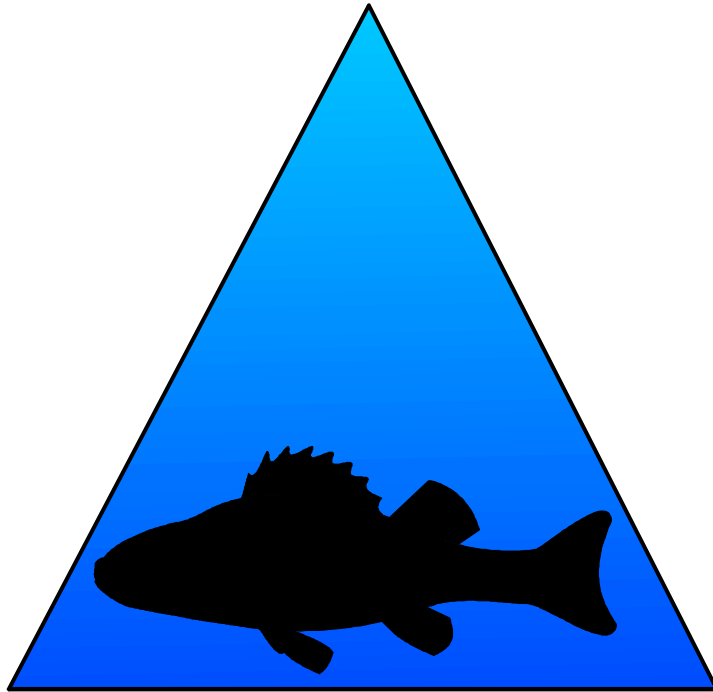


# FiLaMan



(Fish Larval Rearing Manual)

**A Curriculum on the Rearing of Fish Larvae,  
for use in Training Courses  
in Developing Countries**

With support from the European Commission Directorate-General VIII,  
Development Sectorial Implementation Education, Training  
and Cultural Cooperation

The **Content** of the Curriculum will not necessarily provide a complete educational programme for all species but is mainly concerned with biological and biotechnological principles on which the Trainee should gain sufficient knowledge to make appropriate decisions when unforeseen problems are encountered during common commercial operation of hatcheries.

Many of the elements needed are principally addressed (to various level of detail) in the **FiLaMan Training Module** (available on CD-ROM, contact [bueberschaer@ifm.uni-kiel.de](mailto:bueberschaer@ifm.uni-kiel.de)). However, **FiLaMan** should be considered as a supplemental tool for both, teachers and students. It does by far not contain in the initial version a full account on hatchery design and operation.

The **Curriculum** suggests a three weeks course: (a) theoretical teaching (week 1), (b) practical training on key procedures (week 2, either in the laboratory or preferably onsite a hatchery) and (c) visits to several (at least three) commercial hatcheries, each of them rearing a different fish species (week 3).

The following overall structure is suggested:

### **Part A Teaching module**

#### *1) General introduction to fish biology and literature:*

- (a) Overall life requirements, differences between freshwater and marine fish species, considerations on climate and habitat
  
- (b) Familiarization with key literature (textbooks, manuals, computer software, demonstration tools, journals, original papers, leaflets from industry providing specific products relevant to the subject)

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4 hours

#### *2. General introduction to fish behaviour and physiology*

- (a) General aspects of fish metabolism (growth and excretion)
- (b) General hormone physiology (in relation to reproduction and its control)
- (c) General processes of maturation (e.g. gonad types & their development)
- (d) Reproductive guilds (e.g. egg shelders, brood guardians, batch spawners)
- (e) Principle aspects of osmoregulation in fresh- and seawater
- (f) Fish behaviour in relation to reproduction strategies
- (g) Discussing of Part A section 2 with students

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6 hours

### *3. Practical aspects of fish reproduction, incubation and larval rearing*

#### *3.1. Brood stock handling*

Handling of brood fish, including

- catching techniques of brood fish from the wild,
- handling of adults during the final maturation phase (including feeding and feed requirements, possible pre-treatment, e.g. hormone application)
- post-spawning handling of brood stock and
- natural spawning of fish in captivity.

#### *3.2. Spawning*

Spawning types (batch spawners, continuous spawners, 1-time spawners)

- species with pelagic eggs
- species with demersal egg
- species with brood care

#### *3.3 Principles in Fish Embryology and Larval Development*

(a) Developmental stages (cleavages, epiboly, differentiation, stages, hatching, larvae)

- hatching process (factors controlling hatching: light, temperature, pH, salinity, etc.)
- larval stages (the yolk sac phase, stage of organ development in different species, yolk absorption and metabolism of yolk constituents, metamorphosis, first feeding, etc.).

(b) Developmental features and processes in relation to environmental conditions

- caused by various environmental and operational factors under mass culture conditions
- light effects, mechanical stress, influence of temperature, oxygen, pH, salinity, organic load

(c) Nutritional requirements: first feeding, live food versus microencapsulated diets, larval growth

and conversion, feed quality (e.g. HUFAs, PUFAs, vitamins, proteins etc.)

