Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(5): 1040-1043

Received: 20-07-2016
Accepted: 21-08-2016

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Artificial breeding of rainbow trout (*Oncorhynchus mykiss*) at Madyan hatchery Swat, Khyber pakhtunkhwa, Pakistan

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Abstract
Oncorhynchus mykiss is a kind of cold water carnivorous fish whose meat has a delicate and fleshy texture with few bones. Rainbow trout have highly economic value and broad market prospects. For artificial breeding, Stripping method was used during stripping 16 specimens were selected. 8000 eggs were stripped out from the 9 female rainbow trout. The recorded fertilization rate was found 87.5%. In 2nd breeding 40000 eggs were stripped out from 37 female rainbow trout 95% eggs were recorded fertilized. In 1st breeding 84000 eggs were stripped out from 73 female 95.23% eggs were recorded fertilized. In 2nd breeding 40000 eggs were stripped out from 44 female 92.5% eggs were recorded fertilized. In January 1st breeding 48000 eggs were stripped out from 51 females, 93.75% eggs were recorded fertilized. In 2nd breeding 68000 eggs were stripped out from 55 female, 95.23% eggs were recorded fertilized. In February 1st breeding 48000 eggs were stripped out from 51 female, 95.83% eggs were recorded fertilized. In 2nd breeding 20000 eggs were stripped out from 25 female 90% eggs were recorded fertilized.

Keywords: Rainbow trout (*Oncorhynchus mykiss*), eggs, Swat

1. Introduction
The rainbow trout (*Oncorhynchus Mykiss*) belongs to Oncorhynchus genus, Salmoninae Subfamily, Salmonidae Family, Salmoniformes Order, rainbow trout is one of the fish that is commonly cultured. It is a kind of cold water carnivorous fish whose meat has delicate and fleshy texture, fresh and tender flavor with a few fish bones [1]. Rainbow trout are present in all continents and presently are distributed across the globe [2].

Artificial breeding of fish was exposed in the initial 18th century by the scientist *Jacobi*, nevertheless this finding was elapsed, earlier it was presented in repetition 100 years ago by two Frenchmen, *Remy* and *Gehin*, who positively hatched trout [3]. Rainbow trout were first farmed in 1879 in California. Early in 1930 the political agent of Swat started rainbow trout (*Oncorhynchus mykiss*) farming for the first time in swat the species of trout found in Swat is the rainbow Trout (*Oncorhynchus mykiss*). He introduced 200 adults and 1800 fry in the area of Kukari but fry fail to survive. Swat has well-known fast flowing rivers and cold water streams which are best for culturing of trout. Pakistan has more than 186 freshwater fish species [4].

Rainbow trout has highly economic value and broad market prospects [1].Throughout the world, people believe fish to be a significant usual reserve for nutrition feeding. Fish are also valued as a playful reserve for fishermen of all stages of Skill. Fish plays a vital role in Pakistan's economy and is also considered to be an important source of lively-hood for the coastal inhabitants [5]. Through artificial breeding we can get more production from hatcheries, in swat especially from trout hatchery. The aim of the current research work was to find out the artificial breeding of rainbow trout fish and concern optimization and factor which effect hatchery yield.

2. Materials and Methods
2.1 Study area
The study was carried out at Madyan trout culture Madyan Swat village situated at Tangor Madyan town swat.

Madyan town is at altitude of 4335 feet above sea level. It is situated 55 kilometers towards north farm the district capital Saidu Sharif. It has natural beauty with snowcapped mountains, lush green forest and clear water. Rainbow trout fish breeding was studied through these two methods one of natural breeding methods and the second one was artificial breeding. The breeding season of rainbow trout starts from November to February. Material required to be Ms 222 chemicals for anesthesia, Chemical used were polyvinyl pyrrolidone, iodine, Soft cloths and towel were used, Round hand net was used, Round tub, Triangle stand, Bucket, Incubator, trays, rectangle net.

