4. Hatchery implications & Hatchery techniques

Taken from:
http://www.fao.org/3/x3980e/x3980e06.htm

The importance of a properly dimensioned and managed broodstock unit is now fully acknowledged and its relatively high running costs are fully justified.

In the management of a fish broodstock unit the main issues to be considered refer essentially to:

- stock dimensioning;
- stock collection;
- adaptation to captivity and long-term stocking conditions;
- sexual maturation and spawning according to the production schedule;
- renewal of the old breeders.

For practical purposes the following table presents some conservative parameters to be considered as guidelines when dimensioning the broodstock unit.

Table 3.1 - Conservative propagation parameters under hatchery conditions for seabass and gilthead seabream

Species	Egg productivity as No. eggs per kg b.w.	Egg productivity as % of b.w.	Fertilization rate (%)	Hatching rate (%)	Viable larvae (No. Per kg per yr)[1/]	Latency (months)[2/]
Seabass	300,000	20-25	90-95	75-85	220,000	6
Gilthead seabream	800,000	50-80	90-95	70-80	560,000	12

[1/]Average number of viable two days old larvae that can be expected yearly per kilogram of healthy female

[2/]Time between the introduction of brood fish in the hatchery and their first spawning.

Table 3.2 gives further information on size at sexual maturity and optimal size for spawning to be considered in broodstock dimensioning.

Table 3.2 Size at first sexual maturity and optimal size for spawning

Species	Sex	Size at first maturity		Optimal size and age		Reform
		L or W	age	wild	farmed	
		(years)		kg (years)	kg (years)	kg (years)
seabass	M	23-26 cm	2-3[1/]	0.6 (2-4)	0.7 (3-4)	> 1.5 (6)
		28-30 cm	2[2/]			
	F	31-33 cm	4 - 5[1/]	1-1.5 (5-8)	1.5-2 (6-8)	> 3 (9)
		37-40 cm	3[2/]			
gilthead seabream	M	100-300 g	1-2	0.3-0.5 (1-2)	0.3-0.5 (2-3)	
	F	> 600 g	> 3	0.8-1 (3-5)	1-1.5 (4-6)	>2 (8)

[1/]Tunisia

[2/]Mediterranean France

In seabass, as fecundity and egg quality improve after the first spawning, the optimal age for female parent fish is between 5 and 8 years, whereas for males this range is lowered to 2-4 years.

Gametogenesis

The natural process of sexual maturation in both species is briefly described below. By acting on photo and thermo-periods, it is also possible to obtain viable larvae almost throughout the year. A method to delay. spawning is described at the end of the chapter.

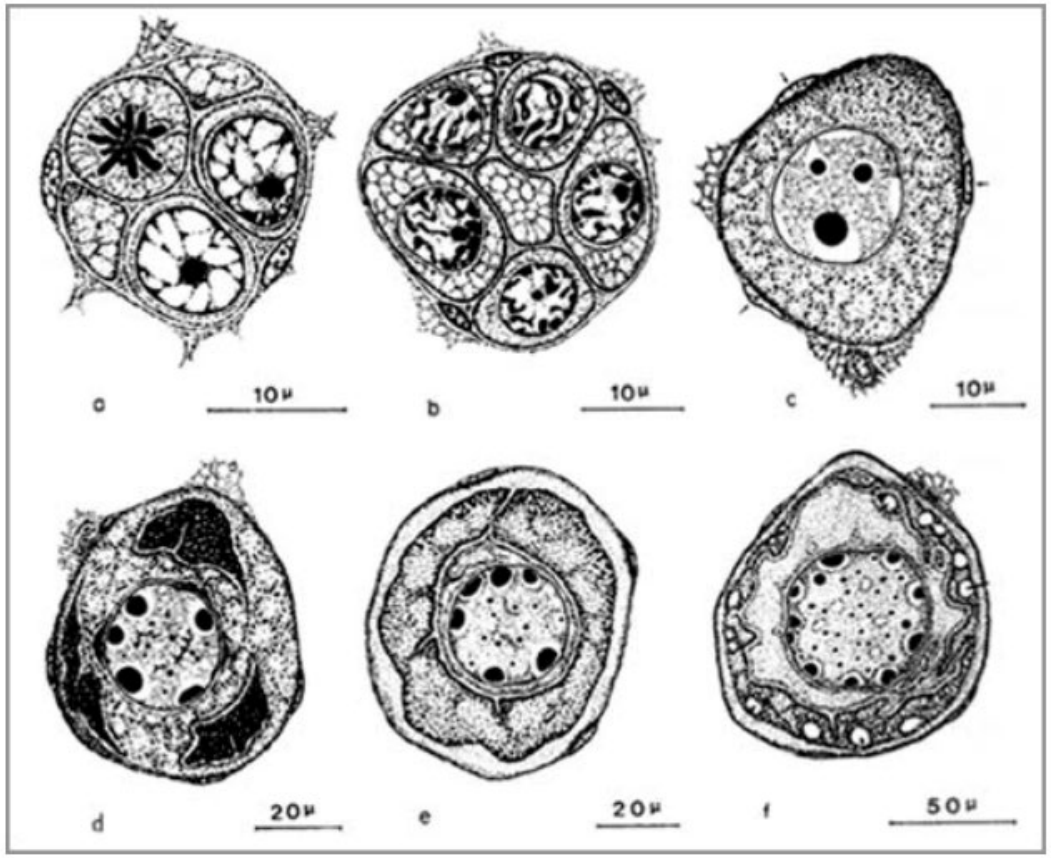
Under natural rearing conditions, and with variations linked to the geographical location, the sexual resting period (only oogonies present in the female gonads) lasts from the end of the spawning season till early autumn when gametogenesis starts. This process is regulated by a complex hormonal and environmental pattern, which has been better investigated in seabass.

