Effect of environmental factors on the development of deformities in Atlantic halibut

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- Halibut hatch at a very premature stage of development

- Halibut has a very long yolk sac stage compared to other marine fish

→ susceptible to environmental stressors

Duration of yolk sac stage

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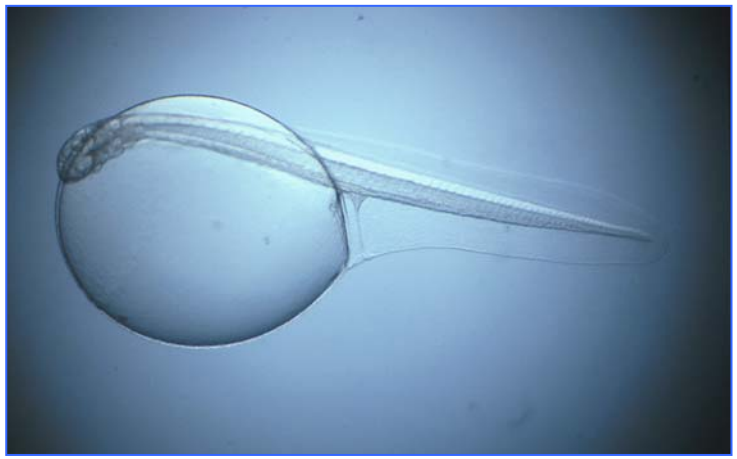
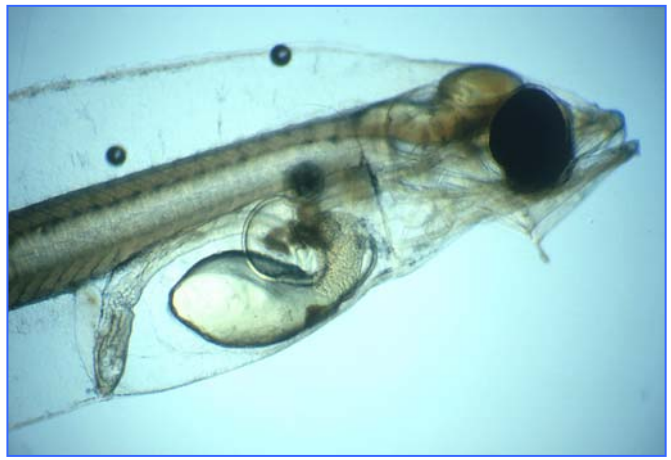
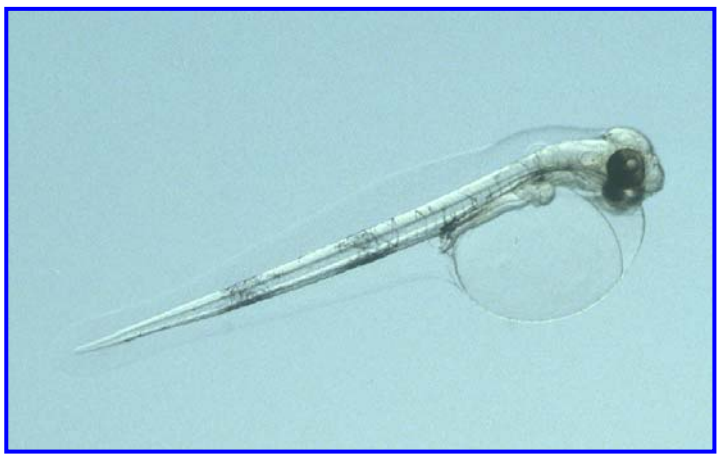


50 days



Newly hatched halibut larvae

Halibut larvae at first feeding



8 days

Newly hatched cod larvae

Cod larvae at first feeding

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Deformities in farmed Atlantic halibut

Variable, but often high frequencies (0-100%)

- Gaping jaws most prominent
- Yolk sac edema
- Other skeletal deformities (head, jaw, tail)

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First feeding - halibut

Normal larvae

Gaping jaw and yolk sac edema

Photo: Trine Galloway, Biomar, Norway

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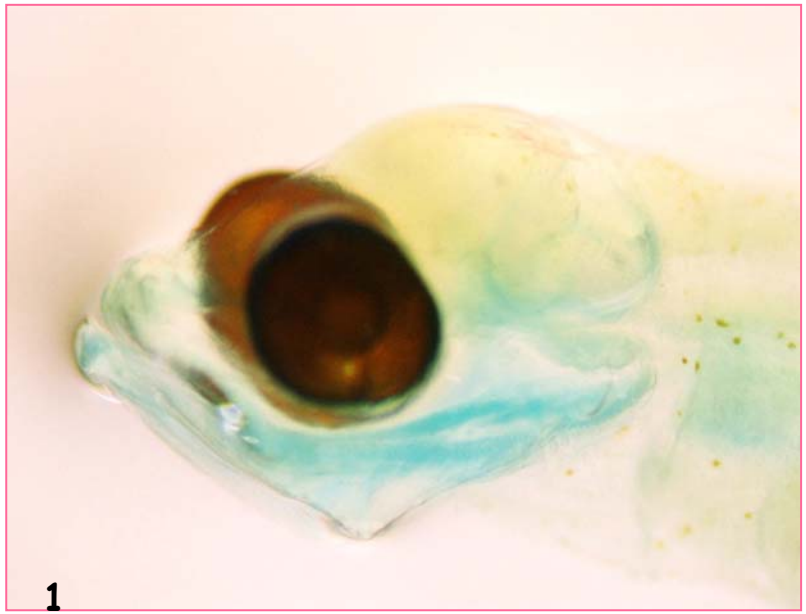

