INSTITUTE OF MARINE RESEARCH

The 3R's and behavioural studies in aquaculture:

Trade off between possible animal suffering and relevance

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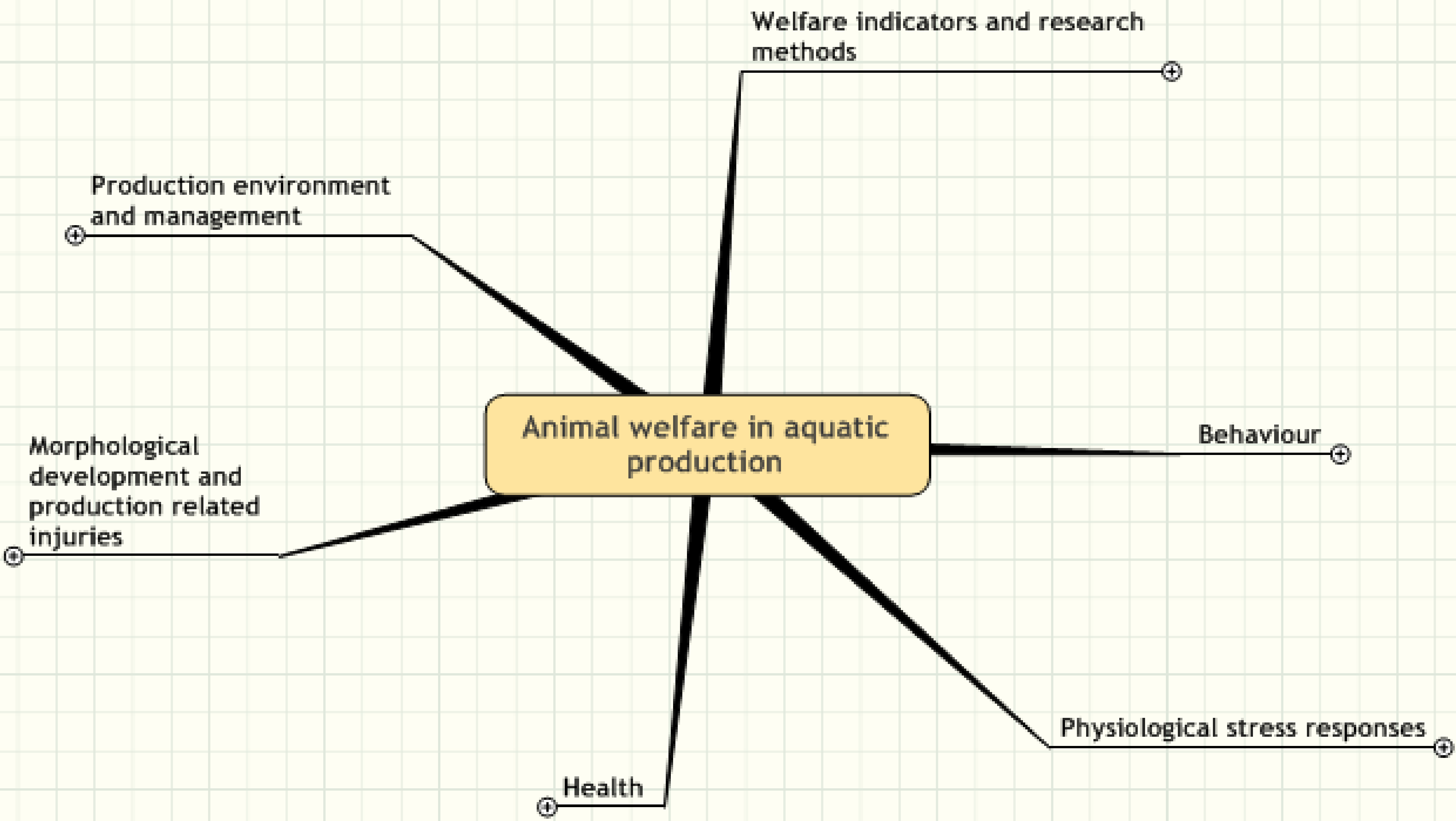
Harmonization of the care and use of fish in research, Gardermoen 23-26 May 2005

Animal welfare - a focus area



Acknowledgements

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- Jan Erik Stiansen
- Tore Kristiansen

- Behavioural studies and aquaculture
- Behaviour and importance of context
- Animal suffering and relevance - the 4th R?

Why study fish behaviour?

- Basic science – model species
- Life history – ecology
- How to catch them sustainably
    - Sport and commercial fisheries
- How to manage/keep them
    - Aquariums
    - Aquaculture
        - The majority of experimental fish

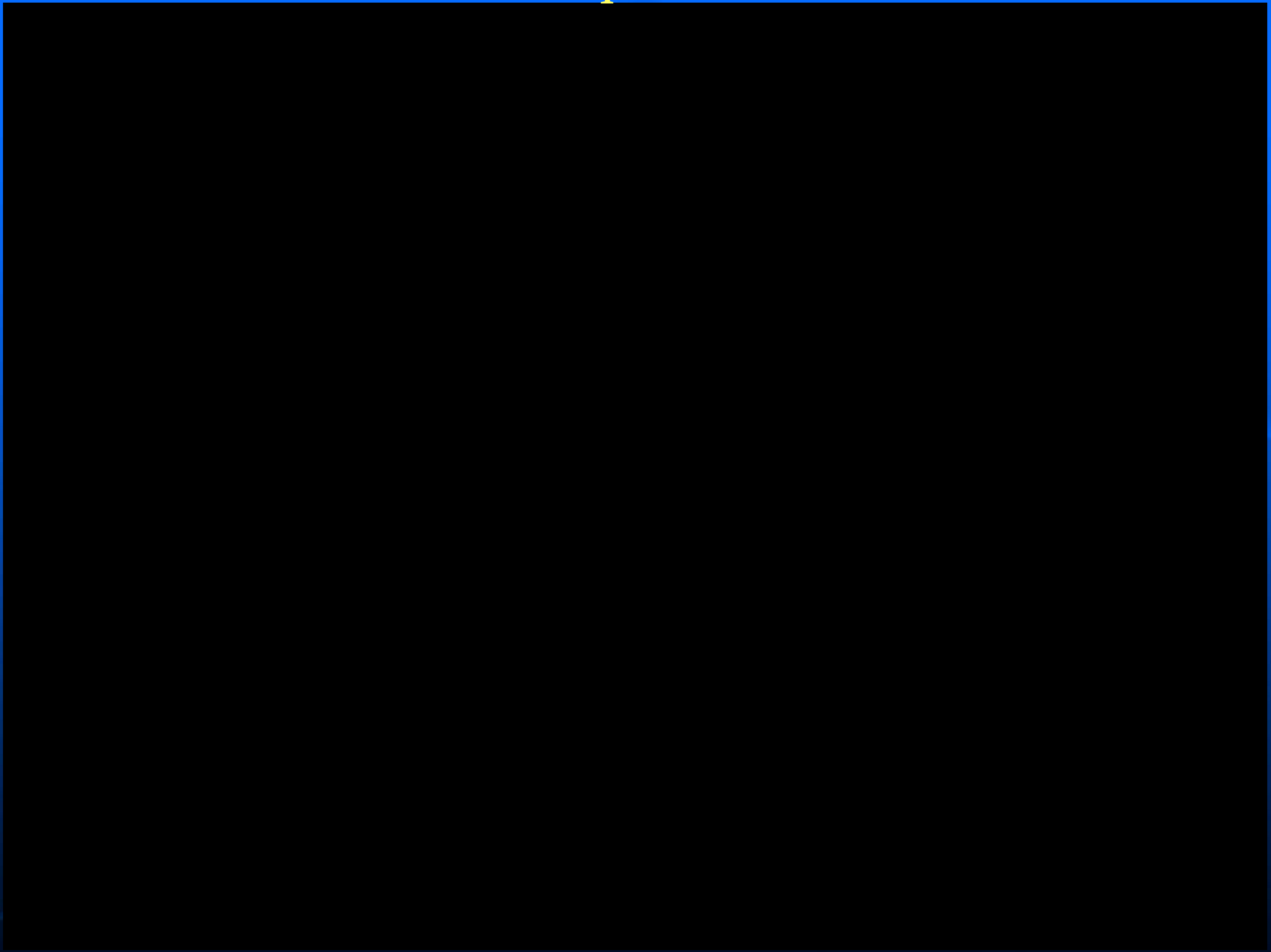
Behavioural studies in aquaculture

- How do the fish respond to management & environmental conditions ?

