



Early weaning and drivers of juvenile quality in Atlantic halibut



Photo: Øystein Sæle

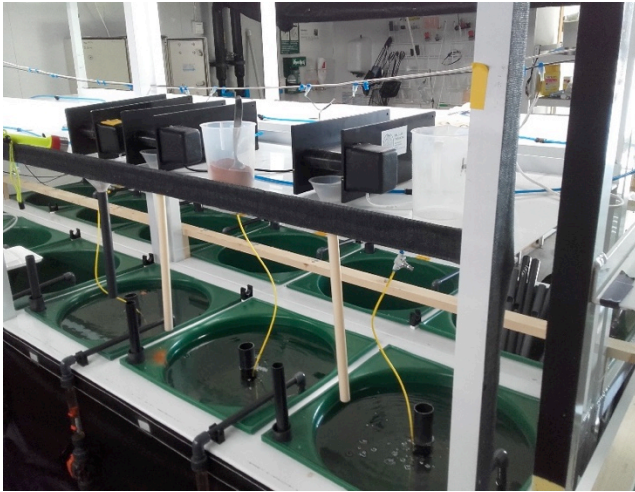
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IMR, SWH, ULL



Early weaning

- Atlantic halibut are fed Artemia until 50-60 dpff, time for developed functional stomach.
- Formulated diets would ease larval rearing.

