

# SALINITY EFFECTS ON SENEGALESE SOLE *Solea senegalensis* Kaup LARVAL DEVELOPMENT: PRODUCTIVE PARAMETERS AND GENE EXPRESSION ANALYSIS

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## Abstract

The flatfish Senegalese sole (*Solea senegalensis*, Kaup 1858) is a teleost with great interest in aquaculture owing to its high commercial value. Although it is an euryhaline species, captivity larval rearing is routinely performed at seawater salinity values (35-38 ppt). In this work, we have evaluated low salinity effects on larval development regarding to productive and metabolic parameters.

## Introduction

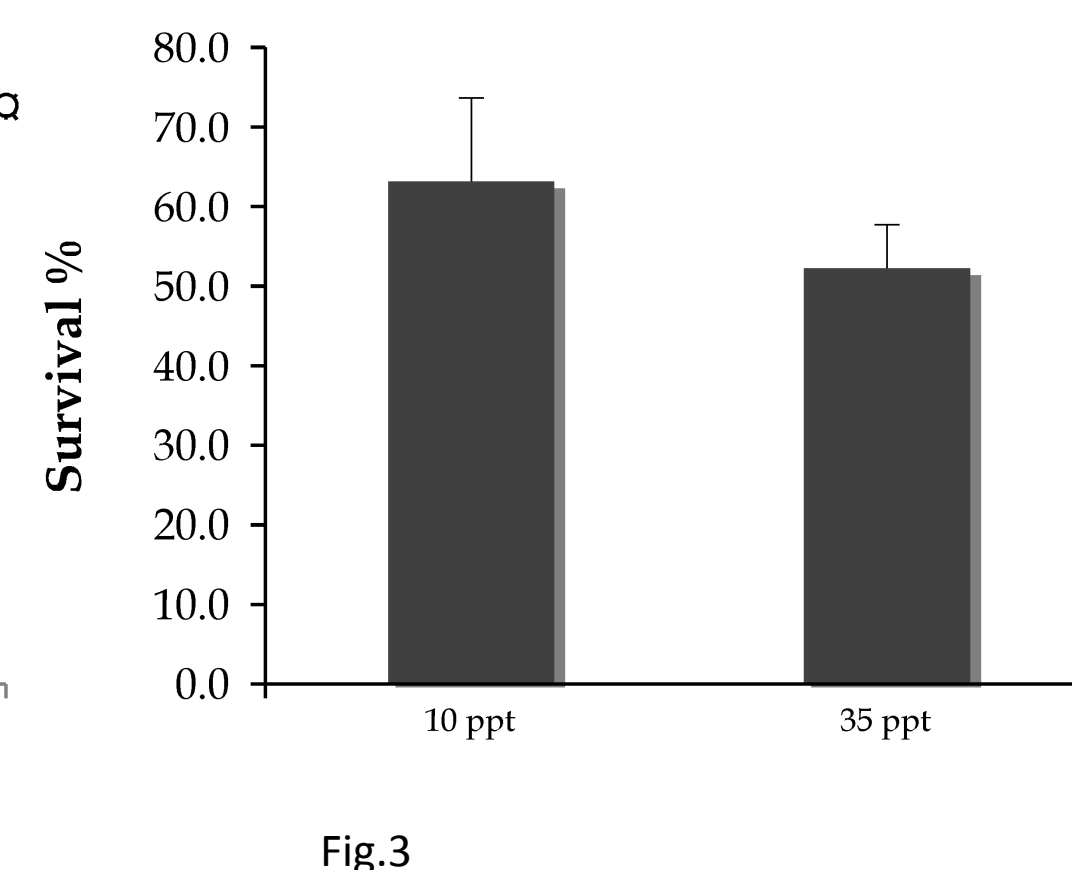
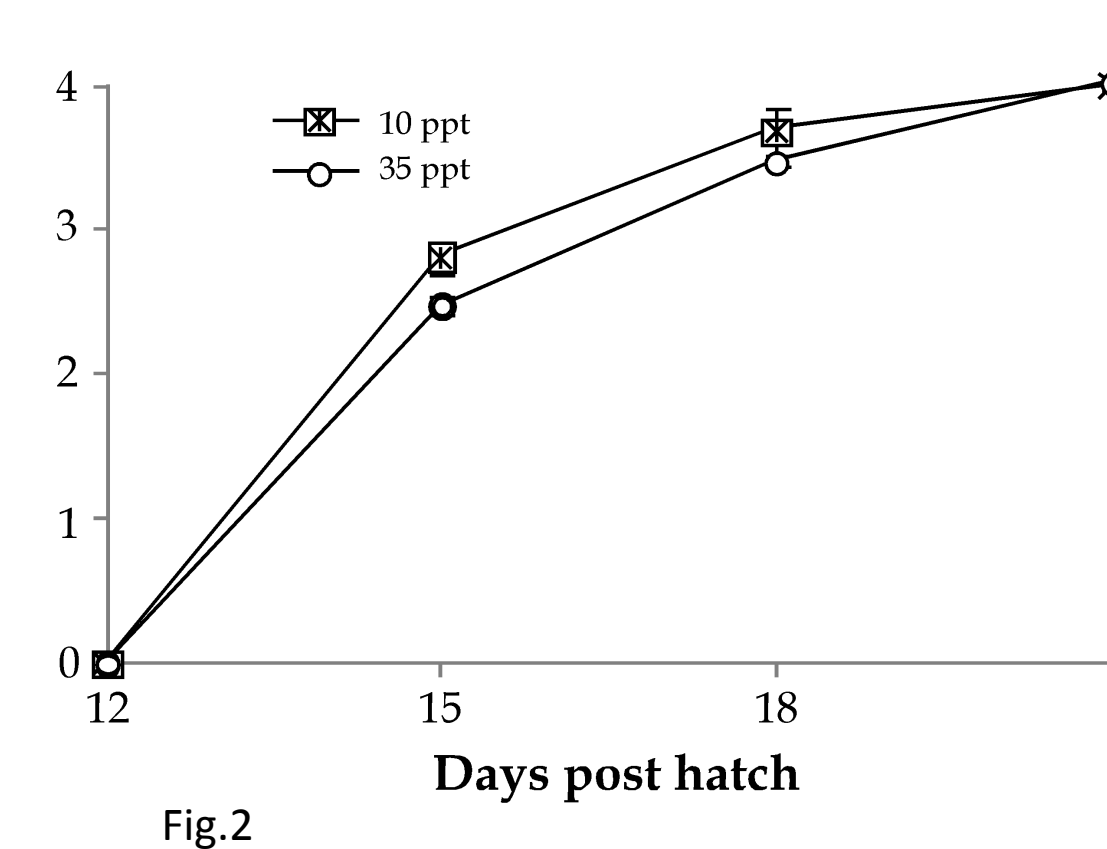
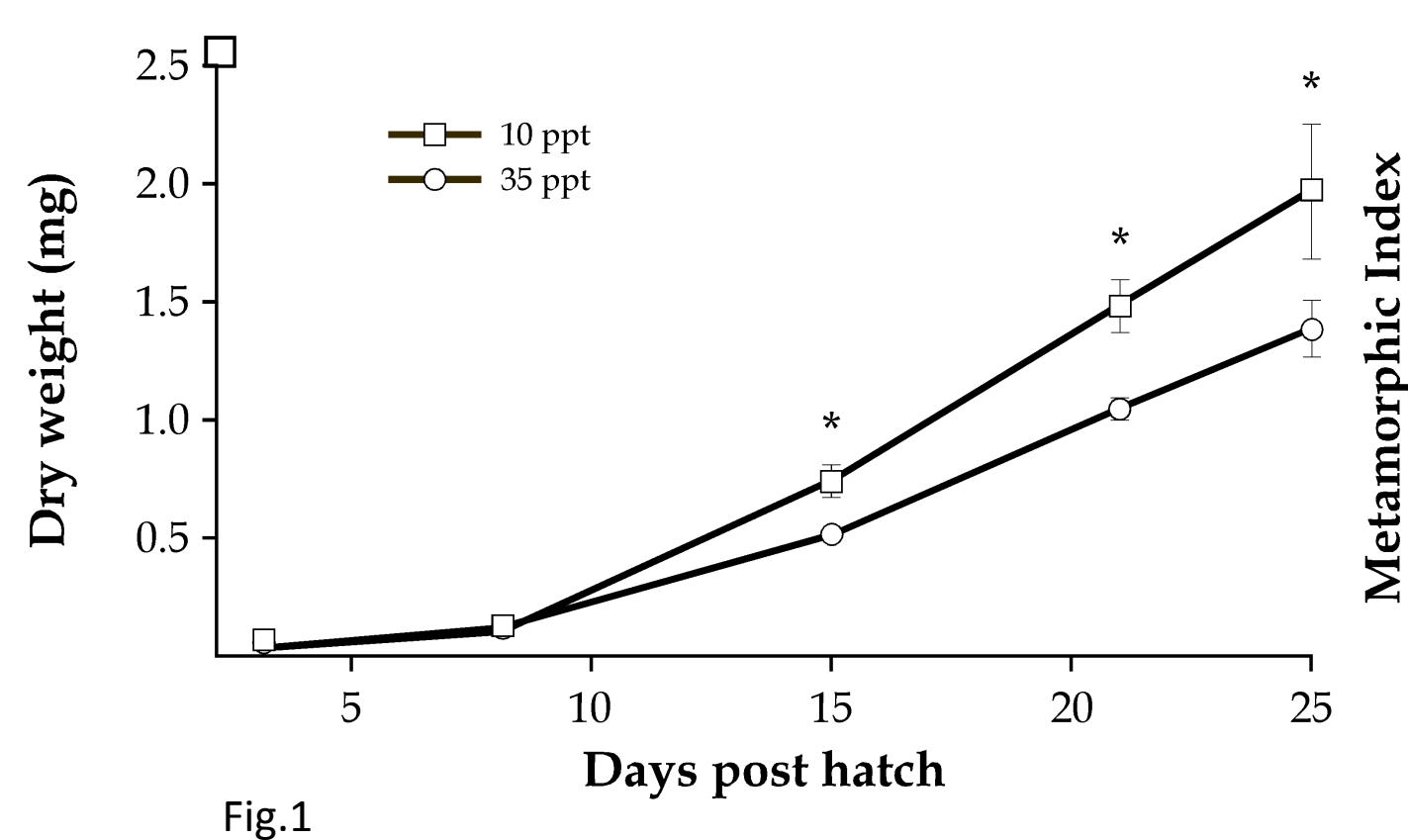
Salinity is an important factor affecting the survival, metabolism and distribution of fish species. It exerts a selective pressure on all developmental stages, including the early ones. While a large amount of information is available regarding salinity influence and ion regulation in adults (Bœuf and Payan, 2001; Varsamos et al., 2005), few data are available on this subject for the larval stages. In order to evaluate salinity influence during *Solea senegalensis* larval stage we have measured productive parameters (growth, metamorphic index and survival) in larvae cultured at low and seawater salinity values (10 and 35 ppt). Additionally, the expression pattern of ten different genes involved in several metabolic processes has also been analyzed.

