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A Floating Trout Hatchery System Applicable in Standing Water

[1]H.M. Buyukcapar, [1]A. Alp, [2]A. Akyuz and [2]Y. Ozturk
[1]Department of Fisheries, Faculty of Agriculture, Kahramanmaras Sutcu Imam University, 46100 Kahramanmaras, Turkey
[2]Department of Agricultural Structures and Irrigation, Faculty of Agriculture, Kahramanmaras Sutcu Imam University, 46100 Kahramanmaras, Turkey

Abstract: A floating trout hatchery system was designed to meet the fry requirement of a 150 tonnes/year capacity floating trout farm. This system is made of angle iron, grooved- galvanized sheet iron, steel sheet and PVC and is floated on drums (60 L). Incubation channels were sunk to a depth of 23 cm below the surface. In determination of the system's performance efficiency the fertilization ratio; eyed-egg ratio; hatching ratio and swim up larvae rate were calculated as 98.18, 80.02, 58.83 and 85.47%, respectively. The overall performance ratio from fertilization through to development of swim-up larvae was also calculated as 39.47%. It was concluded that the system's performance could be increased, if the effect of waves can be reduced.

Key words: *Oncorhynchus mykiss,* floating hatchery, hatchery output

INTRODUCTION

One of the commonest aquaculture systems found in many different water types is floating cage rearing. For the species cultured in this kind of system, in which optimal environmental conditions similar to natural habitat are provided, good economic results can be obtained and developed (Guner *et al*., 1998).

As almost all fry requirements of cage farms come from land in trout farms, cage farms struggle to have sufficient fry at a reasonable price and so cannot compete with other types of trout farms. In addition, uncontrolled transfer of eggs between different trout farms can cause outbreaks of diseases and heightened death rates, increasing the advantages for cage culturists to produce their own fry (Emre, 1998).

Although land-based trout hatchery systems and their success rates are well studied (Rad and Koksal, 2001; Kurtoglu *et al*., 1998; Bascınar and Okumus, 2004; Aras *et al*., 2003; Okumus *et al*., 1997). Studies of floating hatchery systems are limited: The success ratio eyed egg to swim up larvae of *Oncorhynchus kısutch* on the Kennedy River in Canada was 86.6% (Bruce *et al*., 1990). The same ratio for *Salmo trutta* on the Atakoy reservoir in Turkey was 87.6% (Karatas, 1998) and 98.2% for the eggs of *Oncorhynchus mykiss* on the Almus reservoir dam lake in Turkey (Karatas and Tolgacı, 1998). In these earlier studies eyed-eggs were used in the floating hatchery systems; however, in this study, all production steps including, maintenance of brood-stocks, were accomplished on a floating trout farm. Furthermore, the current study was aimed at producing fry in excess of the requirements of the particular floating trout farm, which has a floating hatchery system unique in Turkey.

This study, therefore, differs from earlier studies in both aim and methodology and was targeted to fill gaps in the present knowledge of this subject.

MATERIALS AND METHODS

This research was carried out in the Sır Reservoir on the Ceyhan River, 10 km far from North-west of Kahramanmaras City centre in Turkey in 2004. A floating cage trout farm of 150 tone/year capacity was anchored in the reservoir and breakwaters 2 m deep were placed to protect against water movement and waves (Fig. 1).

The hatchery house (A-A section, Fig. 2), in which the feeding and larva cages were located, was 11.5 m×7m in dimension, with a total height from the water level of 2.32 m. The floor area of the house was 80.5 m^2; its walls were of 40×50×1.2 mm rectangle steel construction and the ceiling was covered with grooved-galvanized sheet iron made of 50×70×3.2 and 40×50×1.2 mm steel. The side walls of the hatchery house were of steel sheet (5 mm thick) from the base to 60 cm above the water level with the rest being of PVC. An entrance was made in the south of the house and the whole basement was designed as hatchery (60×600×40 cm, H×L×W) with the 50 cm wide pathways

