



Improving sustainability of European fish aquaculture by control of malformations

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The final FineFish Workshop successfully took place on the 7th of September in Ghent, Belgium, in the marvellous setting of the University's 'Aula' Auditorium. The workshop was held as an open event that was concurrent with the 5<sup>th</sup> fish and shellfish larviculture symposium 'LARVI 2009'.

The FineFish Workshop combined the presentation of developments made within FineFish but also the results of other RTD projects with complementary objectives. The different experiences and observations from professional hatcheries were also given, providing a detailed overview of relevant knowledge that has been gained on the

root cause of the incidence of malformations in farmed fish.

Almost 100 people participated in the workshop and the presentation of the new knowledge and positions developed. The research outcomes will be summarised within guidelines for malformation classification and protocols (Best Management Practise) for the prevention of malformations. These are designed for specific use in professional hatcheries.

The details of the programme and the presentations can be downloaded from the following web page:

<http://www.aquamedia.org/finefish/>

## Colophon

The FineFish project aims to generate new practical knowledge on how to reduce the incidence of malformations in the major fish species used in European aquaculture production and to apply this to the professional sector. FEAP (Federation of European Aquaculture Producers), ten major European hatcheries and eight leading European scientific institutions participate in this Collective Research Project.

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## FineFish training courses on individual species

Three specific FineFish training courses on the prevention of malformations have now been held during the first half of 2009, covering the major fish species examined.

The first, on cod malformations, was held in Bergen in February, as a satellite workshop to the national cod meeting "Sats på torsk". The second workshop on Atlantic salmon was held in Bergen in March and, during May, the third course on malformations in sea bass and sea bream was held in Athens, Greece. In total around 150 people participated in these training courses and, based on the affiliations of the training course participants, we hit the target groups anticipated – which were fish farmers, hatchery personnel, fish health service personnel, and researchers interested in the topic.

Because of the effects of the financial crisis and its knock-on to the aquaculture sector, a training course on how to prevent malformations in rainbow trout had to be cancelled due to pre-registration numbers that were too low to justify its organisation. In addition, a course on bass and bream that was planned to be held in Madrid was not finalised. These courses may be arranged at a later date since the materials exist.

The training courses primarily focused on skeletal deformities. The use of diagnostic

methods including X-ray, staining, and image evaluation, and also guidelines for classification were important parts of the program. The courses centred on the new knowledge generated during the FineFish project and, in addition, other speakers (often professional hatchery operators) were invited to give targeted talks on status of malformation in the industry, legislation etc.

All speakers were asked to provide practical recommendations on how to prevent malformations in commercial hatchery production.

This approach worked well in all the courses and will serve as input to the species specific BMP.

To view the courses programmes and training material visit the website: [www.finefish.info](http://www.finefish.info).



“Temperature induced fast growth gives a softer bone phenotype accompanied by a reduced expression of genes involved in mineralization”

# Molecular pathogenesis of vertebral deformities in salmon

Elisabeth Ytteborg, Grete Baeverfjord, Jacob Torgersen, Kirsti Hjelde and Harald Takle

Musculoskeletal disorders of the spine are a major cause of disability for humans and an important health problem for intensively produced animals as chicken, broilers and fish.

In salmonids, these disorders are typically found as vertebral fusions; an etiology similar to degeneration of the intervertebral disc in humans. The molecular mechanisms, however, have not been thoroughly described and there has been a lack of good models to study how vertebral fusions develop.