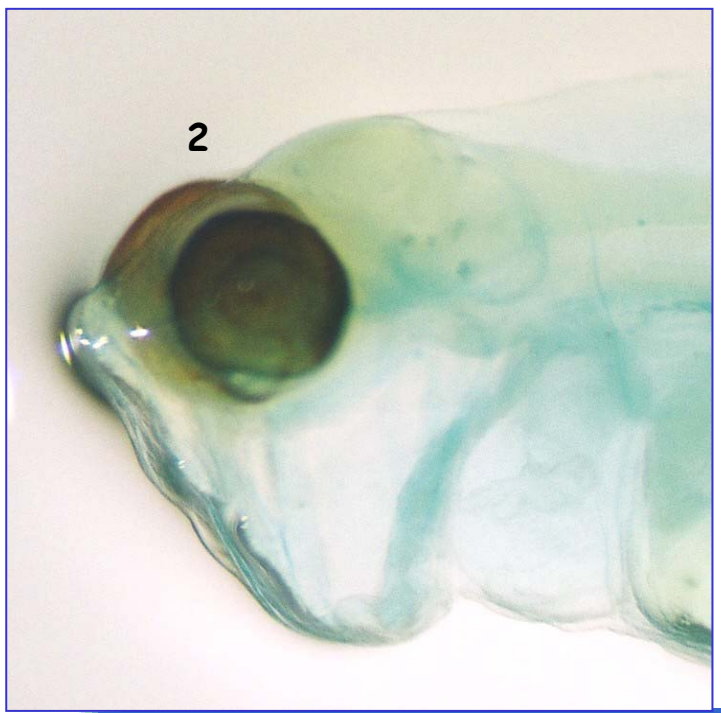

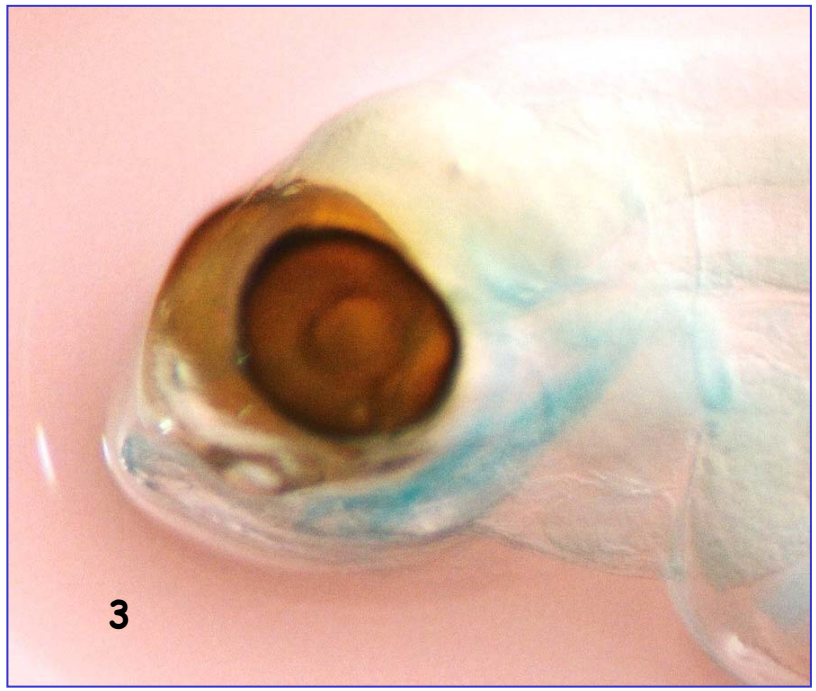

1) Normal jaw

2) Gaping jaw

3) Pug nose

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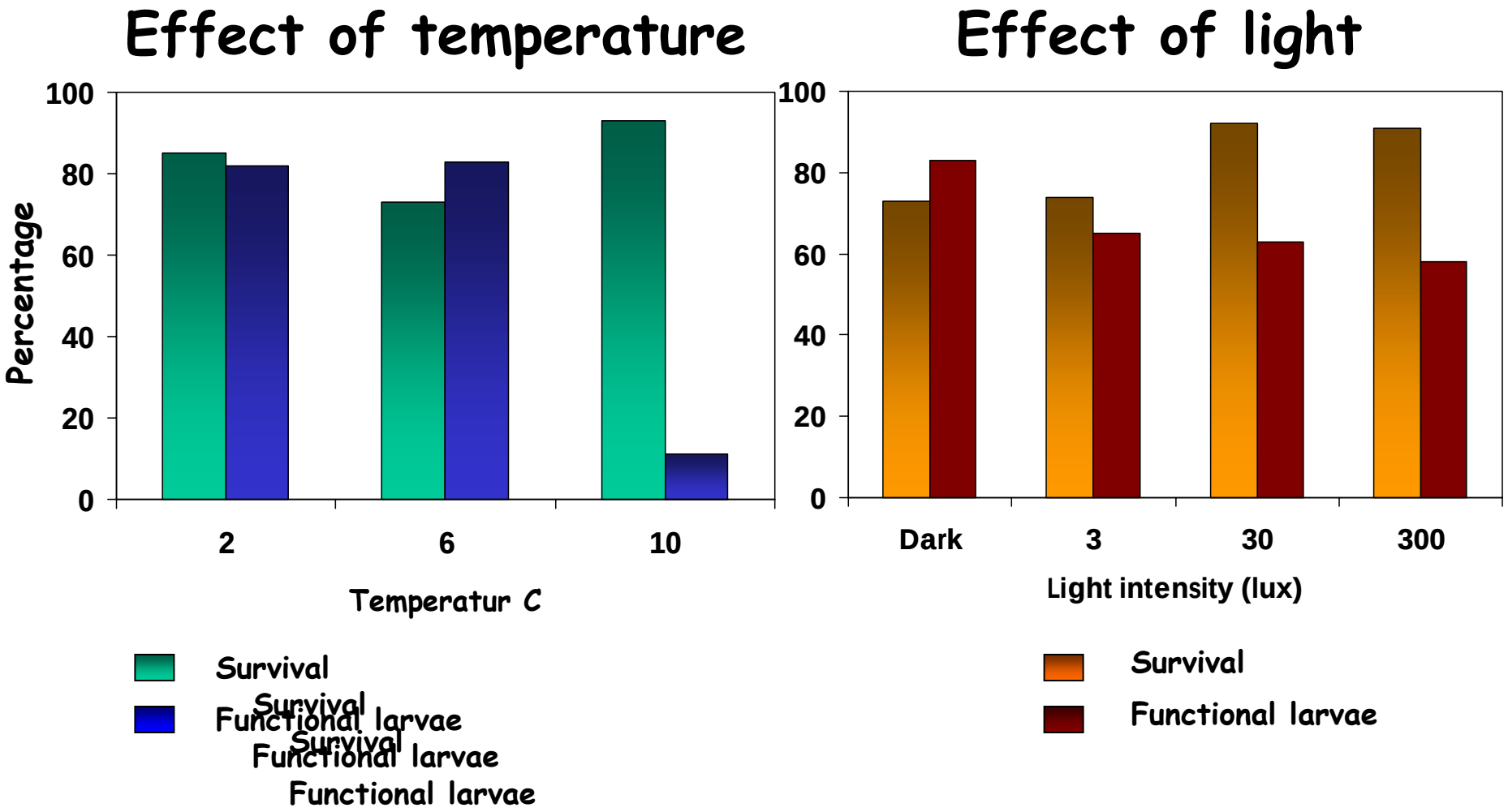
Small scale experiments at AKVAFORSK

- 3 liter glass jars
- Many replicates (4-5)
- Temperature 4 C
- Water filtered to 0.2 micron, UV-treated Oxytetracycline added
- Larval density 75-90/L
- Stagnant water
- Water exchanged two times during yolk sac period

Constant temperatures I



Bolla & Holmefjord, Aquaculture, 1988

Constant temperatures II

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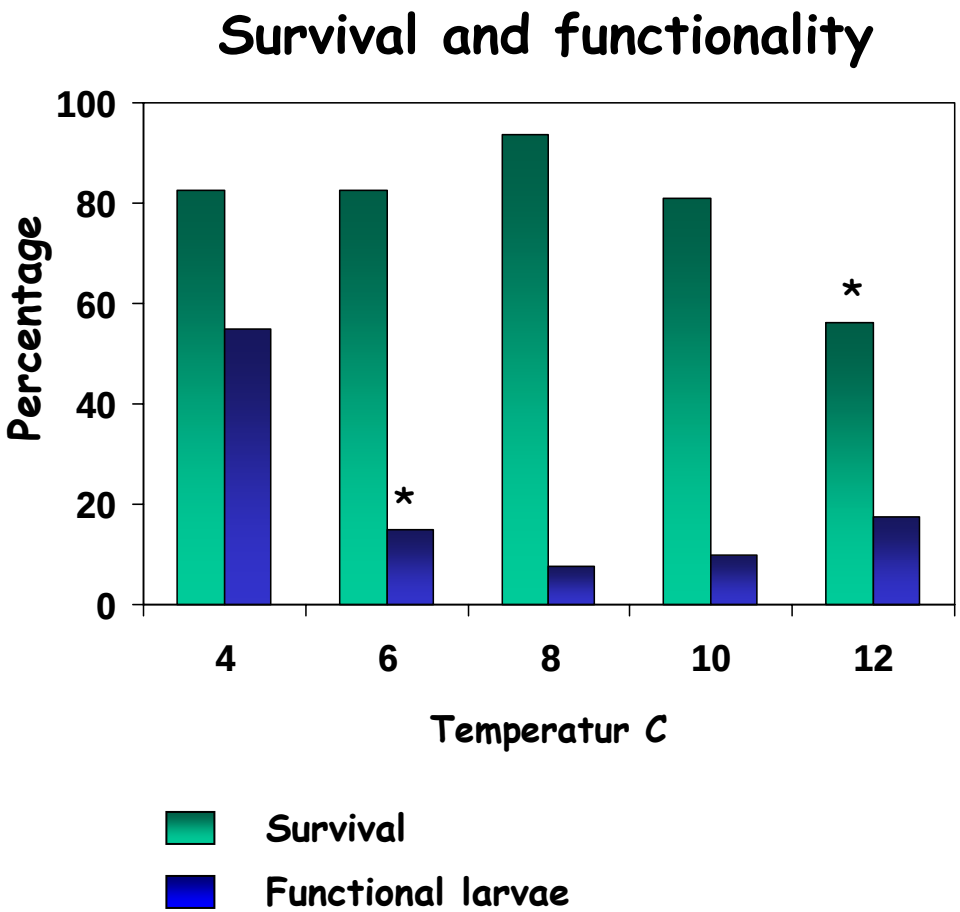