## Methods

Three days post hatch larvae were taken from a primary culture before salinity transfer. Then larvae were cultured in open circuit-pumped water at salinities of 10 and 35 ppt in triplicate until day 25 post hatch (DPH). Growth and Metamorphic Index were evaluated as described in Fernandez-Diaz et al. (2001). Real-time expression levels and statistical significance were determined as described in Infante et al. (2011).

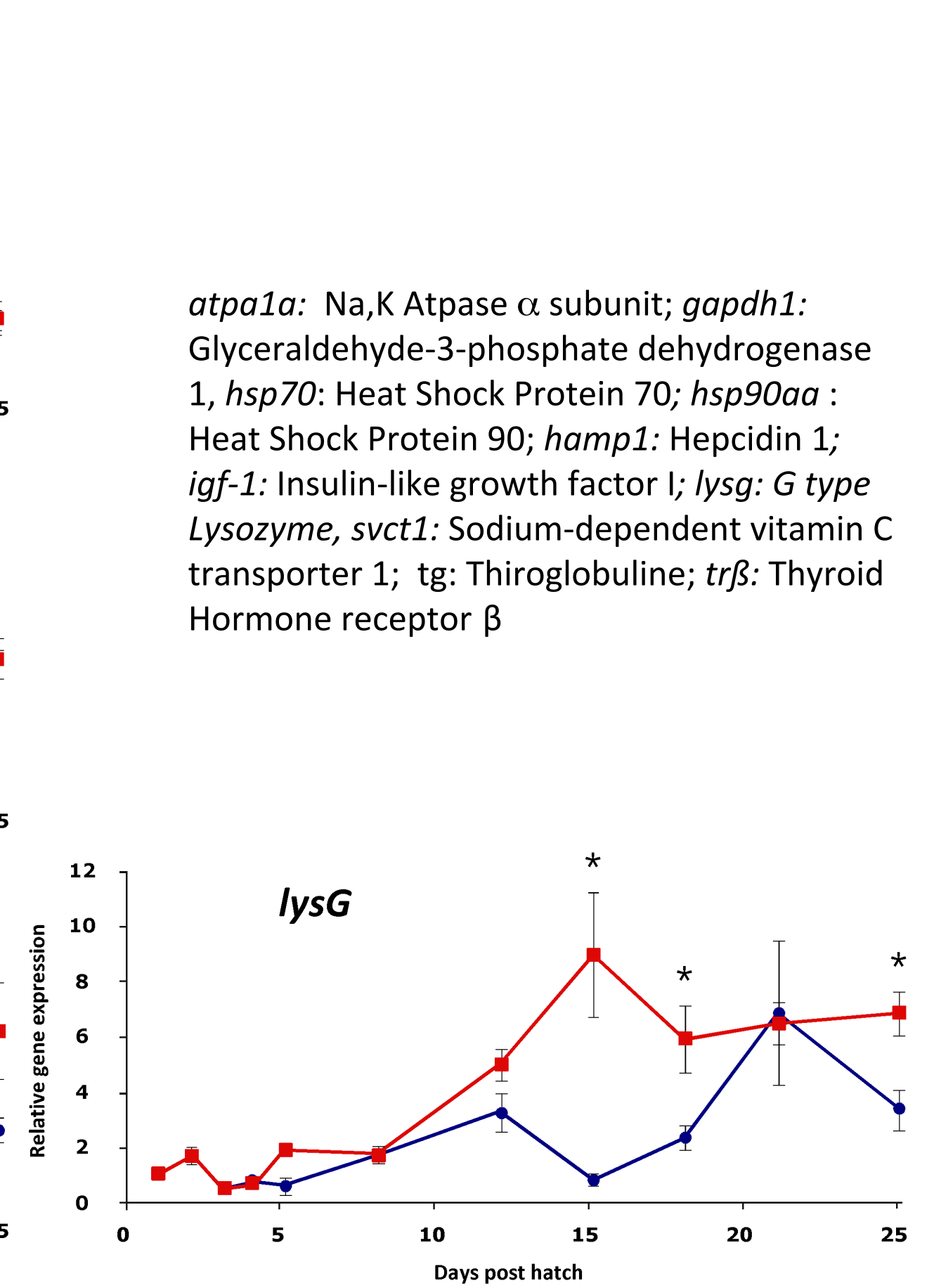
