# SEED PRODUCTION of TURBOT (*Psetta maxima*)

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The Fish Culture Development Project in the Black Sea was started between The Central Fisheries Research Instıtute and Japan International Cooperation Agency (JICA) in Trabzon , in 1997. Turbot seed production technology was developed in this Project.

Since April 1997, the Project has worked for the sustainable seed production of turbot. The target production of the Project iss 10.000 juveniles of 10 cm total lenght (TL). As a result, the production of 8.000 juveniles in 1998, 27.000 juveniles in 2000, 14.000 juveniles 2001, 150.000 juveniles in 2002 and 77.000 juveniles in 2003 was achieved. The production in 1999 was disappointing due to damage of water intake pipes by high waves leading to water quality deterioration.

In addition, knowledge of the different aspects of seed production has been accumulating. From the yearly achievement of the Project, it seems that sustainable experimental seed production is viable.

## 1. LARVAL REARING

Meaning of this period is that larvae transforms from the larval to the juvenile stage and it takes about 70 days. At the end of this period, larvae grow and become adult form of turbot and pass to juvenile stage. Larvae developmental stages are divided into three (3) which are as follows:

**Pre-larval stage** (On the day of hatching, D-0 to D-2):

Larvae are symmetrical in shape, and yolk sac and oil globule present. Newly hatched larvae are 2.5 mm in mean total length. Their eyes are not pigmented, the mouth is not yet opened and the anus not yet formed. The larvae remain in suspension with their head down, near the water surface. Still not starting seawater exchange.

**Post-larval stage** (D-3 to D-29):

On D-3, larvae have their eyes pigmented and mouth (0.15 mm in mouth width), and anus open. Mouth width increases as larvae grow. On D-3, initial feeding and seawater exchange starts. Total length of larvae 17-20mm end of this stage.

**Metamorphosis stage** (D-30 to D-70: transition period from larval to juvenile stage):

Fish become asymmetrical in shape. Eye starts to migrate. Fish start to settle down on the bottom of the rearing tank. Suitable conditions and necessary processes for larval stage are given below:

**Tanks:** All rearing tanks are placed indoors. The shape of the tanks varies from circular, square or a raceway. The sizes of larval rearing tanks range from 2 to 5 $m^3$ in volume with the depth of 0.75 m.

**Temperature :** Larval turbot seems less resistant to changes of water temperature during the early stages. It is important that in transferring eggs or newly hatched larvae, the water temperature from their source is the same as in the tank where they will be stocked. After stocking, the water temperature is gradually increased from 15 to 18 or 21 °C in 4 days.

**Water Quality :** To maintain suitable larval rearing conditions, water is filtered by 5 µm and UV- sterilized.

**Water Exchange :** No water change takes place until D-3. On D-4, water is changed

initially at a rate of 0.3 turn/day to maintain adequate rotifer density and to avoid water deterioration. The rate of change is gradually increased to1.0 turn /day at D-10, 3 turn/day at D-30.

**Aeration :** Aeration and circulation of the water are two of the most important issues in larval rearing. It is practiced to use many air stones (5 cm long, 3 cm diameter) which provide gentle aeration (2.5 *l*/min.). 2-3 air stones/$m^3$ are set hanging around the wall and center of the tank.

**Illumination :** Illumination is one of crucial factors during feeding of larvae. Facility is illuminated from 08:00 to 19:00 h at the intensity of 200-500 lux using fluorescent lamps and avoiding direct sunlight.

**Stocking Density :** Initial stocking density of the eggs or larvae is around 20,000-30,000 ind./$m^3$.

**Feeding :** Three kinds of food items are used for the larvae: rotifer *B. plicatilis*, nauplius of *Artemia* and artificial diet. Table 1 show the feeding scheme and feeding regime for rearing turbot larvae.

Selection of microdiet is based on the quality aspect, since this affects further larval survival and growth. Microdiet to be given to the larvae must satisfy the following conditions:

-Meet the nutritional requirements of the larvae.

-Can be suspended in the water column for several minutes.

-Nutrients in diets should not leach out in the water.

-Show the reasonable stability in the water.

- The freshness of food and storage conditions should be controlled.

**Bottom Cleaning :** The tank bottom is cleaned daily starting on D-5 with an improvised bottom cleaner to remove the dead and uneaten food, fecal matter and detritus. This detritus is suspected to be a hotbed for disease. Aeration is stopped during siphoning .

**Skimming :** Removing debris such as rotifer shells, oil and proteinaceous waste from the surface of the water is an important daily task. This type of cleaning called skimming, promotes oxygen exchange between the air-water interface, removes wastes that foster bacterial growth, and facilitates the ability of the larvae to gulp air, an important behavior in the development of the swim bladder.