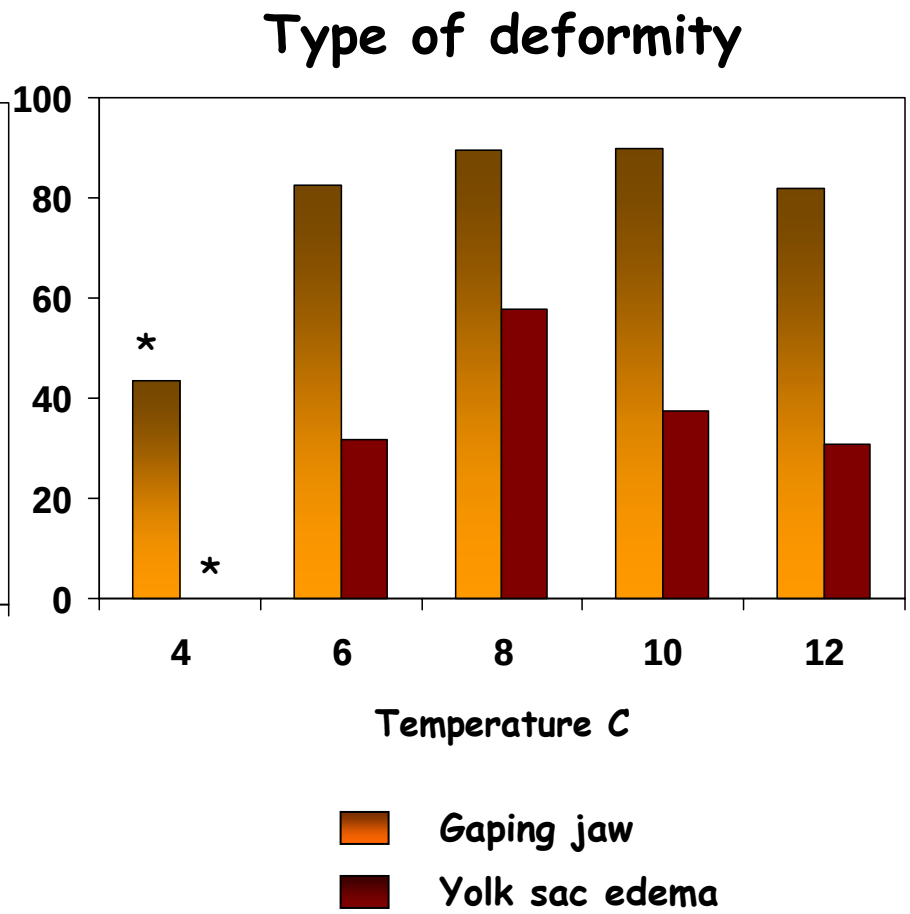

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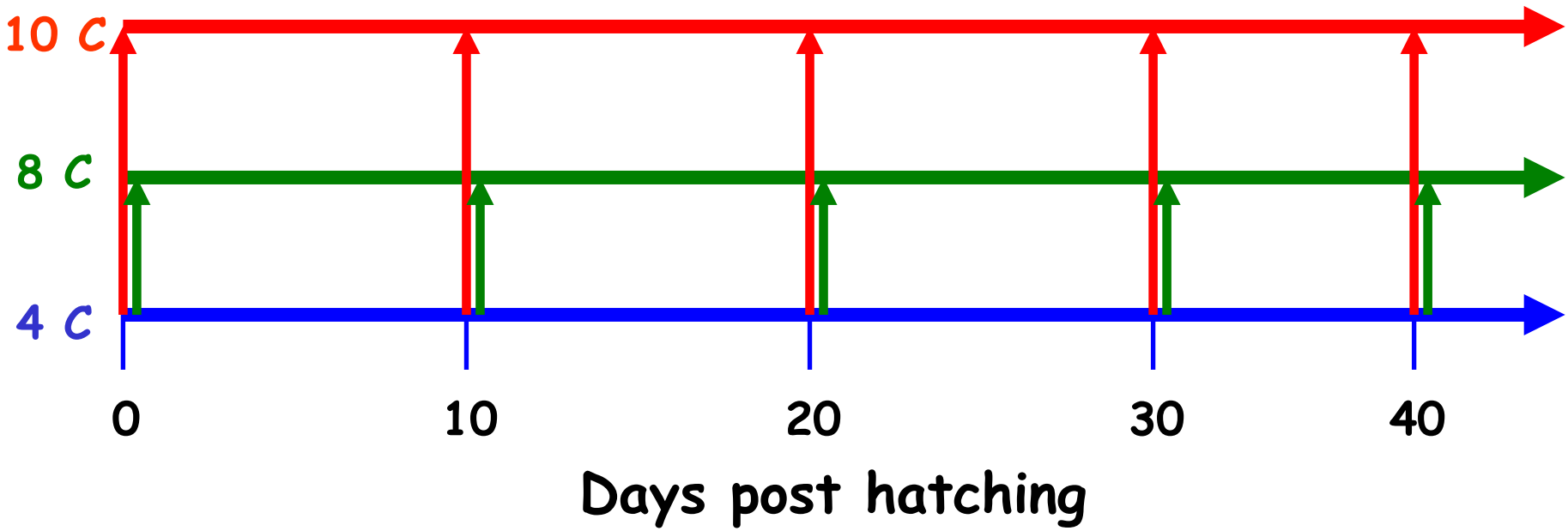
Temperature increase at different ages

Experimental setup



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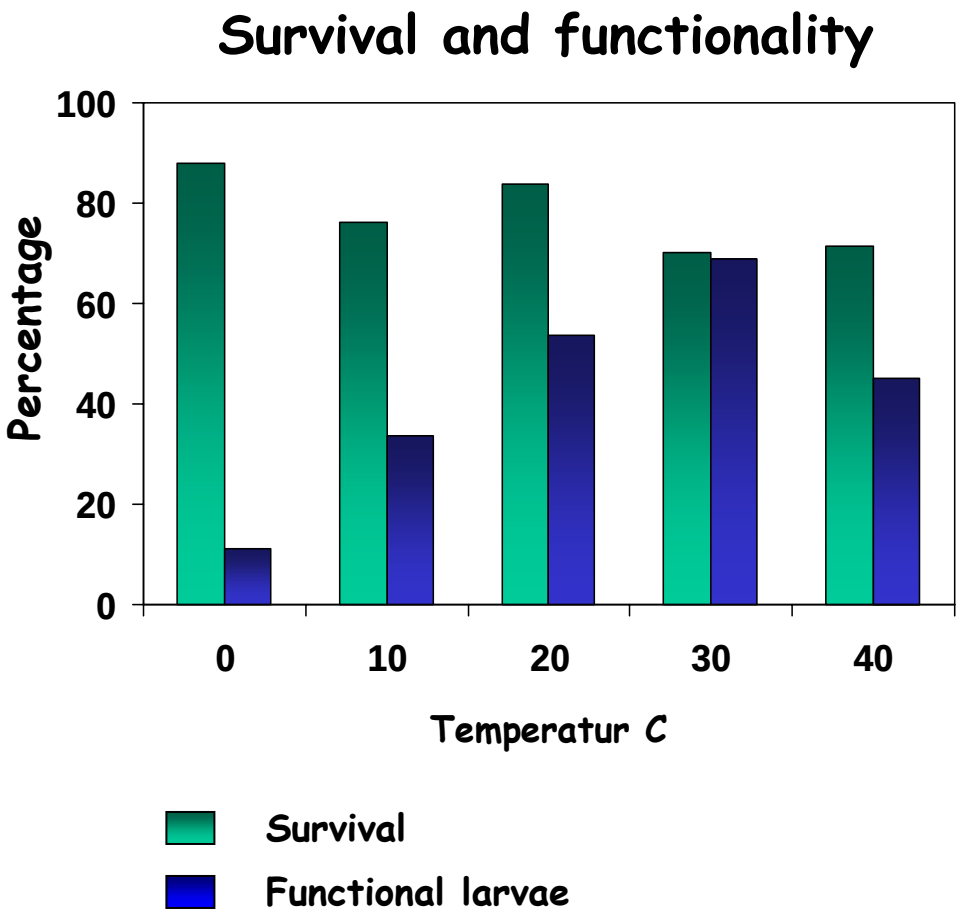
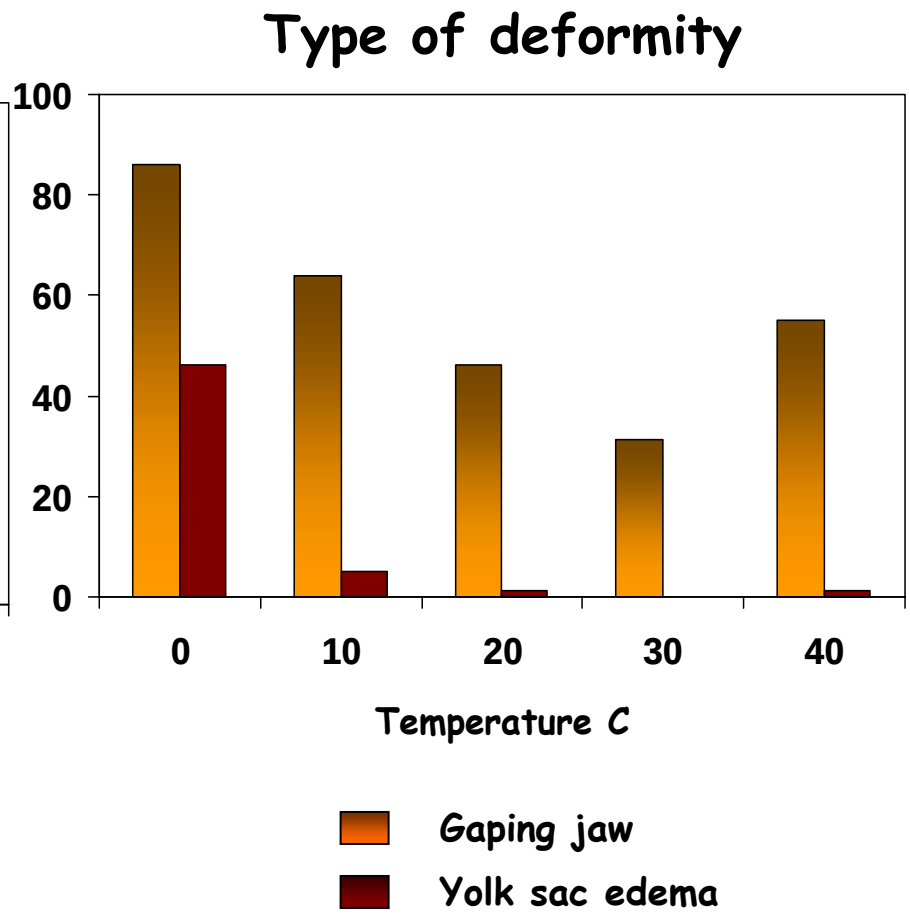
Different periods at 4 °C





