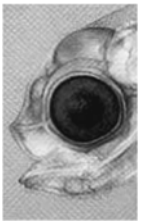


Replacement of live feed in marine fish hatcheries

Replacing live feed to a great extend in the production of fry of marine fish species such as gilthead sea bream (*Sparus aurata*) and European sea bass (*Dicentrarchus labrax*) is feasible, from a technical point of view.
This has been clearly demonstrated in recent trails conducted in Mediterranean hatcheries utilizing BioMar's LARVIVA ProStart diet.

Traditionally European hatcheries use live feed, i.e. rotifers and Artemia, for first feeding of sea bream and sea bass. But there are some restricting factors connected to the utilization of live feed, according to Kostas Ntomalis, who is responsible for sales and technical support for the hatchery feed segment at BioMar, where this issue has been deliberated for some time.

Ntomalis explained: "Rotifers and Artemia are not natural feed sources for these fish species. Live feed can put at risk the outcome of hatchery production as its nutritional value is not stable and thus not predictable. Even if the live feed is supplemented with enrichments, first feeding on live feed cannot ensure that the nutritional needs of the sensitive larvae are fully fulfilled.

"Handling live feed and enrichment protocols is time-consuming and presents substantial costs. Live organisms can present biosecurity issues, occasionally bringing in undesirable pathogens into the hatchery. In addition, it can be risky to have to rely on the availability of a naturally harvested feed source such as Artemia."

First feeding on a larval diet?

Following advice from Ntomalis, BioMar suggests hatchery managers should consider first feeding on the larval diet LARVIVA ProStart that can be fed to marine fish larvae from first day of feeding. "LARVIVA ProStart is a ready-to-use high quality product, produced under controlled conditions, containing the full package of nutrients needed by the larvae and complemented with a probiotic that is proven to contribute to the development of sound and strong fry," explained Ntomalis. "BioMar strives for innovative solutions and the idea of applying an existing product for a new purpose goes in line with this, he added.

Promising results in first trials

In 2013, Nikos Katsarelas from Helenic Fishfarming SA (HFF) in Greece was one of the first hatchery managers to agree to carry out controlled first feeding trials with LARVIVA ProStart. HFF is one of the major players in the Mediterranean production of sea bass and sea bream fry and has a very strong presence in the European market.

"We welcomed the idea of replacing live feed with a ready-made hatchery feed," Nikos said. "Indeed, we are steadily oriented towards the achievement of top quality results and we care for the optimization and continuous upgrading of our means of production. In the first trials, we partly replaced the rotifers and Artemia by LARVIVA ProStart, first in sea bass and

later in sea bream. Results were promising, both in regards to sea bream and sea bass."

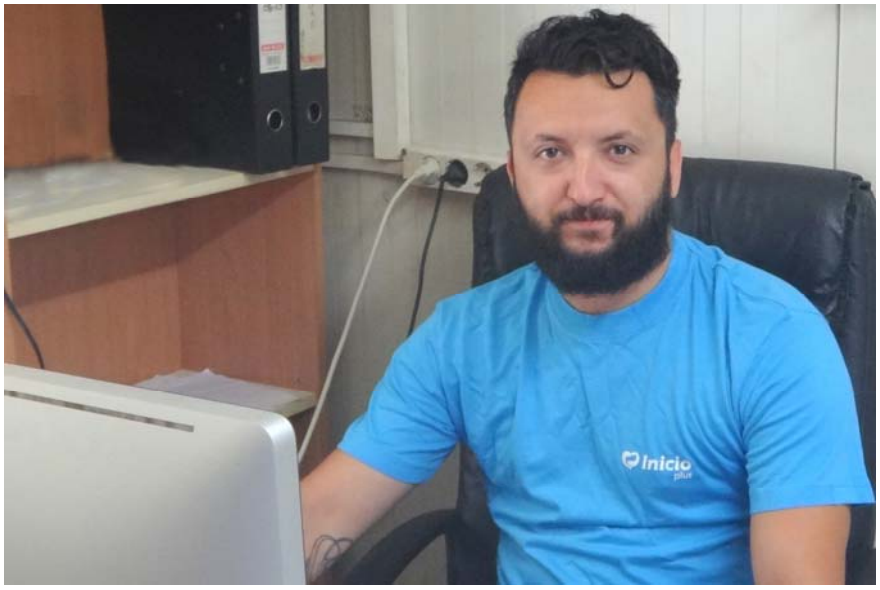
Big scale trials: no negative effect on the fry

In September 2014, Thodoris Antoniou took over the position as hatchery manager in HFF. "We produce more than 40 million fry of both sea bream and sea bass in our two hatcheries per year and having a small picture on the outcome of just a few tanks was not enough to me. It was very important to me to see the average consumption for a full production, so we started using LARVIVA ProStart on a big scale. Today we are very satisfied with the results," Thodoris said.

According to Thodoris, the HFF hatchery uses an average of 128 kg of Artemia per million fry in the traditional protocol for sea bream and sea bass. He explained: "Today, by using LARVIVA ProStart, the Artemia load fed to the fry is on average reduced to 43.5 kg (i.e. by 66 %) per million and our average consumption of rotifers for sea bream and sea bass is reduced by 70%. And we did not see any negative effect on survival, growth or on the deformity level of the produced fry," he said.

