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Note

First rearing attempts of pollack, *Pollachius pollachius*

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Premiers essais d'élevage du lieu jaune, Pollachius pollachius.

INTRODUCTION

Pollack or lythe, *Pollachius pollachius* (Gadidae) is a carnivorous fish. Pollack occurs on the Atlantic coast, from Portugal to the north of Norway. Annual landings are 16 200 tonnes (FAO, 1993).

Data recorded on pollack biology are scarce. Large aggregations are observed during the spawning period. Spawning begins between February in Spain and May in Norway, in depths less than 150 m, at water temperature close to 10°C (Moreau, 1964). Mean egg diameter is 1.16 mm (Hislop and Bell, 1987). Hatched larvae are pelagic and their length ranges from 3 to 4 mm. Larvae occur near the surface, at depth lower than 10 m (Russel, 1976). Pollack growth is rapid: a weight of 0.9 kg was recorded by Dupouy *et al.* (1990) for three-year-old fish. Adult food is primarily composed of fish but also cephalopods and crustaceans (Du Buit, 1982).

Aquaculture of pollack has not been reported in the literature. Because its growth is rapid, the captivity performances of pollack were tested in order to select new candidates for aquaculture. The purpose of this work was to examine the performances of this species during reproduction, larval rearing, weaning and ongrowing phases.

MATERIAL AND METHODS

Reproduction

Mature pollack females (n=12) and males (n=9), weighing from 1.2 to 1.5 kg, were caught in the wild and were transferred to a 15 m^3 cylindrical tank. Fish were weighed at the end of the spawning period. Stocking density was 2 kg/m^3. Fish were exposed to the natural variations of temperature and daylength *(fig. 1a, b)*. Sea water renewal was about 10 % tank volume/hour. Fish were fed *ad libitum* twice a week on fresh trash fish. The weight of ingested food was estimated (weight of distributed food – weight of resting food removed 24 hours later). Eggs from spontaneous spawnings were collected at the surface of the water and concentrated in a plankton net. The eggs were then concentrated in a 1 l volume. The number and quality of eggs were assessed through a dissecting microscope from a 2 ml sample. Eggs were considered viable when stage 2 blastomeres or beyond were observed. Viability rate was defined as the number of eggs undergoing cleavage divided by the total number of eggs.

After decantation, viable eggs were transferred to an incubation system as described by Devauchelle *et al.* (1986) or to cylindroconical 40 l incubators. For the latter, an aeration inlet and a 300 % tank volume/hour water renewal were added. Number of larvae was estimated on two 200 ml aliquots after manual homogenization of the population. Hatching rate was defined as the number of larvae divided by the number of eggs transferred to incubators.

Larval rearing

At day 1 post hatch (D1), larvae were transferred to 250 l cylindroconical tanks. Rearing conditions are summarized in *table I* for each larval rearing attempt. Conditions used for the first attempt were selected according to the larval rearing scheme of turbot (Gaignon and Petton, unpublished result). Then, temperature and photoperiod were modified according to survival rate recorded during the previous attempts. Before use, water was passed through a degassing column. Water inflow (25 % tank volume/hour) was tangential to the surface. Aeration was introduced at the bottom of the tank. Photoperiod was 24 h/day.

Table 1. – Larval rearing conditions and survival recorded for each attempt.

Experiment	Larvae/l	Rearing temperature (day, from-to: °C)	Light intensity (day, from-to: lm.m^{-2})	Replicates (n)	Survival at D30 (%: mean ± SD)
1	24	1-5 : 14-18 5-30 : 18	1-2 < 100 3-30 : 1000	1	2.8
2	35	1-12 : 14 13-16 : 14-18 16-30 : 18	1-30 : 3000	1	8.2
3	25	1-19 : 14 20-30 : 16	1-19 < 50 20-30 > 500	4	28.0 ± 8.0
4	20	1-20 : 15 21-23 : 16 24-30 : 17	1-11 < 50 12-30 > 500	4	17.0 ± 7.6
5	28	1-20 : 15 21-23 : 16 24-30 : 17	1-11 < 50 12-30 > 500	7	13.7 ± 7.1