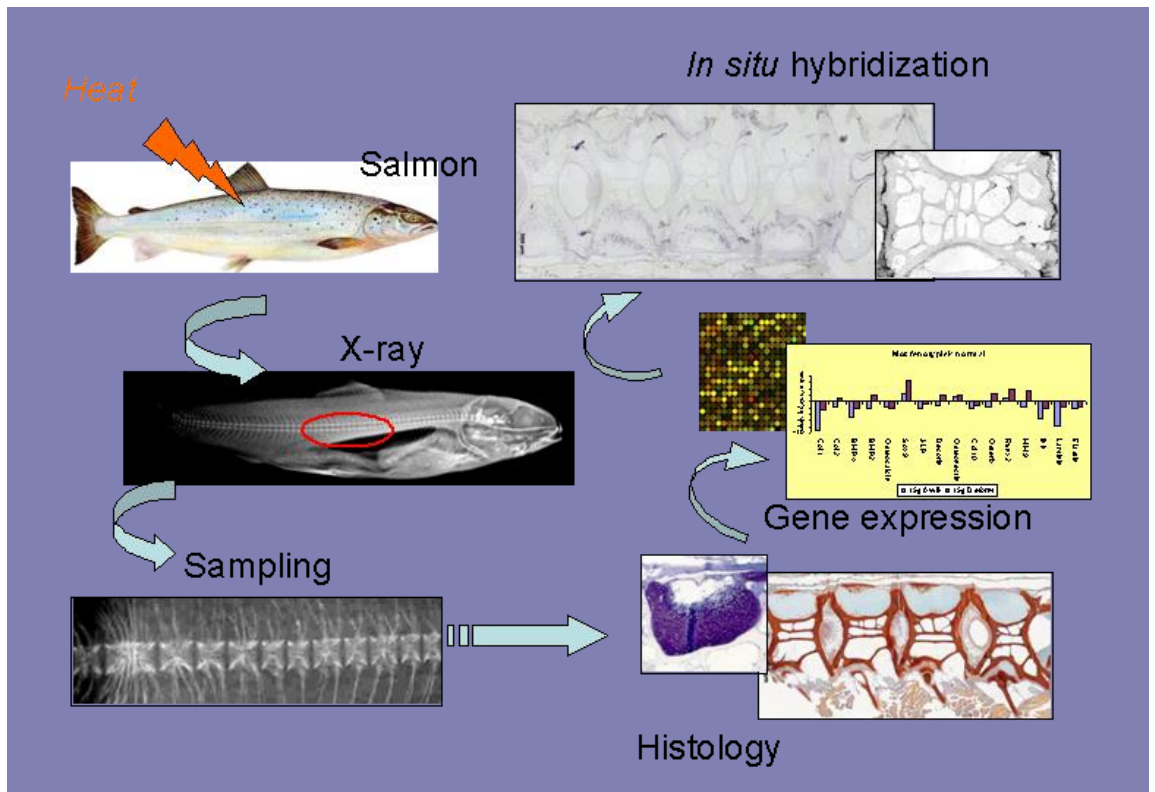
In this project, we designed an experimental model where elevated water temperature was used to explore both normal bone development and pathogenesis of vertebral fusions in fast growing Atlantic salmon. As part of this work, our group has built up a large methodology platform ranging from radiography and histological methods to molecular techniques for locating and measuring the expression of 30 important skeletal genes.

This work has revealed that temperature induced fast growth gives a softer bone phenotype which is accompanied by a reduced expression of the genes involved in mineralization of bone cells. To compensate for the

softer bone, the cartilage is remodelled to improve the strength of the spinal column.

However, this compensation is apparently not sufficient for all individuals, and we found that more than 30% of the salmon juveniles developed vertebral fusions at the high temperature regime. Examination of different stages of the vertebral fusion process showed that the pathology involves a degeneration of the intervertebral notochord during fusion of two vertebral bodies. This process is administrated by genes controlling the trans-differentiation of skeletal cells.

Importantly, management control of deformities and health in general demands precise tools and knowledge to depict any problem as early as possible in the production line. The reliable correlation between defined skeletal markers and the risk of developing vertebral deformities found in our temperature experiments indicates that these genes can be developed as prognostic markers. Further, our skeletal tool-box can be used to investigate how the progression of skeletogenesis is modulated in response to other stimuli. The results will be published in peer-review journals in 2010.



Overview of the experimental pipeline used to study bone development and vertebral deformities in Atlantic salmon (*Salmo salar*).