Trials with full replacement of Artemia

HFF is now aiming at further reducing its production costs. In spring 2015 they started testing the possibilities to reduce or even eliminate the use of Artemia in both sea bream and sea bass. "First we managed to reduce the consumption of Artemia to 20 kg per million fry, with the help of LARVIVA ProStart and by using more rotifers. And now we are in small-scale production of both sea bream and sea bass fry without any Artemia," Thodoris said.



Hatchery manager Thodoris Antoniou from Helenic Fishfarm, Greece, confirms he did not see any negative effect on survival, growth or on the deformity level of fry produced in trails where live feed was replaced by LARVIVA ProStart and now the hatchery is producing batches of both sea bream and sea bass fry without any Artemia.

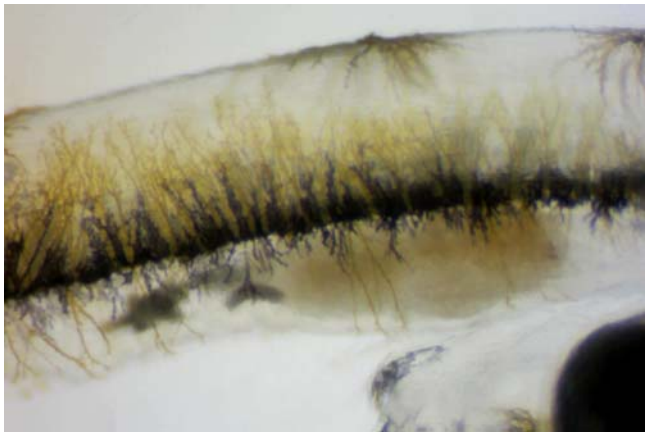
"Looking at the results, we can now say that by using rotifers for a longer period during larval stages together with LARVIVA ProStart – up to 35 Days Post Hatching (DPH) for sea bream and up to 32 DPH for sea bass – we can wean sea bass and sea bream larvae without using any Artemia," Thodoris said.

"In sea bream we succeed in this without negative effects in survival, performance or quality of the fry. In sea bass we see an extra mortality of up to 10 % between 35 to 45 DPH; but maybe this fact is not so bad after all as survival of sea bass is always very high and by this we do not have to feed on the smaller, less strong larvae."

Ntomalis explained that the trial demonstrates that savings related to not utilizing Artemia can be significant, even by taking into account an extra mortality rate of 10 % as seen in the sea bass trial.

According to Thodoris, the total consumption of rotifers per million fry increased when not feeding Artemia. "However, the total rotifer consumption is just the same as it was before we started utilising LARVIVA ProStart in our hatchery," he said.

"We started these trials because we were triggered by the potential of having access to a stable, nutritional



Recent trials show that fry of sea bass and sea bream produced with the larval diet LARVIVA ProStart as of first feeding - replacing live feed to a large extend -, perform similar to the performance of fry produced with classic protocols. The photos show the digestive tract of an approx. 110 degree-days old sea bass larva fed on LARVIVA ProStart 100. The larva absorbs the mayor part of the feed: to the left we see LARVIVA Pro Start particles in the first part of the digestive tract and to the right the few undigested, remaining feed particles in the end of the tract.

wise full-package carrier that allows for avoiding biosecurity hazards. And, last but not least, that allows for fry production at lower costs. The trails show that mortality rates of the fry are promising - that is one good step," Thodoris concluded.

Good performances in grow out cages

Since September 2014 Nikos Katsarelas has held the position of production manager at HFF. "What counts even more is the quality of the fry and its further performances when transferred to on-growing cages. This is a key factor for marine culture. I now have the opportunity to closely follow the fry produced with LARVIVA ProStart during all growth stages in several farms belonging to the HFF group and to checking production results," he said.

According to him, the fry from the trial batches performed as well in the on-growing stage as the other fish and the first fry produced by first feeding with LARVIVA ProStart are sold to the market.

In order for BioMar to be able to closely follow the fry produced with LARVIVA ProStart by HFF and to check their performance during all grower stages, the company bought some of the fry from HFF and distributed it to selected customers. Kostas Ntomalis confirmed that all results show that the performance of the fry produced with the LARVIVA ProStart protocol is similar to the performance of fry coming from other hatcheries produced with classic protocols.

Focus on further R&D efforts

"Nikos and Thodoris from Helenic Fishfarming did an excellent and thorough work and the results are impressive," said Ntomalis. "BioMar is now receiving similar encouraging results from many producers of sea bass and sea bream fry all over in the East Mediterranean and we are grateful to hatchery managers and staff for their help on this.

"Experiences of this kind shows that technically there is a way to reduce the costs and the risks connected with live prey in hatcheries of marine fish species. "We have a close co-operation with our customers to document the outcome of first feeding on formulated feeds such as LARVIVA ProStart and for certain we will focus on further research and development of both feed and first feeding protocols. After all we hope to pave the way to a future for first feeding without depending on rotifers and Artemia and look forward to presenting new, encouraging results," Ntomalis concluded.