- Underlying mechanisms and functions?
  - Needs
  - Preferences
  - Aversion

- How can we secure animal welfare?
  - Non - invasive welfare indicators

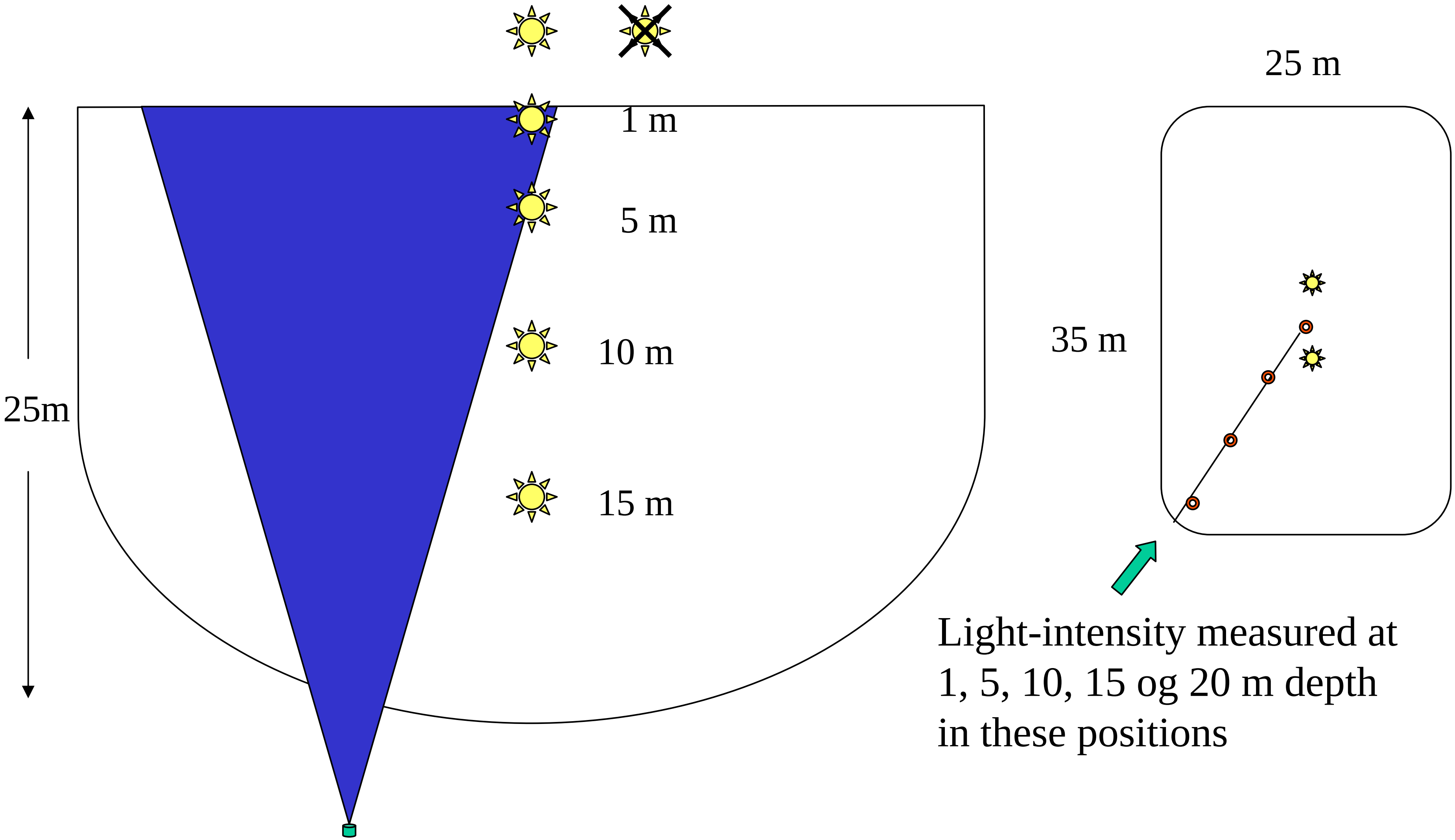
”What is the aquaculture context?”



Field studies

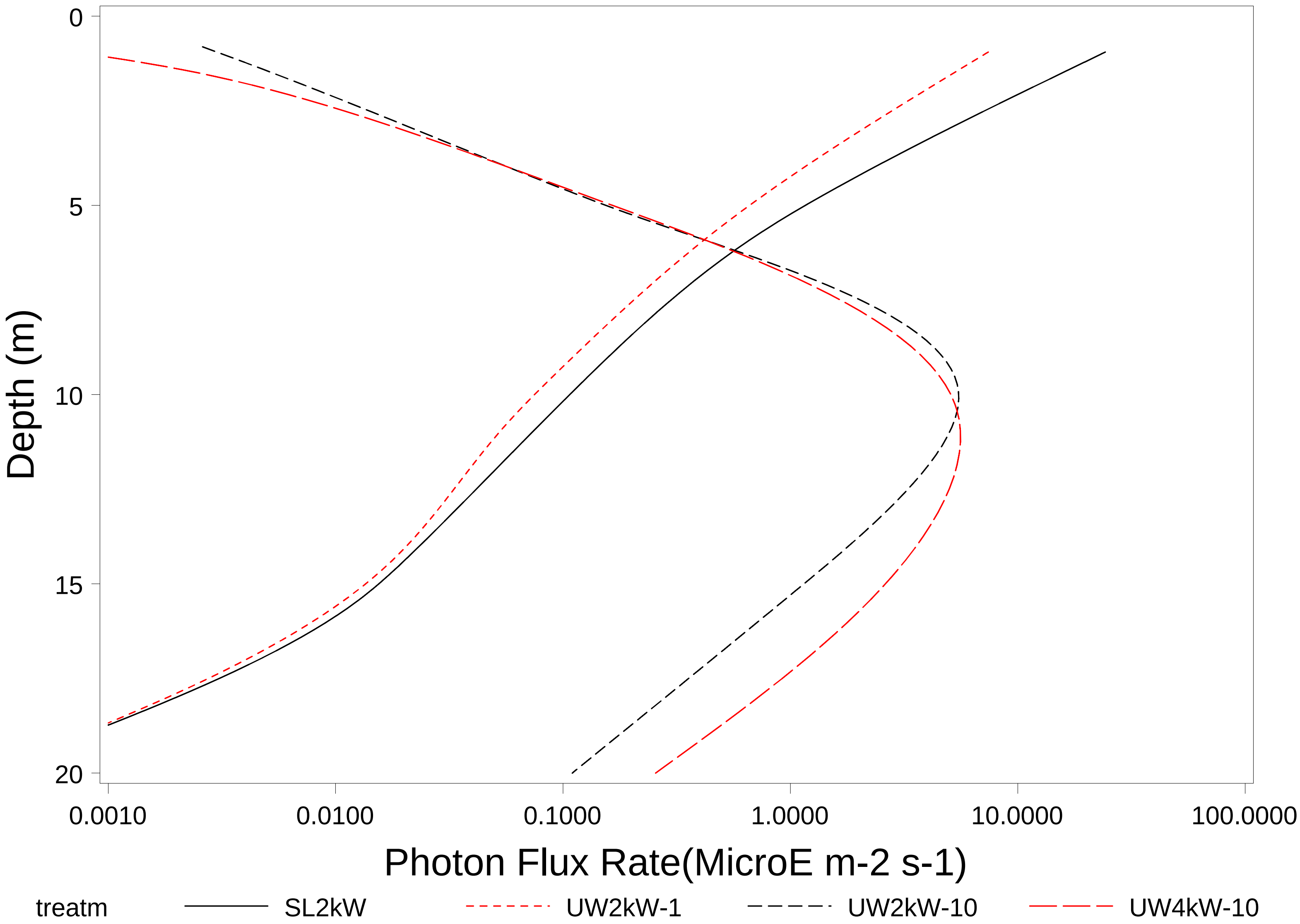
Kobbevik og Furuholmen A/S, Austevoll

How does light regimes influence swimming behaviour?