Constant salinity from hatching to first feeding

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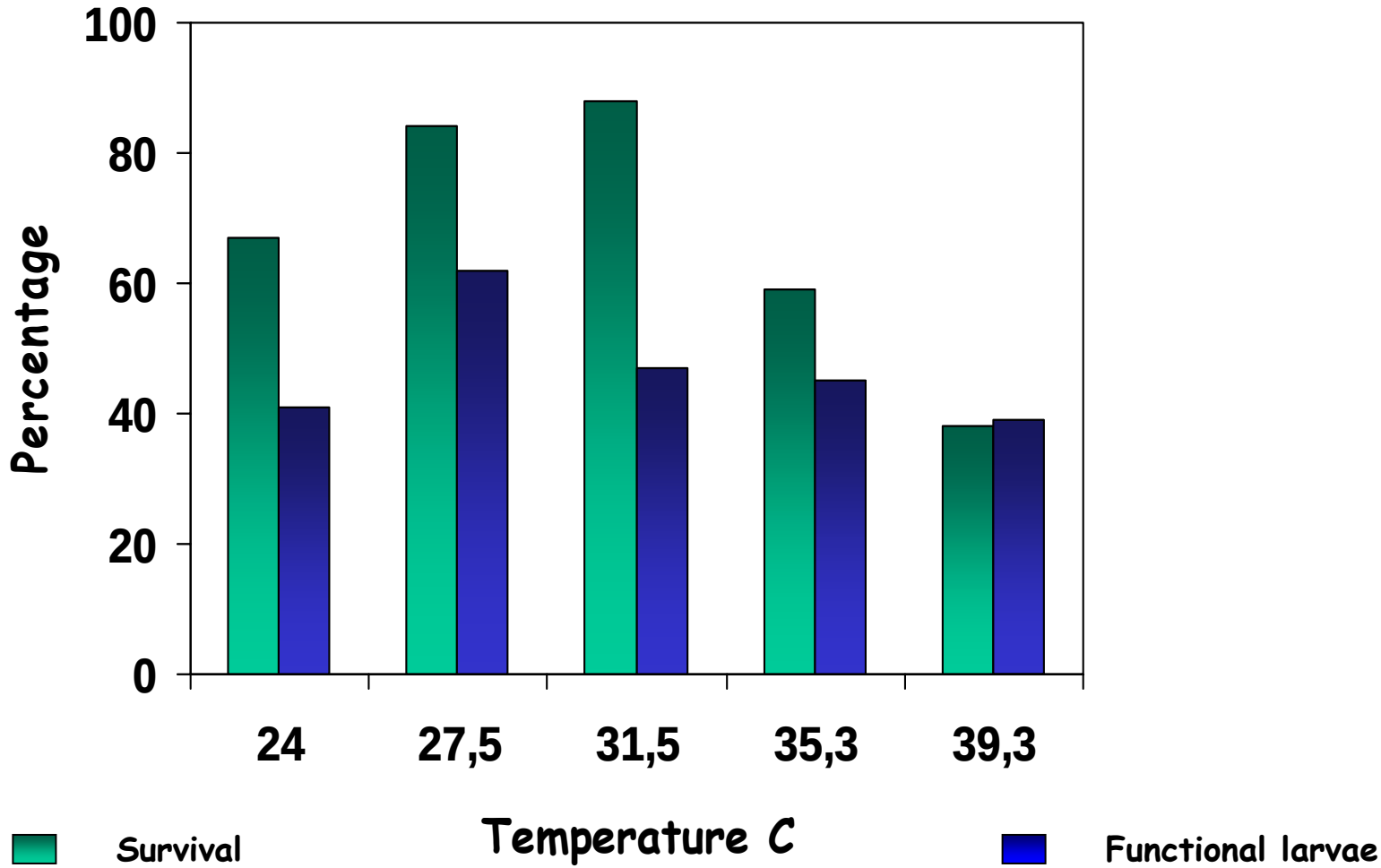

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Increase in salinity at different ages

- The larvae were held at 35 ppt (ambient salinity) for 30 days p.h.

- At day 30 p.h. The larvae were transferred to nine different salinities.

