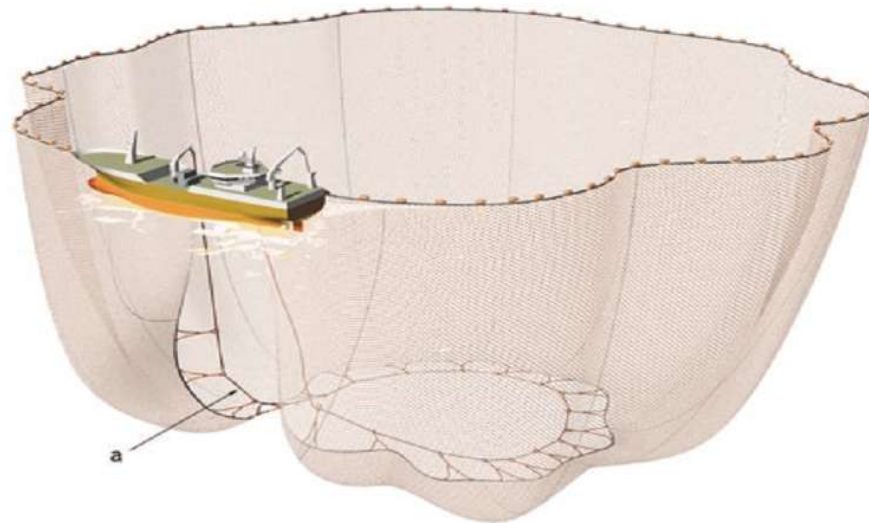




INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET



Can knowledge of fish behaviour during capture be used to reduce the risk of slipping mortality?



Mike Breen, Maija Tenningen, Nils Olav Handegard, Jostein Saltskår, Guillaume Rieucou, Neil Anders, Rachael Morgan, Kirsten Howard, Bjørn Totland, Jan Tore Øvredal & Aud Vold.