Table 3.3 - Gametogenesis: environmental parameters and duration

Species	Period (length)	Temperature (°C)	Hours of light (hours)	Duration (days)
Seabass	Sept. to Jan. (3 months)	20-8	14-8.5	16-95 mean: 74
Gilthead seabream	Sept. to Dec. (3-4 months)	20-9	14-8.5	30-154 mean: 107

Both species may start ovogenesis in water with a salinity lower than 35 ppt, such as in the case of estuaries and coastal lagoons, but the final steps leading to maturation (exogenic vitellogenesis and meiotic divisions) require full seawater (= 35 ppt). Temperature has an effect on the speed of vitellogenesis and acts as a minimum/maximum threshold for the spawning.

Fig. 22.00 Ovarian development in *Dicentrarchus labrax*



a) Stage 1: oogonia

b) Stage 2: young oocytes

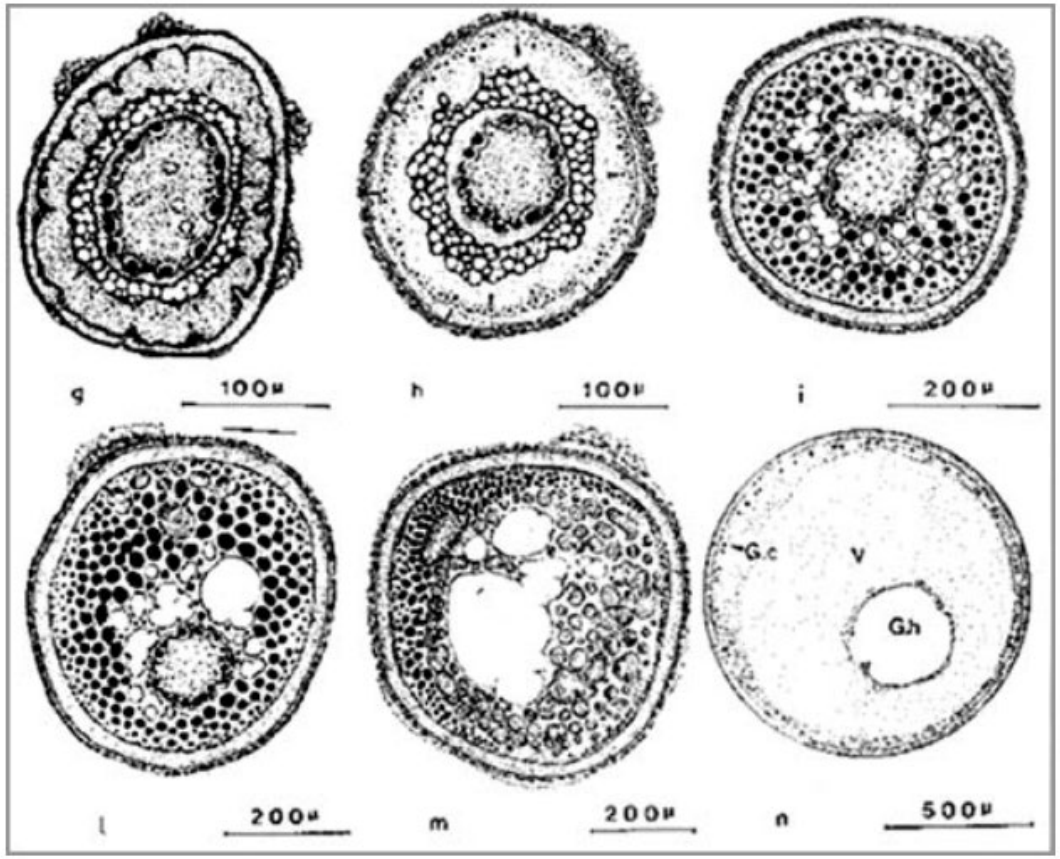
c) Stage 3: individualization of oocytes and appearance of follicular cells