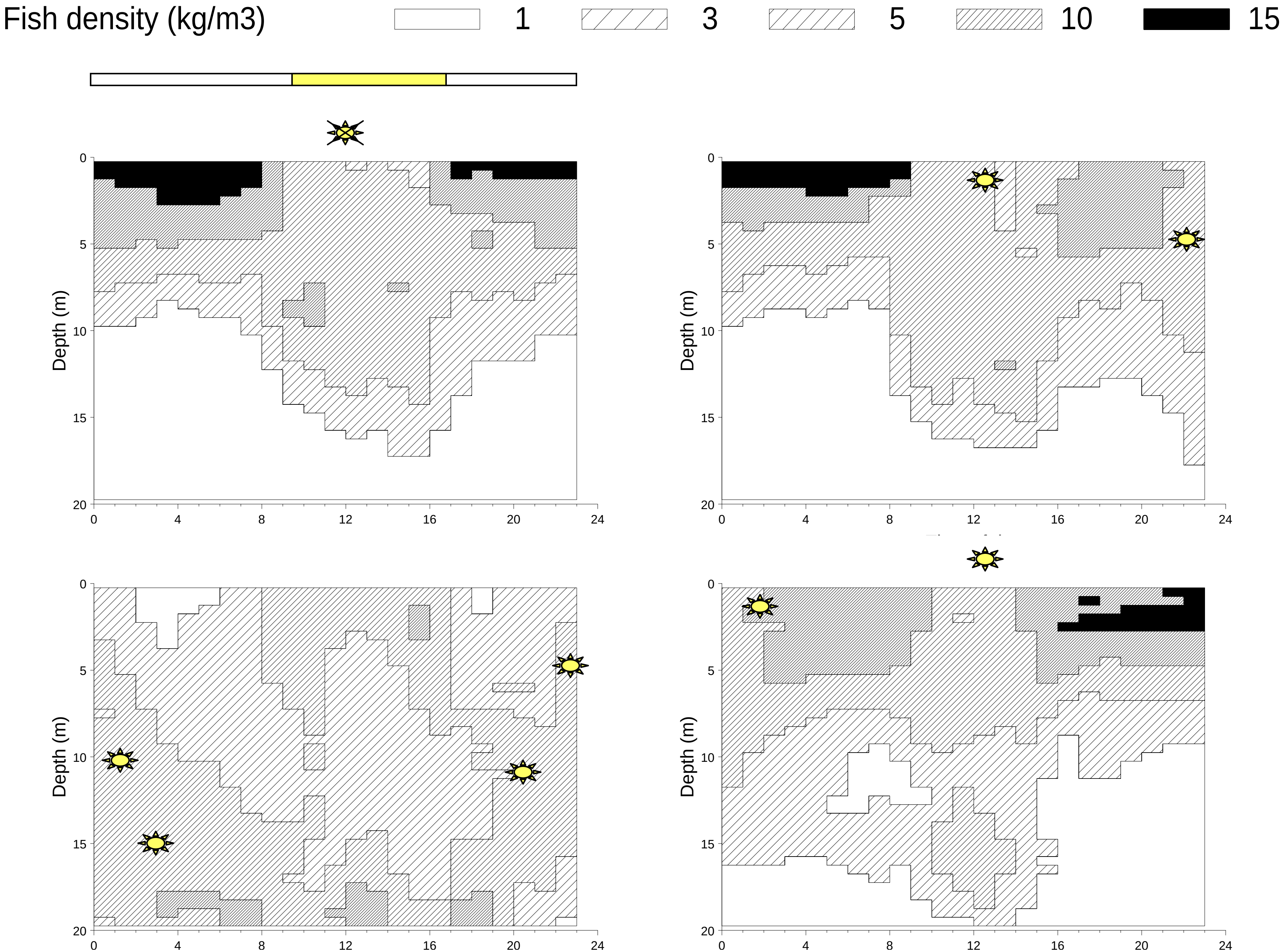


Echo-integration → Swimming depth and fish density

A highly variable light environment

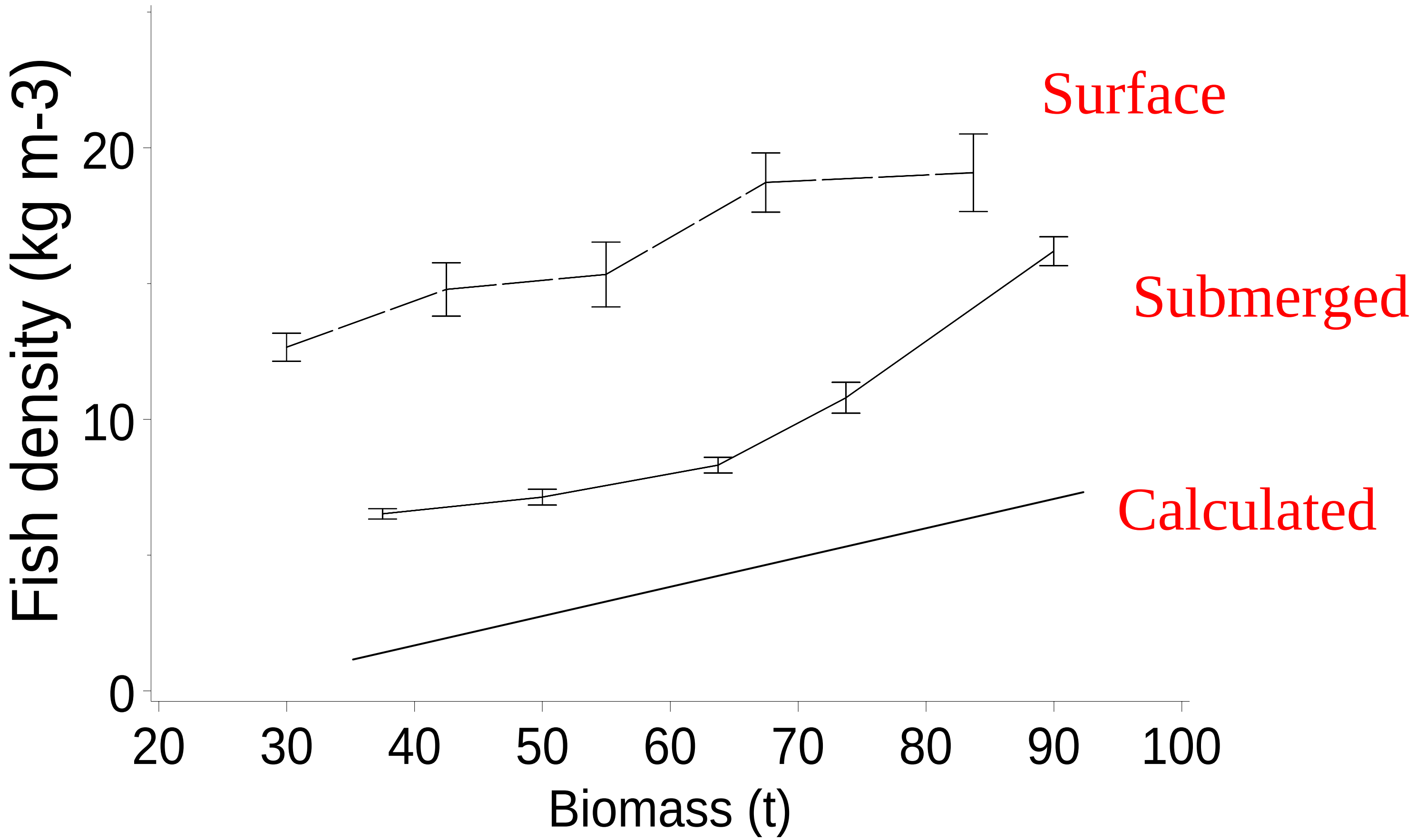


Center of cage - between lights



Juell and Fosseidengen (2004)

Surface lights crowd the fish



Juell et al 2003

Conclusions

- Artificial light sources have a strong influence on swimming depth and fish density both night and day
- Due to large variations in light intensity within the cage volume
  - Light intensity reduced by the square of the distance from the source
  - The large number of fish adds to attenuation of light

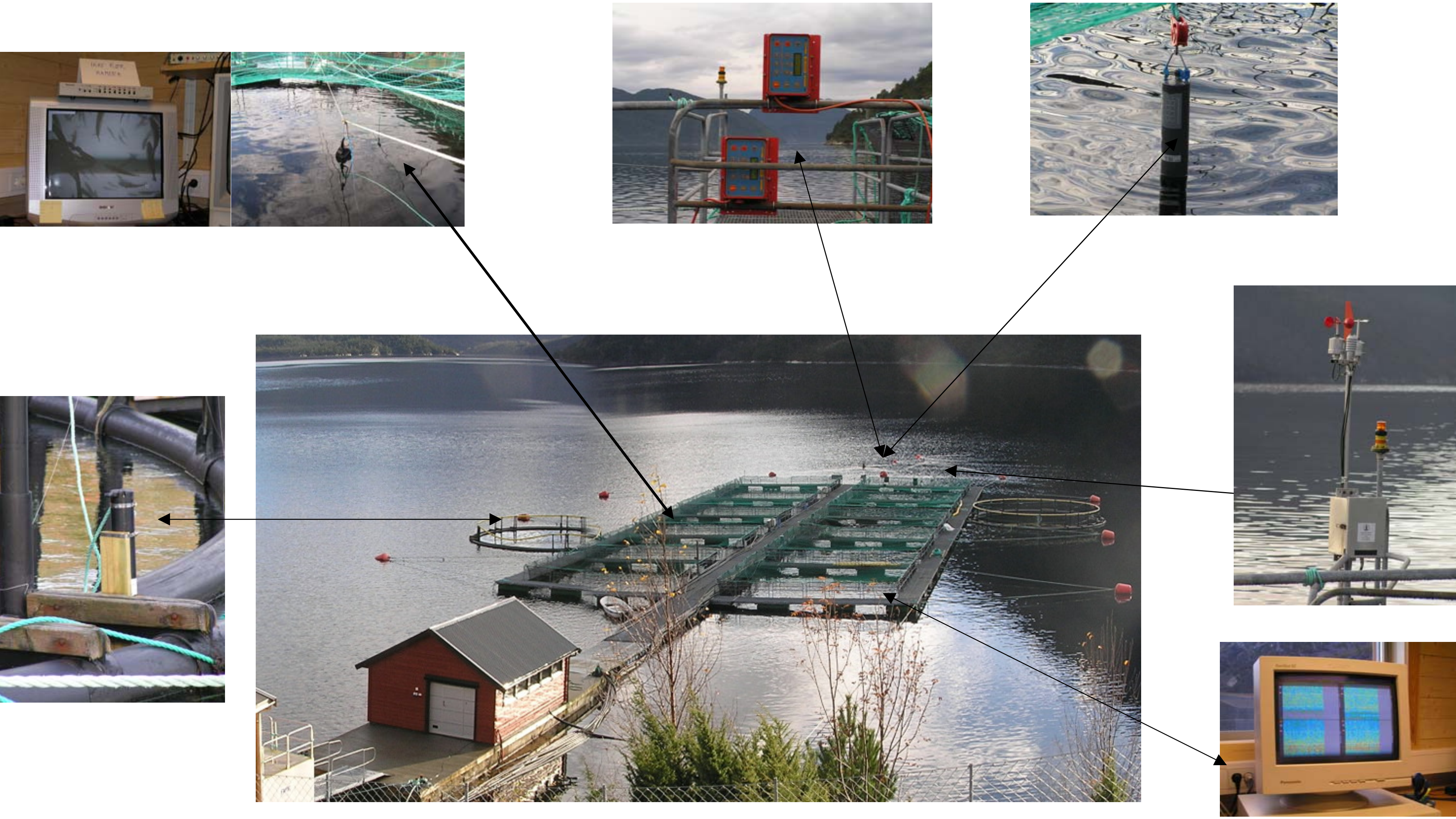
Why?