2.2 Methods

The rainbow trout when reached to 3 years the mature male changed into black and female into white green. On the onset of maturity, small scales begin to appear. Male and female were selected from mature population of Madyan hatchery. For catching fish round hand net was used, soft cloth and towel was used for holding. Two days before stripping food was not given, to avoid interference of waste materials inside the body with sperms. MS222 was used for anesthesia. For stripping the fish were kept in the tub for four to five minutes. The male and female were stripped simultaneously the level of water in the tub was 15 inches, to complete fertilization the eggs were kept for ten minutes in the tub. The eggs were then washed three to four times with clean water by doing so the unfertilized eggs were raised up to the surface of water. The fertilized eggs were than treated with (polyvinylpyrrolidone) disinfectants, after 3- 5 min the eggs were than rinsed with clear water to remove polyvinylpyrrolidone. The eggs were counted in the trays and placed in incubators for hatching. It was observed that eggs should not be infected after five days of hatching as this can cause excessive mortality and or premature hatch. It was observed that within 5 to 15 days the eggs arrived in the eye egg stage**.** After 2 to 3 days the eggs were hatching. We noticed white foam on the surface during hatching which is due to embryonic fluid which should be removed. After 1 to 2 weeks' we observed the changes in the yolk sac by looking at the abdomen or ventral side of the fish. We didn't forget to remove dead fish daily. When this yolk sac was completely disappeared, the fish were now fry, about 3-4 week the fry raised to the top of the hatching incubator. At this time we out them from the incubator and start feeding. After 4 weeks the percentage of fry that survived depended on many factors including environmental, physical conditions. Some fry would die and other would survive which are now fingerlings.

3. Results

In the current study artificial breeding of trout fish was carried out in the Madyan river swat. Fertilization of fish was observed during winter form November to February. Temperature observed in different months is show in graph 3. The optimum temperature concentration for best fertilization was (temperature concentration 11 °C). It was observed that within 5 to 15 days the eggs arrived in the eye egg stage and these were very vulnerable to environment stimuli such as light and changes in temperature. So the eggs should not be exposed to sunlight or fluorescent light. The tanks should be covered with some martial to provide shade and to avoid pollution. The temperature was kept nearly 12 °C to 14 °C providing spring water conditions. For maintaining high oxygen and suitable tank temperature we facilitate the water flow continuously. In November out of 84 specimens 16 specimens were selected for stripping. In which 7 male and 9 were female. 8000 eggs were stripped out from the 9 female rainbow trout fish. After treating 87.5% eggs were fertilized and 12.5% unfertilized. In November Second breeding was carried out 150 rainbow trout specimens were taken for 2nd stripping in November. Out of these 31 male and 37 females were selected for current study. 40000 eggs were stripped out form 37 female rainbow trout fish. After treating 95% eggs were fertilized and 5% unfertilized. (Table 1) 260 specimens of rainbow trout fish were produced in the month of December. There were 54 male and 73female.84000 eggs were stripped out. After treating 95.23% eggs were observed fertilized and 4.76% unfertilized. In December Second Breeding was carried and the total specimens were 215. There were 44 male and 44 female. 40000 eggs were stripped out. After treated 92.5% eggs were fertilized and 7.5% were unfertilized. (Table 1) In January 195 specimens of rainbow trout fish were ready for stripping. There were 46 male and 51female which were taken. 48000 eggs were stripped out. After treating 93.75% eggs were recorded fertilized and 6.25% unfertilized. In January second breeding Total members of rainbow trout were 210 which were selected for Second stripping in the month of January. There were 43 male and 55 female, 68000 eggs were stripped out. After treating 95.23% eggs were recorded fertilized and 4.76% were unfertilized. (Table 1.0) 142 specimens were selected for stripping in the February 1st breeding. In which 42 male and 51 were female. 48000 eggs were stripped out. After treating 95.83% eggs were fertilized and 4.16% were unfertilized. In February's Second stripping total specimens were 200. In which 24 male and 25 were female. 20000 eggs were stripped out. After treating 90% eggs were fertilized and 10% were unfertilized. (Table 1)

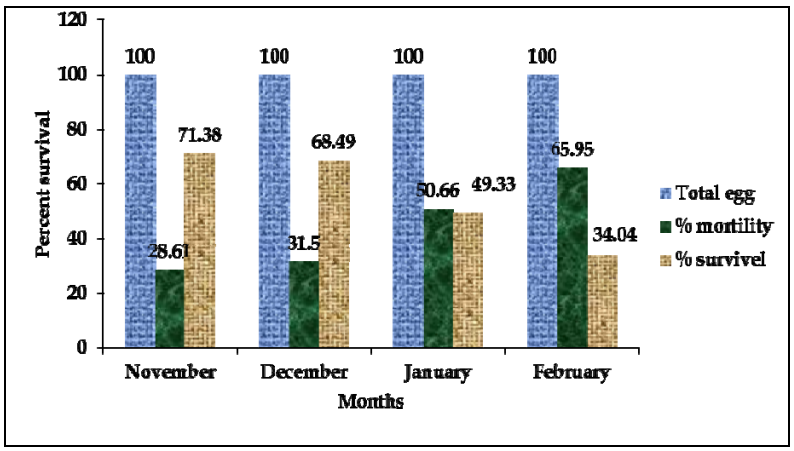
Table 1: Percentage of fertililized eggs and percentage of unfertilized eggs.