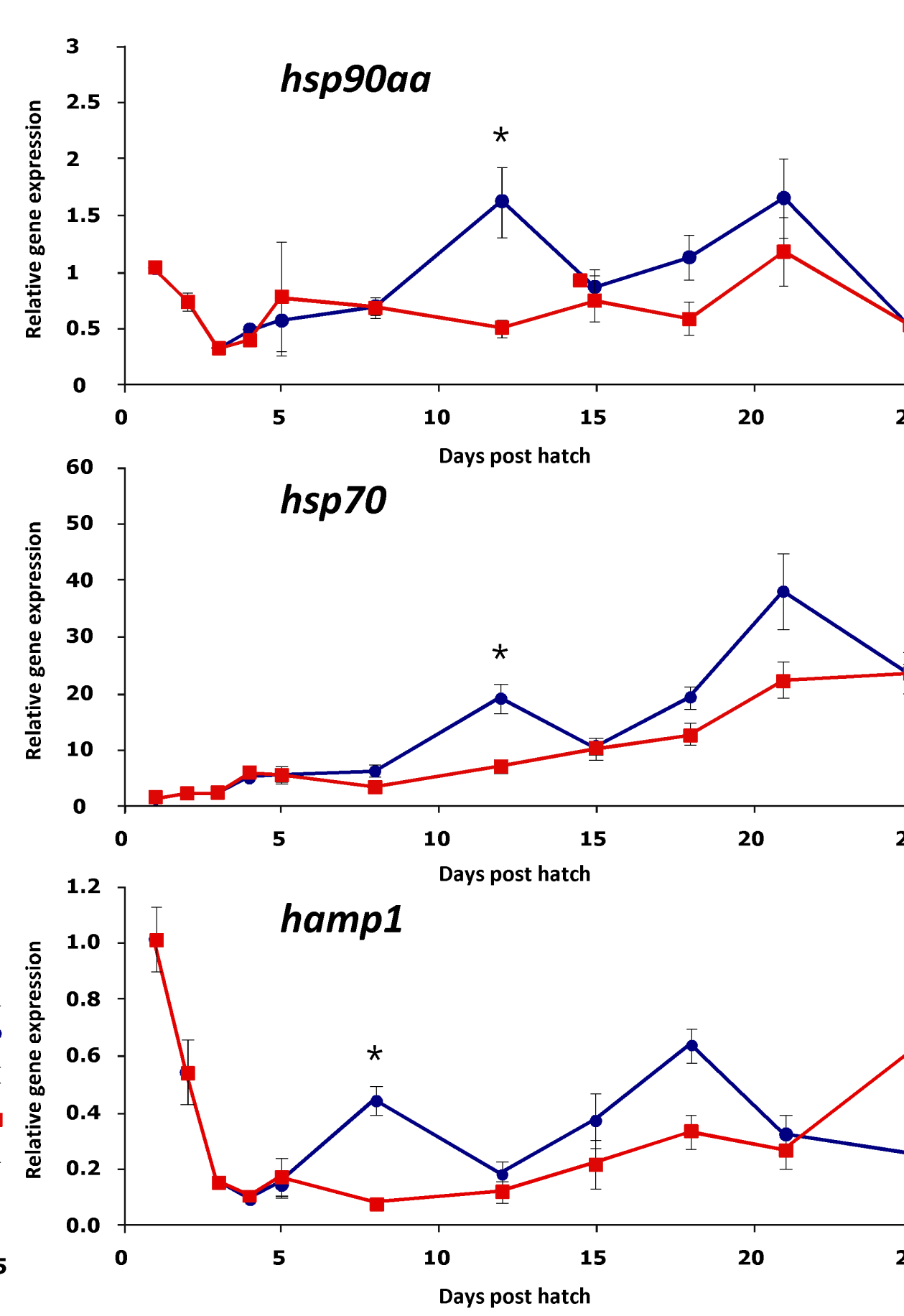
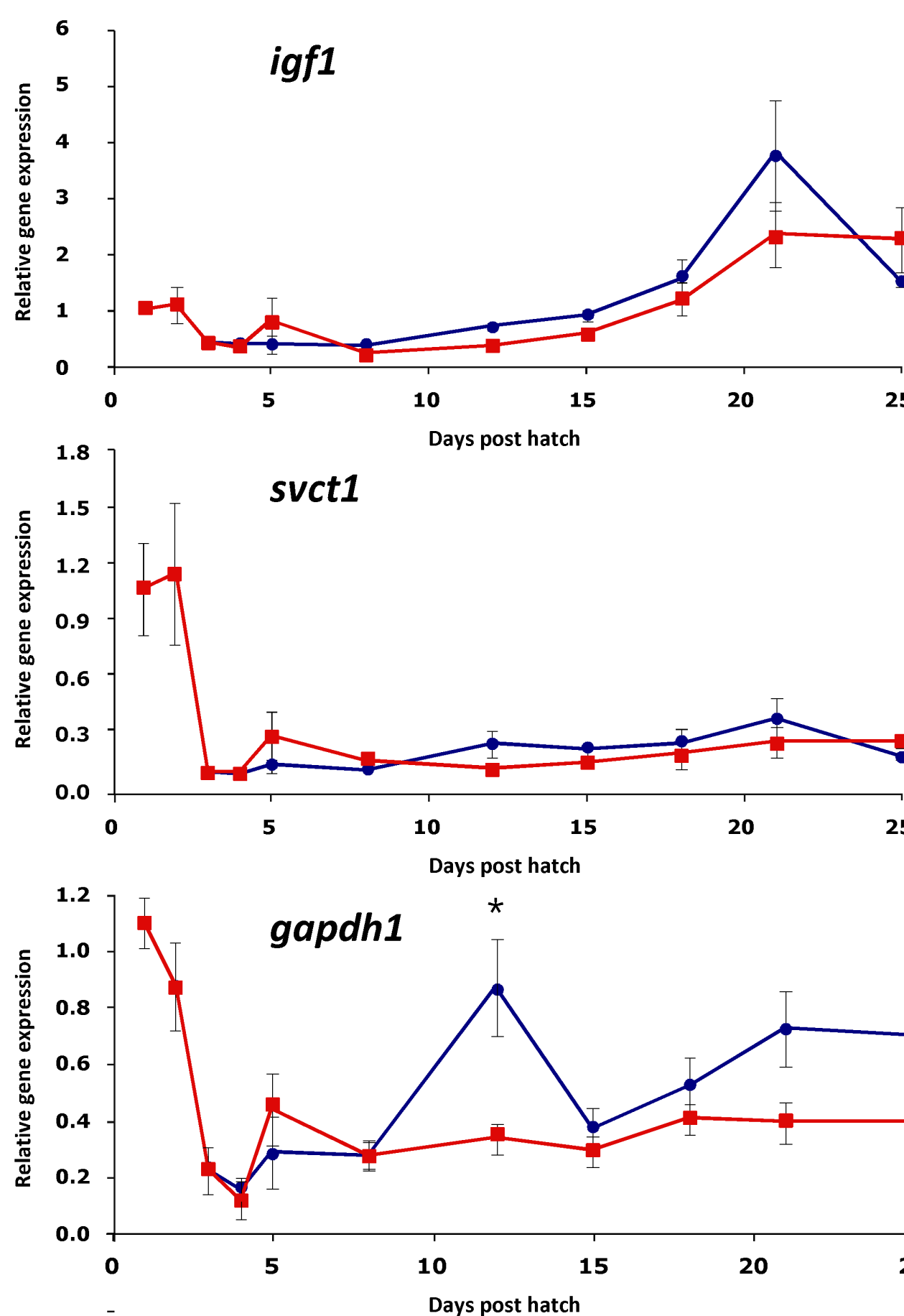
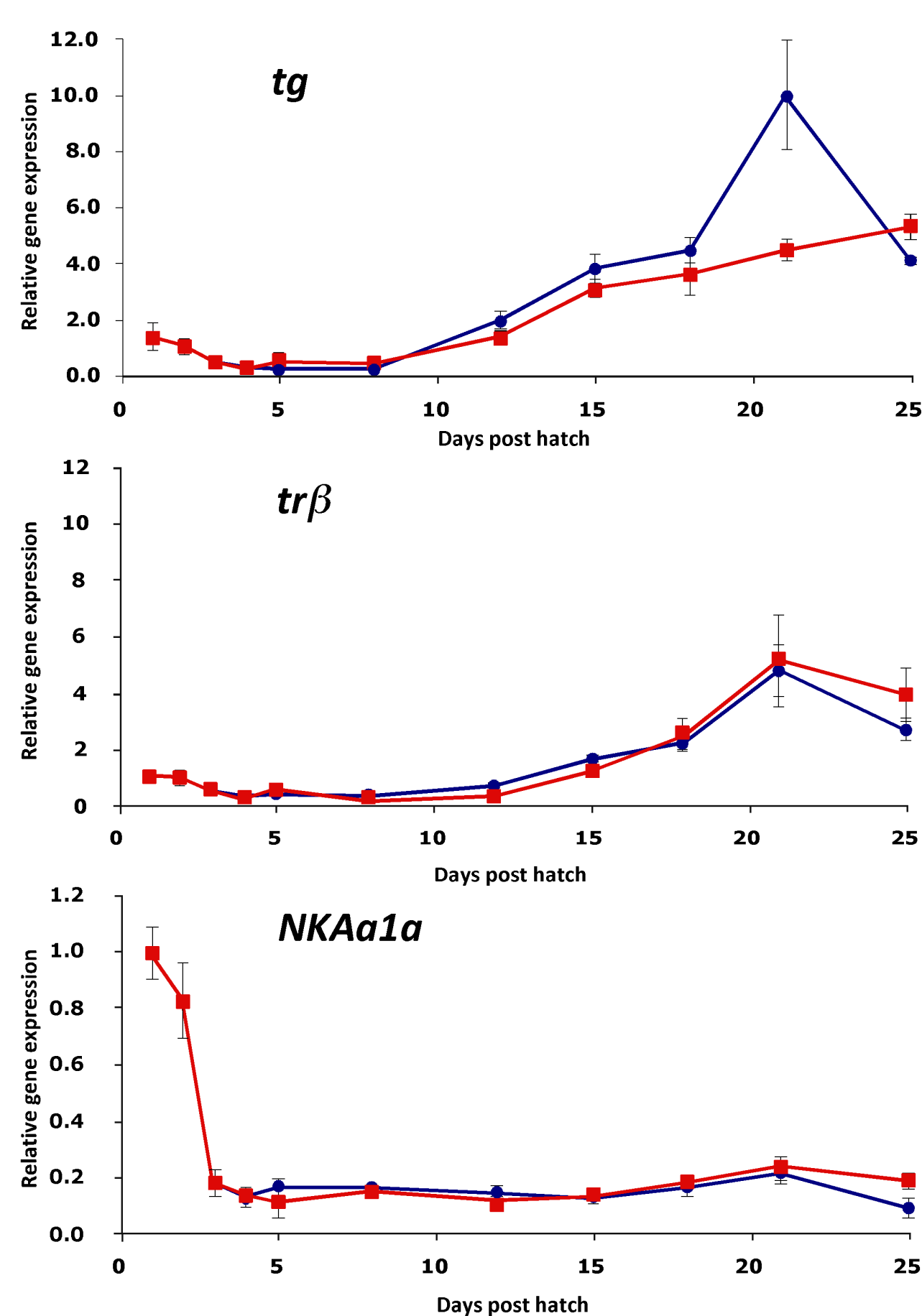
## Results