## 2. JUVENILE REARING

Tank conditions and process should be as follow:

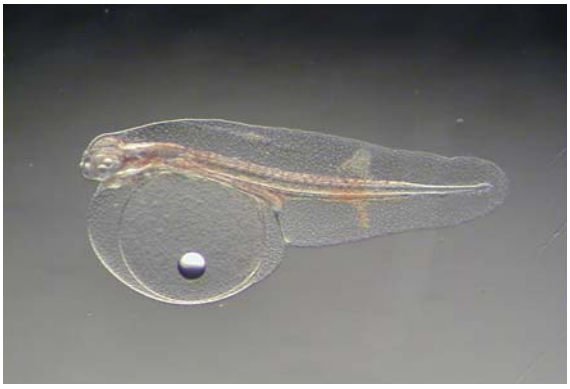
**Tanks :** Fish are reared in shallow concrete or FRP tanks of 0.3 to 0.5 m depth. The tank could be circle, square or could be raceways of about 5-7 $m^2$ surface.

**Temperature :** Water temperature is maintained at 18-24°C.

Table 1. Feeding regime for rearing larval turbot

| Days | 3-5 | 6-11 | 12-15 | 16-17 | 18-20 | 21 | 22-23 | 24-25 | 26-29 | 30-40 | n+1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Algae (cells/*ml*) | | | | $0.5 \times 10^6$ | | | | | | | |
| Rotifer (ind./*ml*) | 2 | 5 | 5 | 5 | 5 | 4 | 3 | 2 | | | |
| *Artemia* nauplius (ind./*ml*) | | | 0.2 | 0.1 | | | | | | | |
| Enriched *Artemia* (ind./*ml*) | | | | 0.1 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | |
| Artificial feed | | | Particle size (µm) | | | | 250 | 400 | 700 | | |
| | | | Quantity (g/10x$10^3$ larvae) | | | | 10 | 15 | 18 | | |

**Water Exchange :** Since the juvenile fish during nursery stage is fed artificial diet and feeding rate is increased with fish growth, there is a great possibility for water deterioration. Thus water exchange rate should be more than 15 times a day throughout the nursery phase. It is also recommended to clean the bottom twice a day, in the morning and in the afternoon.



**Aeration :** The rearing tanks are aerated with two air-stones/$m^2$ placed at the wall and centre of the tank. Oxygen level should not be below 4 mg/.

**Illumination :** Illumination is maintained at 200-500 lux with a fluorescent lamp placed above the rearing tanks between 08:00 and 19:00 h. /.

**Feeding :** Crumbled pellet, 0.7 to 1 mm diameter, is fed at the start of juvenile rearing. As fish grew, crumbled pellet is gradually replaced by pelletized diet. Feeding rate of juvenile Kalkan start at 4 to 5 % of the body weight at about 20-50 mm TL (four to five times a day) and gradually decreases between 2 to 3 % at about 100 mm TL (three to four times a day).

The diet quality is likewise assessed in terms of survival rate (SR), growth rate in TL (GRTL) and feed conversion ratio (FCR).

Turbot requires high dietary protein of 55 %. In contrast, the requirement of lipid level is estimated to be below 15 % in the diet. For protein and lipid source, high quality ingredient such as fishmeal of whiting is used. It is also recommended to adjust diet pH between 7,1 and 7,5.

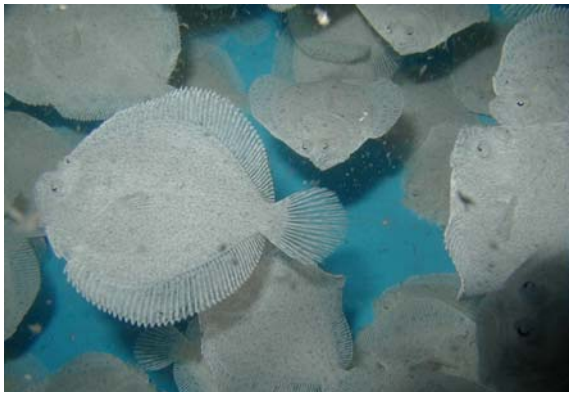
**Grading and Stocking :** During juvenile stage, fish are graded by using small basket for the following reasons:

-Removal of malpigmented or deformed juvenile

-Size sorting

-Determination of the exact stock number

Only normal and size-graded juveniles are transferred to the new tank by pail. Grading should be minimized since frequent grading cause injury to the fish.



**Stock Density :** Since larvae start to set on the tank bed at 20 mm TL, the surface area of tank bed becomes more important than the tank volume. The stocking density of fish is calculated based on the surface area from this phase.

The stocking density depends on the size of the fish and carrying capacity of the rearing water. Standard stocking density is shown in Table 2.

Table 2. Relationship between the size and stocking density

| Total length (mm) | Stocking density (ind./$m^2$) |
|---|---|
| 20 -50 | 400 – 500 |
| 50 -80 | 250 -300 |
| 80 – 100 | 120 – 150 |