Different salinities from day 30 p.h. to first feeding

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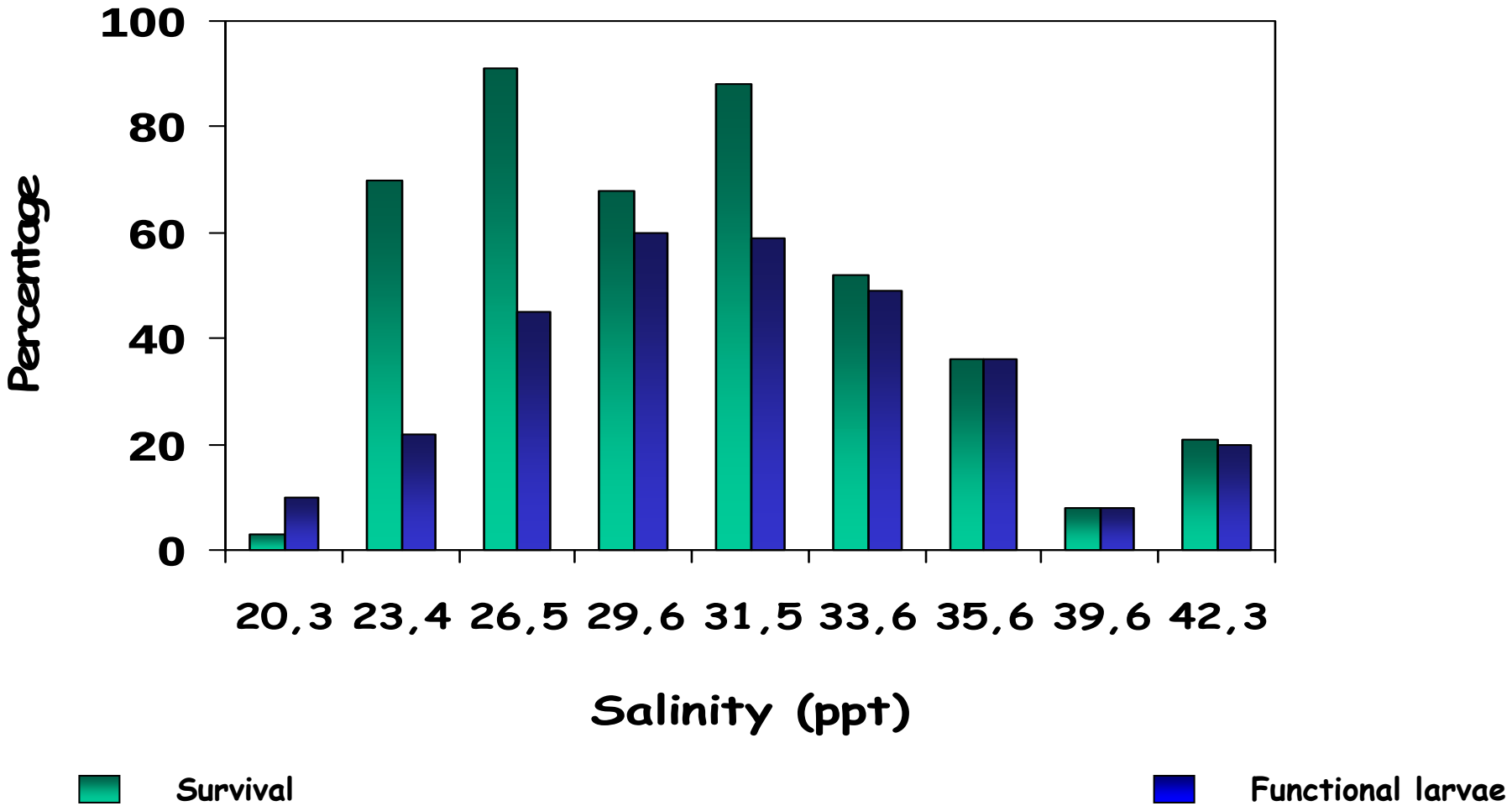

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Effect of water flow

- One exchange of total water volume every three days
- Start flow at day 6, 16 and 24 days p.h.
- Control kept stagnant from hatching to first feeding

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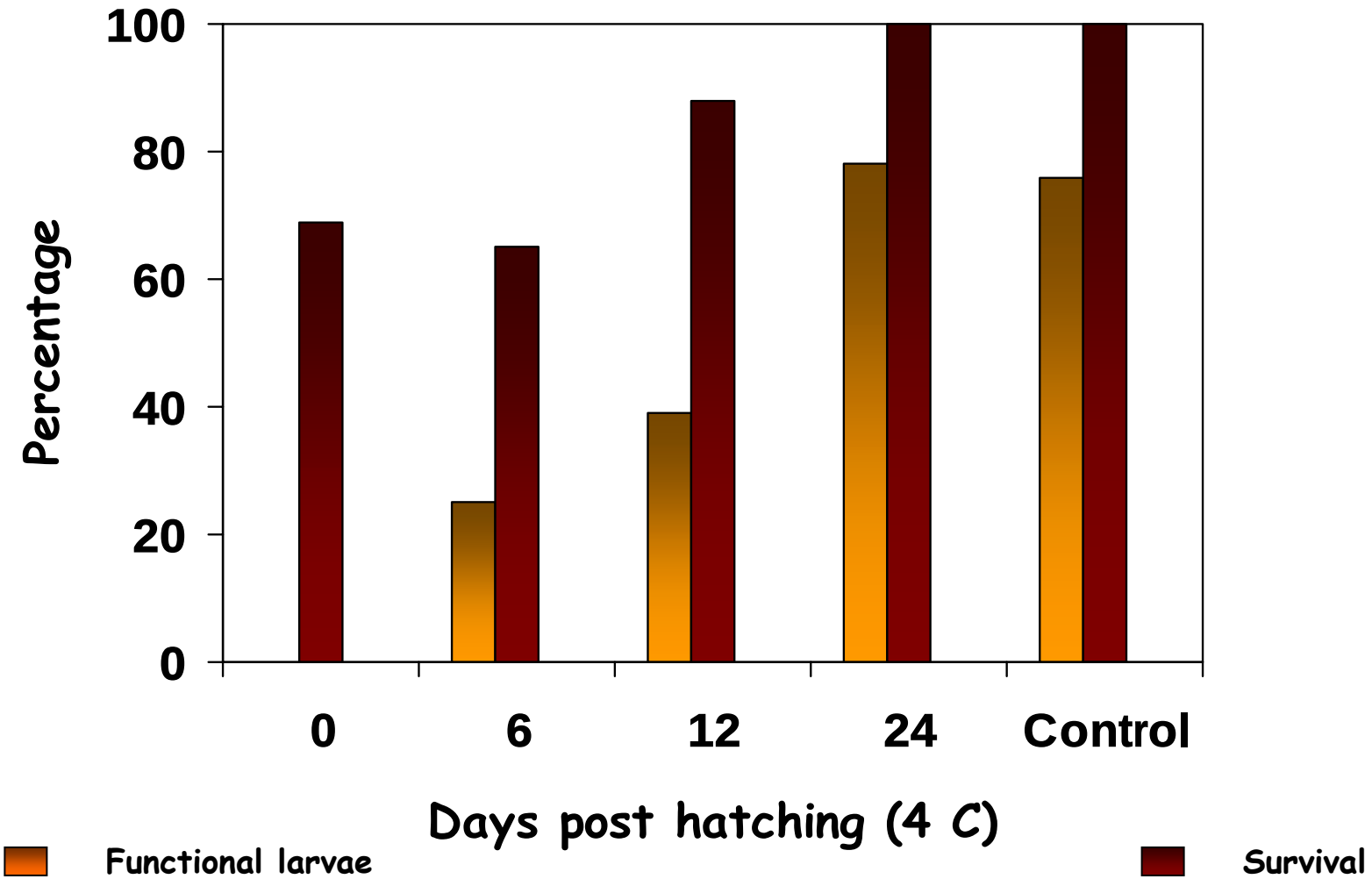
Age of larvae at start of water flow



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Effect of different materials

- 3-liter glass jars used as experimental units
  4 replicates per treatment

- Water filtered through 0.2 micron filter and
  UV-treated

- Small pieces (5x5 cm) of different materials placed at the bottom of each unit after hatching