### Productive parameters in larvae cultured at salinities of 10 and 35 ppt



As it is shown in Fig. 1, a higher and statistically significant dry weight of larvae reared at 10 ppt in relation to 35 ppt was detected from 15 to 25 DPH. However, no significant differences were found in the progression of metamorphosis (Fig. 2) or in survival (Fig. 3) at the end of the assay (63,3±10,12% and 52,5±5,42% at 10 and 35 ppt, respectively).

### Relative expression of genes involved in several metabolic processes



*atpa1a*: Na,K Atpase  $\alpha$  subunit; *gapdh1*: Glyceraldehyde-3-phosphate dehydrogenase 1; *hsp70*: Heat Shock Protein 70; *hsp90aa*: Heat Shock Protein 90; *hamp1*: Hecpudin 1; *igf-1*: Insulin-like growth factor I; *lysG*: G type Lysozyme; *svct1*: Sodium-dependent vitamin C transporter 1; *tg*: Thyroglobuline; *trβ*: Thyroid Hormone receptor  $\beta$

As a whole, analyzed genes exhibited a very similar expression profile both at 10 and 35 ppt. No significant differences were found in mRNA levels of thyroid axis genes (*tg* and *trβ*), *atpa1a*, *igf-1*, and *svct1*. However, significant higher expression levels were found at low salinity in *gapdh1*, *hsp90aa* and *hsp70* prior to the commencement of metamorphosis at 12 DPH. Salinity also influenced the expression of immune system genes. At 10 ppt, *hamp1* exhibited higher transcript amounts at 8 DPH, but *lysG* expression was significantly lower at 15, 18, and 25 DPH.

## Conclusion

Taken together all data, we can conclude that Senegalese sole larval rearing can be successfully carried out at a salinity of 10 ppt, although a possible stress response affecting innate immune system needs to be further evaluated.

Bœuf and Payan 2001. Comp. Biochem. Physiol. Part C 130:411-423  
Fernandez-Diaz et al. 2001. J. Fish. Biol. 58:1086-1097  
Infante et al. 2011. Comp. Biochem. Physiol. B 160:15-23  
Varsamos et al. 2005 Comp. Biochem. Physiol. Part A 141:401-429



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