- Salmon normally school in a high density cage environment and needs visual contact to do so
- Dark-adaptaion of the the salmon eye is a ”slow” process
- Change of swimming depth is a behavioural adaptation to the reduced natural light intensity at dusk
- Change in swimming depth influence fish-density

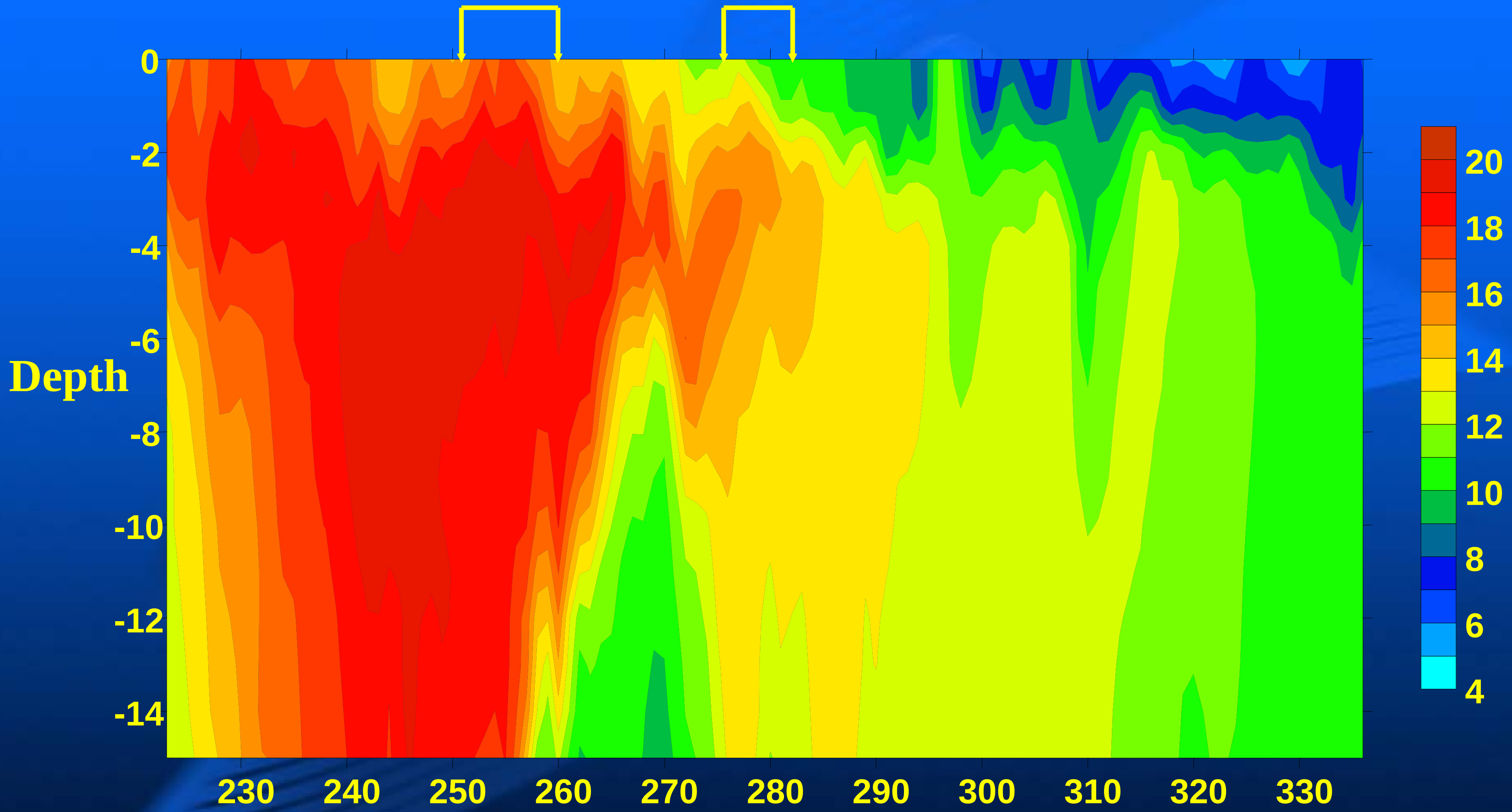
Implications for fish welfare?

- Control fish density and swimming depth in production cages
    - Reduce crowding (hypoxia, fin erosion)
    - Reduce exposure time to sub-optimal waterlayers (Al-toxity, salmon lice)