Corresponding Author: H.M. Buyukcapar, Department of Fisheries, Faculty of Agriculture, Kahramanmaras Sutcu Imam University, 46100 Kahramanmaras, Turkey Tel: 90 344 223 76 66 Fax: + 90 344 223 00 48

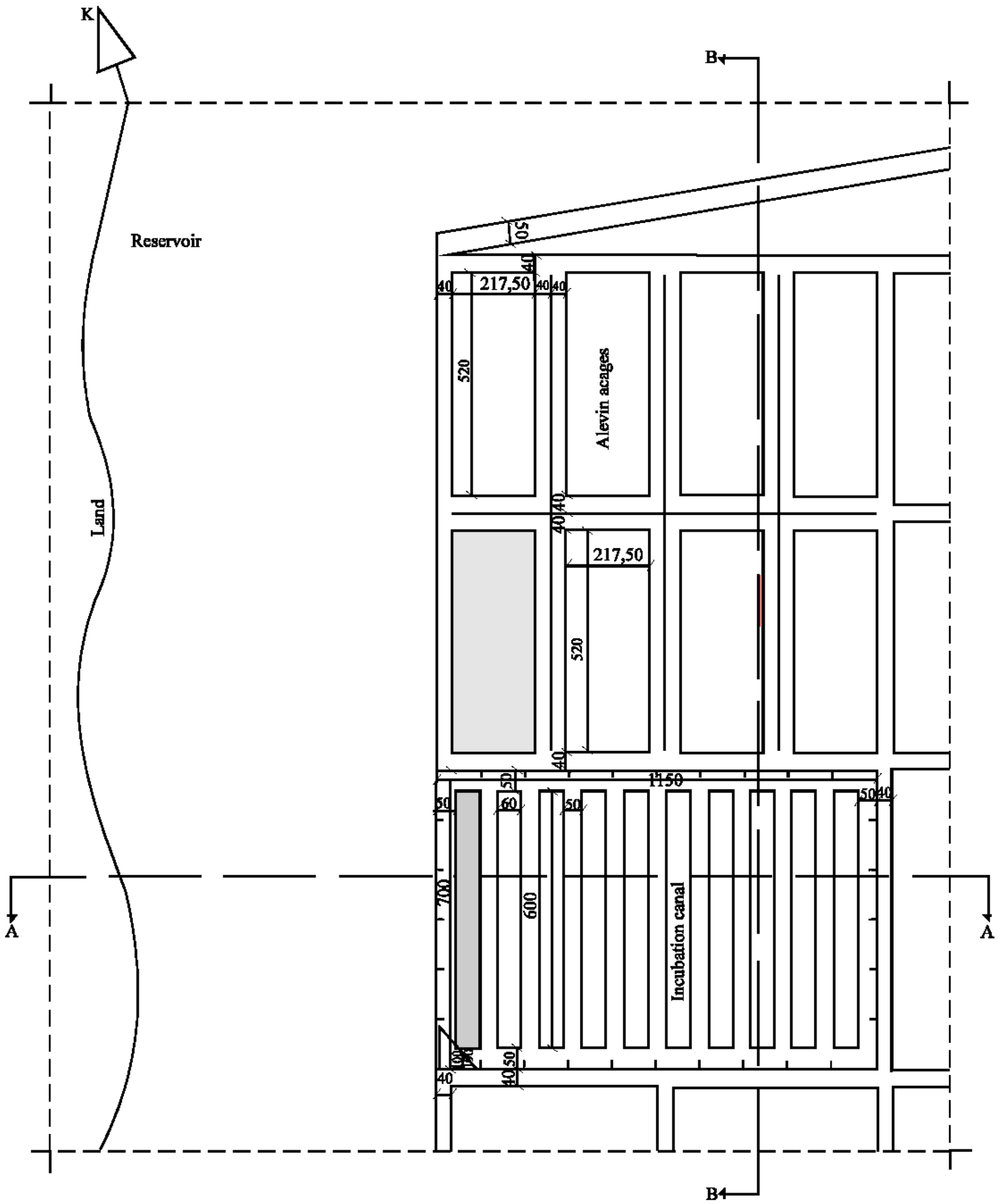

Fig. 1: Floating trout farm and hatchery house

at the sides. Under the pathways 60 L plastic floating drums were located on housings made with 35×35×5 mm angle-iron and 5×30 mm sheet metal and steel sheets (5 mm) were used to make pathways on the floating drums (Fig. 2 and 3). Incubation channel basins were constructed on a framework made of 30×30×5 mm angle-iron covered by 5 mm thick steel sheets that had 5 mm (diameter) holes in both their ceilings and floors. The tops of the incubation channels were located parallel to the water currents and an incubation cassette (57×40×20 cm) was set in each incubation channel so that there was a depth of 23 cm of water (Fig. 4). The frameworks of the incubation cassettes were made of 30×30.5 mm angle-iron with 5 mm thick steel sheets for side walls and floors (base) with 2 mm (in diameter) holes. The tops of the incubation cassettes were made of 30×30.5 mm angle iron and were designed to have 3 cm water over them (Fig. 5). When the fish were large enough to swim and feed, they were transferred from the hatchery house to the larval cages (5.20×2.17 m) located to the north of the hatchery house. These cages, made of 4 mm net thins, were shaded using PVC of 2 m height above.

