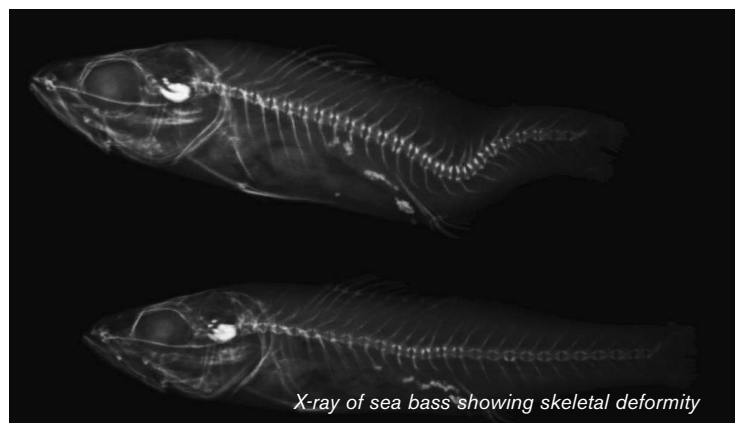




WORK PACKAGE 2 – JUVENILE QUALITY AND GROWTH POTENTIAL

The Challenge

Skeletal deformities and other developmental abnormalities arising during the hatchery stage influence subsequent larval and adult quality, by negatively affecting external morphology, growth potential and disease resistance. Identifying the main production factors and biological mechanisms that control quality during early development and how these link with variable larval and juvenile quality is critical to improve husbandry and management practices. More consistent production quality will increase predictability of hatchery production and ensure high-quality juvenile fish with optimal growth and robustness during on growing stages. There is a clear need for improved and integrated scientific knowledge and practical solutions for hatchery production to support sustainable growth of the Mediterranean aquaculture industry.



PerformFISH Proposed Solution

PerformFISH directly addresses factors that determine juvenile quality and growth potential, by exploiting existing technical and biological knowledge and establishing standard operating procedures (SOPs) to assess vulnerability of larvae and juveniles across European commercial hatcheries. The link between egg quality, the microbiome and live feed on juvenile performance will be determined as part of this research. An ambitious meta-analysis approach using zootechnical parameters and biological characteristics is being taken within the project. Recurring zootechnical and management parameters linked to larval performance and subsequent juvenile quality will be extracted, with a view to developing metrics and indicators for real-time quality monitoring.

Scientists from Greece, Italy, Spain and Portugal are collaborating, and their complementary expertise is being used to target immunological, physiological, meristic, morphological, molecular and microbial indicators strongly associated with larval robustness, with LTP industrial partners monitoring production parameters. The correlation between these parameters in different larval ontogenetic stages, with varied hatchery conditions and juvenile quality, will yield key knowledge and tools for testing and deployment in hatcheries. This will form the basis of the **PerformFISH** reference framework for a European juvenile quality certificate and will also produce new tools for monitoring and managing production. Epigenetic programming is being explored as a means to manipulate larvae for more robust juveniles, and also to find potential foresight solutions for the future challenges of ocean warming due to climate change. Robust field trials will be used to challenge the potential and impact of the developed tools and solutions in real-life scenarios.

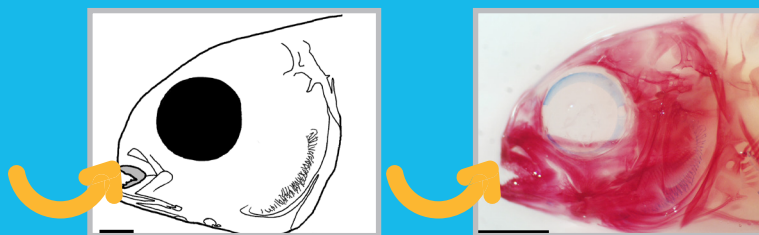
Main Results to Date

Two main areas have been developed by **PerformFISH** partners so far: a) Establishing larval and juvenile quality indicators and production conditions and b) variability of juvenile phenotype and the link with performance during the grow-out stage.

Larval and juvenile quality indicators

A biological bank containing samples for osteological and genetic analysis has been generated from 15-20 hatchery production batches of sea bream and sea bass from four European hatcheries. This has been made possible by establishing effective collaboration mechanisms between European fish producing companies and national fish farming associations, whose geographical spread offers a rich variety of environmental parameters for comparative validation.

Pughead



Morphology evaluation

Optimisation and validation of larval and juvenile quality indicators

Remarkable progress has been made towards the optimisation and validation of existing quality indicators and the development of new markers of egg, larvae and juvenile quality that relate to KPI production indicators. This progress includes biochemical, morphological, molecular and immunological markers which were developed and validated using experimental material provided by the associated commercial hatcheries. These were based on indicators developed by national and European projects. The preliminary phase has been concluded, with the optimisation of preservation and observation methods, as well as the validation of parameters included in the assessment.

60-75% samples collected from hatcheries by **May 2018**



Skeletal abnormalities during the hatchery phase can pose significant quality issues, and although hand sorting to remove deformed fish minimizes the impact of abnormalities on production quality, this time-consuming exercise still leads to financial losses for hatcheries. Research conducted by **PerformFISH** partners establishes the link between the quality of juvenile (fry) morphology (presence of skeletal malformations) to the phenotypic quality of table-size fish (end of on-growing). They showed for the first time that the prevalence of fish with a lordotic (abnormality of the vertebral column) external morphology decreased by 50% during grow-demonstrating that fish can recover from skeletal malformations. Furthermore, the body shape of fish that had skeletal malformations as juveniles was not significantly different in adults, indicating that they recovered a normal phenotype during grow-out. This is good news for aquaculture and fish welfare as it suggests costly hand sorting to remove abnormal fish can be avoided. The full publication can be downloaded here: go.nature.com/2mMb1KE.



Normal fish (A) and Lordotic fish (B)

Going Forward 2019-2022

Markers of egg quality will be linked to larval and juvenile quality with a further targeted analysis on the capacity of specific proteins to affect larval and juvenile quality. These markers will also be linked to composition and trace nutrients, and the microbiome. Overall, the aim will be to define egg biomarkers that predict good and bad quality production cycles in hatcheries. The results of cross-referencing immunological, physiological, meristic, morphological, molecular and microbial markers with production conditions will yield hatchery biomarkers strongly predictive of juvenile quality. These biomarkers will then be used for field testing. Experiments with modified hatchery conditions to promote epigenetic programming of egg and early larval stages will be used to establish imprinting protocols that improve juvenile performance.

This baseline information will be used in a reliable manner and add robustness to the assessment of juvenile performance and nutritional condition, to enhance sampling and operational protocols. This is expected to improve resistance, survival and growth of future selected genotypes fed with substituted feeds.

Optimised KPI quality markers of juvenile morphology

Multi-parameter analysis of core factors affecting hatchery KPI quality and variability

Self-assessment certification procedure for industry regulating production regime with selected critical markers

2019

Technical and photographic atlas of quality indicators in key industrial production stages

Field testing and validation studies

2022

Find out more:

www.performfish.eu
@PerformFISH_EU
www.linkedin.com/company/performfish/

Contact Details:

WP2 Leader:
Deborah M. Power
dpower@ualg.pt

Communication & Press:

Emma Bello Gómez
emma@aquatt.ie



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