The cage environment laboratory, IMR Matre

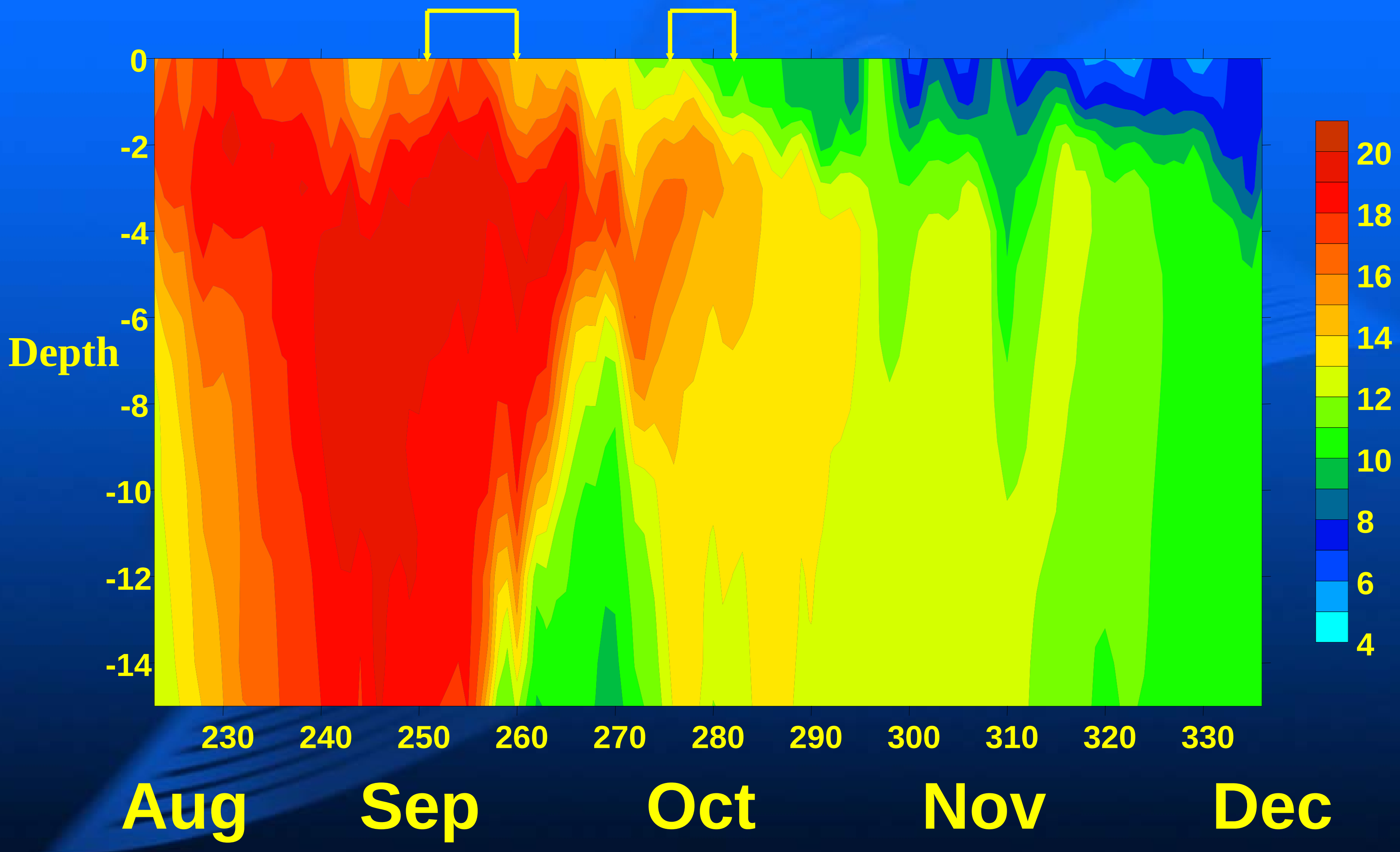


Temperature

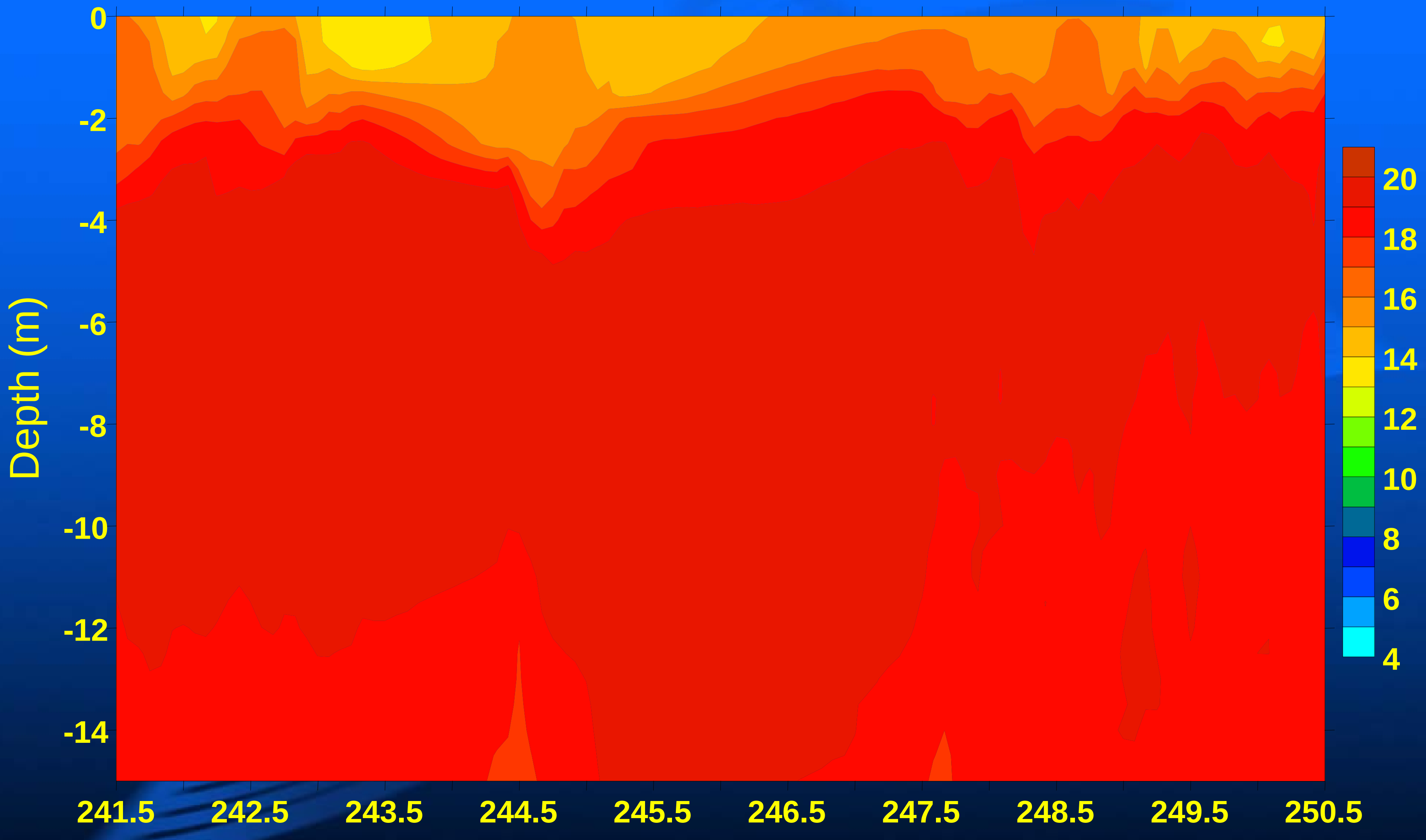


Aug Sep Oct Nov Dec

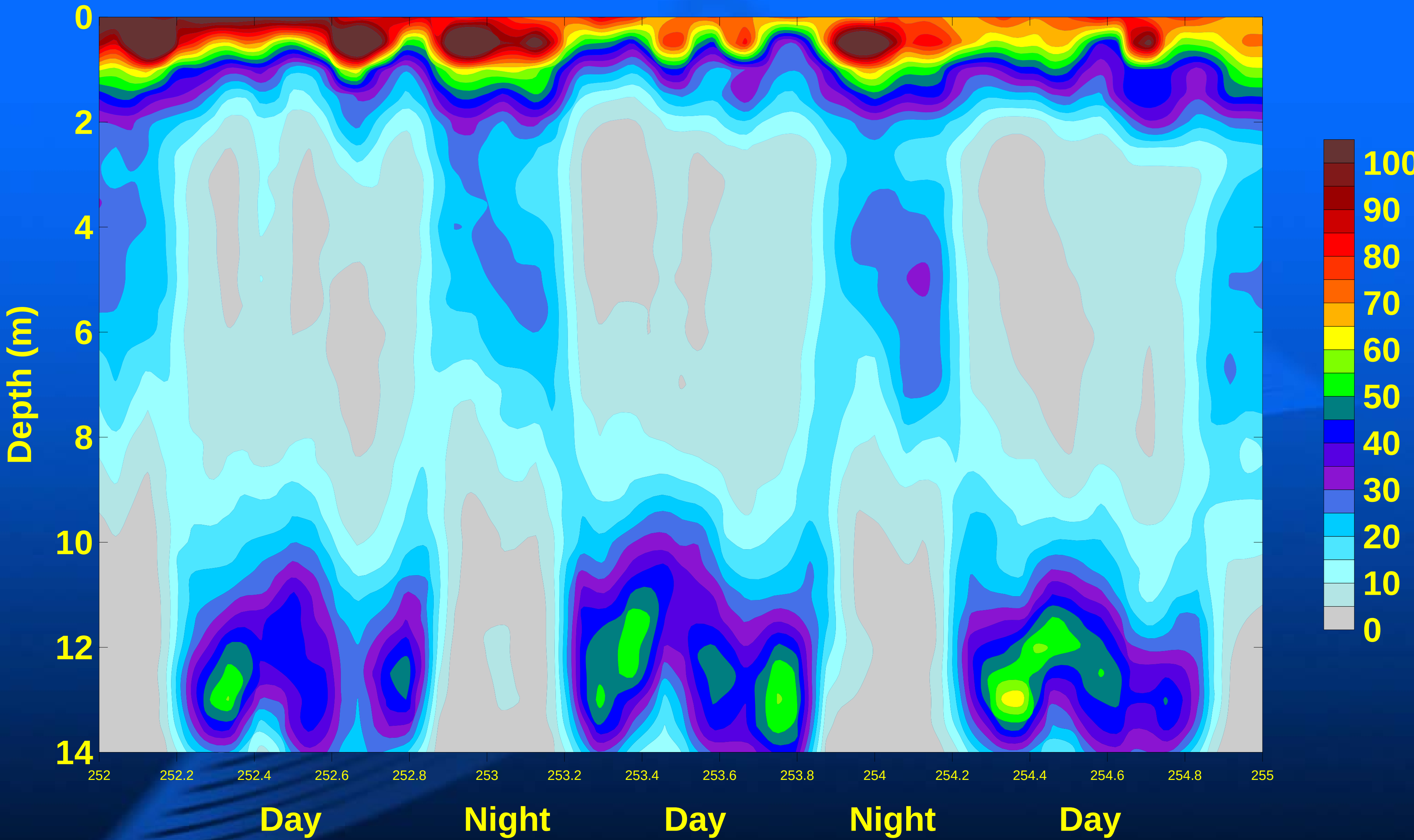
Temperature



Temperature