Months	Total population	Selected members		Total eggs	Fertilized With percentage	Unfertilized With percentage
		Male	Female			
November	*16	7	9	8000	7000 (87.5%)	1000 (12.5%)
	**68	31	37	40000	38000 (95%)	2000 (5%)
December	*127	54	73	84000	80000 (95.23%)	4000 (4.76%)
	**88	44	44	40000	37000 (92.5%)	3000 (7.5%)
January	*97	46	51	48000	45000 (93.75%)	3000 (6.25%)
	**98	43	55	68000	60000 (88.23%)	8000 (11.76%)
February	*93	42	51	48000	46000 (95.83%)	2000 (4.16%)
	**49	24	25	20000	18000 (90%)	2000 (10%)

Table above shows the results in percentage for four months, * indicates first breeding and ** indicates 2ndbreeding.

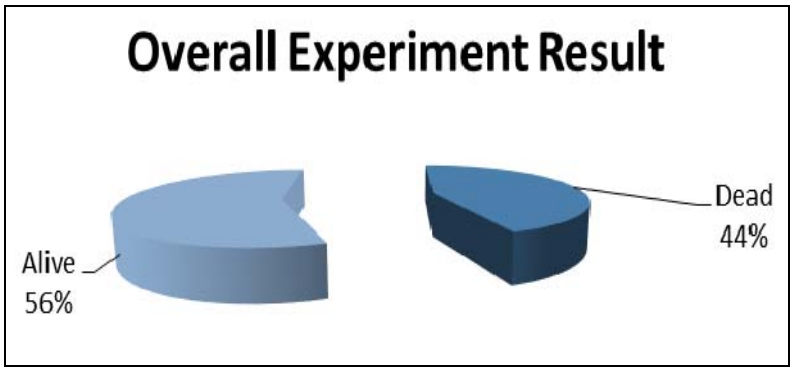
3.1 Overall breeding

The total number of eggs (Incubated eggs)/processed in four months percentage of viability and mortality is shown in Figure. Highest breeding was observed in November (73.68%) while lowest in February (29.05%). The viability rate of breeding was observed in November and December while the mortality rate of breeding was in January and February. The rate of artificial breeding was decreased from November to February. The last breeding (high mortality rate) was observed in due cold temperature and changes in other environmental condition. The November 2nd is more productive for overall breeding of four months shown in Graph 1.0.



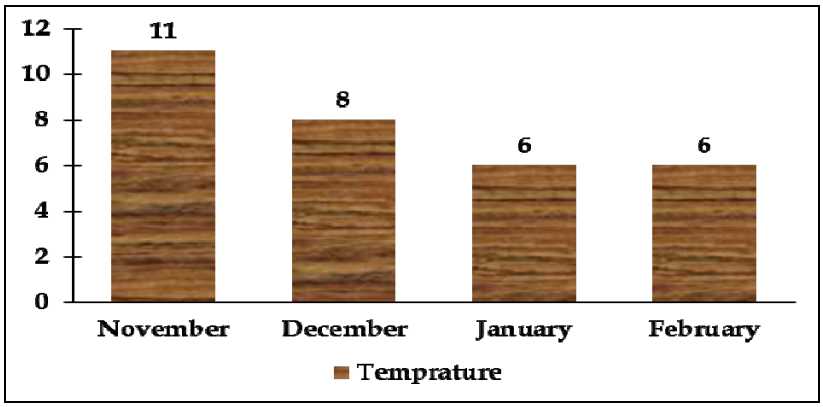
Graph shows percentage of mortality and survival in each month of breeding

Graph 1.0: Four months percentage of viability and mortality.



Graph 2.0: Above graph shows the Overall results of experiment.

In the month of July the adult fish were transferred to separate tanks. After three months they were ready for striping so the production year starts from July.



Graph 3: The Graph above shows temperature of four month taken in average for each month.