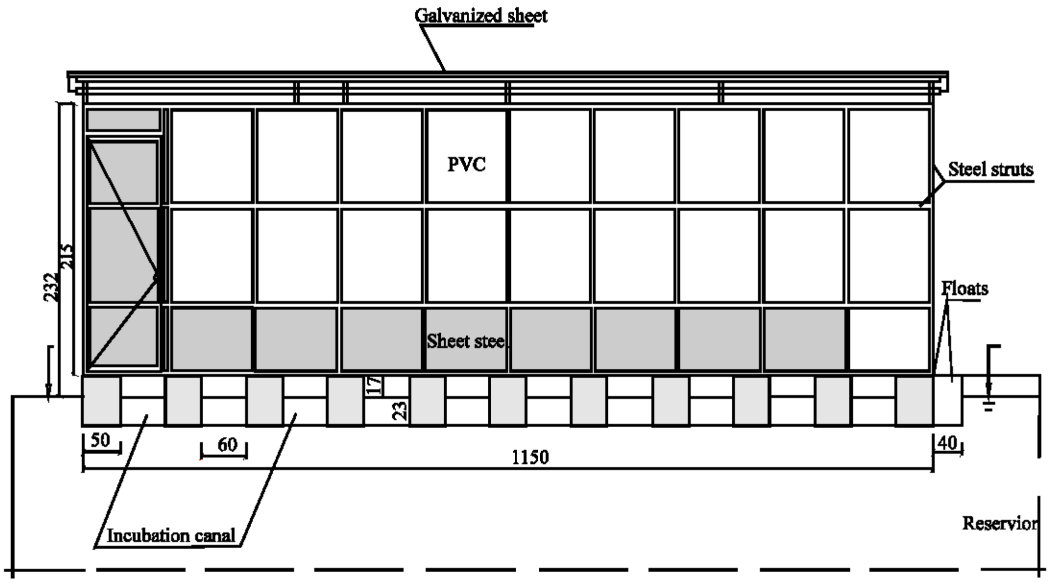

Fig. 2: A-A section of hatchery house building

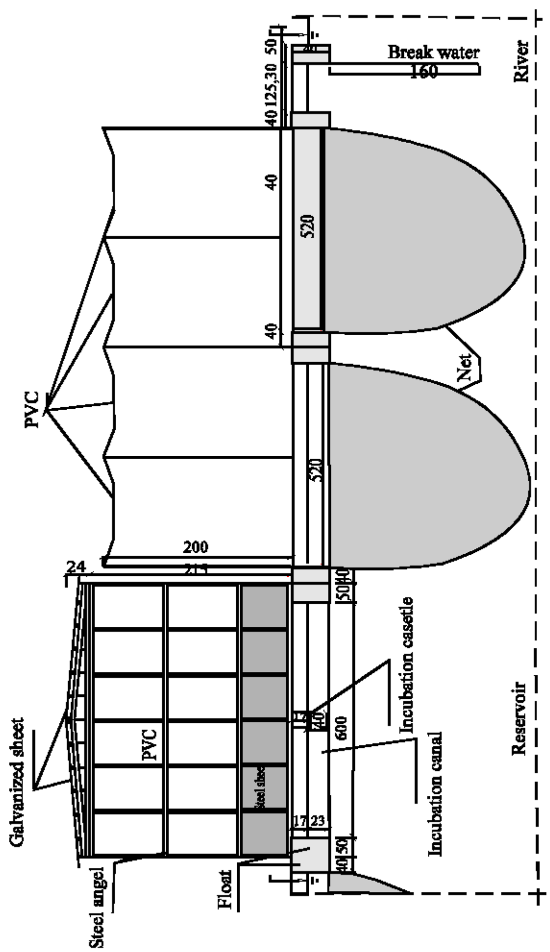

Fig. 3: B-B section of hatchery house building

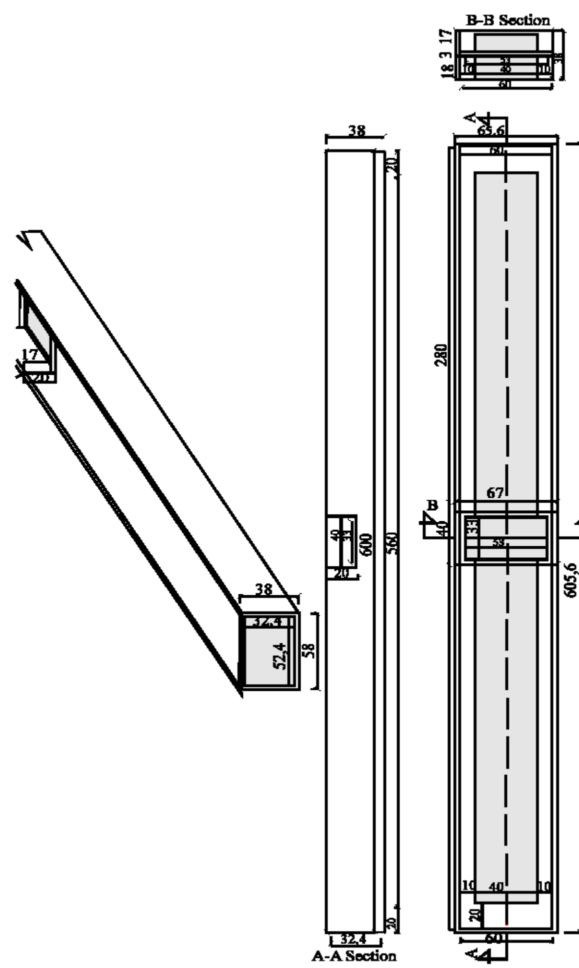

Fig. 4: Incubation canal

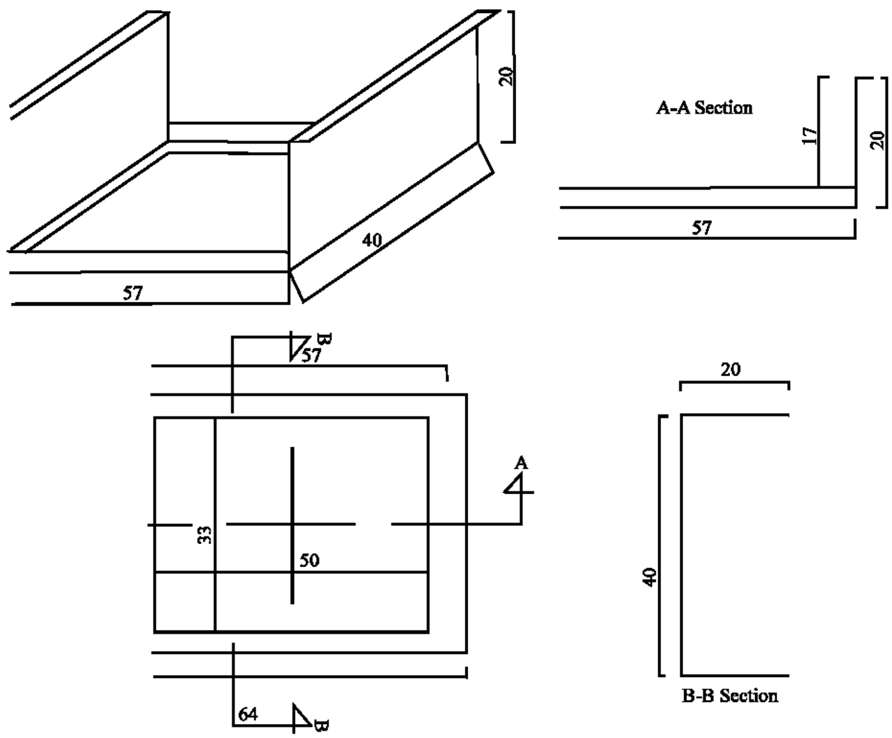

Fig. 5: Incubation cassette

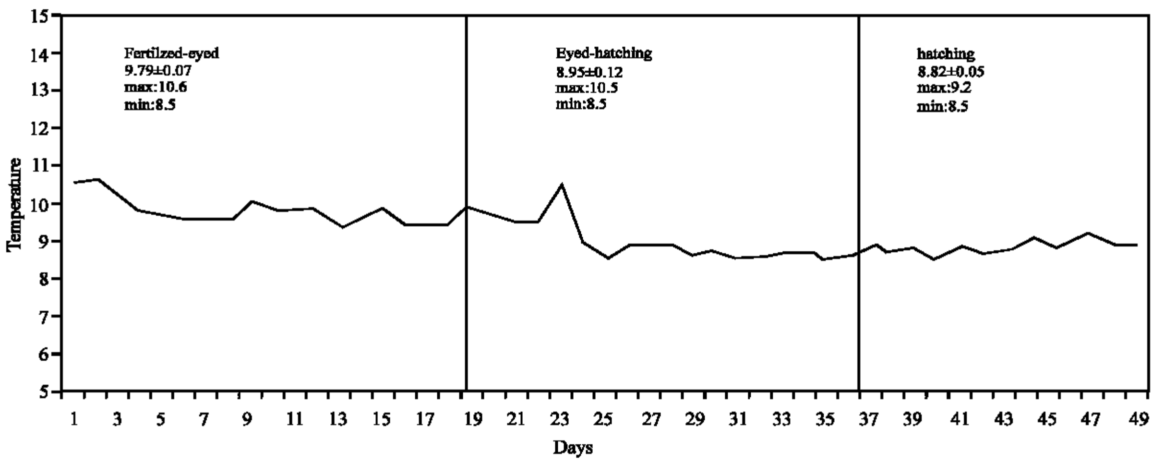

Fig. 6: Temperature values during the experiments

In this study, 3-year-old Rainbow trout (*O. mykiss*) were used and fed with a commercial pelleted feed. Experimental animals were starved two days prior to spawning and were anaesthetized using phenoxyethanol for determination of their total weights (g). The quantity and weight of eggs were determined by taking a 15 sample from each spawner whilst egg diameter was calculated from an average of 10 egg diameters measured by digital compass. A total of 35000 fertilized eggs were put into each of two incubation canals in 5 incubation cassettes (each of 7000 egg capacity) in order to determine fertilized; eyed eggs; hatched alevins and swim-up larvae ratios.