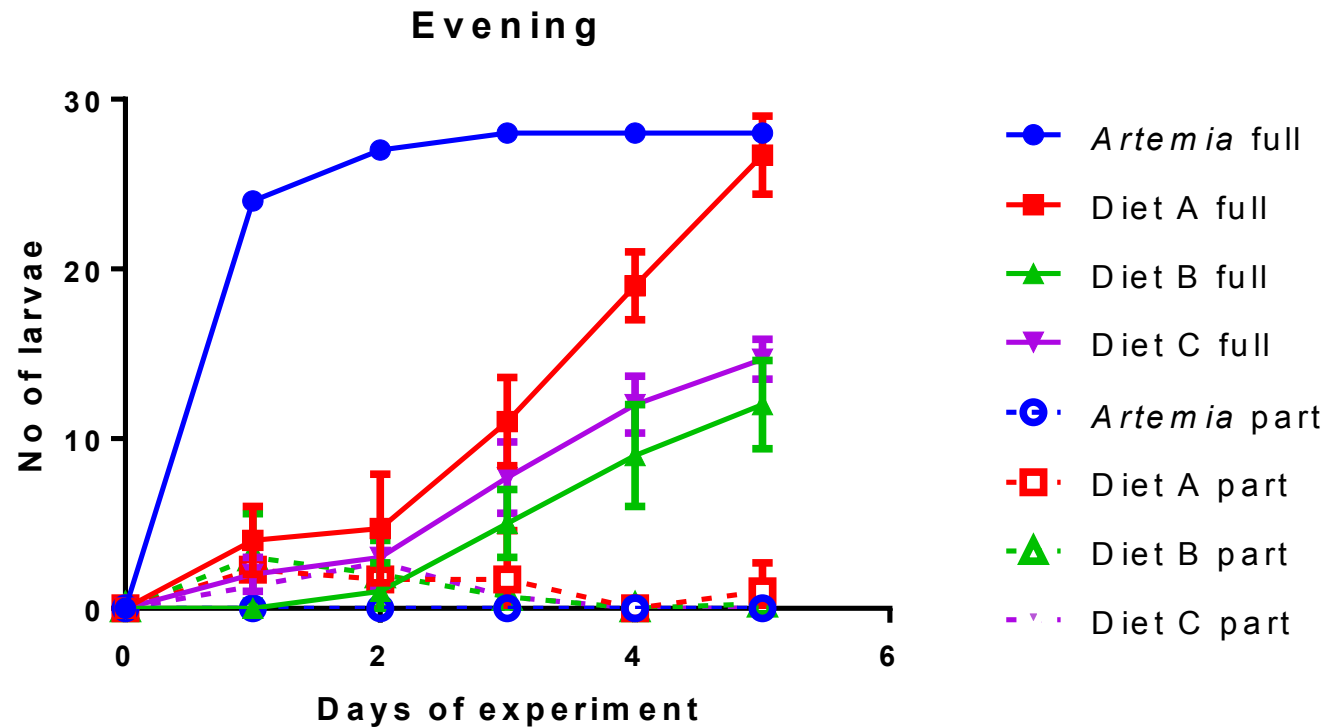


Test of different diets for early weaning

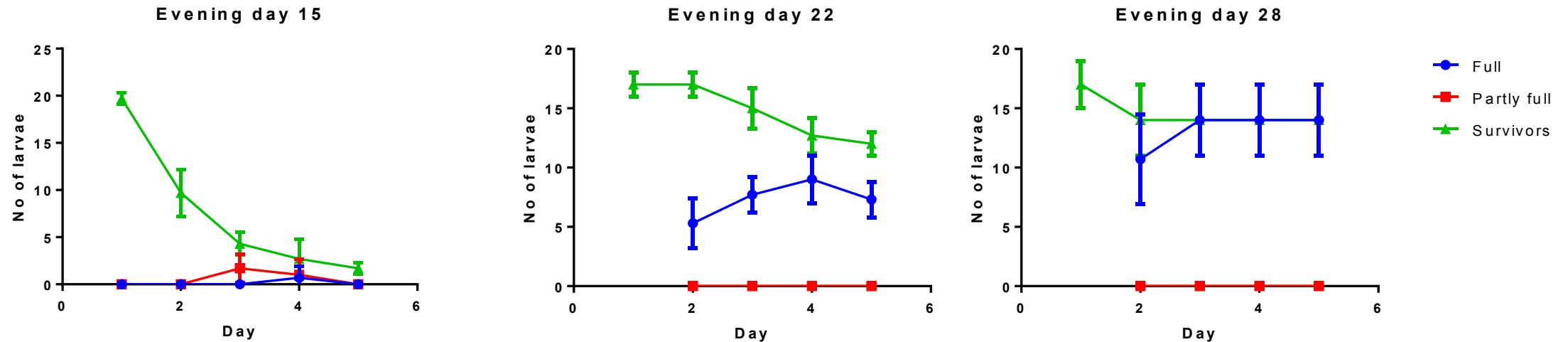
- The diets were fed for 5 days starting at 28 dpff
- Continuous belt feeding and hand feeding morning, midday and evening
- Triplicate 50L tanks with 25-30 larvae initially
- Larvae with filled guts were counted morning and evening using a strong flashlight