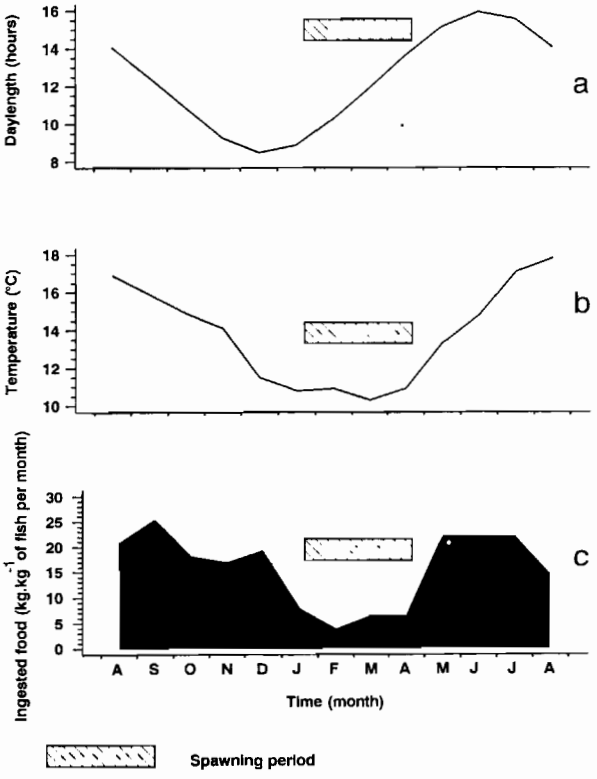

Figure 1. – Annual changes in daylength (a), water temperature (b) and food ingested by pollack broodstock (c).

Rotifers were cultured in sea water and fed with algae *(Platymonas)*, baker's yeast, cod liver oil and vitamin premix (vitamin A, D and E). Before feeding to the larvae, rotifers were transferred into a clean seawater tank where they were enriched with baker's yeast and cod liver oil. Rotifers were then continously distributed to the larvae for 20/24 hours, between D3 and D12 post-hatching. During this period, the rotifer concentration was kept between 60 and 140/larva. Newly hatched artemia were supplied between D8 and D12. Then, one-day-old artemia (between D10 and D20) and two-day-old artemia (from D18 up to weaning) were added. Artemia supply ranged from 15 (D8) to 200 (D30)/larva. Artemia were enriched using Super Selco (INVE). At the end of the larval rearing period, (between D26 and D35) all larvae were counted.

Weaning

Pollack juveniles were then transferred to 1 m^2 (0.5 m^3) flat bottom square tanks. Initial stocking density was about 6 kg/m^3. When the stocking density reached 20 kg/m^3, each stock was divided into two tanks. Water renewal and temperature were respectively 300 % tank volume/hour and 18°C. Moist pellets composed of crushed fish (sardine or mackerel) and weaning pellets (SEVBAR, INVE) 1V:1V, were distributed *ad libitum*. Pellets were supplemented with decreasing quantities of two-days-old Artemia (maximum: 50/larva).

Ongrowing

From the end of weaning to D380 post hatch, the rearing conditions of the pollack juveniles remained unchanged. Fish were then transferred to a 15 m^3 cylindrical tank. Water temperature ranged from 13 to 18°C. Fish were fed *ad libitum* on dry pellets (ECOLIFE, AQUALIM).

RESULTS AND DISCUSSION

Reproduction

A decrease in feeding was observed during the spawning period *(fig. 1c)*. The main characteristics of the spawning period are reported in *table 2*. Pollack

Table 2. – Main characteristics of the spawning period.

Beginning-end of the spawning period	January 23, 1995-April 24, 1995
Duration of the spawning period (days)	92
Spawning temperature: minimum-maximum (°C)	9.5 - 11.8
Spawning daylength: minimum-maximum (hours, min)	9.05-14.11
Total number of batches	61
Theoretical mean number of batches/female*	5.5
Total number of collected eggs	18 603 000
Mean number of eggs/batch (± SD)	305 000 ± 272 000
Total number of eggs/kg of female**	626 000
Mean number of viable eggs/batch (± SD)	250 200 ± 249 000
Mean egg viability rate (%, ± SD)	73.6 ± 24.3
Mean hatching rate (%, ± SD)	16.5 ± 12.9

* calculated using the total number of batches divided by the number of females in the tank (n=12),

** calculated using the weight observed at the end of the spawning period.

spawned spontaneously in captivity. Considering the mean number of batches per female, it can be suggested that pollack are multiple spawners. In captivity, total number of eggs collected per kilo of female was lower than cod, *Gadus morhua* (Kjesbu, 1989).

At a temperature of 10.5°C, hatching was observed after 6 to 7 days. Mean hatching rate was low and has to be improved. Because spawn were collected at the overflow pipe of the tank, eggs were contaminated by organic matter rejected by spawners. At hatching, larval length was 3 mm, similar to the length of turbot, *Scophthalmus maximus* (Person-Le Ruyet, 1991) but smaller than cod (Huse, 1991).

