Present Status of Fish Culture Development Project in the Black Sea under JICA Program

Shiro Hara*
Central Fisheries Research Institute, P.O. Box 129, 6001 Trabzon, Turkey

* Corresponding Author: Tel.: +90.462.341 10 52; Fax: +90.462.341 11 57;
E-mail: turbotpj@gul.net.tr

Abstract

Since April 1997, a collaborative project between Japan International Cooperation Agency (JICA) and Ministry of Agriculture and Rural Affairs, Central Fisheries Research Institute in Trabzon has been working for the sustainable seed production of Black Sea turbot, *Psetta maxima*. Through this project, 8,000 fish juveniles were produced in 1998, 27,000 in 2000 and 14,000 in 2001. The target production was 10,000 juveniles of 100 mm total length (TL). Production in 1999 was disappointing low due to the destruction of the water intake pipes resulting in water quality deterioration. Juvenile production increased with accumulation of more knowledge of its seed production.

From the yearly achievement of the project, it seems that a sustainable experimental seed production is viable. As year 2002 is the final year of the project, to attain its goal in developing fish culture in the coastal waters of the Black Sea, the following technical subjects should be worked out:

1) Establishment of spawning technique in hatchery-bred broodstock
2) Improvement of larval survival
3) Establishment of high quality artificial feed

Key Words: turbot, *Psetta maxima*, JICA project, Black Sea, seed production.

Background

Since 1990, as part of the sixth and seventh five-year development plans, the Turkish government has worked on the projects that aim to increase the output of marine products, in order to improve people's dietary life and for export purposes. To increase the per capita consumption of marine foods from 6.6 to 16.2 kg a year, emphasis was in the promotion of fisheries policies. Before the sixth five-year plan, the government initiated preferential measures for the purchase of large fishing boats in order to increase fish catch, but this resulted in indiscriminate fishing that ultimately led to decreasing catch. With this experience, the government, decided to encourage fish culture. In 1994, the Turkish government requested technical assistance from Japan for the sound development of fish culture. At first, there was a list of several target species to be cultured, such as salmon, trout, green sturgeon and turbot. After the preliminary and long-term investigations, Black Sea turbot was the species selected because of its high resource conservation capacity, economic value and consumer acceptance. Thus, in 1997, the two governments signed the memorandum of agreement that research and development will be focused on the seed production and culture of the species.

Situations of Project Implementation

Implementation system

With the project term of five years starting in April 1997, this collaborative project was started at the Trabzon Fisheries Research Institute (presently named Central Fisheries Research Institute; hereinafter referred to as the "Institute") located in the suburbs of Trabzon, a city facing the eastern part of the Black Sea. The Project aims to develop the technique for the seed production and grow-out culture of flatfish species. So far, Japan has sent four long-term experts, one coordinator and 18 short-term experts for the project with 11 Turk counterparts previously trained in Japan. Through the project, repair of the existing hatchery facilities as conducted in 1997, while on the Turkish side, new water intake systems were constructed at 20 m and 40 m depth in the Black Sea. In 1999, a grow-out research laboratory was constructed. Up to the present, Japan has provided machines, equipments, and materials for seed production and grow-out culture that valued to about 164 million Japanese yens. These provisions have greatly contributed to the improved performance of the Central Institute.

© Central Fisheries Research Institute (CFRI) Trabzon, Turkey and Japan International Cooperation Agency (JICA)

Project activities

Considering the responsibility of the Institute in maintaining the hatchery facilities after the project is completed, it was agreed that the activities would be carried out at a relatively small R&D facility. The objective was to develop the technique to constantly produce 10,000 Black Sea turbot juveniles of around 100 mm in TL. These activities were covered in the following five main technical areas, each areas with specific indicator followed by the achievements for each activity:

1) Identification of target species of flatfish

Indicators: A guidebook of flatfish found in the Turkish coastal waters for the correct identification of the target species in relation to other closely related species.

