GAINING INSIGHTS INTO THE INITIATION OF VITELLOGENESIS IN EELS

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Background

A negative correlation exists between the maturation stage at the start of the oceanic reproductive migration and the migration distance to the spawning grounds for the various eel species. The European eel *Anguilla anguilla* migrates up to 6,000 km and leaves in a previtellogenic state. The shortfin eel *A. australis* migrates 2-4,000 km and leaves in an early vitellogenic state. In this study, we compared previtellogenic European silver eels with immature yellow eels, and early vitellogenic silver shortfin with yellow eels, to gain insights into the initiation of vitellogenesis.

Methods

- Immediately after being caught and at the catch site, measurements were performed and eels (N=6 yellow and N=6 silver eels for each species) were sampled for blood and tissues.
- Eye index (EI), gonadosomatic index (GSI) and hepatosomatic index (HSI) were calculated.
- 11-ketotestosterone (11-KT) and 17β-estradiol (E2) were measured by specific radio-immunoassay.
- RT-PCR in pituitary: dopamine D2B receptor *d2br*, gonadotropin-releasing hormone receptors 1 and 2 *gnrhr1* and *2*, follicle-stimulating hormone-β *fshβ* and growth hormone *gh.*
- RT-PCR in liver: estrogen receptor 1 *esr1.*
- RT-PCR in ovaries: follicle-stimulating hormone receptor *fshr*, androgen receptors α and β *ara* and *b*, vitellogenin receptor *vtgr* and P450 aromatase *cyp19.*
- For each species, fold-change (FC) expression was determined of yellow *vs.* silver eels and these were compared between species.

Results

GSI values of 3.0 ± 0.2% in silver shortfin eels reflected a vitellogenic maturation state while GSI values of 1.5 ± 0.1% indicated previtellogenesis in European silver eels. Plasma 11KT levels were much higher in shortfin than in European silver eels (82.3 ± 11.3 *vs.* 1.2 ± 0.3 ng mL^{-1}), whereas plasma E2 levels were higher in European silver eels (3.1 ± 0.5 *vs.* 1.5 ± 0.1 ng mL^{-1}).

Increased dopaminergic signaling and activation of the brain-pituitary-gonad (BPG) axis

In the pituitary of shortfin eels, expression of *d2br, gnrhr1* and *2,* and *fshβ* was up-regulated in the silver-stage compared to yellow-stage females (**Fig.1**).

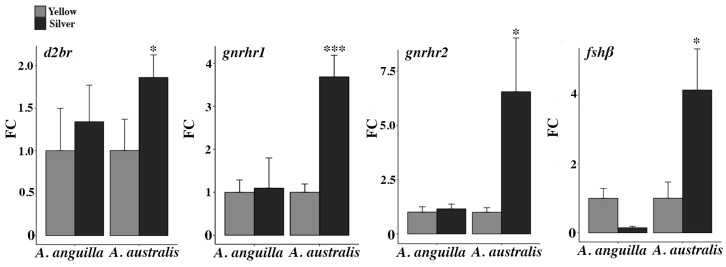

Figure 1. Pituitary fold-change (FC) expression of *d2br, gnrhr1, gnrhr2* and *fshβ*.

In the gonads, expression of *fshr*, *ara* and *b* expression was up-regulated in silver shortfin eels (**Fig.2**). For the European eel, *d2br, gnrhr1* and *2*, *fshβ*, *fshr*, *ara* and *b* expression did not show any change between yellow and silver eels (**Fig.1 and 2**).

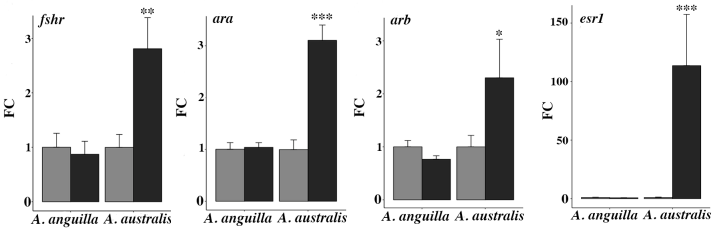

Figure 2. Gonad fold-change (FC) expression of *fshr, ara, arb.*

Figure 3. Liver fold-change (FC) expression of *esr1.*

Increased liver sensitivity

Expression of *esr1* in European eels was low while *esr1* expression was up-regulated over 100-fold in silver shortfin eels (**Fig.3**).

Synthesis

Differences along the BPG axis between the European eel and the shortfin eel during silvering suggest events that occur during the initiation of vitellogenesis. Pituitary dopaminergic signaling (*d2br*) is increased, the BPG reproductive axis (*gnrhr1* and *2*, *fshβ*, *fshr*, and *ara* and *b*) is activated and liver sensitivity (*esr1*) is increased (**Table 1**).

Table 1. Comparison of changes along the BPG-axis that occur during silvering between the European eel (*A. Anguilla*) and the shortfin eel (*A. australis*).

		A. anguilla	*A. australis*
	EI	++	++
Plasma	11KT	+++	+++
	E2	++	+++
Pituitary	*d2br*	0	+
	gnrhr1	0	++
	gnrhr2	0	+
	fshb	0	+
	gh	-	--
Liver	HSI	0	+
	esr1	0	++
Gonad	GSI	++	++
	fshr	0	++
	ara	0	++
	arb	0	+
	cyp19	0	0
	vtgr	--	0

Conclusions

The initiation of vitellogenesis is characterised by:
- Increased dopaminergic signaling (*d2br*)
- Activation of the BPG axis (*gnrhr1* and *2*, *fshβ*, *fshr*, *ara*, *arb*).
- Increased liver sensitivity (*esr1)*

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Acknowledgements

DUPAN foundation; The Dutch Ministry of Economic Affairs and the European Union, European Maritime and Fisheries Fund; Department of Zoology Research Enhancement Grant (PBRF63); COST Action FA1304 FITFISH, and partners of the international EELRIC consortium (www.eelric.eu).