4. Discussion

Research work was carried out our in breeding season which starts from November and ends in February. In each month we observed different percentage of egg fertilization and survival. It was reported by the proprietor of a fish hatchery that stripping was being realized throughout 9 months and the brood stocks spawn in irregular time had been selected from fries hatching summer eggs bring from south Africa farms, 77% in January, 63% in February, and 56% in November had stripped egg. In common, that spawning time was mid-

November and April most farms finished the egg stripping in one or two months was resolute. In Brazil, where rainbow trout is an exotic species and the import of new brood stock fish is restricted, consanguinity may have contributed to low survival. The reproductive capability, including fertility, egg size and hatching success is frequently affected by consanguinity [6]. In First breeding of November we stripped out 8000 eggs after processing 87.5% eggs were observed fertilized and 12.5% unfertilized. While in 2nd breeding of November 40000 eggs were stripped out after treating 95% eggs were observed fertilized and 5% unfertilized.

In First Breeding of December 84000 eggs were stripped out in which 95.23% eggs were recorded fertilized and 4.76% unfertilized while in Second Breeding in December 40000 eggs were stripped out after treating 92.5% eggs were recorded fertilized and 7.5% unfertilized. First Breeding in January data presenting table 48000 eggs were striped out after processing 93.75% eggs were recorded fertilized and 6.25% unfertilized. While in Second breeding in the month of January 68000 eggs were stripped out after processing 95.23% eggs were observed fertilized and 4.76% unfertilized. First breeding in month of February 48000 eggs were stripped out after treated 95.83% eggs were recorded fertilized and 4.16% were unfertilized. In second breeding in month of February 20000 eggs were stripped out. After treated, 90% eggs were recorded fertilized and 10% unfertilized. The overall results of this four months show that, the survival rate of rainbow trout is 56.14%.According to petter [4] the Survival of swim-up fry from eggs planted directly into the gravel was 3.5 times greater than that from WV box plants. The interval between fertilization and the end of the first week, which summed up to a mean survival rate of 55.6% was the period in which the greatest accumulated mortalities occurred. In the field the fertilization rate was not determined, eggs which were not fertilized, this value includes as well. The Egg transport to the experiment site, the low survival indicates a possible effect of mechanical impacts. After one hour of fertilization Losses begin, and this sensibility is doubled after four hours of fertilization [7, 8] obtained survival rate ranging from 55% to 66.7%. In Goetz and Coffman's study as in ours the eggs were obtained from commercial hatcheries [6].

During the experimental period the highest mean temperature was 13 °C [9]. In our experimental period the temperature cycle was observe in between 6-11˚C. In the month of November the temperature observed is 11 ˚C while in December, January and February the temperature was 8 ˚C, 6 ˚C and 6 ˚C respectively. The highest yield observed was in the November 2nd breeding in which the temperature was 11 ˚C while according to Molony, B [10], Salmonid species considered having slightly lower thermal limits than rainbow trout the upper limit for egg development is between 14 °C and 16 °C for brown trout, *Salmotrutta*. The lowest yield observed in the month of February. In the 2nd breeding of February survival rate was 29.05% which is the lowest survival rate among all the months of breeding. While according to Easty, F [9] Incubation experiments with O. *mykiss* eggs in Chile showed that the highest survival rates were obtained at 8 °C or lower. Although thermal limits may vary for salmonid populations in different eco regions [11].

5. Conclusion

From the current study we conclude that Rainbow trout can easily be cultured by striping method. Artificial breeding was new method and knowledge through which we can increase productivity. For artificial breeding the best month is November, in which the temperature is 11 ˚C, so throughout the observation of our research work is that 11 ˚C is the best suitable temperature for fertilization of rainbow trout's eggs. The ratio of survival changes due to physical factors in which the main factor is temperature, dissolved oxygen, salinity and carbon dioxide.

6. Recommendation

From the current study were commended that the artificial breeding is more applicable than natural breeding because if we look at the natural rainbow trout egg breeding in seas or rivers so they have to face a lot of difficulties like flood, sudden change in temperature and other predators, so they lose lots of fries in early stage. By artificial method we can save it from danger mentioned as above through this procedure, we ware make more eggs to be fertilized and more production can be expected.

It was observed in our research work that environmental factor has great effect on trout, for quality assurance at hatchery pollution should be controlled.

The Pakistani government should pay more attention to this kind of hatchery and provides more and more facilities to this field.

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