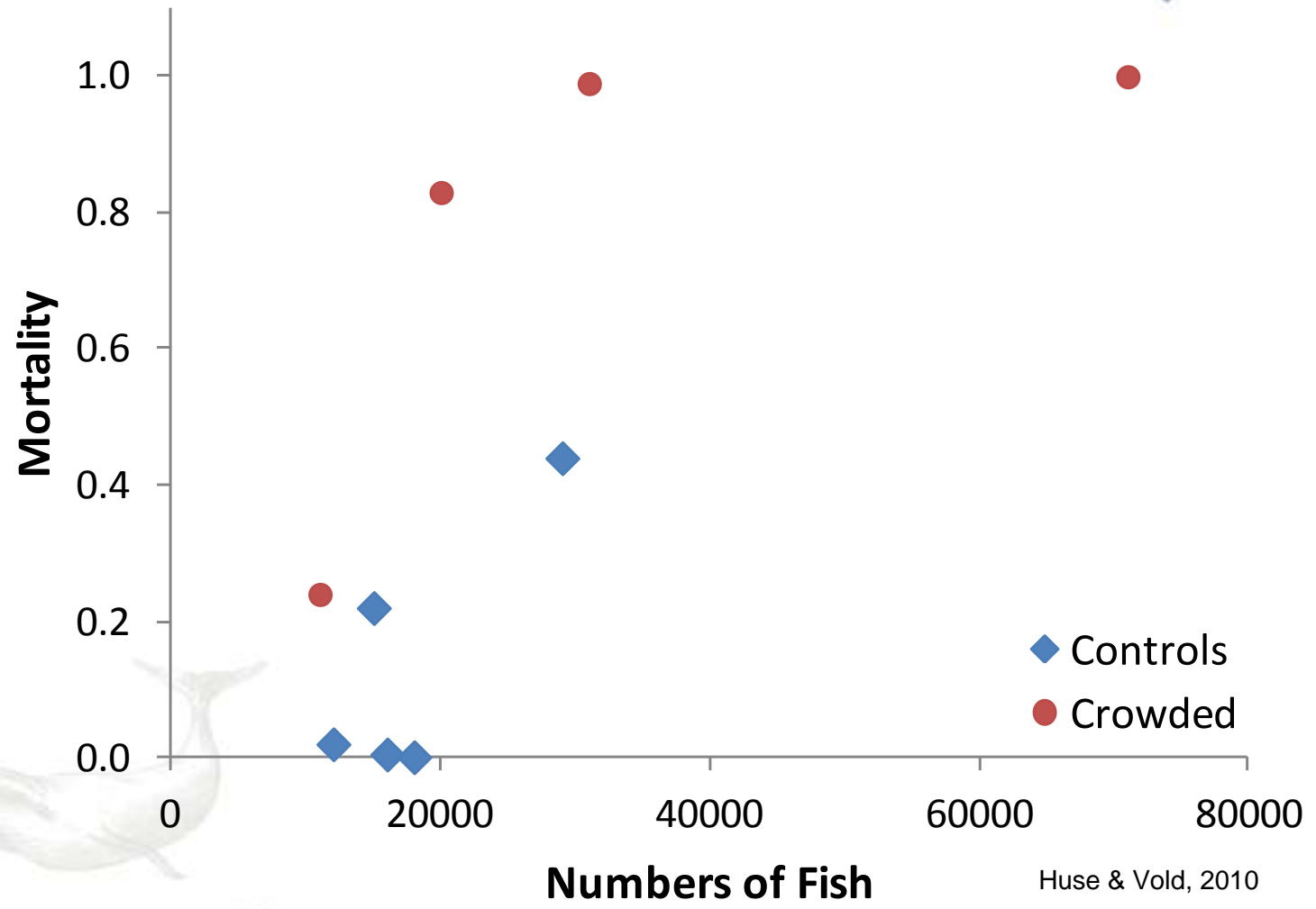
Introduction

- What is "Slipping Mortality"?
- What is "Stress" & "Behaviour"?
 - Schooling vs. Individual
- Current Research
 - RedSlip (NFR)
 - Slippingmetodikk (FHF)
- The future ...



Slipping Mortality

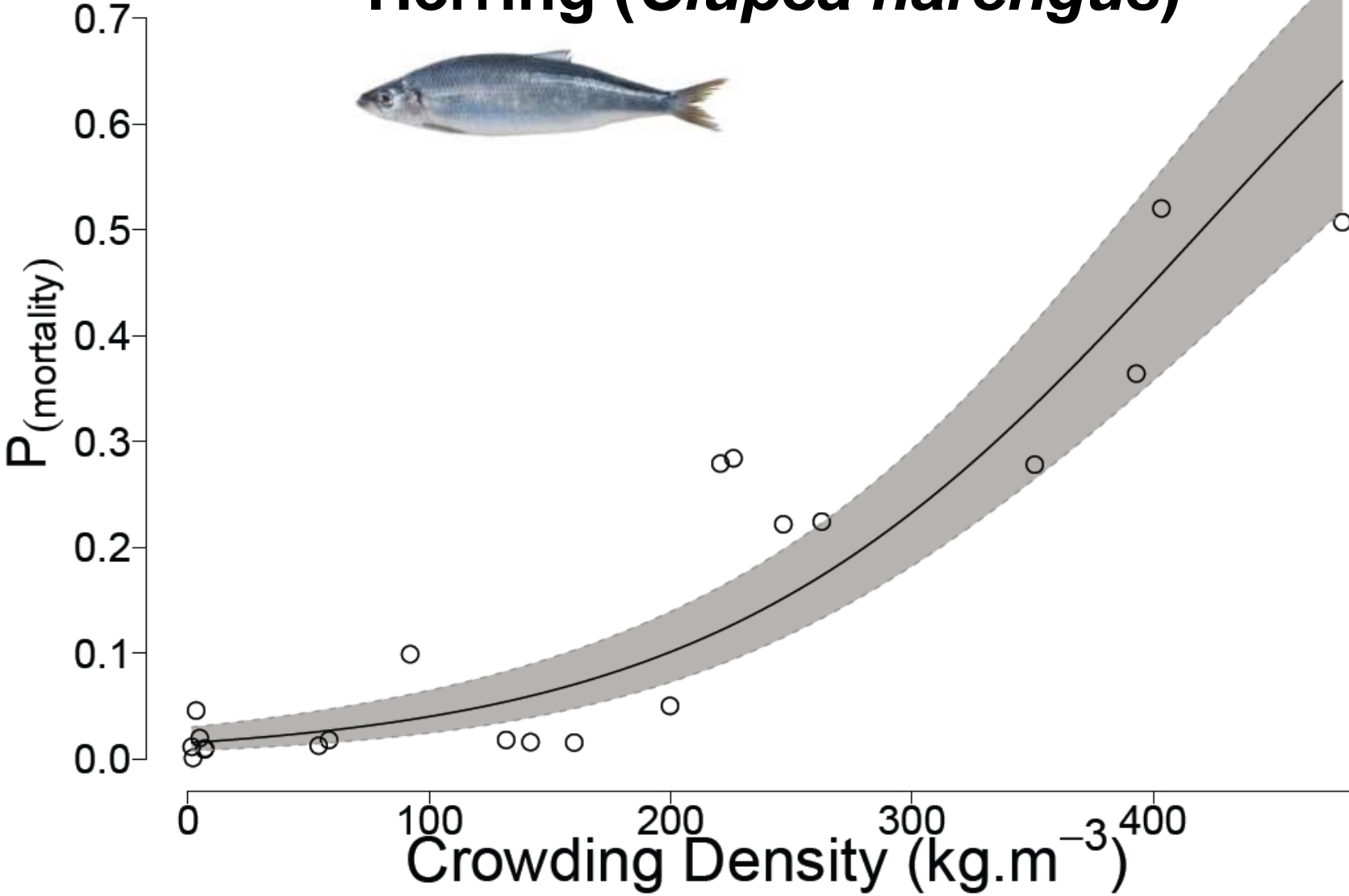
Mackerel (*Scomber scombrus*)