Larval rearing

Results recorded during the different larval rearing trials are summarized in *table 1*. The effect of two parameters during this rearing phase could be highlighted: water temperature and light intensity. When compared to results observed for high temperature (14-18°C), better survival was recorded by decreasing rearing temperature (14-16°C). Furthermore, the best survival was observed at low light intensity (< 50 $lm.m^{-2}$) during the first days of rearing. Cod larvae should also be cultured in low light intensity (Huse, 1994).

Figure 2 represents morphological changes of pollack larvae from hatching to D 35, at 14-16°C (*table 1*, attempt n° 5). Opening of the mouth and metamorphosis were respectively observed at D3-D4 and between D25-D30 post-hatch. The change in larval wet weight during the same period is presented in *figure 3*.

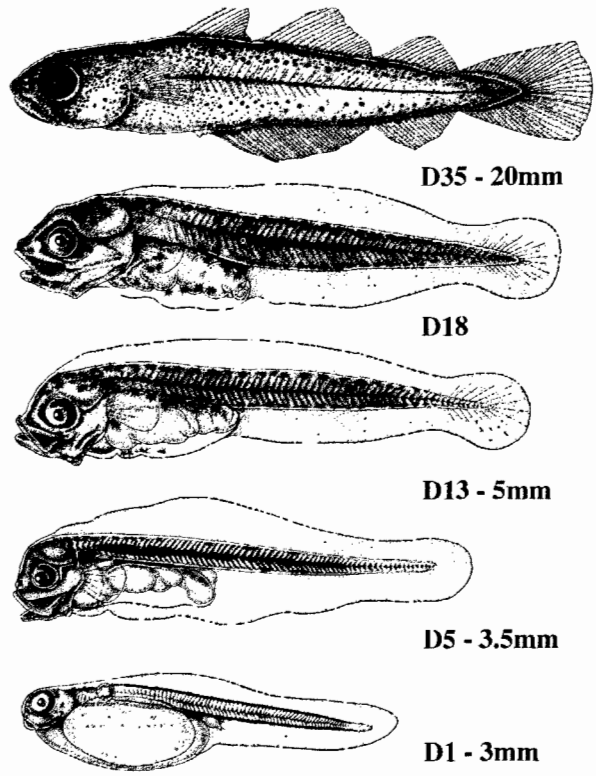

Figure 2. – Morphology of pollack larvae from hatching to D 35 post hatch, for a 14-16°C water temperature.

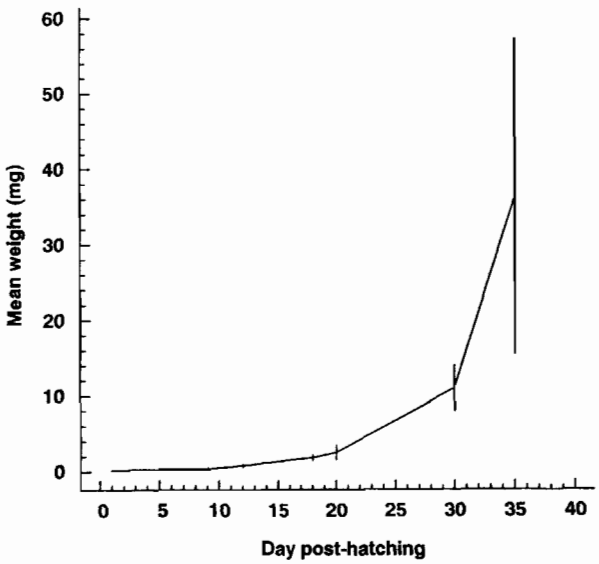

Figure 3. – Change in pollack larvae wet weight from hatching to D 35 post hatching (mean ± SD, n=7-12 larvae; larval rearing attempt n° 2 and 3).

Weaning

A high mortality was observed during the weaning phase: at D90 post hatch, a 28 % survival of larvae was recorded. In cod, the mortality observed during the

weaning phase is decreased for 100 mg fish, compared to 20 mg fish (Ottera *et al.*, 1994). The weight of the pollack at the beginning of the weaning phase was between 10 and 35 mg. The influence of the initial weight of pollack on the success of the weaning phase has to be investigated.

Ongrowing

The change in the wet weight of pollack juveniles from D135 to 534 are presented in *figure* 4. A mean weight of 400 g was reached 18 months after hatching. An increase in growth was recorded after transferring pollacks to a larger tank and decreasing water temperature from 18°C to range of 13-18°C. The growth of pollack juveniles was close to that reported in the wild by Dupouy *et al.* (1990). Similar results were observed in cod (Svasand *et al.*, 1993).