Achievements: A field guide was published in May 2001 (Amaoka *et al*., 2001). Through taxonomic identification and comparison of the 12 species of flatfish, it was concluded that the Black Sea turbot is the same species as what is called the Atlantic turbot (*Psetta maxima*) (Yoseda *et al*., in preparation). In addition, it was found that Black Sea turbot is the only target species of flatfish for aquaculture in the Black Sea waters.

2) Broodstock development

Indicators: Identify the environmental conditions needed for broodstock development.

Achievements: Data on the relationship between water temperature changes and feeding activities of the fish, it was concluded that control of water temperature is important for broodstock management. The optimum water temperature is below 17°C for rearing both 4 years old hatchery-bred and wild broodstock. Frozen whiting as its feed is the best based on ecological and nutritional aspects. In spring 2000, it was confirmed that some of 2 year-old hatchery-bred fish spawned in the tank under water temperature of 14°C. In addition, results from studies on migration pattern (Yoseda *et al*., in preparation), age and growth (Suzuki *et al*., 2001) and maturation process of wild turbot helped much in the establishment of broodstock rearing techniques.

3) Development of spawning and incubation techniques

Indicators: Development of techniques to induce spawning and achievement of more than 30% hatching rate.

Achievements: Captive wild stock was induced to spawn through hormonal treatments using luteinizing hormone-releasing hormone analogue or a mixture of a human chorionic gonadotropin and white salmon pituitary gland (Hara *et al*., 1998). It was also observed that cryo-preserved sperm gave higher fertilization rate more than fresh semen and also resulted to hatching rates of more than 30%.

4) Development of larval and juvenile rearing techniques

Indicators: Development of stable culture techniques for zoo- and phyto-planktons and improvement of their nutritional value; and increasing the survival rates of larvae (size range of 2.5 – 20 mm TL = > 10%) and of juveniles (size range of 20 – 100 mm TL = > 50%).

Achievements: Mass-culture techniques for *Nannochloropsis* sp. and rotifers, *Brachionus plicatilis*, were established. Enrichment of rotifers and *Artemia* with *Phaeodactylum* and HUFA-rich oil prior to feeding to the larvae/juveniles control the occurrence of malpigmented fish, and improve larval survival.

Larval rearing with a feeding scheme using rotifer, *Artemia nauplii*, enriched *Artemia* and artificial food was successful achieving an average survival rate of 6% at 20 mm TL throughout the 4 years (1998 to 2001) operation.

Juvenile rearing with a feeding scheme using enriched *Artemia* and artificial food yielded increasing survival rates of 35% in 1998, 82% in 2000 and 83% in 2001.

Other studies such as the detailed larval and juvenile development of feeding and swimming characters were investigated (Moteki *et al*., 2001; Kohno *et al*., 2001) that also helped in the development of the rearing techniques.

5) Development of grow-out culture techniques

Indicators: Development of grow-out culture systems and understanding the growth pat-terns and the nutritional needs of juveniles and young turbot.

Achievements: After the completion of grow-out laboratory in 1999, optimum stocking density and nutritional requirements of juveniles had been studied. However, these studies are still on going since it needs long-term observations to attain verifiable and reliable results.

In totality, all these activities mentioned, resulted in the production of 8,000 juveniles in 1998, 27,000 in 2000 and 14,000 in 2001. The production in 1999 was disappointing low due to the breakdown of water intake pipes, resulting to water quality deterioration.

6) Other activities

The Institute also organized two projects in 1998. One of them is turbot aquaculture in net cages

and tanks and the other was the survey of young turbot released into the sea for the recovery of the fishery resources of the Black Sea. To expand the grow-out culture, the project has already distributed a total of 12,000 young turbot to fish farmers for trial runs. It has also provided 8,000 young turbot to the Institute for restocking program. A part of the Black Sea turbot released in 1998 grew to 2 kg in two and a half year culture and have been sold at fish shops. This is one of the indirect effects of the technical assistance project.

