7. Marketable fish production

Stocking facilities

After quarantine, parent fish are moved either into larger tanks where they remain for a couple of months until full recovery, or directly into the long-term holding facilities. Lowering salinity down to 20 ppt for a few days helps the recovery of weak animals. In any case, the weight of each female fish is recorded to estimate its potential egg output (see Table 3.1). For gilthead seabream weight gives also an acceptable estimate of the broodstock sex ratio (see Table 3.2).

Long term stocking facilities exist in a variety of designs and capacities. When land area is not a constrain, earthen ponds stocked at low density (up to 0,5 kg/m^3) represent a reliable and easy to manage solution. They usually measure up to 500 m^2 in size with an average water depth of 1.5 m and have a rational water exchange with inlet and outlet systems through loosely screened monks to allow small fish and crustaceans, which may represent an additional source of food, to enter the pond. The outlet offers the possibility to empty the pond by gravity. During the hottest months, a shelter should cover at least 10% of the pond area to provide some protection against the sun and a quiet place to rest. If necessary, protection against fish-eating birds should also be contemplated. Another cheap solution to stock broodstock is given by floating cages, provided that suitable sheltered coves are available. Fish control is however less easy than in land-based facilities.

Feeding broodstock

Although studies on the effects of diets on the reproductive capacity of seabass and gilthead seabream are far from being complete, it is generally acknowledged that a diet rich in vitamins, poly-unsaturated fatty acids (n-3 PUFA) and other micro-nutrients is essential in obtaining viable eggs and larvae.

For practical purposes, two distinct feeding regimes are applied: a maintenance diet after spawning till the onset of the next ovogenesis period, some three to four months before the next spawning season, and a boosted diet thereafter to provide the essential nutritional requirements for proper gametogenesis (Annex 3).

Maintenance diet

The maintenance diet should keep spent fish or new fish breeders in good health until the onset of the gametogenesis. It should therefore be rich and varied both in quality and quantity, and should be assessed by regular controls. It should preferably be as close as possible to the fish natural diet, including fatty and lean fish, crustaceans and molluscs. According to availability from the local fishery and suppliers, trash fish may represent a cheap solution, paying due attention to the increased pollution load in the stocking facilities. To keep their original quality, trash fish should be purchased fresh and then cleaned, minced and deep frozen immediately. This process also lowers the risk of parasitic infection.

It is advisable to get broodstock used to pelletized dry feed in order to have an alternative to fresh food at hand in case of shortage. Moreover, dry feed is useful when drugs or other feed integrators have to be supplied to the fish. The use of automatic feeders is only possible with dry pellets.

Even if the choice between fresh food and dry feed depends on several factors such as their availability, cost, use of feeding equipment and management, it is advisable to use both feed types in order to benefit from a broader range of possibilities. A practical solution envisages the distribution of pellets 6 days a week supplemented with moist food twice a week, and with no feeding one day a week, typically on Sunday. This pattern reduces the workload to manageable proportions, and still provides fish with a proper diet. The daily feeding rate usually ranges between 0.7% and 1.4% of body weight in seabass and 1 to 1.5% in gilthead seabream, both adjusted in line with water temperature and physiological status of the fish (Annex 3).

From a management point of view, a feeding schedule should be prepared at regular intervals based on periodical controls of fish weight. Feeding by hand is recommended because it would be possible to prevent food leftovers, which may rapidly deteriorate water quality, and to observe the behaviour of broodfish. Food is usually given once a day, early morning or late afternoon. Water renewal in the tank is adjusted to keep DO levels at saturation and ammonium nitrogen below 1 ppm. Pollution caused by feeding fresh food can be controlled by using a flow-through water system and frequent cleaning. When broodstock is kept in a system using water recirculation, a mechanical filter to remove suspended solids is frequently added to improve the performance of the biofilter.

Breeding period diet

During gametogenesis female fish require a food richer than usual in proteins and lipids to produce the vitellogenin, which is progressively stored as yolk in the oocytes. As the sole source of food for the developing embryo and the early larval stage until feeding on live preys starts, yolk quality and quantity are key factors for a successful reproduction.