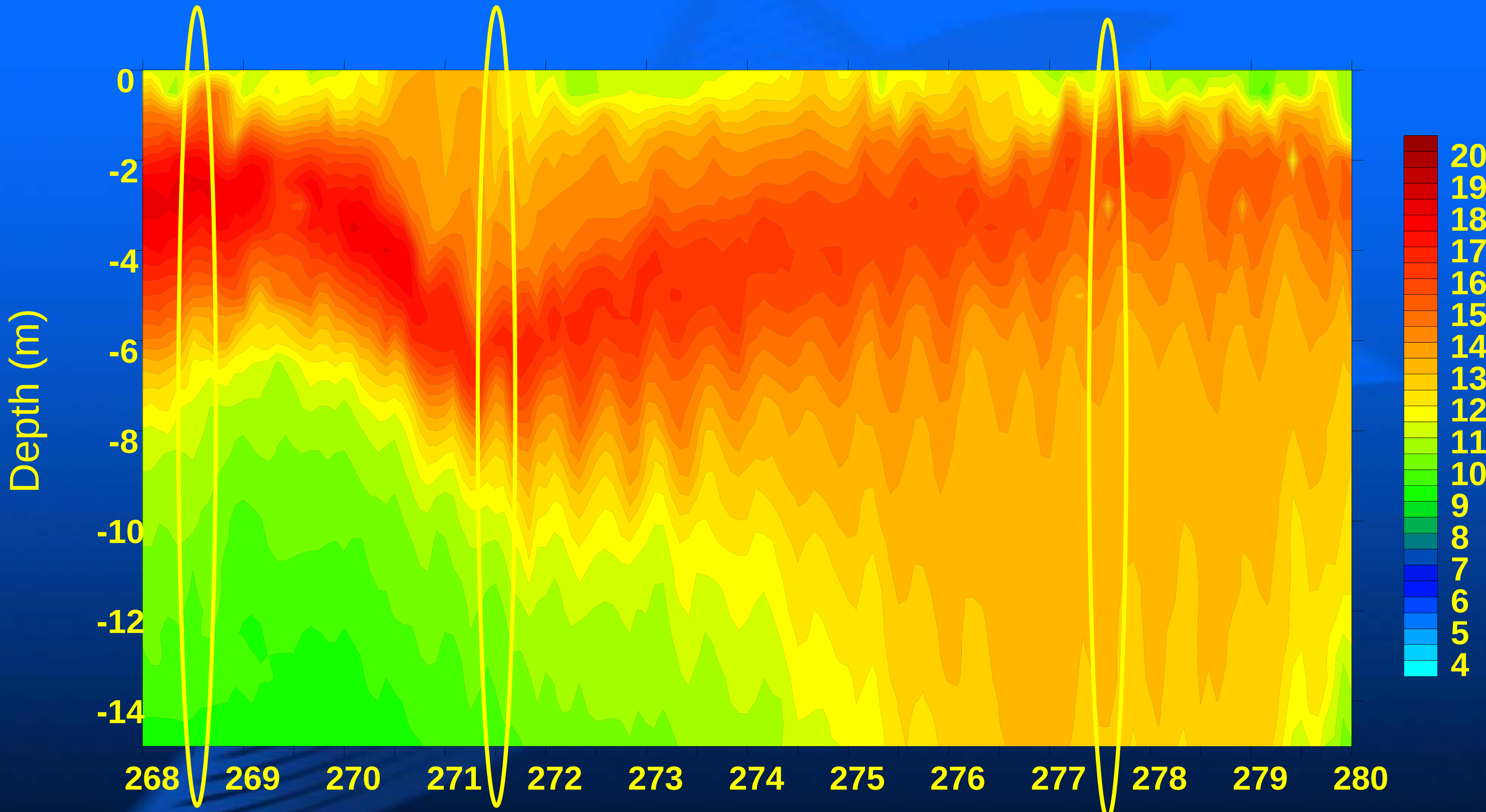


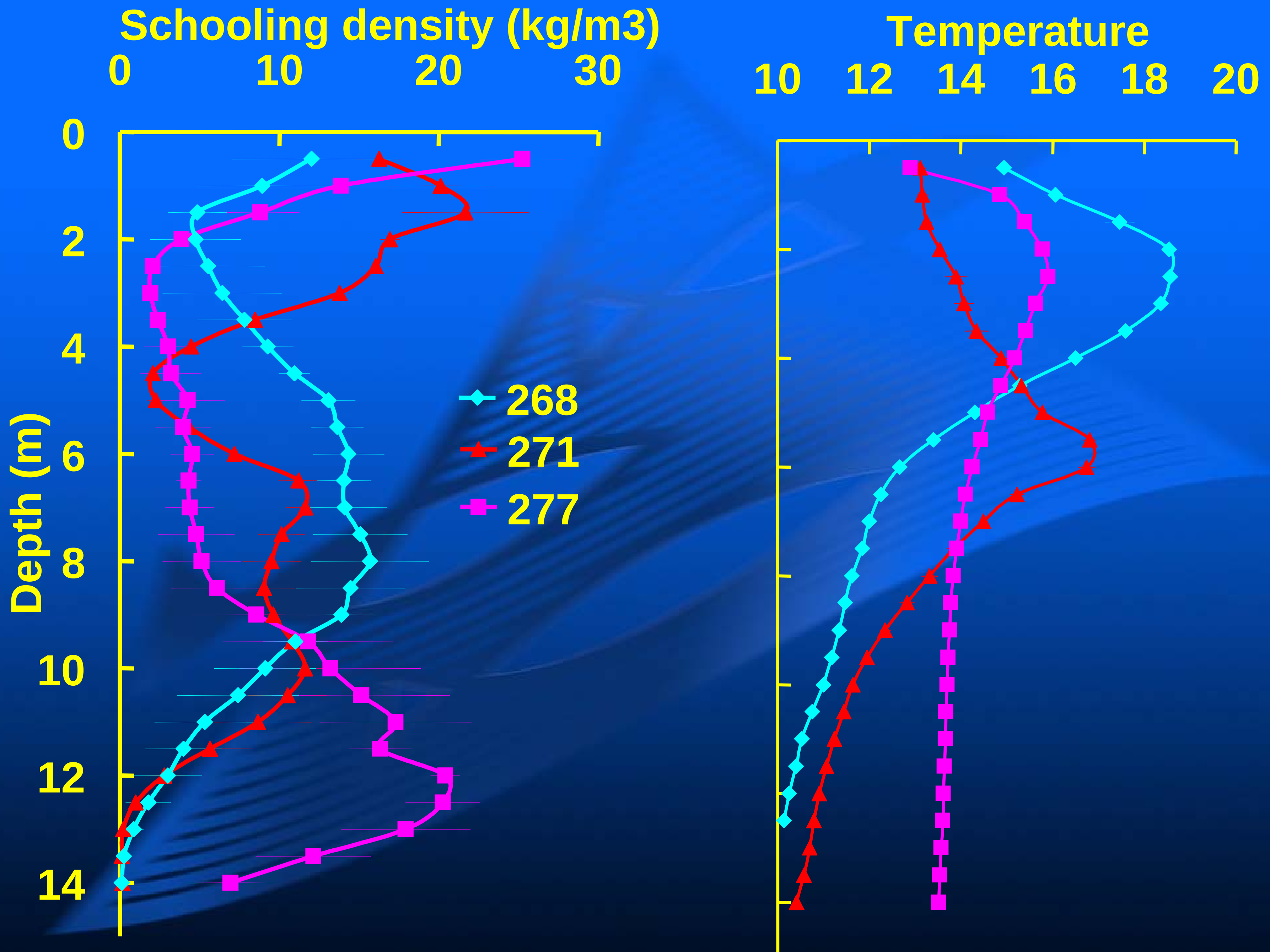
Schooling density 10-12. September



Stocking density: 19 kg/m³

Temperature, day 268-280

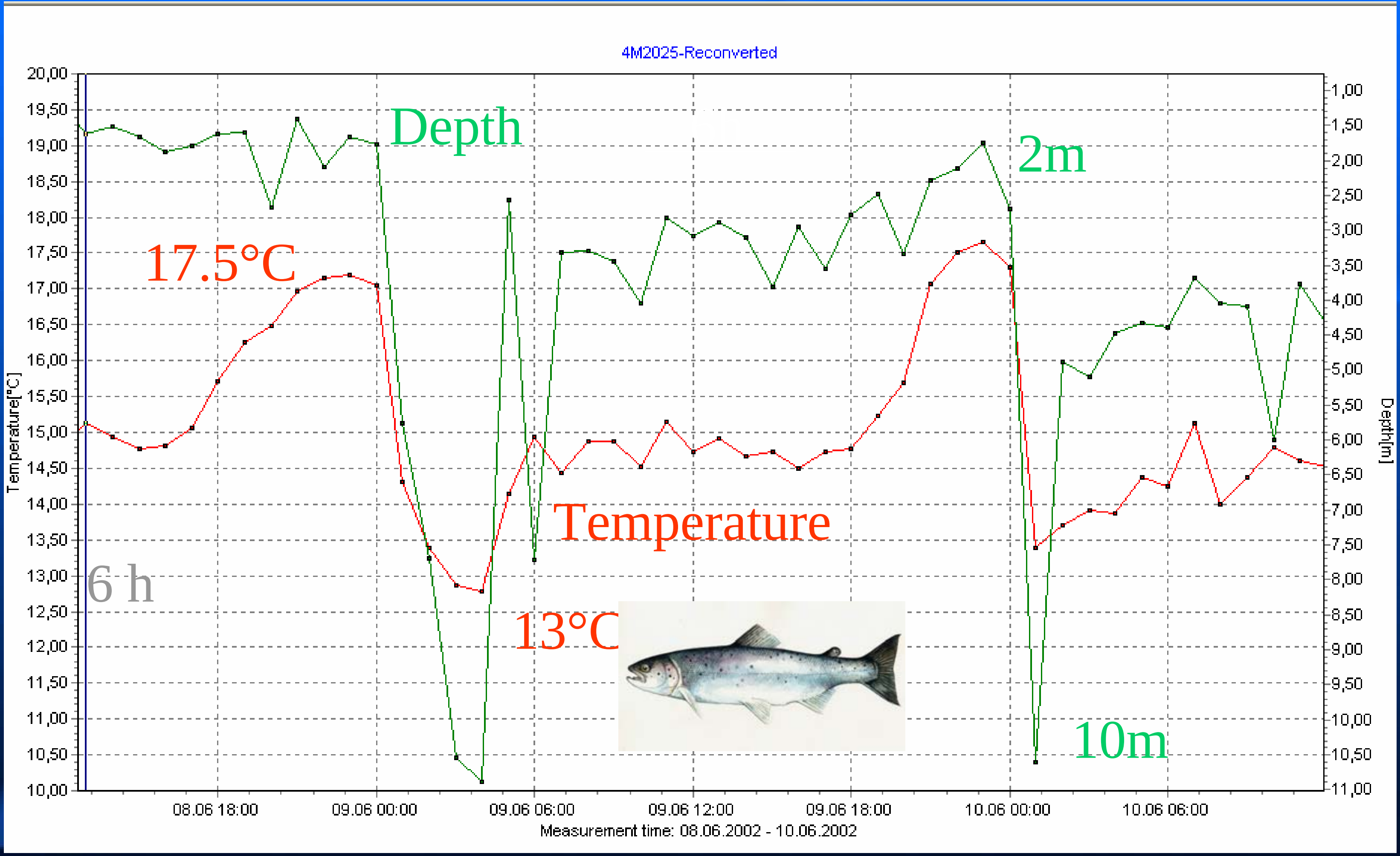




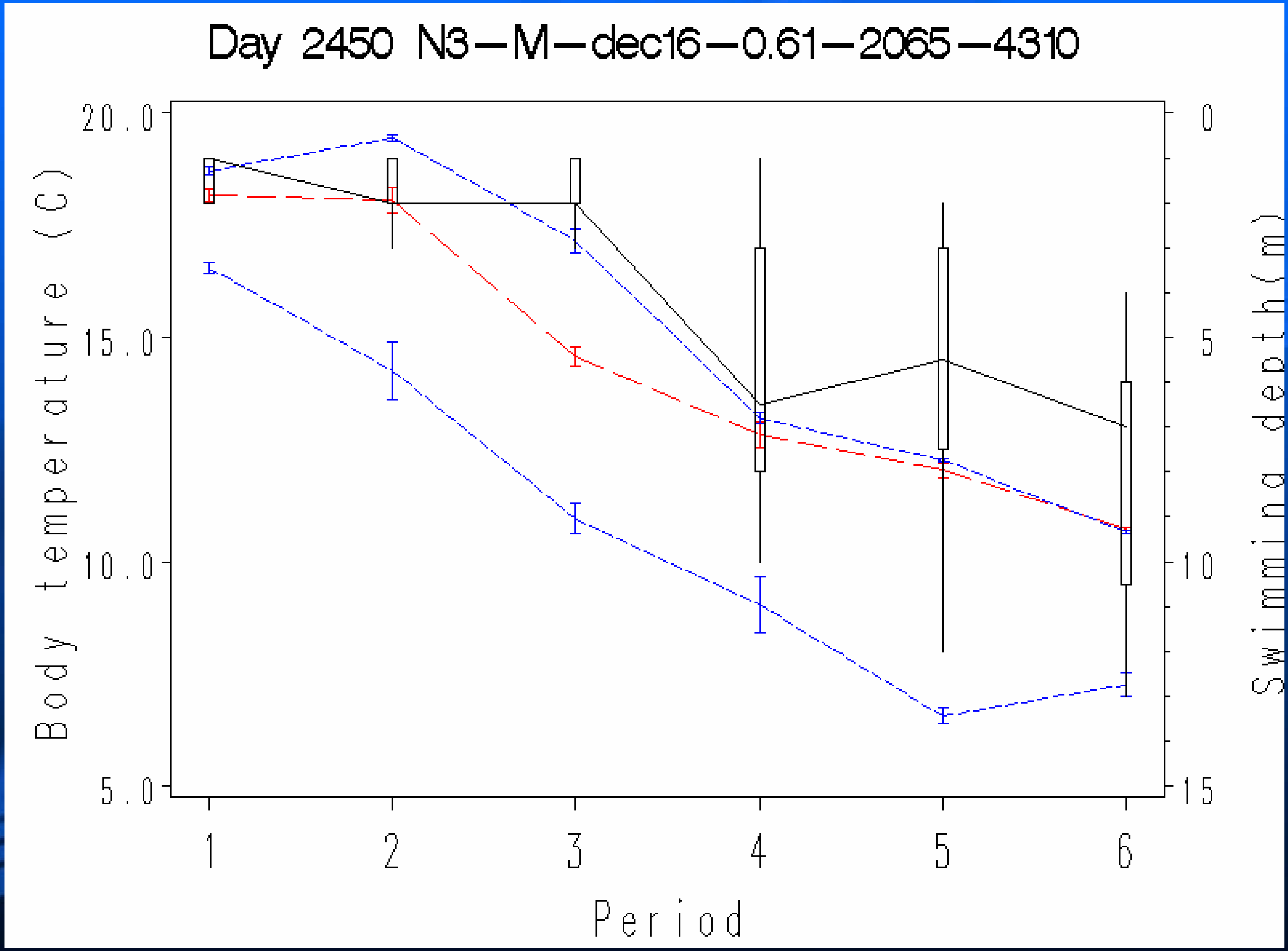
