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ON THE ARTIFICIAL PROPAGATION OF
TSING-FISH, *MATSYA SINENSIS* (BLEEKER)
FROM YANG-TSUNG LAKE, YUNNAN
PROVINCE, CHINA

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MATSYA SINENSIS (BLEEKER) FROM YANG-TSUNG
LAKE, YUNNAN

INTRODUCTION

For two seasons (1943-1944) we have been working on the artificial propagation of *Matsya sinensis* (Bleeker). *Matsya sinensis* is one of the valuable fresh water food fishes in Yunnan province and it is of considerable economic importance, fleshy and delicious. The Chinese name is "Tsing-yu," it belongs to the family Cyprinidae and is characteristic of the lakes and rivers of south-western China as well as those of Yang-Tze valley. The total annual production is, however, not as much as that of the *Cyprinus carpio* Linneaus in Yang-Tsung lake.

The present paper not only deals with the technical problem of artificial propagation, but also gives a brief account of the morphology and habits of the species.

This experiment was carried out the first year with the cooperation of K. C. Koo of the Department of Biology, Sino-French University, Kuming. The authors wish to express their thanks to him and to Dr. H. W. Wu, Ichthyologist of the National Research Institute of Zoology, Academia Sinica, who kindly identified this species.

MORPHOLOGICAL STUDY

Head 3.7-4.4 in standard length. Depth 3.3-3.9. Eye 4.8 in head, snout 2.9, pectoral fin 1.2, ventral 1.3. D. III, 9, C. III, 5, dorsal fin short with two simple rays. Scales in a longitudinal series to base of caudal 32-37. Abdominal scutes 6 + 5.

Body elongate moderate compressed, abdomen round, head rather short. Caudal peduncle somewhat narrow. Eye lateral, moderately large, high up. Snout larger than eye, its tip bluntly pointed in a lateral view, nostrils elongate-oval, nearer eye than tip of snout. Mouth moderate, terminal, slightly inferior, nostrils ovate, nearer to eye than snout, two barbels on each side of tip, the anterior barbel located below nostrils, posterior barbel located at the corner of mouth, posterior barbels longer than anterior barbels.

Origin of dorsal fin slightly before ventral fin, nearer to tip of snout than base of caudal fin, a horizontal spine lying in front of origin of dorsal, with the tip pointed anteriorly. Pectoral fin not reaching ventral, ventral not reaching anal, caudal moderate, deeply forked. Gill rakers few, short and blunt, pharyngeal teeth strong, 5, 3, 2/2, 3, 5 in series. Air bladder large. Colour dark blue above, grayish-white below.

DISTRIBUTION

South-western China, such as Sze-chwan, Yunnan and Kwang-tung Provinces. It is more abundant in lake Yang-Tsung, Fu-Hsien and I-Lung of Yunnan province.

SPAWNING

The notes upon the spawning behaviour of *Matsya sinensis* are compiled chiefly from observation at the natural spawning ground. The natural spawning ground of this fish in Yang-Tsung lake is situated in the lower stream of Tang-Chih near the village of O-Tang-Chen, which belongs to I-Lieng district, or on the shoals of the lake. Spawning usually takes place in the months from May to September, the spawner always laying its egg under the surface of water about 1½ metres deep in fine weather and with the following important factors in common: (1) bottom deposits, sand and gravel, (2) temperature of surface water between 18.0°-22.0°C., (3) the water very transparent, (4) the speed of flow moderate. Under the conditions mentioned above the adults, being adapted to their environment and being sexually agitated, swim down the river in shoals towards the flow, and when there is a good spawning ground they will perform their fertilization.

FEEDING HABITS

This fish inhabits the lakes and rivers; it has seldom or never been cultured in the pond at Yunnan before. Their food is miscellaneous materials. According to the stomach analysis, their food consists of Cladocera, Copepoda, aquatic plants, algae and diatoms: such as the *Daphnia*, *Cyclops*, *Diaptomus*, *Ceratophyllum*, *Myriophyllum*. The aquatic insects and their larvae were also eaten. In every period of the year, vegetable matter was the most important food.