d) Stage 4: differentiation of oocyte cytoplasm

e) Stage 5: separation of three areas in cytoplasm

f) Stage 6: early signs of vitellogenesis and start of membrane differentiation

Fig. 22.00 Ovarian development in *Dicentrarchus labrax*



g) Stage 7: organization of yolk globules in perinuclear layer

h) Stage 8: a second type of yolk globules are evident and the zona radiata appears

i) Stage 9: distribution of the two types of yolk globules

l) Stage 10: a third type of yolk globule appear

m) Stage 11: end of vitellogenesis and polar migration of the nucleus

n) Stage 12: the oocyte with oil droplet (G.h.) homogeneous yolk (V.) and cortical granules (G.c.).

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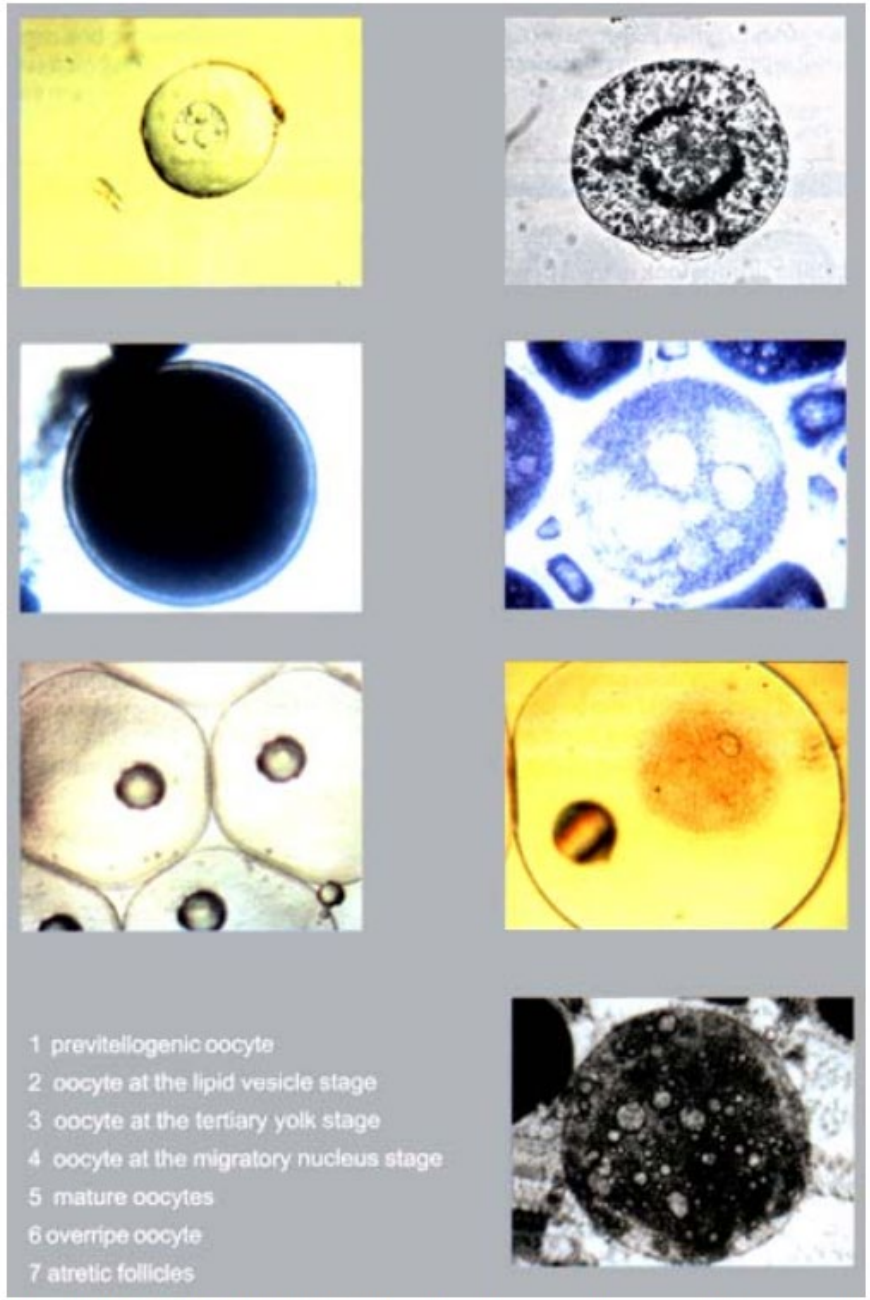