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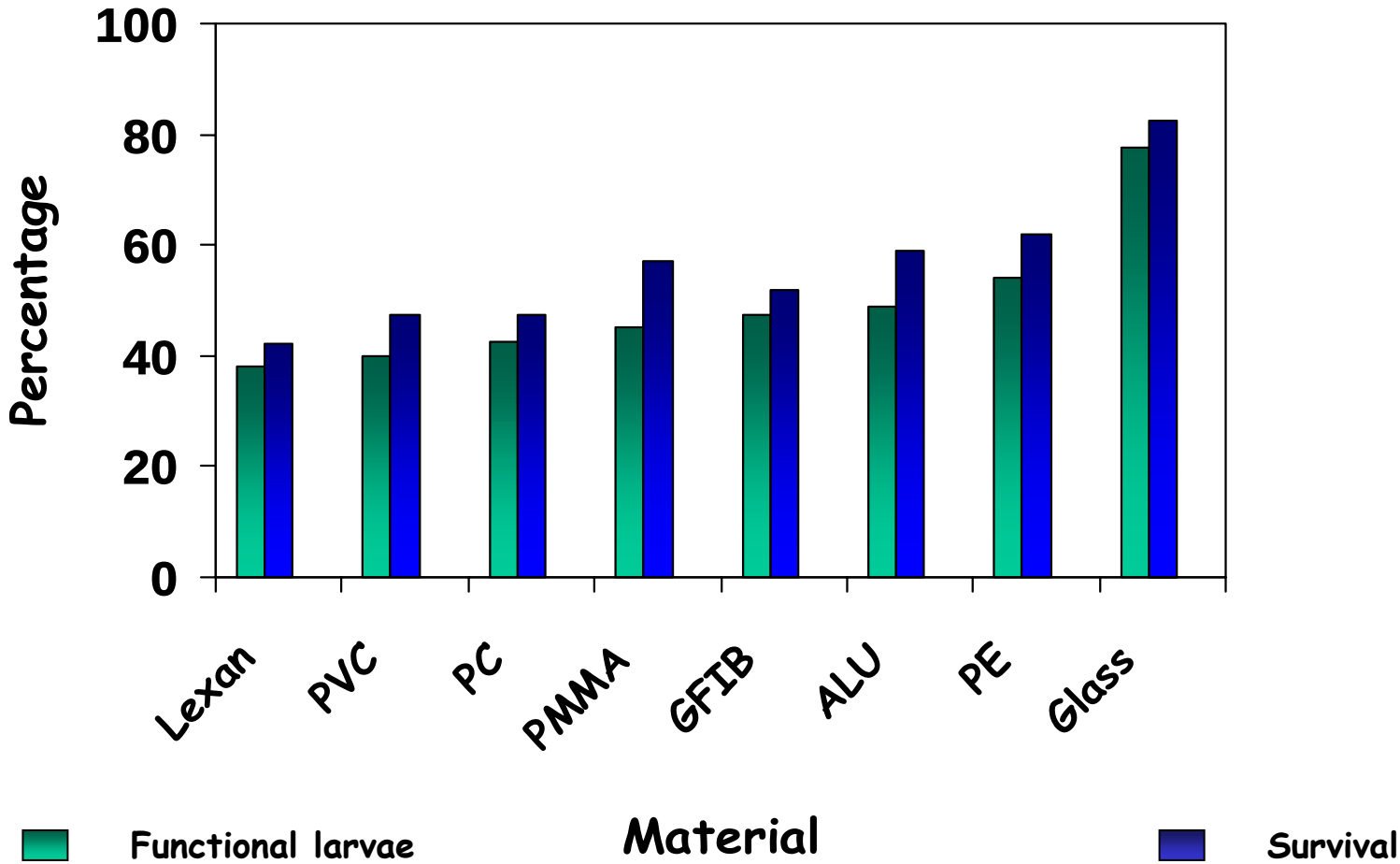
Effect of different materials



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Conclusions - environmental factors

- Different environmental stressors applied during the first 2-3 weeks p.h. causes increased frequencies of deformities in halibut larvae

- The halibut larvae become more tolerant to environmental stressors approximately 3 weeks p.h.

- The increased tolerance to environmental stress coincides with the completion of major organ structures

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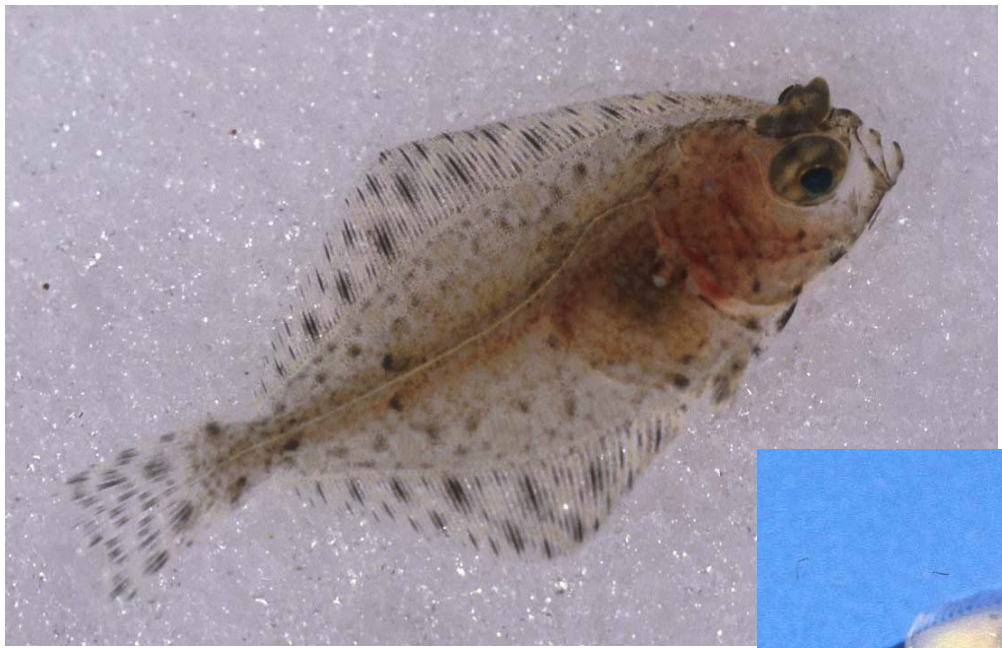
Atlantic halibut - juveniles



Normal pigmentation and eye migration

Malpigmented halibut juvenile with poor eye migration (high ARA)

Pigmentation:

Related to feed compsition, especially DHA-content and DHA/EPA-ratio, phospholipids?

Halibut and turbot have lower requirements for ARA than other marine species such as seabass and sea bream

Eye migration:

Seems to be more related to total energy intake, but also correlated with feed composition, especially fat classes (phospholipids/triglyserids)

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Skeletal deformities in farmed halibut

Leah M. Lewis, Dalhousie University, Halifax, NS

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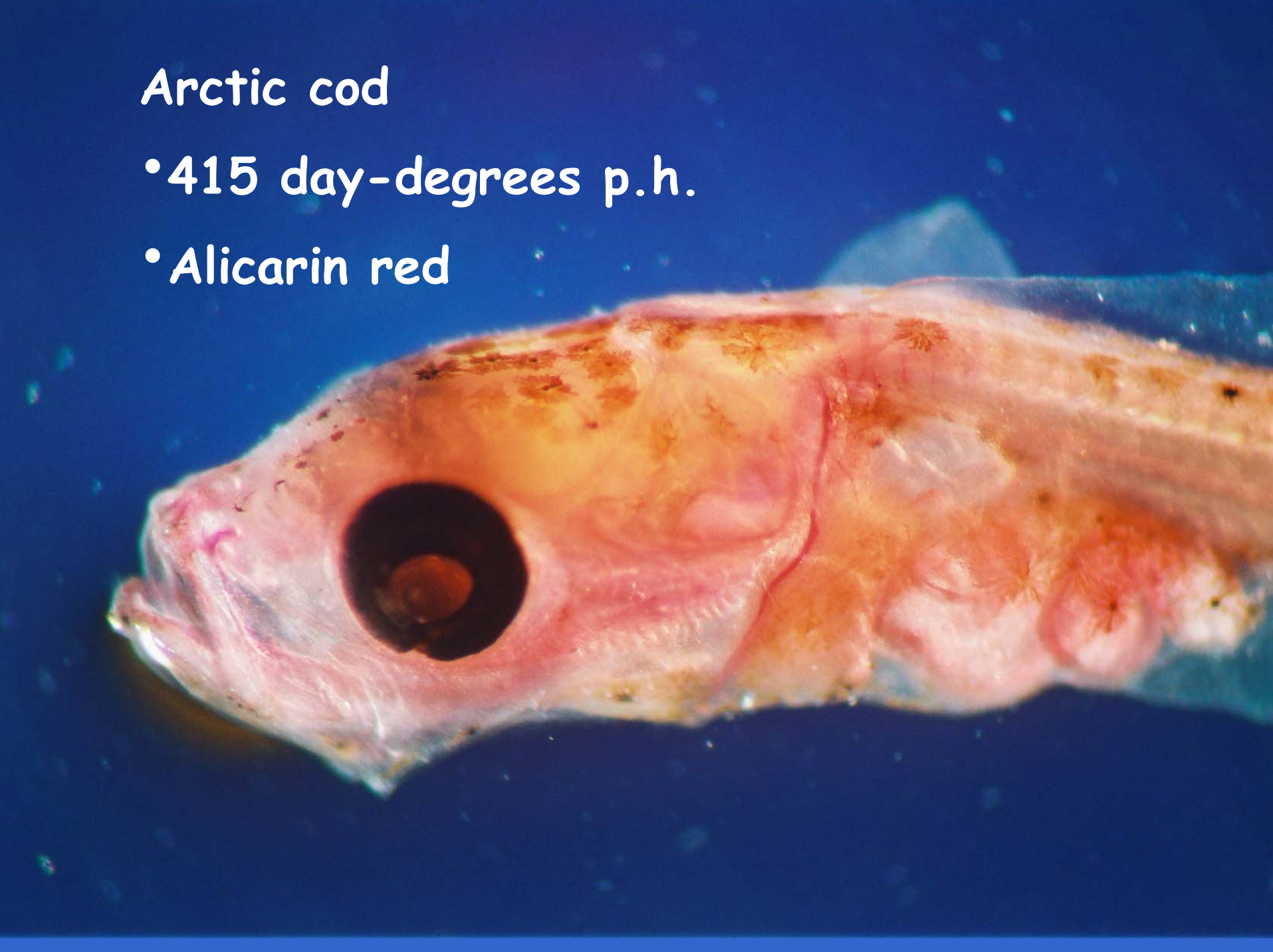
Further perspectives