In conclusion, this first rearing attempt of pollack suggests a good adaptation of this fish species to captivity. However, problems were observed during the incubation and weaning phases. In order to determine the potential of pollack for aquaculture development, further investigations are needed, taking into consideration the intermediate selling price of this fish species.

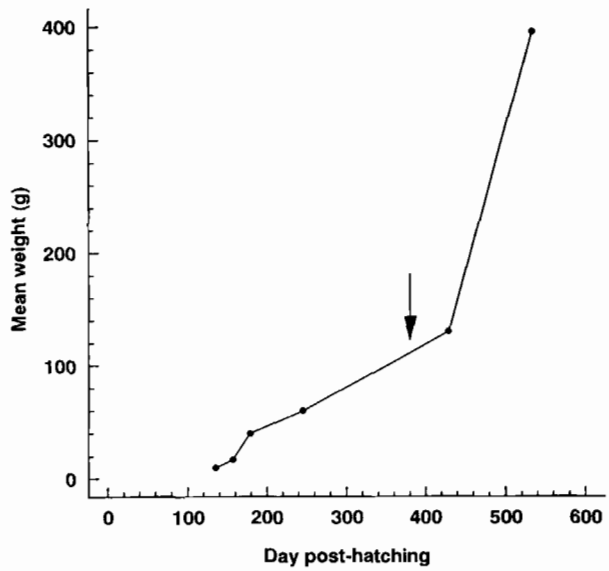

Figure 4. – Changes in pollack mean weight from D 135 to D 534 (The mean is calculated from a global biomass, $50 < n < 150$). Arrow indicates transfer of pollack to 15 m^3 tank.

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REFERENCES

Devauchelle N., Y. Letty, M. Quere 1986. Experimental units for incubation and larval rearing with special reference to four marine fish species. *Aquaculture* **58**, 297-304.

Du Buit M. H. 1982. Essai d'évaluation de la prédation de quelques téléostéens en mer Celtique. *J. Cons. int. Explor. Mer* **40**, 37-46.

Dupouy H., D. Christien, B. Kergoat 1990. Estimation de la mortalité par pêche et rendement par recrue du lieu jaune *(Pollachius pollachius)* du plateau celtique. *Int. Counc. Explor. Sea* G:21.

FAO 1993. Fishery statistics, catches and landing, FAO yearbook.

Hislop J. R. G., M. A. Bell 1987. Observations on the size, dry weight and energy content of the eggs of some demersal fish species from British marine waters. *J. Fish Biol.* **31**, 1-20.

Huse I. 1991. Culturing of cod *(Gadus morhua* L.). In: Finfish Aquaculture, CRC Handbook of Mariculture. J. P. McVey ed. Vol. 2, CRC Press, Boston, 43-51.

Huse I. 1994. Feeding at different illumination levels in larvae of three marine teleost species: cod, *Gadus morhua* L., plaice, *Pleuronectes platessa* L. and turbot, *Scophthalmus maximus* L. *Aquac. Fish. Manag.* **25**, 687-695.

Kjesbu O. S. 1989. The spawning activity of cod, *Gadus morhua* L. *J. Fish Biol.* **34**, 195-206.

Moreau J. 1964. Contribution à l'étude du lieu jaune *(Gadus pollachius* L.). *Rev. Trav. Inst. Pêches marit.* **28**, 237-255.

Ottera H., G. I. Hemre, O Lie 1994. Influence of dietary water content on feed intake, growth and survival of juvenile of Atlantic cod, *Gadus morhua* L., during the weaning process. *Aquac. Fish. Manag.* **25**, 915-926.

Person-Le Ruyet J., Baudin-Laurencin F., N. Devauchelle, R. Métailler, J. L. Nicolas, J. Robin, J. Guillaume 1991. Culture of turbot *(Scophthalmus maximus).* In: Finfish Aquaculture, CRC Handbook of Mariculture. J. P. McVey ed. Vol. 2, CRC Press, Boston, 21-41.

Russell F. S. 1976. The eggs and planktonic stages of British marine fishes. H. B. Jovanovich Publishers, Academic Press, London, 524 p.

Svasand T., K. E. Jorstad, H. Ottera 1994. Growth of juvenile Arcto-Norwegian and Norwegian coastal cod reared under similar conditions. Cod and climate change. *ICES Mar. Sci. Symp.* **198**, 624-625.