Fig. 22.01-2-3-4-5-6-7 Follicular stages observed in ovarian biopsies of gilthead sea bream (photos A. Francescon and A. Barbaro)

Taken from:
http://www.fao.org/3/x3980e/x3980e06.htm

The native form of this hormone is not used because of its low bioactivity, due to the deactivation by specific peptidases, which cannot deactivate the analogue form. Its dosage and response are given in Table 3.5. In seabass LH-Rha is delivered with two intraperitoneal injections 4-6 hours apart at 5 and 10 mg/kg b.w. respectively. In gilthead seabream hormonal dosages are much lower. The hormone is dissolved in a 0.9% sterile saline solution as 5 mg per 1 ml.

Table 3.5 - Induced spawning. Minimum oocyte size and hormonal treatments.

Species	Min. oocyte diameter (mm)	HCG (IU/kg b.w.)	LH-RHa (mg/kg b.w.)	No. of Injections (hours)	Latency (hours)
Seabass	700	800-1,000	-	2 (6)	48-72
	650	-	5-10	2 (4-6)	72
Gilthead seabream	500	100-250	1	2(4-6)	48

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Out-of-season spawning

When fertilised eggs are required outside the natural spawning period, out-of-season sexual maturation is obtained through environmental phase shifting of the gametogenesis by manipulation of photoperiod and temperature. The technique is successfully applied to both seabass and gilthead seabream and out-of-season spawning is now a current practice in many large Mediterranean hatcheries.

Different methods can be applied for out of season spawning:

- fish are kept under compressed photoperiods and temperatures cycles (the commonest);
- fish under constant day length are exposed to brief periods of long or short days;
- fish live in different 12-month long natural cycles, but shifted by three months each.

The following description refers to the last phase shifting method as it gives fertilised eggs year round. The hatchery management can decide on the periods of egg production according to its marketing and/or farming needs.

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The broodstock is divided in four groups including both males and females: three groups are exposed to environmental regimes that are shifted by 3,6 and 9 months respectively compared to the natural environmental regime, which is left for the fourth group. In this way, the hatchery will have a group of fish ready to spawn on each season: in winter the parent fish exposed to natural environmental conditions, in spring, summer and i autumn the other three groups. Shifting should start when fish are still in the resting phase of their sexual cycle.

If breeders are properly managed, eggs produced out of season with shifted cycles do not differ significantly in quality and quantity from the in-season eggs.

An out of phase maturation unit requires specific facilities:

- an independent sector equipped with tanks suitable for long term stocking, where light and water temperature conditions can be set independently from the natural cycle;
- a timer-controlled lighting, preferably equipped with a dimmer to avoid abrupt changes in light intensity (and to create a twilight effect);
- a water heating/cooling system (usually heater and heat-pump);
- a computerized control of temperature and photoperiod.