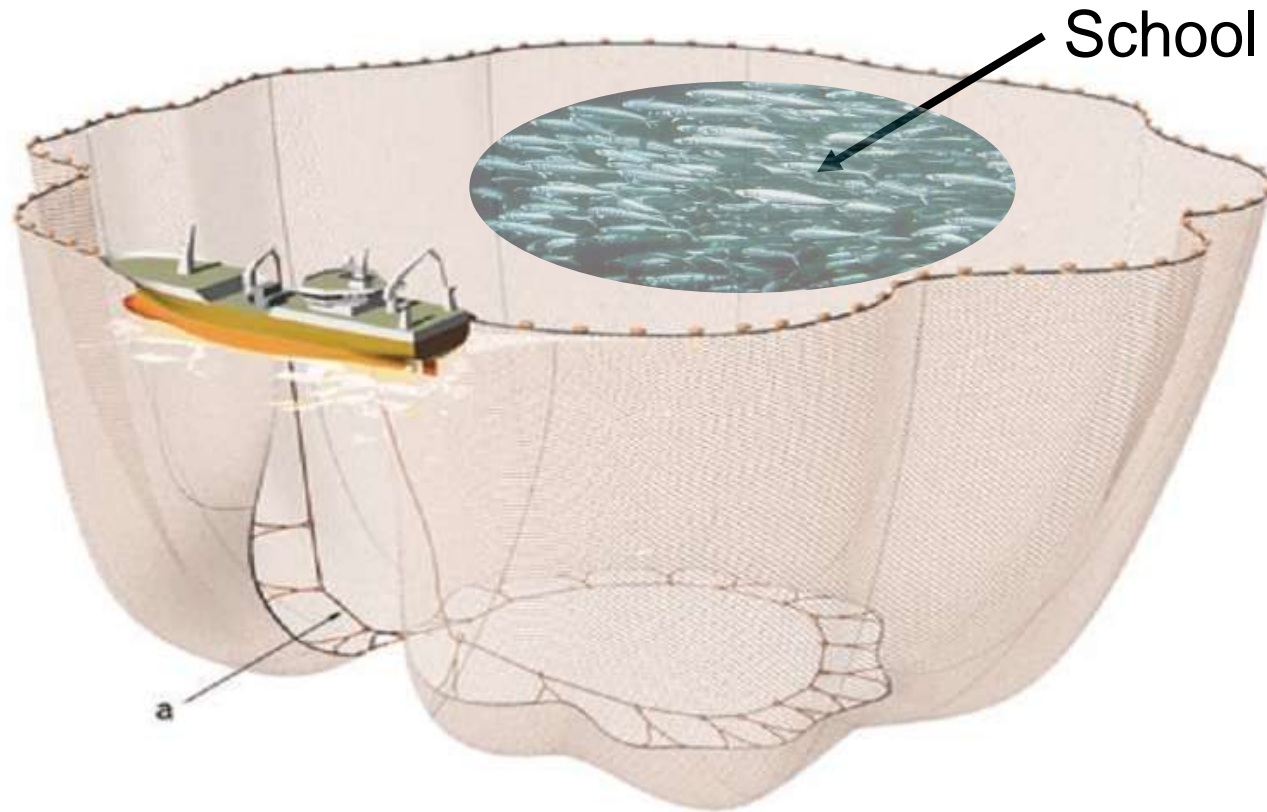
Huse & Vold, 2010

Slipping Mortality

Herring (*Clupea harengus*)