Effect of feeding three different commercial diets to 28dpff Atlantic halibut



Effect of weaning Atlantic halibut with diet A at 15, 22 or 28 dpff

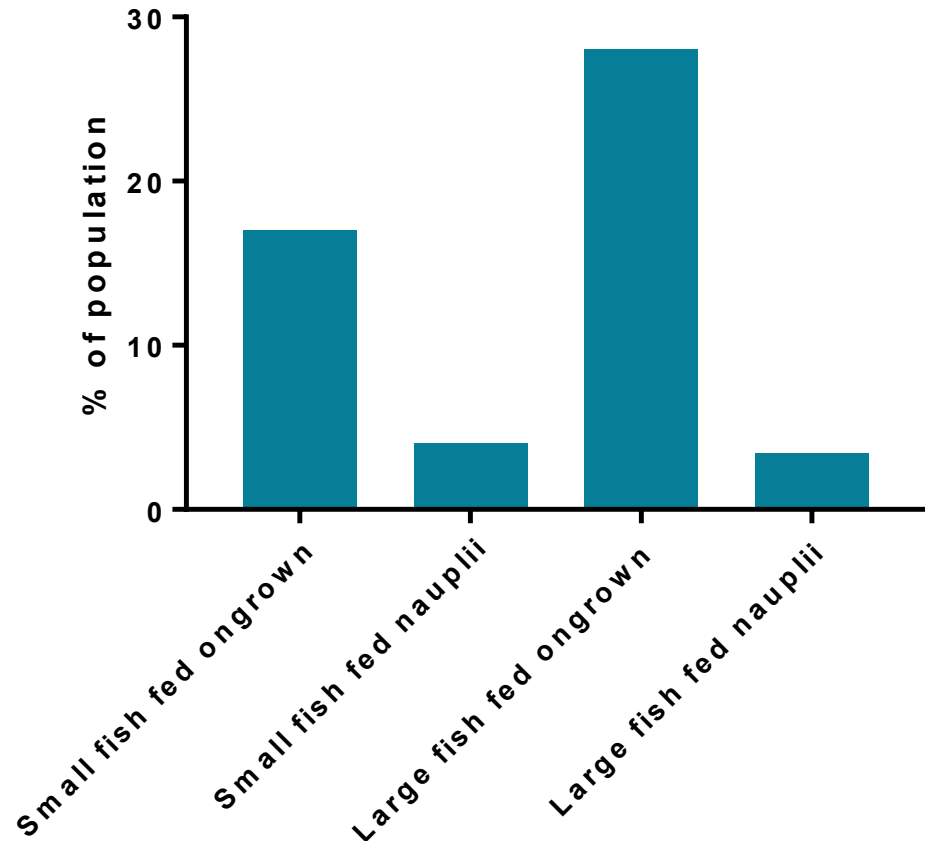


- Development of the digestive tract?
- Coping with the tank system?

Ongrown Artemia has been shown to improve juvenile quality in halibut

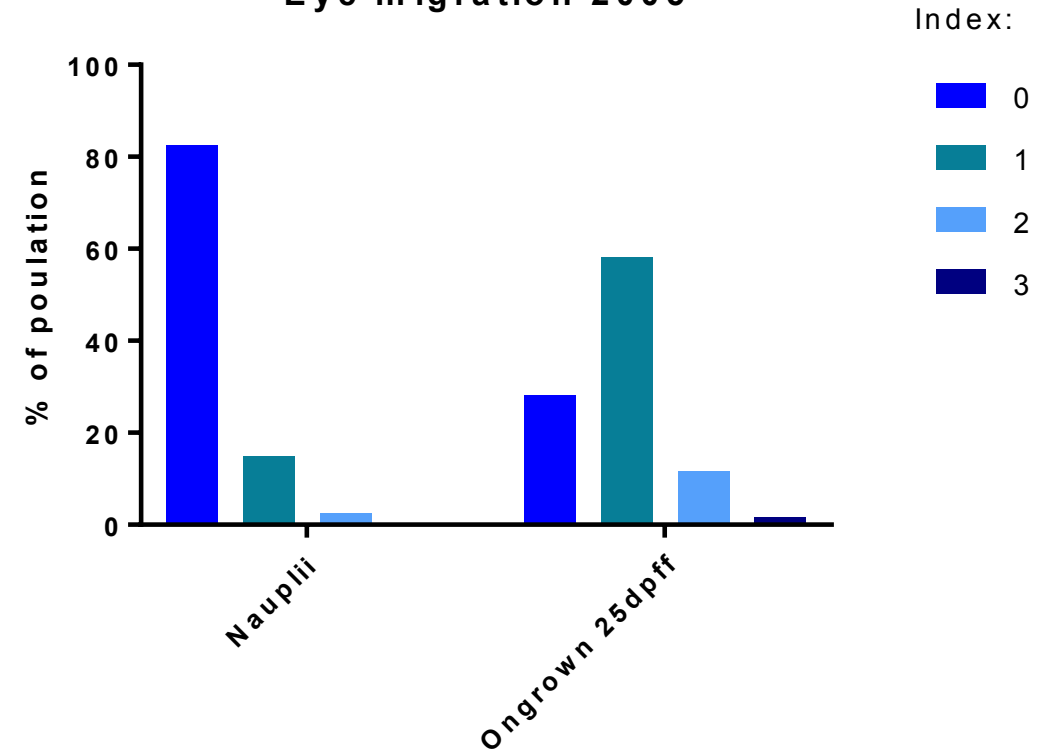
Olsen et al., 1999:

% perfect metamorphosis



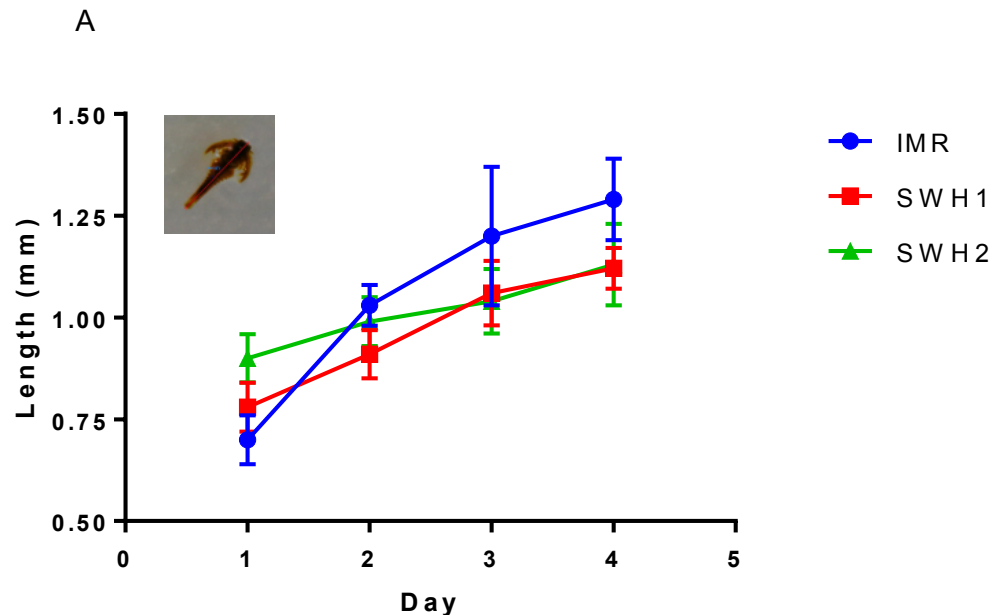
Harboe and Hamre unpublished:

Eye migration 2005



Growth and change in nutrient composition of Artemia

Lengthwise growth of Artemia

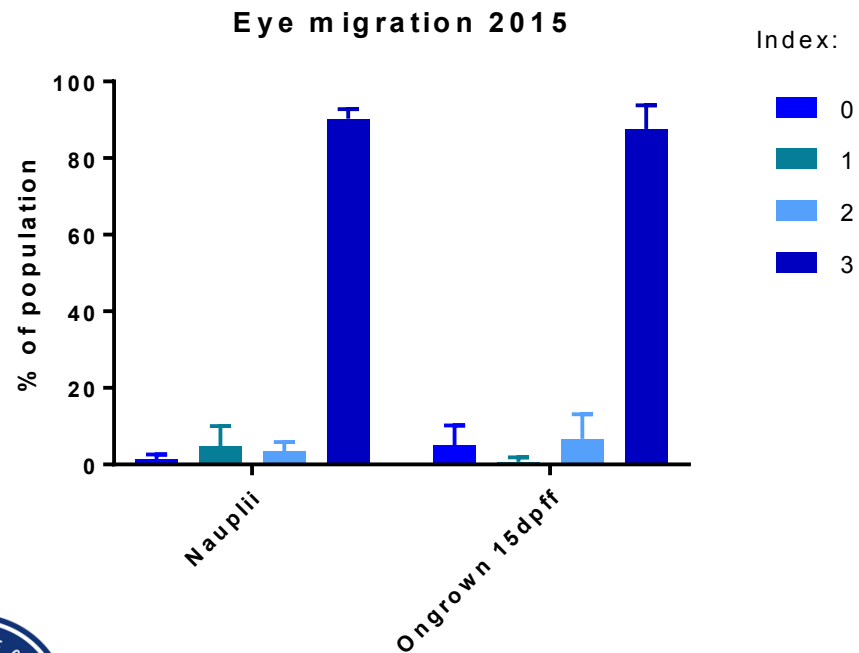


Feed: OriGreen or OriGo

- Improvements in nutrient composition:
 - More protein
 - Less lipid
 - Less glycogen
 - More free amino acids
 - More phospholipids
 - Minor changes in vitamins and minerals