The JICA short-term experts had been tapped to study the economic feasibility of turbot culture in 2001. The results seemed to be economically promising although a final report has yet to come out.

Among the three fisheries research institutes in Turkey, the Central Fisheries Research Institute is playing a major role in the coastal areas of the Black Sea. It is also the only one equipped with hatchery and grow-out facilities for marine species. Thus, it is certain that the Institute will become the information center on marine aquaculture and its role will increasingly be more important in the future. The publications of the newsletter in September 2001 and a research journal (Turkish Journal of Fisheries and Aquatic Sciences) in November 2001 are regarded as part of the Institute's regular activities.

Future Subjects

This year is the project's final year. To develop fish culture industry in the coastal waters of the Black Sea, it is necessary that the activities to be conducted will focus on the solution of the following technical problems:

1) Spawning of hatchery-bred broodstock

It is essential to establish the spawning technique for hatchery-bred broodstock for a sustainable supply of good quality eggs and larvae. Collection of mature wild fish for seed production purposes is unstable depending on the weather condition. Aside from that, wild Black Sea turbot population is declining and the relatively low hatching rate of larvae is associated with the physical stress of spawners during capture.

2) Improvement of larval survival

Recent larval survival is low. It is essential to take a countermeasure to improve larval survival. High quality-fertilized eggs sourced from hatchery-bred broodstock may help this problem. Efficiency of the hatchery system should also be rechecked such as water supply, filtration and heating systems. There is also a need to refine the rearing techniques with regards to environmental, nutritional and pathological aspects of larviculture.

3) Feed development

It is absolutely necessary to establish high quality feed for grow-out of Black Sea turbot. Available commercial feed for the fish gave slower growth rates compared to trash fish. Target production size is 1 kg of fish after 20 months rearing.

Acknowledgments

I express my gratitude to Mr. Y. Bekiroglu, Institute Director, Y. Kayıkçı, former Institute Director, G. Nezaki, F. Sakamoto, Mrs. Y. Nakazawa, JICA experts, Mr. K. Yoseda, former JICA expert, M. Özongun, A. Erteken, Y. Çiftçi, A. Haşimoğlu, Mrs C. Üstündağ, B. Ceylan, Turkish side counterparts and Mr. E. Güneş, former Turkish side counterpart, Central Fisheries Research Institute, Trabzon, Turkey for their invaluable advice and support during the project implementation.

References

Amaoka, K., Yoseda, K., Şahin, T., Üstündag, C. and Çiftçi, Y. 2001. Flatfishes (Order *Pleuronectiformes*) found in Black Sea and its adjacent waters. Special publication No.1, Central Fisheries Research Institute, Ministry of Agriculture and Rural Affairs, Trabzon, Turkey. 27 pp.

Hara, S., Güneş, E. and Özongun, M. 1998. Spawning of the Black Sea turbot *Psetta maeotica* (Pallas), with special reference to egg development. Oral presentation with English abstract. The First International Symposium on Fisheries and Ecology, 2-4 Sept. 1998, Karadeniz Tech. Univ. Trabzon, Turkey.

Kohno, H., Moteki, M., Yoseda, K., Şahin, T. and Üstündag, C. 2001. Development of swimming and feeding functions in larval turbot, *Psetta maxima*, reared in the laboratory. Turk. J. Fish. Aquat. Sci., 1: 7-15.

Moteki, M., Yoseda, K., Sahin, T., Ustundag, C. and Kohno, H. 2001. Transition from endogenous to exogenous nutritional sources in larval Black Sea turbot *Psetta maxima*. Fish. Sci., 67: 571-578.

Suzuki, N., Kondo, M., Günes, E., Özongun, M. and Ohno, A. 2001. Age and growth of turbot *Psetta maxima* in the Black Sea, Turkey. Turk. J. Fish. Aquat. Sci., 1: 47-55.