Fish was exposed to a high and low intensive temperature regime from fertilization till 20g. During the experiment, fish were sedated and radiographed at 2g, 15g and 60g. From the live-radiography, normal, aberrant and deformed spinal columns were sampled and used for histological analysis, real time RT PCR and *in situ* hybridization. This methodological approach has given new insight into the underlying mechanism of vertebral deformities in vertebrates.

# Present and future status of Mediterranean fry production

Pavlina Pavlidou—Hatcheries Division Manager Selonda

“The increased proficiency of hatcheries contributes to the reduction of fry cost in vertically integrated operations and a significant reduction of the ongrowing cost through the improvement of fry quality”

Seabass and gilthead seabream are the main fish species produced in Mediterranean marine aquaculture. Production levels of these two species have been increasing gradually in recent decades, in part due to the development of new technologies for fry and juvenile production in hatcheries. Mediterranean hatchery technology is still evolving so as to provide higher quality animals and to minimise production costs.

The development of the hatcheries is therefore a key piece in the Mediterranean aquaculture production puzzle since:

- Hatcheries ensure fry availability for ongrowing, ensuring both the availability of different species and the quantities required.
- The quality of fry is stable and the growing results are guaranteed.
- Moreover, the increased proficiency of hatcheries contributes to the reduction of fry cost in vertically integrated operations (a gain of approximately 30-35 cents/kg of finished product), giving a high profit margin from sales (approximately 10 cents/fry) and a significant reduction of the ongrowing cost through the improvement of fry quality (absence of deformities, reduced production cycle time, lower FCR, lower mortality and losses).
- Furthermore there is the increased possibility of producing new species for the ongrowing sector.

Juvenile production in the Mediterranean has increased steadily during the last 10 years, climbing from 384 million in 1998 to more than 1 billion fry in 2007, an increase of 175% (see Figure 1).



Figure 1 : Evolution of the Med fry production and mean fry price - (2009 is an estimate)

However, for 2009, a considerable fry production decrease of 25% (750 mil fry) is foreseen, reflecting the current price crisis.

The only other year, apart from 2009, where there was a slight decline in fry production was 2004, which was attributed to the effects of the 1st price crisis in the sector that happened during 2001-2003.

Nevertheless, during all these years, the fry price

has remained relatively stable (from 26 cents/juvenile in 1998 to just below 20 cents in 2009), representing a decline of some 23% in 10 years.

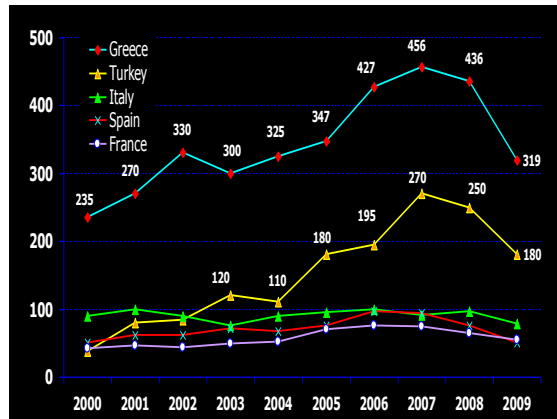


Figure 2: Bass & Bream Fry Production of the key countries (million) - (2009 is an estimate)

The key Mediterranean countries producing seabass and seabream fry are Greece, Turkey, Italy, Spain and last France.

In 2007, Greece reached a production of 450 million fry (see Figure 2) and, together with Turkey, dynamically increased its fry production from 2004 until 2007. At this point, it started to decrease until reaching, in 2009, the levels of 2004-2005. Moreover, we can observe that the course followed by Turkey is relatively the same as that of Greece, meaning that these countries are following similar patterns of production programming.

On the other hand, Italy, Spain and France have similar trends, within a production range that does not pass 100 million juveniles.

## Influence of the fry production on the ready product price

If we analyse the Greek fry production, which holds the dominant position in the Mediterranean, we can observe that there is a continuous increase of the proportion of seabream in the total fry production from 2004 until 2007 (Figure 3), at which time it reached the record value of 326 million (72%). During the same period, the bass fry quantity remains stable.