Effect of ongrown Artemia on juvenile quality of Atlantic halibut

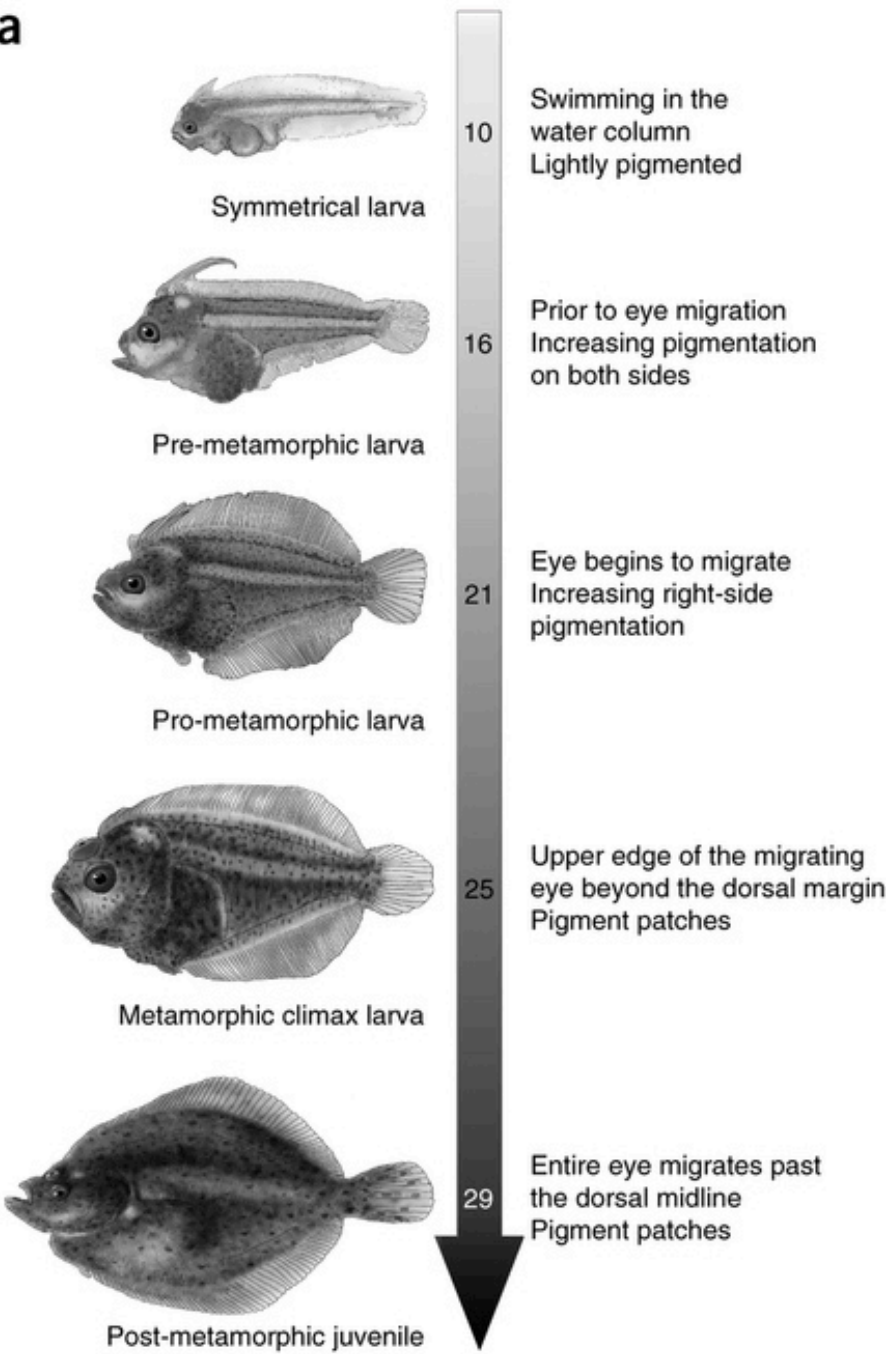


- Conclusion

- Modern diets and rearing methods for Atlantic halibut make Artemia nauplii a nutritionally sufficient larval diet



a



Shao et al., 2017

Tilting, light and vitamin A drives pigmentation and Eye migration in flatfish



1. The fish tilts increasingly during metamorphosis
2. A gradient of light falls on the skin of the fish
3. Generates a gradient of retinoic acid
4. Gives direction of eye migration
5. Gives signals to melaocytes to produce melanine



Vitamin A is a morphogen

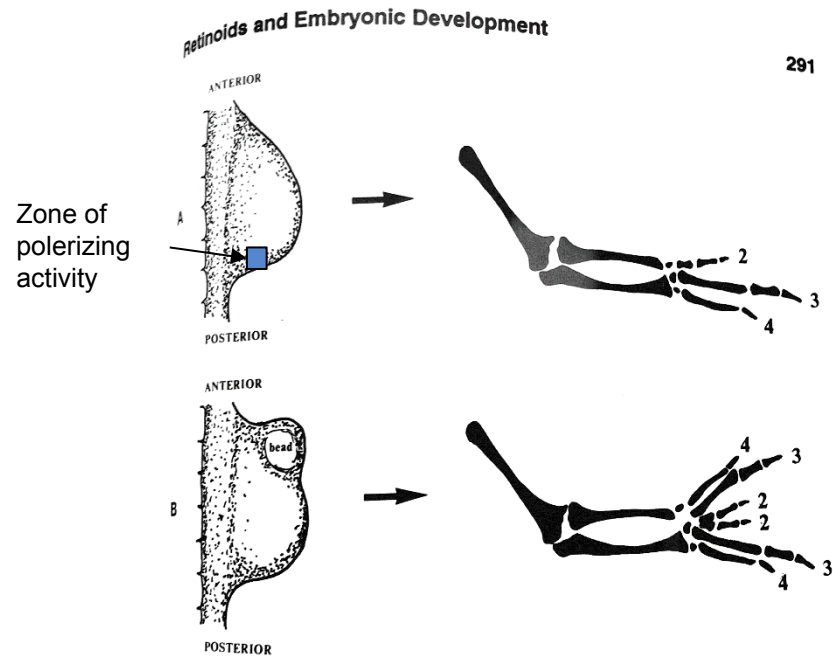


Figure 1 Effects of RA on the chick limb bud. (A) A stage 21 chick limb bud is drawn with its anterior and posterior margins marked which gives rise to a normal three-digit limb. The digits are numbered 2, 3, and 4. (B) After implantation of an RA-soaked bead into the anterior margin of the limb bud a six-digit mirror-imaged limb is produced. The digital sequence of such a limb is 432234, i.e., double posterior.