Capture: The Fishes' Perspective

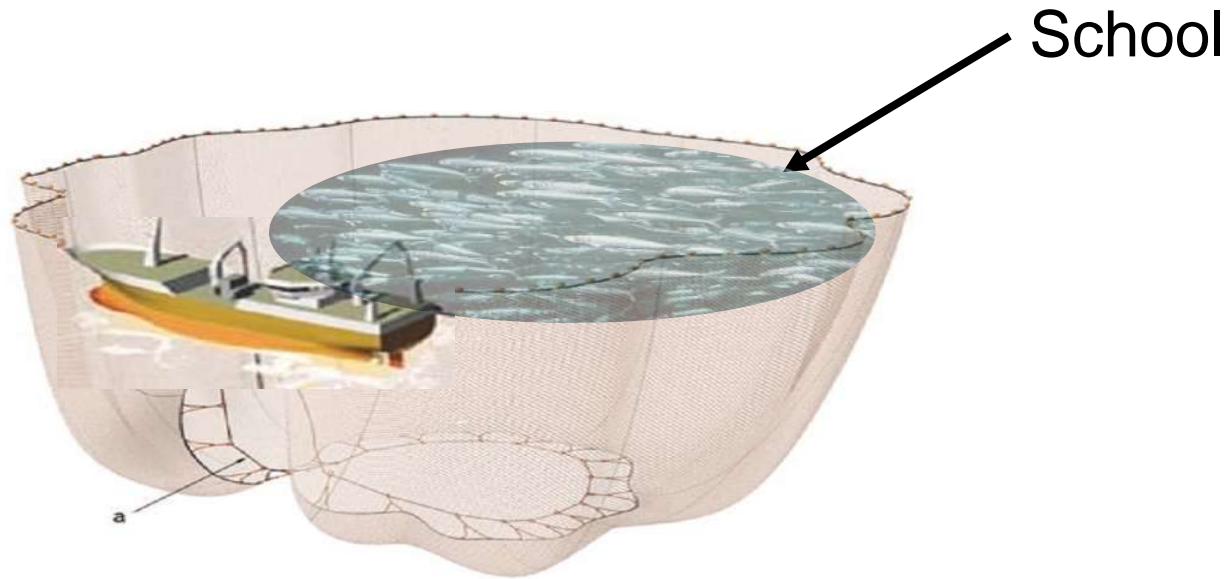


Voluntary
Density

Net Volume = f(Time)