RESISTANCE TO DRYNESS

The resistance to dryness of this fish is rather great; they were alive about 1½ hours to 2½ hours in the air, but varied with the humidity. When we wish to carry on the experiment of artificial propagation with the adults of this fish, taken in the natural spawning ground, fifteen minutes at least is needed to finish the experiment. Neither the male nor the female were injured, and they were alive and well for several days living in the flowing water, being fastened through the gills with a piece of string to the post.

METHOD OF CAPTURING PARENT STOCK

Field work was carried on during portions of the years 1943 and 1944; parents were procured in June, July of these years from the nets of fishermen. As we prepared for the artificial propagation, the good parents must be captured first; by our investigation the entrance of the Tang-Chih river and its vicinities are the good spawning grounds. There are several old trained fishermen fishing with the nets and hooks. These are set down under the water surface of 1½ metres deep, in the months from May to September, and this fish was easily captured at their proposal. We made acquaintance with them and told them that we wanted all the good adults of Tsing-fish that they captured, and we would pay a good price for that fish. We confess that the results were rather good than otherwise.

TABLE I.—Resistance to dryness of *Matsya sinensis*.

Date	No.	Sex	Length of body (cm.)	Weight of body Kg.	Temperature of air (C.)	Resistance to dryness
June 17, 1944..	1	♂	47	1.2	26° 0	1h. 55m.
"	2	♀	63	3.15	26° 0	2h. 7m.
June 28, 1944..	3	♂	42	0.9	22° 0	1h. 30m.
"	4	♀	50	1.8	22° 0	1h. 35m.
"	5	♀	55	2.1	22° 0	1h. 37m.
"	6	♂	42	0.9	22° 0	1h. 37m.
"	7	♂	43	0.9	22° 0	1h. 50m.
"	8	♀	48	1.5	22° 0	2h. 15m.

PARENTS FOR EXPERIMENT AND THEIR EGGS

The ratio between female and male is 1 to 2 for the purpose of experimenting artificial fertilization, both the two are at maturity, the body length of females is 48-63 cm. long, the weight 2-3.5 kg., the males are 30-47 cm. long, with a weight of 1-2 kgm. at least. They were never injured, but were strong and lively after being captured by the fishermen.

The eggs of this fish are orange in color, non-adhesive and half floating, smooth and spheroid of 2-2.5 mm. in diameter; the size varies with the individuals of the female. As the eggs are separated from each other, and are non-adhesive, they flow out easily like the milt of the male with gentle pressure.

As soon as they are laid they swell so that the diameter of the egg increases by about one-quarter; it also becomes somewhat transparent. The number of eggs deposited by a female varies of course with her size, the total number of eggs of this fish flowed at one time can be known by counting the number in a small part of an ovary, and then weighing the total weight of the ovaries. The number of eggs thus estimated was 13,000 in a fish of 48 cm. long. The largest one which we captured (63 cm. long), taken from lake Yang-Tsung, deposited 18,000 eggs.

METHOD OF ARTIFICIAL FERTILIZATION

There are two methods of artificial fertilization, namely "dry method" and "moist method." In the present experiment, dry method was adopted. When the adults were captured, if the belly of the ripe female felt soft, its eggs would settle downward, the milt of male would easily flow out; this condition is good for the purpose of experiment. When all is ready, the work begins, firstly: take the ripe female's head with right hand, support its breast with the left, and hold over the basin with the fish's belly as near the basin as possible. An assistant holds its tail with one hand and presses the belly gently from the base of pectoral to the genital opening with the other hand, causing the eggs to flow gently into the basin. Secondly: take the ripe male as the female, the sperms flow out easily into the same basin, but two or three males are needed. After the eggs and milt have been taken, they are mixed by means of a goose's feather. After fifteen minutes, the eggs are fertilized;

they then are washed thoroughly with clean water, at temperature of 22.0°-25.0°C. Ninety per cent of fertilized eggs can be obtained under good conditions and this will be nine times the percentage of natural fertilization of eggs in this lake.