Wikipedia:

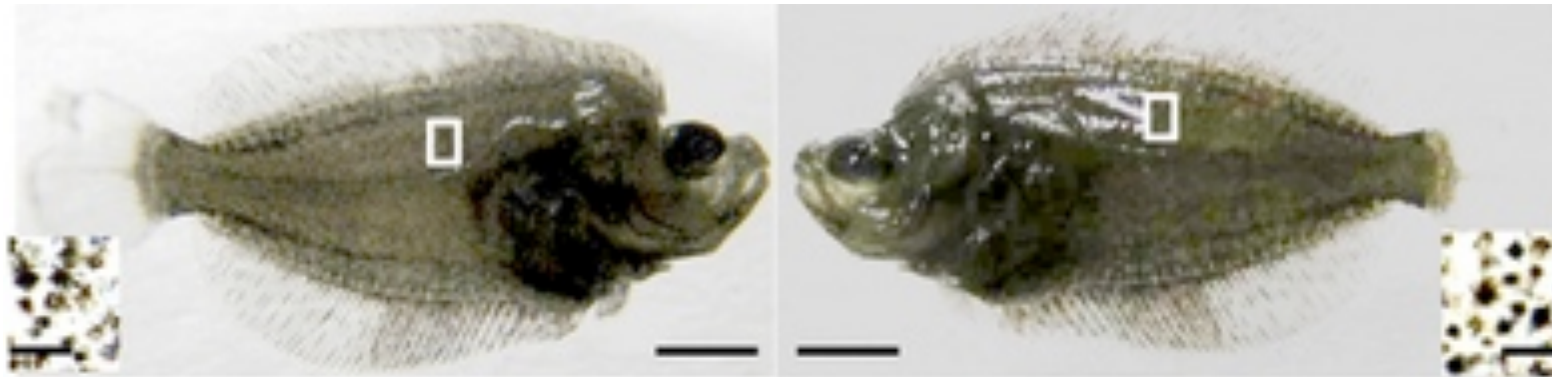
A **morphogen** is a substance whose non-uniform distribution governs the [pattern](#) of tissue development in the process of [morphogenesis](#) or [pattern formation](#), one of the core processes of [developmental biology](#), establishing positions of the various specialized cell types within a tissue. More specifically, a morphogen is a signaling molecule that acts directly on cells to produce specific cellular responses depending on its local concentration.



Evidence of mechanism

Blind side

Ocular side



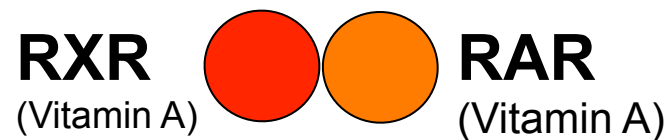
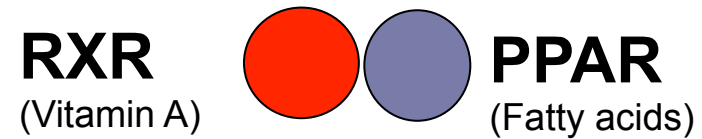
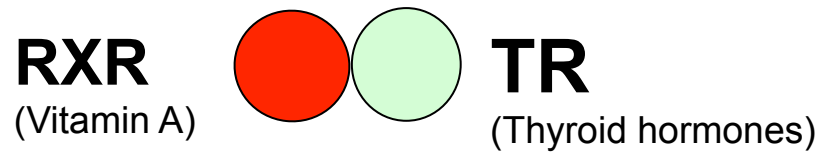
Blue light or
retinoic acid
injection on the
blind side



Control



Vitamin A interacts with thyroid hormones and fatty acids through nuclear receptors



The heterodimers of nuclear receptors control gene expression



Vitamin A deficiency



(Photo: Mari Moren)



Gaia and an Atlantic halibut at the Aquarium in Bergen



Photo: Irene Biancarosa



To avoid malformation

1. No light from tank walls or bottom
2. Sufficient amount of vitamin A (Too much vitamin A gives skeletal deformities)
3. There is sufficient cantaxanthin in Artemia to cover vitamin A requirement in halibut larvae
4. Sufficient general nutrition
5. Best hatchery practice