Schooling density (kg/m3)
0
10
20
30
Temperature
10
12
14
16
18
20
Depth (m)
0
2
4
6
8
10
12
14
268
271
277

What about the indivdual fish in large groups?

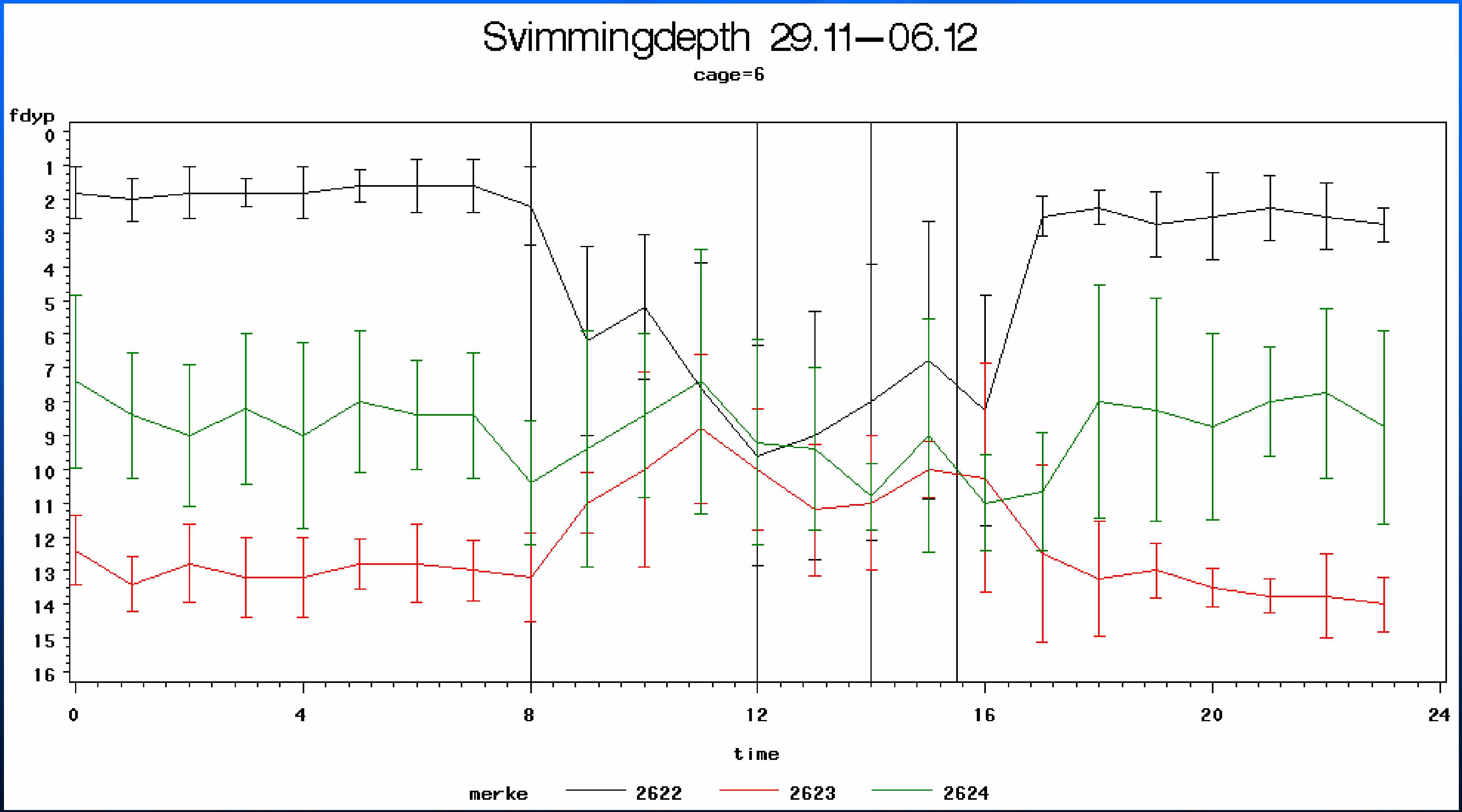
Swimming depth and body temperature?