Both dry pellets and moist food are employed in this period. Dry pellets should include all the nutritional elements which are acknowledged to be essential in the development of viable larvae, such as the poly-unsaturated fatty acids (n-3 PUFA), in particular EHA (20:5 w 3) and DMA (20:6 w 3), which have to be supplied with food, as they cannot be produced by fish metabolism. In case of poor diets, the perivisceral fat of the females, rich in saturated fatty acids, is utilised for yolk production, resulting in poor egg quality and reduced larval viability.

Commercially available integrators are now widely adopted by modern hatcheries to boost the quality of pelleted feeds formulated only to grow fish. As a better alternative, specially formulated pellets or natural enrichment components such as squid oil are fed to the breeders. As a general rule, during this period the distribution of moist food should replace most of dry feed, if possible, due to its superior nutritional value.

Feed distribution follows the pattern mentioned above. A difference between the two species comes from their different spawning characteristics. As a synchronous spawner, seabass is not fed during its brief spawning period, but gilthead seabream, with its sequential emissions lasting several weeks, should always be.

Daily operations

Weaning requires the same carefully planned and implemented working protocol as set for the larval rearing sector. Annex 27 summarises the activities to be performed during working hours. The use of all consumables should be recorded on a specific file and their replacement must be ordered well in advance. Proper hygienic conditions are mandatory (see below), as well as a complete separation among the sections of the hatchery to avoid possible contamination.

Control of environmental and biological parameters

The weaning procedures require a close monitoring of environmental conditions (abiotic parameters) and of the fish population (biological parameters). The first ones, to be checked as a routine daily, have already been described before and their frequency is indicated in Annex 27. The biological parameters are detailed below in terms of their operating procedures and frequency of monitoring.

As weaning fry are much sturdier than post-larval stages, they can be periodically sampled and checked for a closer control on the population.

These observations should focus on:

- fish behaviour,
- growth and food conversion rate (leading to grading),
- deformity rate (selection),
- swim bladder presence
- mortality and final survival rate.

Fish behaviour

As a general rule, any trouble with the environmental conditions in the tanks directly affects fish behaviour before the onset of unequivocal signs of stress such as a large mortality. A routine watching by experienced personnel immediately reveals if something is going wrong. A healthy fish displays the following signs of normal behaviour:

- complete control of the swimming activity
- successful feeding/preying activity (even some cannibalism),
- fast response to sudden stimuli (typically a hand waved over the tank),
- proper colour (silver grey instead of black),
- mass concentration under feeders and artemia buckets,
- all water volume occupied by actively swimming fish,
- absence of mass concentration at the water inlet (which may reveal oxygen deficiencies).

Controlling growth and deformity rate

Weaning growing performance should be assessed fortnightly, and possibly in coincidence with fish grading. If that is not possible, weight and length are measured on a limited samp of the population as follows:

1. prepare one 1-l beaker filled with 300 ml of water from the rearing tank. Put it on the balance and tare;

2. harvest some fish by means of a hand-net and place them in the beaker, trying to avoid adding water to the beaker in the operation (the use of a tea strainer may help);

3. for greater accuracy, the amount of water added could be calculated in advance by weighing the difference between a wet and a dry strainer, and this difference can then be subtracted from the final weight;

4. weigh the beaker with the fry and record the weight;

5. return fish to a bucket and count them;

6. repeat the previous steps for every new batch taken with the hand-net from the tank till a sample of 100 fish is obtained;

7. calculate the average individual weight by dividing the sum of weights by the total number of fish;

To measure body length and perform other biological controls proceed as follows:

1. anaesthetise with 2-phenoxyethanol the sampled animals (200 to 400 ppm solution depending on fish size), place them on a clean glass and measure length (in mm) with a small piece of millimetric paper placed under the glass;

2 .for each individual record its total length (TL) and any morphological abnormality (see below for details);

3. by placing a strong light source below the glass, the presence of the swim bladder can be easily detected in seabass, while it is more difficult to visualize for gilthead seabream;

4. anaesthetised animals should be returned as quickly as possible to a bucket with clean aerated seawater, but they should be returned to the rearing tank only when they have totally recovered, to avoid aggression by the other fish.