METHOD OF ARTIFICIAL PROPAGATION

The fertilized eggs are then set in the hatching apparatus which is a round disk made of wood, 25 cm. in diameter and 6.5 cm. deep, with bottom of fine linen, or of fibre of palm tree. The apparatus is held half under the water surface where the water flows moderately, each apparatus contains 3,000 fertilized eggs and these should not be crowded together. The apparatus is made stable in the flowing water by fastening it to two or three posts. The fry were hatched between 72-96 hours after fertilization. The water temperature was 20.0°-25.0°C. The fry hatch about 24 hours earlier when the water temperature rises to 25.0°C. or more; the optimum temperature is 24°C. The total body length of newly hatched larva is 8-9 mm. The percentage of hatch was 80 per cent. Two or three days after hatching they may swim for a short time, but as soon as their effort ceases, they sink down and lie on their sides upon the bottom of the disk; they seem to be still rather than active.

TRANSPLANTATION OF FERTILIZED EGGS AND FRY

Transplantation of eggs: twenty-four hours after fertilization the eggs were transplanted from O-Tang-Chen to Si-Shan hatchery, Kunming, by train and bus. The transport apparatus was the hatching apparatus used above, but without water, each apparatus contains 3,000 fertilized eggs, not crowded together. They were covered by aquatic plants to keep them moist. Five or six apparatus may be transported at once, setting them in a wooden bucket horizontally. After a nine-hour trip both in train and bus, the mortality was only 10 per cent.

Transplantation of fry: five days after hatching, the fry were transported from O-Tang-Chen to Si-Shan hatchery, Kunming, by train and bus, the transport apparatus was a common wooden bucket, 33 cm. in diameter and 33 cm. deep, two-thirds filled with water, 10,000 fry were transported at once with two buckets. There were very few dead fry at the end of the trip; the water temperature varied from 21.0° to 25.0°C.

FRY AND FINGERLING CULTURE

The fry had a large yolk-sac on hatching; fifteen days after, the yolk-sac was absorbed and then we called them fingerlings. They began to swim and search for their food at the water surface; then we put them in the pond, which was 100 square feet in area. They usually schooled among leaves of *Chara*, *Ceratophyllum demersum*, and *Myriophyllum spicatum*, which were very abundant in the pond. In the first month a good artificial food for feeding the fry was the bean milk which was thrown down along the outer parts of the pond once a day, and $\frac{1}{2}$ -litre in quantity. In the second month after hatching good materials for feeding them were the baked horse bean powder, dry shrimp powder and buckwheat powder, of which the baked horse bean powder was the best. The feeding method was same as earlier, but 20 grams for 10,000 fry, twice a day.

After three months the body length of fry was 40 cm. They were then put into another pond which is 100 feet in length, 20 feet in breadth, and 3 feet in depth. They fed chiefly on the natural food, such as the *Daphnia*, *Cyclops*, *Diaptomus*, and Diatoms which were very abundant in the pond. They usually remained at the bottom of the water, but occasionally swam to the surface on fine days.

CONCLUSION

According to our experiment the artificial propagation on the productivity of fry of *Matsya sinensis* has proved possible and successful. The percentage of fertile eggs was high, about 90 per cent, the percentage of hatch was 80 per cent and nine times the percentage of natural fertilization under natural conditions in lake or river. We have also obtained a good result in transplantation of the fertile egg and fish-fry, which, transplanted from Yang-Tsung lake to Si-Shan hatchery, was expressed in a low rate of mortality of both fertile eggs and fry; the mortality of eggs was only 10 per cent.

The *Matsya sinensis* is not an abundant fish in Yang-Tsung lake. The lake was practically unexploited; it is an excellent body of water in which we shall increase the fish population by artificial propagation in the future. Application of artificial fertilization, combined with hatching operations might become a practical means of improving the yield of inland fisheries and lead to a future when fisheries will follow the path of agriculture—when development and production will take place of conservation and restriction.

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