After 4 years of dynamic annual increases in seabream quantities, as a consequence. There was a dramatic drop in the price of market products in 2008-2009 - from around 4 €/kg in 2007 to 3,3 €/kg in 2009.

At the same time, the seabass price for the market product remained stable and relatively high since, unlike bream, no overstocking of seabass fry took place in the preceding years.

**We conclude therefore that one of the main reasons for the price crisis of 2008-2009 was the disturbance of the balance between supply and demand, created by production companies which overstocked their ongrowing farms with seabream juveniles.**



Figure 3: Species share in fry production & ready product prices per species in Greece

**“It looks likely that there will be a further decrease of the number of operating hatcheries as a result of the double effect of the sectoral crisis”**

#### Consolidation of the sector

The price crisis of 2008 intensified the corporate consolidation that was, in any case, taking place in the sector and had been evident since the first price crisis in 2003-4.

In direct relation to Mediterranean fry production, during the last 5 years the total number of hatcheries has decreased continuously by some 24% (moving from 78 in 2004 to 61 hatcheries in 2009). Just during the most recent production season (2008-2009), 6 Greek hatcheries and 4 Turkish hatcheries ceased their operations.

In Greece, out of the total of 22 hatcheries, 8 (36%) belong to two major Greek companies, Selonda and Nireus. In 2009, these 8 hatcheries are expected to produce around 200 million fry, representing 62% of the total expected Greek

production (325 million fry). Apart from these, 3 other large scale hatcheries that belong to other important corporate groups are expected to produce 28% of the total Greek production. Therefore, in Greece, 5 groups - with 11 hatcheries - are expected to produce 90% of the total production in 2009.

#### Conclusions

**In conclusion, it looks likely that there will be a further decrease of the number of operating hatcheries as a result of the double effects of the sectoral crisis and the wider financial crisis. This position will probably lead to further consolidation of the professional activities in the Mediterranean hatchery sector. Third party sales are expected to decrease with the benefits of vertical integration playing a major role in improving efficiency.**

**The sector will move towards the operation of larger nursery units that are able to support larger volumes of juveniles with a higher individual mean weight at sale, improving the timing of juvenile availability and the capacity to maintain higher stock levels during crisis periods.**

**Further investments will be devolved to new research projects, setting in place breeding programmes and the development of production techniques to improve both production and fry quality.**

**Special attention will be given to the production of new species to provide new diversification opportunities and to strengthen competitiveness in the market place.**

### Promoting/improving the use of the malformations/operational database developed in the FineFish Project

The high importance of developing and applying new and innovative technology for the monitoring and data analysis of European fish hatchery procedures is one of the conclusions of the FineFish project.

In an advanced phase of the project, the IT company PEPITE - "experts in software procedures and data solutions" - became involved as a project partner to develop a web-based recording system that is able to integrate all available information on production in hatcheries within one standardized database. The scope of the system is to enable the comparison and the benchmarking of production data collected within a hatchery and/or between different hatcheries and to follow this with the automated analysis and extraction of useful information to improve current practices and production performance and to reduce malformation incidence.

The initial result, "FindIT", has been developed as a web-based system for data collection and monitoring, containing integrated analytical tools for the user. At the present, "FindIT" is a functional prototype and it is understood that more development is necessary before the system can be considered viable and opened to professionals within the sector.

It has been recognised that the potential of the database, data mining and the associated analytical tools is far greater than what was defined

originally within the FineFish project. During its development, it became clear that this system has the potential to become a unique tool for the aquaculture hatchery sector, by offering advanced analytical powers for use at all levels in the organisation, from day-to-day hatchery management to strategic decisions on a higher level.

A first training course on how to use the FineFish web portal to import both farm structure and monitoring data and on how to apply data mining tools for data analysis, was achieved with project partners in June 2009.

The presentations made and the associated training materials can be downloaded from the FineFish public website: [www.finefish.info](http://www.finefish.info).

A project proposal to develop and apply this tool

has been developed and submitted for evaluation. Hatcheries that are interested in participating in the development and applications of FindIT should contact the FEAP Secretariat for further information.



<http://doc.pepите.be/finefish/>