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## CAN WE COMBINE GENETICS AND A TWO-STEP TEMPERATURE CONTROL TO MOVE TOWARDS MONOSEX EUROPEAN SEA BASS *Dicentrarchus labrax*?

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### Introduction

The sea bass, *Dicentrarchus labrax*, is an important species for European mariculture, mainly in Mediterranean countries. In this species, females grow faster and reach a higher weight than males. However, most farmed fish batches show a highly male-skewed sex-ratio. The sea bass has a complex sex determination system, combining both genetic (polygenic) and environmental (temperature) influences. Low initial temperatures (<17°C) favor female sex determination. In contrast, temperature in the late post-larval phase has the opposite effect, with cold temperature favoring male differentiation and high temperature (up to 23°C) favoring female differentiation (Clota et al., 2021). However, data on the combined effects of genotype and temperature are lacking. We need to know whether there is genotype-by-environment (GxE) interaction or not, to deploy a strategy towards producing monosex female individuals for production while keeping a balanced sex-ratio for hatchery and selective breeding.

### Results

Starting at 1 day and using incremental rearing periods at 16°C (31 to 244 days), followed by an increase to 21°C, we first showed that, while 31 days at 16°C led to 26% of females, increased cold exposure promoted the proportion of females, up to 46% after 74 days at 16°C. Conversely, exposure to 16°C for a period longer than 74 days progressively reduced the proportion of females, reaching a minimum of  $\approx 10\%$  after 230 days at 16°C. In a second experiment, we demonstrated that after an initial rearing of fish for 90 days at 16°C, a secondary exposure to four different temperatures (19, 21, 23, 25°C) resulted in different sex-ratios, with more females at higher temperatures (from 30% at 19°C to 49% at 25°C). Then, we examined the genotype-by-environment interaction in both periods, by genotyping fish with a 57K SNP chip, comparing 1) two groups reared at 16 or 21°C during the first 60 days and 2) four groups of fish reared at 19, 21, 23 or 25°C after 90 days at 16°C. The genetic correlation of sex tendencies between the two early temperature groups was very high ( $0.91 \pm 0.09$ ). In the late temperature treatments, the genetic correlations of sex tendencies between the first three temperature groups (19, 21 and 23°C) were close to unity ( $0.98 \pm 0.16$  to  $1.00 \pm 0.16$ ), showing little, if any, GxE interaction. Conversely, the genetic correlations of sex tendency at 19, 21 and 23°C with sex tendency at 25°C were lower ( $0.82 \pm 0.21$  to  $0.91 \pm 0.21$ ). Thus, genomic predictions of sex tendency can be reliably performed using data from any temperature treatment, provided the late temperature (after 90 dph) is not higher than 23°C

### The way forward

Based on these findings, we propose a method combining temperature treatments and genomic evaluation of sex tendency to 1) identify individuals with a strong “female” genetic background, including “neomales” sex-reversed by temperature treatments, and 2) use them with adequate temperature treatments to obtain near-monosex batches.

### References:

Clota F., et al., 2021. Late high temperature promotes fast growth and female differentiation in European sea bass *Dicentrarchus labrax*, while early photoperiod has no effect on either trait. Aquaculture Europe 2021, Funchal, Portugal, 4-7 October 2021.