- Need for more knowledge about the effect of environmental factors during first feeding and juvenile stages of Atlantic halibut

- Need for more knowledge about the nutritional requirements of Atlantic halibut during early life stages with regard to deformities


Arctic cod
•415 day-degrees p.h.
•Alicarin red

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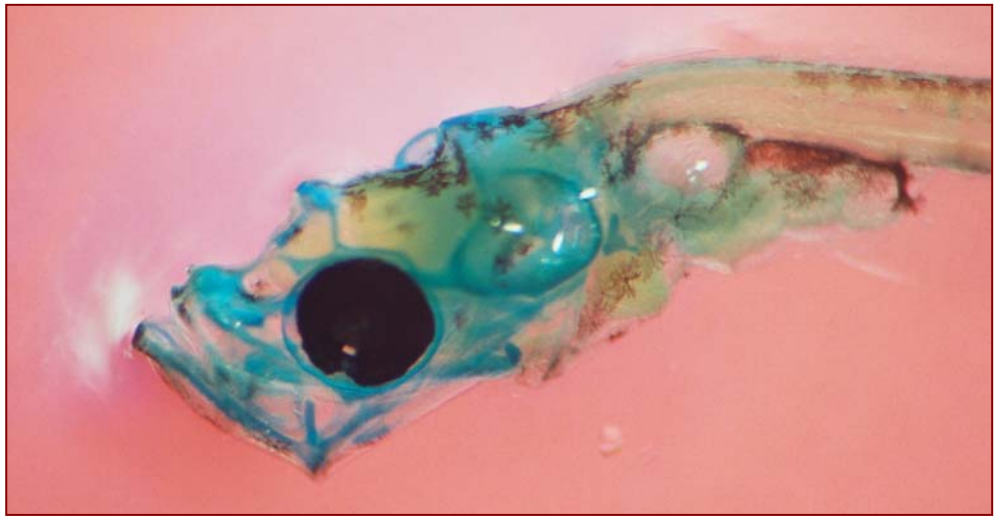
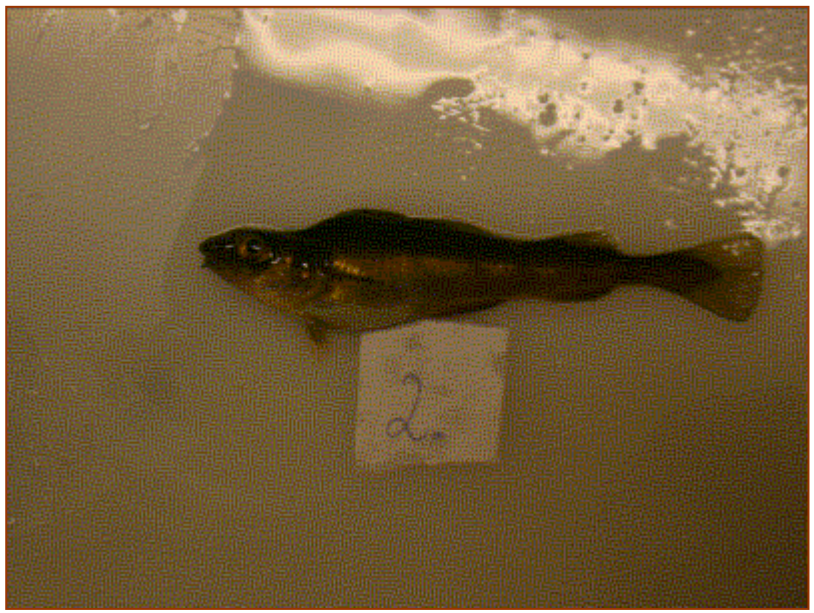
Atlantic cod -
Examples of deformities



Bent neck



"Star watcher"

Lordosis

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Ongoing experiments on cod

- Eggs are incubated at three different temperatures

- Larvae are first-fed at three different temperature regimes:
  1) 8 ℃ until metamorphosis
  2) 12 ℃ until metamorphosis
  3) Gradually increase from 6 to 12 ℃

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Frequencies and types of deformities 414 d° p.h.

Temp regime	Neck area	Vertebral column	Head/ jaw	Tail
6-12 °C	2.5	0.0	7.5	0.0
8 °C	0.0	0.0	13.0	0.0
12 °C	13.0	10.0	7.5	10