RESULTS

The average water temperature (±CI 95%) for the first 19 days was as 9.79±0.07 while the average for day 20-37 and 38-49 were 8.95±0.12°C and 8.82±0.05 °C, respectively (Fig. 6).

The average live weights of the female brood-stock (g±CI) were 1438±40.51 g; average egg number was 3880±190.79; average total egg weight was 243.28±15.70 g and average egg diameter was 4.45±0.09 mm (Table 1).

At the end of the 3rd day of the experiment, an average of 6881.3±7.13 eggs per cassette were recorded as

Table 1: Research findings, general means and proportions

Brood-stock	Average brood-stock weight (g) (n=20)			1438±40.51*	
Characteristics	"	total egg count		3880±190.79	
	"	total egg weight (g)		243.28±15.70	
	"	egg diameter (mm)		4.45±0.09	
Hatching	Number of eggs per cassette at start (n=10)			7000	%
Characteristics	Average number fertilized eggs (day 3)			6881.3±7.13	98.19
	"	"	eyed- eggs (day 19)	5507.2±140.39	80.02
	"	"	alevins (day 35)	3234.8±91.46	58.83
	"	"	swim-up alevins (day 49)	2763.3±80.77	85.47
	Overall hatching performance				39.47

*Confidence interval

having been successfully fertilized and on the 19th day an average of 5507±140.39 live eggs was observed. The average number of hatched alevins on the 35th day was calculated as 3234.8±91.46 and at the end of the experiment (49th day), the average number of swim-up larvae was 2763.3±80.77 (Table 1). The fertilized; eyed; hatching and swim up rates of larvae were therefore 98.19±0.16, 80.02±2.01, 58.83±1.40 and 85.47±1.02%, respectively (Table 1). The overall success rate of the hatchery house, based on the number eggs (7000) in the incubation cassettes and average number of larvae surviving at to swim-up age, was 39.47%.

DISCUSSION

In previous studies, on hatching systems of land-based operations, the rate of larvae surviving to the free swimming period, were reported as 66-73%, 61-98%, 72-93% and 52%, respectively (Rad and Koksal, 2001; Kurtoglu *et al*., 1998; Bascınar and Okumus, 2004; Aras *et al*., 2003; Okumus *et al*., 1997). Rad and Köksal (2001) reported that the overall average fertilization rate of trout in Turkish hatcheries was 80% whilst survival to larvae stage was 67%. The hatching to larvae ratio of the current study is therefore relatively less than that of these earlier studies 87.6% (Bruce *et al*., 1990) study, 98.2% in Karatas (1998) study and 86.6% in Karatas and Tolgacı (1998) study, whilst other results of the current work are more similar to the results of previous research.

It was surmised that the hatching to larvae survival rate was adversely affected by shaking due to the waves on the reservoir and that the low hatching to larvae survival ratio resulted in the low overall success rate of hatching unit. Breakwaters included in the original project designs but were subsequently rejected due to their effect on the streamlining of the unit. However it was observed during the hatching experiments that this precaution is necessary in order to minimize the adverse affects of waves and water movements. It is suggested that the hatchery buildings could be located in the middle of floating units to overcome the problems caused by waves. Unstable water quality (muddy at times) might have been another reason for the low egg-hatching ratio in the study. The quality of water used in cage systems is unstable due to the fact that such water sources can be easily affected by environmental incidents. For this reason, floating hatchery systems should be constructed on the canals at the outlets of dams where water quality is more stable.

It is seldom feasible and generally uneconomic to re-model and/or re-design the systems of concrete hatchery buildings established on land. Almost all the parts of the floating hatchery establishment are however, portable, so whole systems can be re-modeled easily if needed and this is an important advantage for such systems. The advantage is crucial not only for biological factors (such as genotype, age and nutrition) that affect egg yields, but also for minimizing the structural arrangements that result in low hatching performance.

In conclusion, this system is feasible for reservoirs that have appropriate quality of water for trout growing. As more floating hatchery systems are established, the structural and engineering knowledge and experiences required for their success will increase.

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