AQUACULTURE III

6. WEEK

Advances in aquaculture hatchery technology

WEEKLY TOPICS

Week	Topics
1. Week	Aquaculture Science and Aquaculture Engineering
2. Week	Aquaculture: Economic and Environmental
3. Week	Aquaculture: Innovation and Social Transformation
4. Week	Aquaculture: Food Ethics
5. Week	Shellfish Aquaculture and the Environment
6. Week	Advances in aquaculture hatchery technology
7. Week	Recirculating Aquaculture
8. Week	Selection and Breeding Programs in Aquaculture
9. Week	Ecological and Genetic Implications of Aquaculture Activities
10. Week	Aquaculture: Biotechnology
11. Week	Aquaculture nutrition: gut health, probiotics, and prebiotics
12. Week	Mucosal Health in Aquaculture
13. Week	Off-Flavors in Aquaculture
14. Week	Sustainable Aquaculture Techniques

- The hatchery layout is presented following its production units. Criteria to be adopted rather strictly for architectural and engineering solutions are:
- overall economic feasibility of the project with cost effective solutions,
- rational exploitation of available space and energy,
- rational choice of materials and equipment,
- maximum technical reliability, achieved through a correct choice of equipment and the organization of its maintenance,

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- reliability of production methods, obtained through adoption of standard working methodologies based on proven production techniques, efficient use of resources at disposal and ergonomics,
- easy servicing and maintenance,
- adopt flexible solutions to enable future technical upgrading,
- ensure optimal hygienic conditions.
- The description of hatchery production systems is divided into two main components:
- the production units, where true production activities take place;
- the service units, which provide the necessary support to production units.
- The function of this unit is the proper maintenance of adequate stocks of parent fish to assure a timely supply of fertilized eggs of the best quality to the larval rearing sector.

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- Broodstock units have facilities placed both outdoors and indoors. Outdoors facilities are mainly used for long term stocking purposes, but also for quarantine treatments and to recover spent or newly captured breeders. Indoor facilities are mainly used for:
- overwintering, where severe winter conditions could affect fish survival,
- shifting reproduction periods by manipulation of temperature and photoperiod,
- spawning.
- Different tank designs are used for different purposes. Before going into their description, it is necessary to know how to calculate the size of the facilities on the basis of the planned production.

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- **Calculating the size of the stocking facilities**
- The broodstock unit requires enough space to keep breeders in healthy conditions so that they can spawn viable eggs and can be used for more than one breeding season.
- The total water volume **V** required for long term rearing of broodstock can be calculated by taking into account the following points:
- the total female body weight **fbw**, which in turn depends on the quantity of eggs needed (this figure can be calculated using the already described average female fecundity, that is 120 000 two-days old larvae per kg b.w. in case of seabass and 350 000 for gilthead seabream;
- the total male body weight **mbw**, which depends on the sex ratio (number of males, normally two per female) and the average individual size of the males;
- the larval survival rates for the different species to be reproduced;
- the stocking density **D** (expressed in kg/m^3);
- the reproductive pattern (gonochoric or hermaphrodite);
- the number of spawns per year **S**, plus eventually a safety margin for the stock of 50%.
- D should be 1 kg per m^3 in large earthen ponds, and up to 5 kg per m^3 in smaller plastic or concrete tanks.

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- **Calculating the size of the stocking facilities**
- The required water volume for species 1 (V1) expressed in m3 is calculated as:
- V1 = [(fbw1 + mbw1): D1] x S1

- The required total water volume **V** is calculated as the sum of $\mathbf{V_1 + V_2 + V_3 ...}$, which depends on the number of reared species and adding the 50% safety factor.
- This formula refers to the final standing stock of breeders, where all the required biomass is represented at its peak. When the volume includes also the out-of-season reproduction, it must be considered that it refers to the additional tanks placed indoors for control of temperature and photoperiod.