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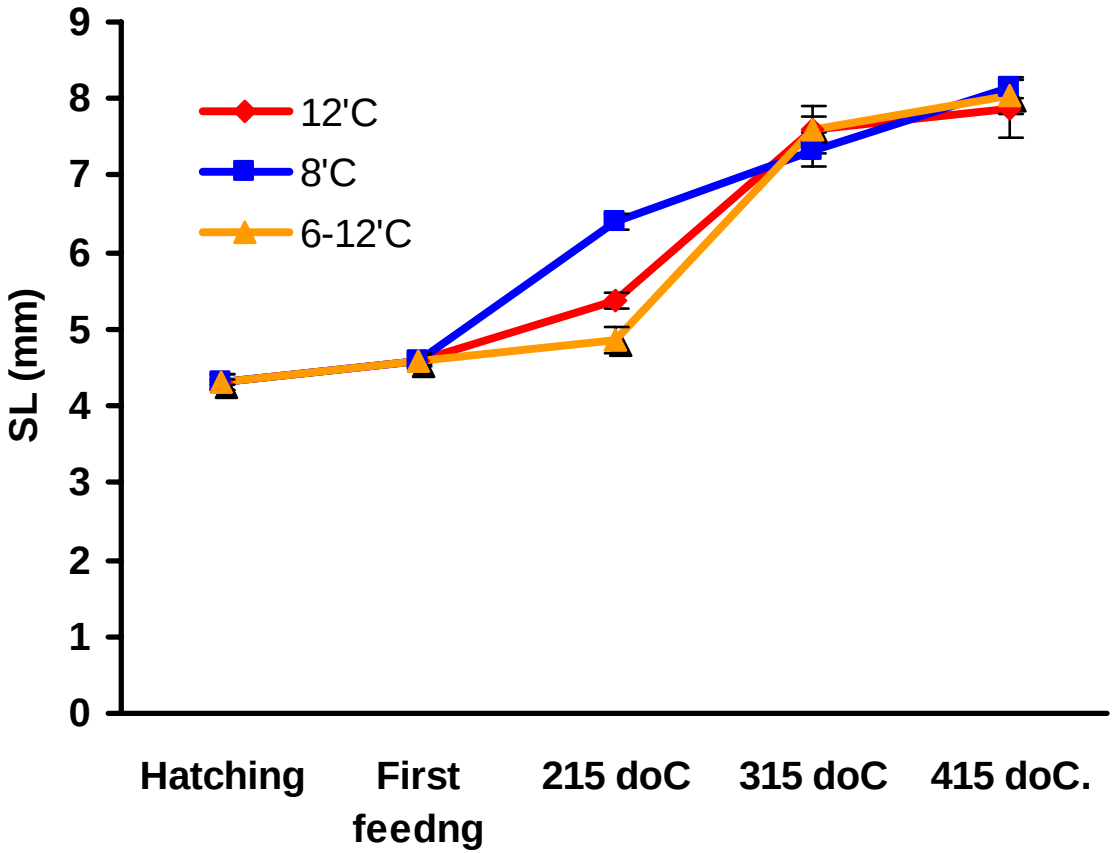
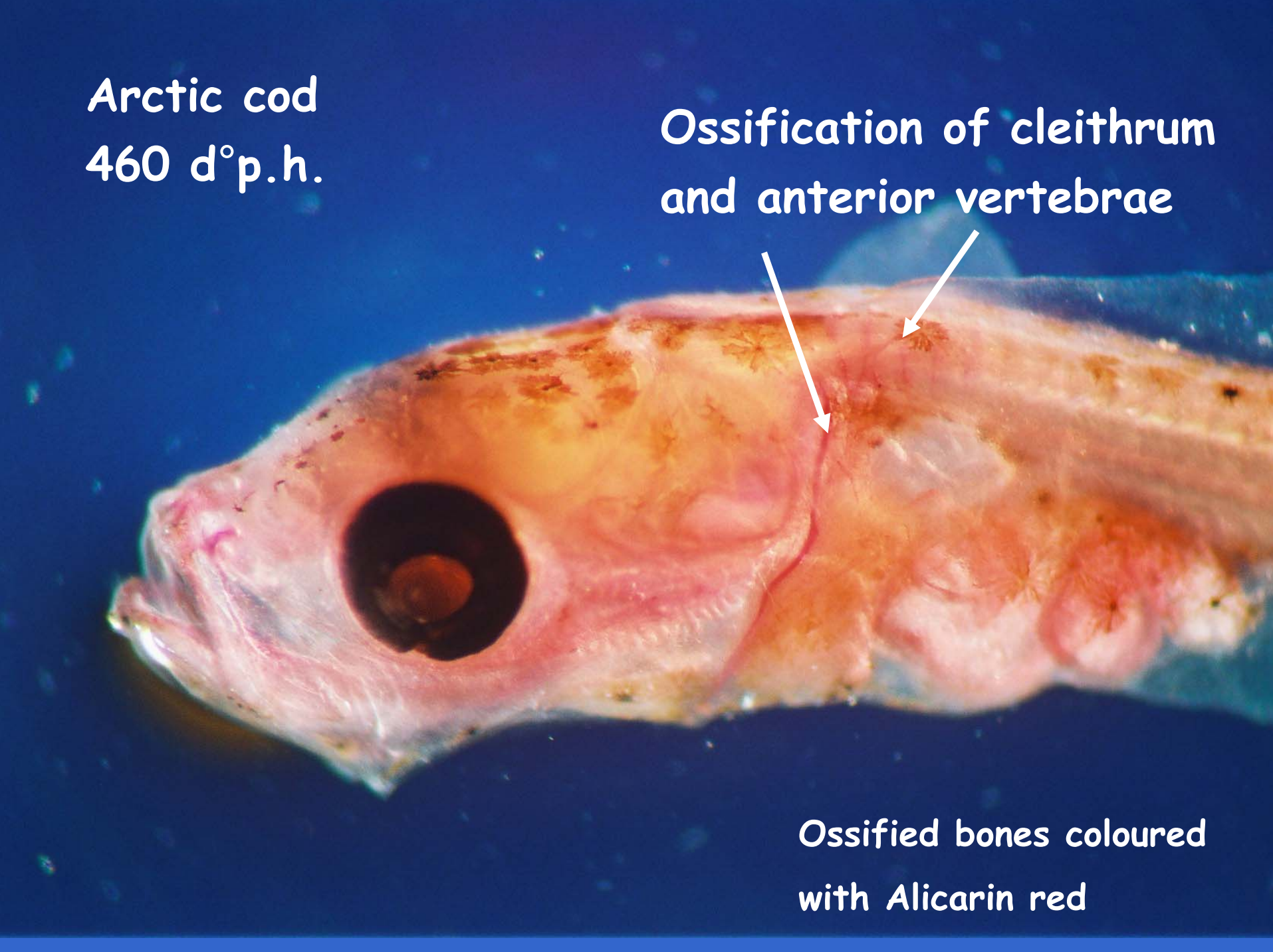
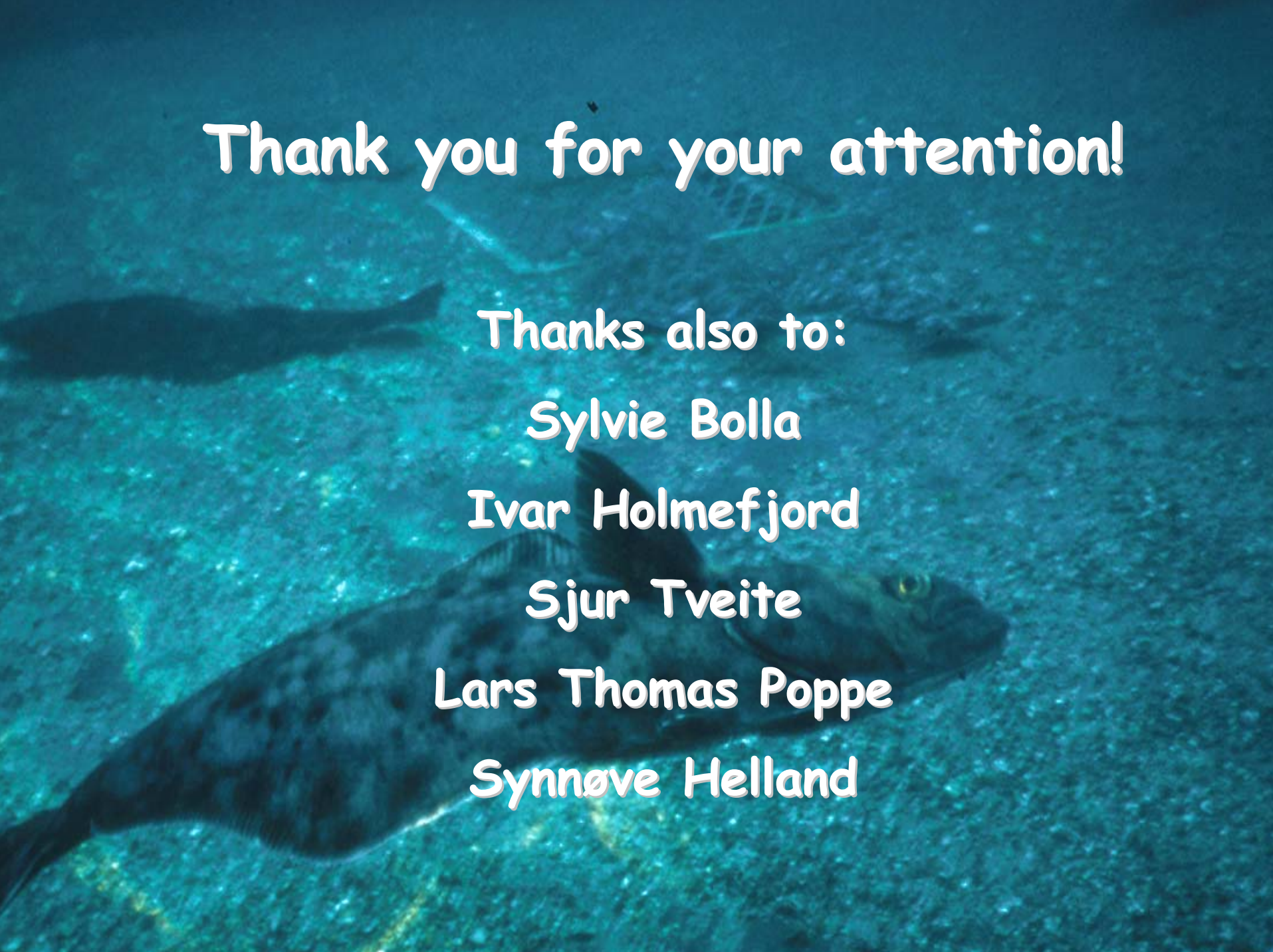
Growth of cod larvae fed at different temperatures




Arctic cod
460 d°p.h.
Ossification of cleithrum
and anterior vertebrae
Ossified bones coloured
with Alicarin red



Thank you for your attention!

Thanks also to:

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Synnøve Helland