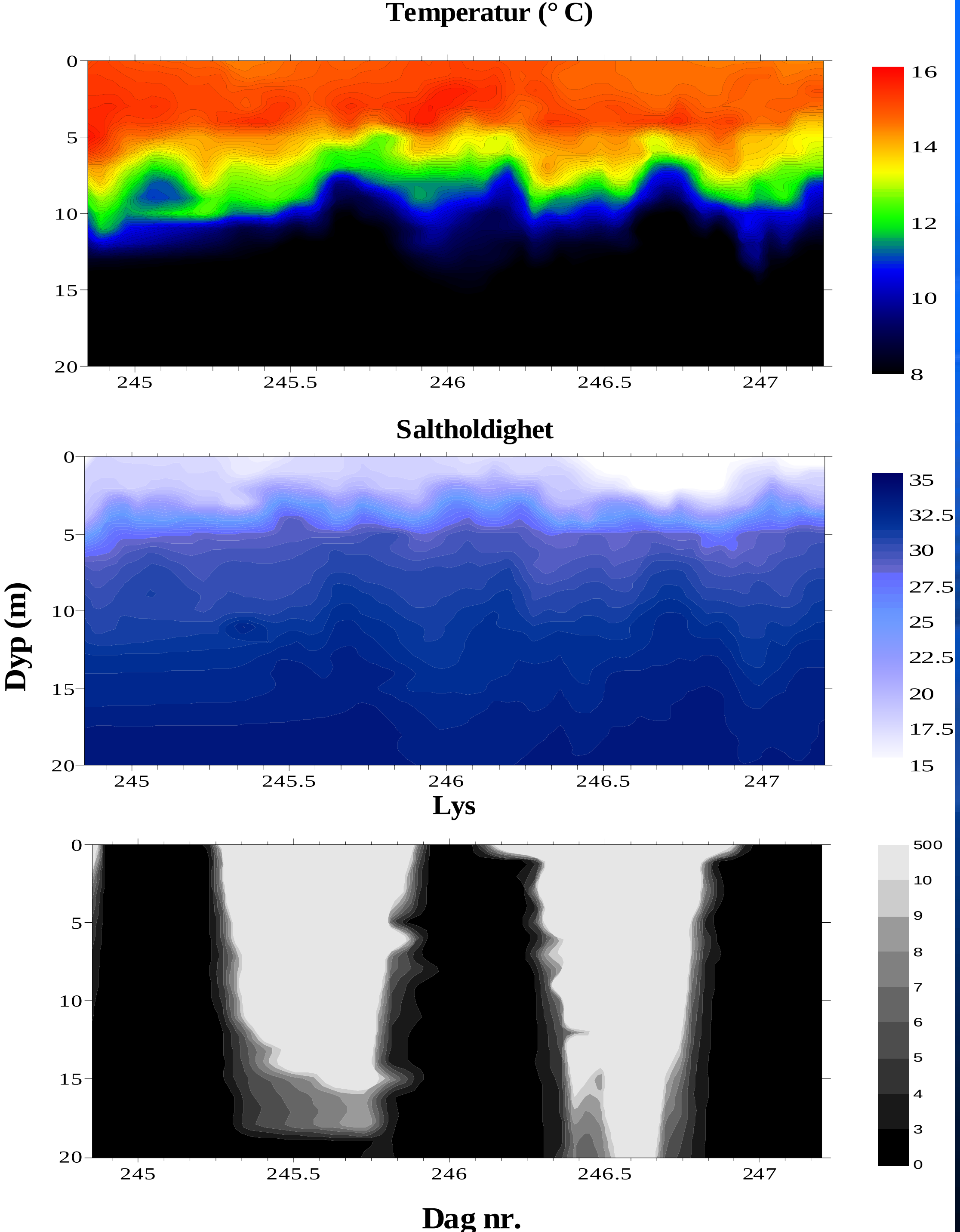


Temperature as a physiological resource



3 salmon in a group of 10000
Competition for space and coping strategies?





Environmental variability:

Vertical gradients

Johansson m.fl. 2004

Questions

- Should all of them be counted as experimental animals?
- Do they suffer?
- How should we implement the 3 R’s?

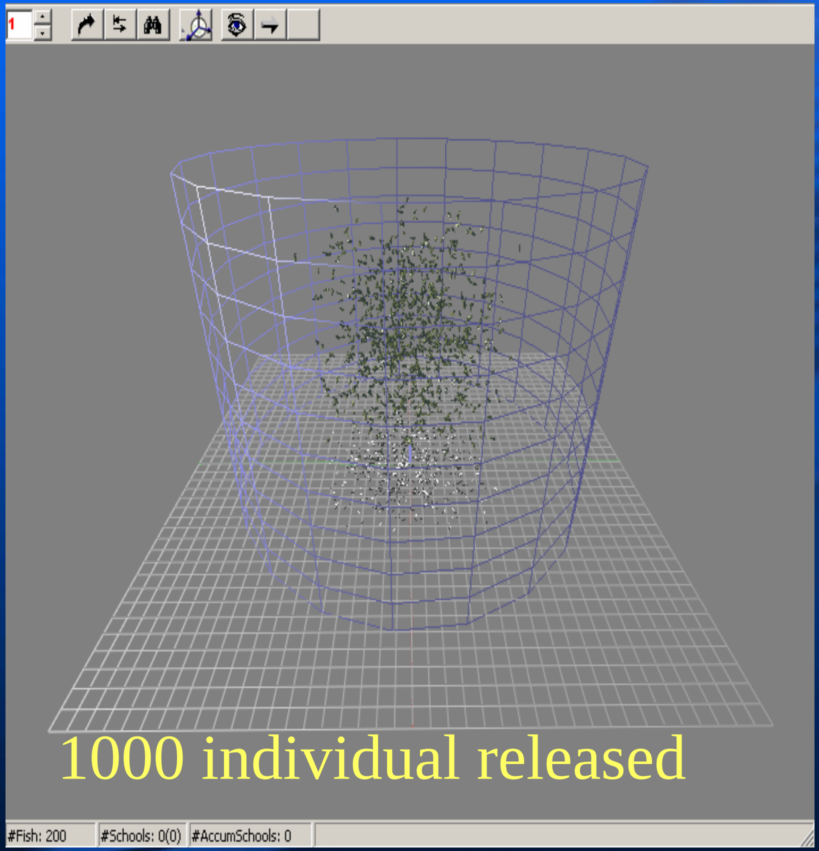
Animal suffering vs. relevance

- Individual behaviour depend on others
  - Social interactions
    - Aggession and dominance hierarchies?
    - Scramble competition
    - Schooling behaviour
      - Polarization
      - Group rather than individual control of behaviour
      - Behavioural adaptation to high density environments?
- Species specific
      - Atlantic mackerel – Salmon- Cod - Halibut

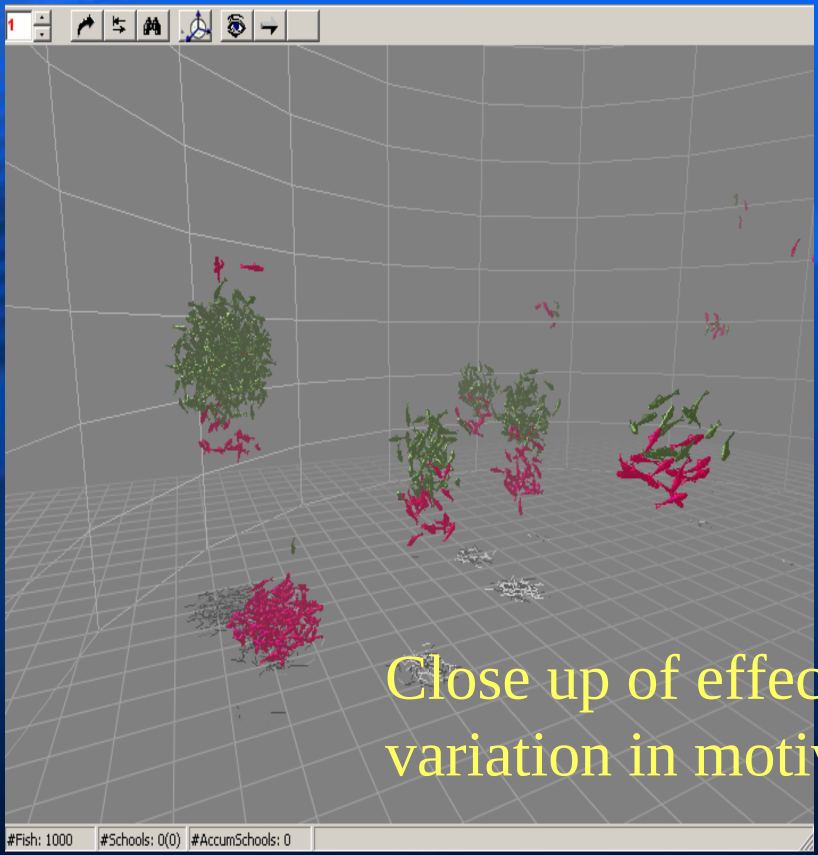
Behaviour, aquaculture and the 4R's

- Relevance?
  - The aim of the study?
- Reduce ?
  - Effect of group size
  - Risk analysis on possible animal suffering?
- Refine?
  - Number of fish subjected to invasive procedures

Replace?
Individual based modelling



1000 individual released



Close up of effect of variation in motivation

Vabø & Skaret (submitted)