.18

Figure 2 depicts the relationship between *D. labrax* size and that of the *Sarotherodon* sp. it consumed. We found that *D. labrax* of 25–29mm total length were able to prey on *Sarotherodon* sp. of 13mm size. A near linear relationship was observed between the predator's size and that of the prey it consumed.

DISCUSSION

Before undertaking the feeding experiments, we ascertained that *D. labrax* could readily adapt to fresh water (a 77.5% survival rate, similar to the 82.4% previously obtained upon adaptation to brackish water (Chervinski, 1979)).

Previous experiments had been carried out in France (Berahona - Fernandes and Girin, 1976; Metailler et al., 1977) on fry and juveniles of *D. labrax* in order to determine the minimal size at which they could be fed pellets and also to check the growth rate and protein requirement of the fry. Metailler et al (1977) found that the optimum concentration of feed-protein for young *D. labrax* was 47–50%.

In the present work, it was found that juvenile *D. labrax* (0.05g) were able to feed on small Cladocera and Copepods. Upon consumption of small zooplankton the fish growth rate was higher than when they were supplied with pellets (Table 1). Metailler et al (1977) determined an individual growth rate of 0.03g/day for fish of initial weight ranging between 0.4–0.9g. Our findings were somewhat lower (0.018g/day), but for fry of 0.050g.

In our experiments, once the *D. labrax* fry had reached a weight of 0.77g, they were able to grow on small *Sarotherodon* sp. The growth rate was 0.06–0.11g/day. In previous experiments (Metailler, 1977) fish of similar weight fed pellets had shown a growth rate of only 0.07g/day.

Our experiments revealed that *D. labrax* of 25–29mm total length were able to prey on *Sarotherodon* sp.of 10–14mm size. This would mean that *D. labrax* is probably capable of feeding upon the progeny of wild spawnings and upon small, undesirable fish.

Further experiments need to be carried out to determine the optimum size and number of *D. labrax* that as police fish could be introduced into fish ponds and even into Lake Kinneret . The present results are sufficiently promising to warrant stocking a limited number of *D. labrax* fry in Lake Kinneret and studying their food habit therein.

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