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- **Example**: calculation of the outdoor tank volume for a small multispecific hatchery with an annual requirement (one natural spawning season) of 4 million two-day old larvae of both seabass and gilthead seabream.
- In seabass, considering the average female fecundity conservatively estimated above, we obtain:
- 4 000 000: 120 000 = 33 kg of females,
- which with an average individual weight of 1.25 kg corresponds to 27 females. With a sex ratio of 2:1 (males per female), the 54 males required with average weight of 0.8 kg per male add about 43 kg. Thus, the total biomass ($fbw_1 + mbw_1$) would be 76 kg (33+43) and it represents the minimal requirement of seabass spawners for one production season.
- For gilthead seabream we have:
- 4 000 000: 350 000 = 11 kg of females,
- which with an average individual weight of 1 kg corresponds to 11 individuals. With the same sex ratio, the 22 males required, with average weight of 0.4 kg per male, add about 9 kg. Thus the total biomass ($fbw_1 + mbw_1$) would be 20 kg (11+9) and it represents the minimal requirement of gilthead seabream spawners for one production season.
- To cover possible accidents, diseases and stock renewal, an extra 50% should be considered for safety reasons. Therefore, the total biomass of seabass would be around 114 kg, to which 30 kg of gilthead seabream breeders should be added.
- With a long term stocking density of 1 kg per m^3 in earthen ponds, 114 m^3 would be required for seabass broodstock and 30 m^3, for gilthead seabream, hence a total volume requirement of 144 m^3.

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- Indoor facilities
- The tanks where fish are temporarily stocked to obtain fertilised eggs are usually placed in a dedicated sector. They should be located in the quietest corner of the building to reduce disturbance to broodstock. An adjacent area should be reserved to clean, disinfect and store the equipment of the spawning unit.
- Windows for this indoor section are not strictly necessary as spawning requires controlled light conditions, but they can be installed to renew the air and reduce humidity inside the spawning unit. Air extractors could be used in place of windows.
- The floor of this unit should be tiled or painted with epoxy coatings to facilitate cleaning, and to maintain hygienic conditions. In order to drain the tanks an adequate drainage system made of screened channels under the floor is required. It should have a slope of at least 2%.
- Thermal insulation of walls and roof is advisable in locations with cold winters to save on heating costs. A framework of zinc-coated steel beams suspended over the tanks should be considered to allow the installation of the main support systems such as heating, water supply and recirculation, light and electric systems, air and emergency oxygen supplies.
- When considering a water recirculation system, enough floor space close to the tanks should be planned in the design stages to house its various components such as mechanical filters, biological filters, pumps, sterilizers, and heating devices. If the drains can be placed under the floor, the gutters going to the biological filters should be built well above the floor level to prevent dirt or toxic chemicals, such as disinfectants used to wash floors, from entering the recirculation system.

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- Spawning tanks
- Water circuit
- Lights
- Aeration system
- Overwintering facilities
- Conditioning facilities

- LIVE FOOD UNIT
- PURE STRAIN AND UP-SCALE CULTURE ROOM
- Support systems
- Equipment
- INTERMEDIATE ALGAE AND ROTIFER BAG CULTURE ROOM
- Bags and stands
- Support systems
- Equipment
- Space requirement calculations

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- ROTIFER CULTURE AND ENRICHMENT
- Production facilities
- Support systems
- Equipment
- Space requirement calculation

- BRINE SHRIMP PRODUCTION AND ENRICHMENT
- Production facilities
- Support systems
- Equipment
- Space requirement calculation

- LARVAL REARING UNIT
- Production facilities
- Support systems
- Space requirements

- WEANING UNIT
- Production facilities
- Support systems
- Space requirement calculations
- SUPPORT UNITS
- Pumping station
- Seawater wells
- Pumping station to hatchery connection and wastewater treatment
- Boiler room
- Electricity generator room
- Workshop
- Feed store
- Hatchery laboratory
- Cleaning areas
- Offices

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