(d) Metamorphosis and transitional stages (metabolism, general morphology & physiology)

(e) Juveniles up to stocking size (rearing of postlarvae to fingerling stages, e.g. smolt production in

salmonids)

(f) Disease diagnosis, and prevention (hygiene, prophylaxis, treatment)

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7 hours

#### 4. Hatchery design and operation in relation to species

##### 4.1 Hatchery design

###### (a) Principle designs of hatcheries for various species

- site selection
- environmental requirements
- planning of layout, construction and financing
- planning of timing from scratch to start-up

###### (b) Infrastructure needs and equipment

- water sources and supply
- water purification

##### 4.2 Hatchery operation

###### (a) Stripping and fertilization procedures (wet and dry; disinfection procedures)

###### (b) Collecting eggs from natural spawning in containments (transportation)

###### (c) Handling of eggs (preparation of and transfer to incubators, counting methods)

###### (d) Controlling environmental conditions (e.g. flow rates, light, pH salinity, oxygen)

###### (e) Controlling mortality and hygiene (e.g. removing dead eggs and debris)

###### (f) Preparation of rearing units (tanks/ponds)

###### (g) Stocking of rearing units

###### (h) Management of rearing units

###### (i) Disease prevention

##### 4.3 Feeding of fish larvae

###### (a) Natural live food organisms in ponds

###### (b) Production of live food organisms in the hatchery (establishing a food chain)

###### (c) Use of supplemental feeds (powders, microencapsulated diets, micropellets)

##### 4.4 Grading and other handling procedures of juveniles

###### (a) Use of sedatives

###### (b) Prophylactic treatment (e.g. vaccines and antimicrobials)

###### (c) Intermediate holding during grading

###### (d) Health control (regular sampling and monitoring)

##### 4.5 Schematic approach to disease and parasite identification in fish and holding systems

###### (a) Sampling procedures

###### (b) Regular monitoring of health status

#### 4.6 Bookkeeping for hatchery management purposes

- (a) Protocols, flow charts and worksheets for hatchery staff
- (b) Booking for spare parts and routine services
- (c) Financial bookkeeping

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8 hours

### **Part B: Hands on training module (to be performed by participants)**

#### 1. Practicing basic calculations commonly applied in hatcheries

Examples:

- (a) Calculation and preparation of stock solutions for disinfectants
- (b) Calculating oxygen consumption rates for various species in relation to stocking densities
- (c) Calculating feed conversion rates and preparing feeding schedules

#### 2. Exercising basic operational procedures (routine hatchery work)

- (a) Water quality analysis; preparing stock solutions, standards and calibration curves for major water quality parameters
- (b) Performing sampling and analysis of samples
- (c) Installing and starting incubators and other hatchery equipment
- (d) Handling of hatchery equipment: e.g. controlling flow rates, servicing pumps and maintenance
  - of probes (e.g. oxygen & pH meters, conductivity & redox electrodes)
- (e) Operation of feeding devices

#### 3. Exercises for the handling of brood fish, eggs and larvae (species selection depending on region, season and facility)

- (a) Stripping and fertilization methods
- (b) Incubating eggs and following their development
- (c) Exercising disease prevention methods and disinfection procedures
- (d) Simulating transportation of broodstock, eggs and larvae
- (e) Estimating stocking density in rearing units by stratified random sampling
- (f) Size and weight termination (demonstrating accuracy and precision by using different methods)
- (g) Building of food chains for larval rearing (e.g. maintaining algal and rotifer cultures) and monitoring of growth of batch-cultured food chains.

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14 hours

### **Part C: Excursions to operational commercial hatchery facilities**

It is recommended to visit if possible more than three hatcheries of different design which are culturing different species. The choice will depend on region and season. If no farms are within reach of the institution which carries out the course, one should attempt to provide individual participants with the opportunity for a one week internship elsewhere (if necessary with the assistance of national or international sponsoring agencies). In some cases such linkages may be arranged via AQUA-TT (Dublin, Ireland; EU-founded) or ICLARM (in context of ACP-Training courses).

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20 hours

### **Part D (last day of week three): Presentation and performance control of participants (5 hours)**

At the end of week one (part A) each participant should prepare a 15 minute oral presentation on a subject within part A of the curriculum. This presentation should be summarized in writing for distribution to all other participants.

Rating:

30 points as a C; 37 points as a B; 45 points as a A max 45 points

At the end of week two (part B) each participant should deliver a report on the calculations and the practical work performed in this part. This protocol should contain (a) a description of the work performed, (b) a report on difficulties encountered and (c) a critical account on methodological approaches. (What can be done better...)

Rating:

20 points as a C; 28 points as a B; 35 points as a A max 35 points

At the end of week three (part C) a report describing the hatcheries and facilities visited during the excursions (part C) has to be delivered. The report should focus on specific techniques used and different species reared. The report will be rated according to (a) clear description, (b) logical structure on system design and operation, and (c) clear and complete explanations of graphics and tables.

Rating:

10 points as a C; 15 points as a B; 20 points as an A max 20 points

Final rating

60-79 points as a C; 80-92 points as a B; 93-100 points as an A total max 100points