Capture: The Fishes' Perspective



Voluntary
Density

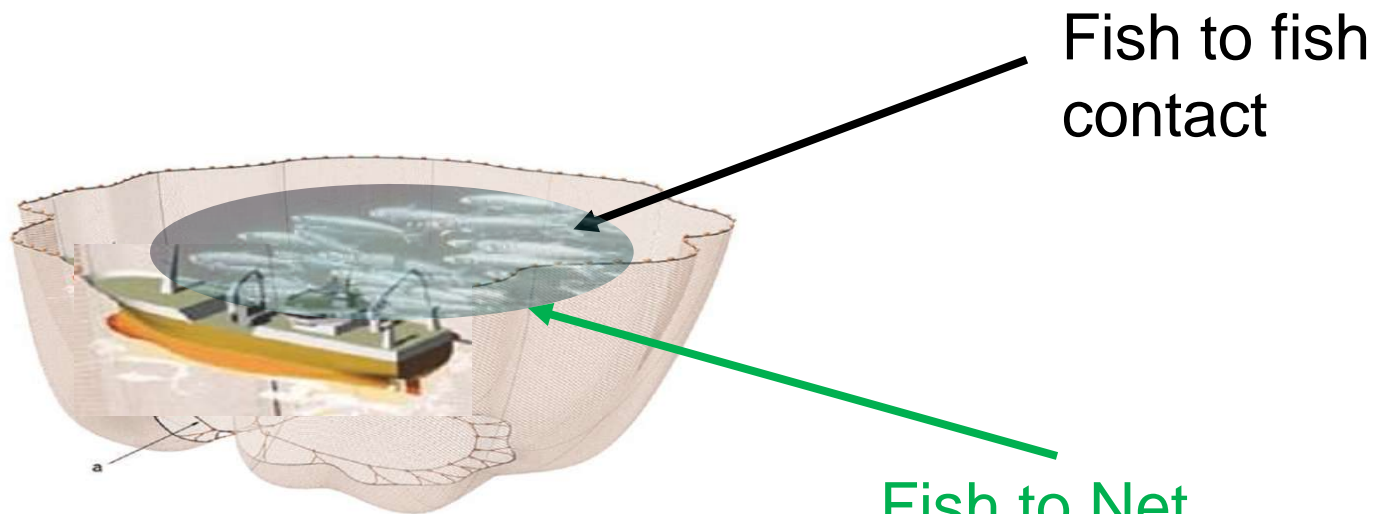


Contained
Density

Net Volume = f(Time)



Capture: The Fishes' Perspective



Voluntary
Density



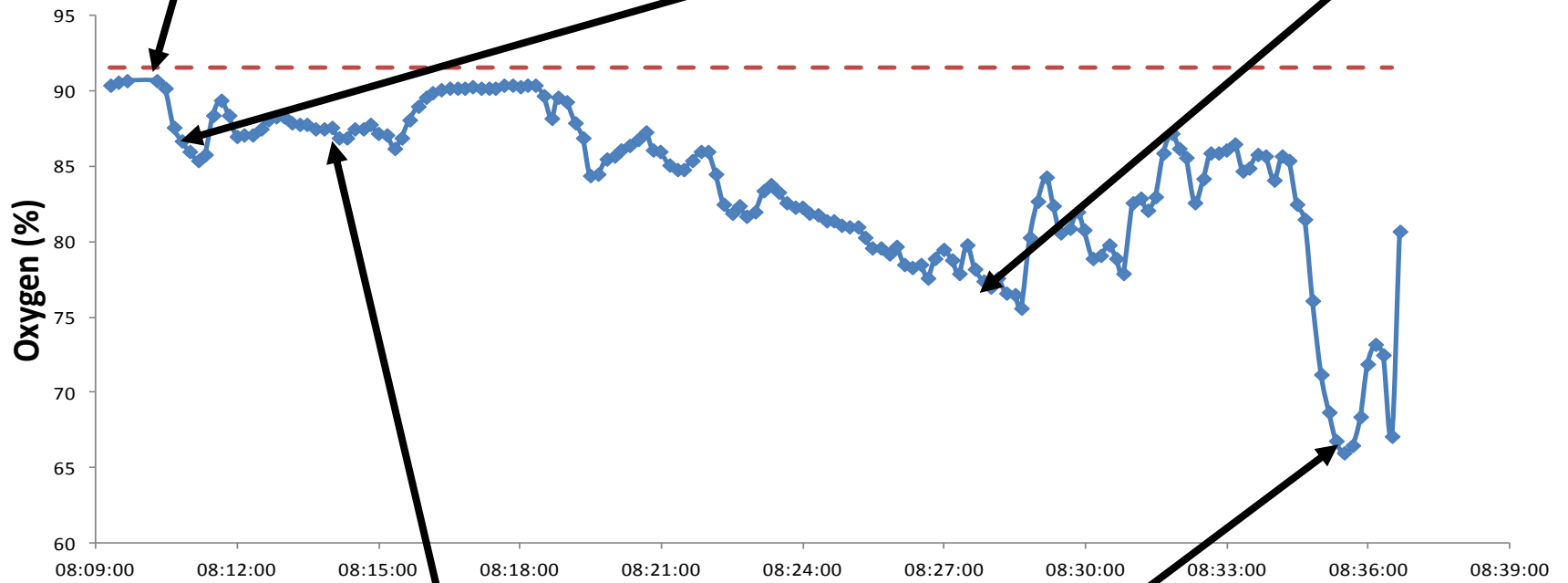
Contained
Density



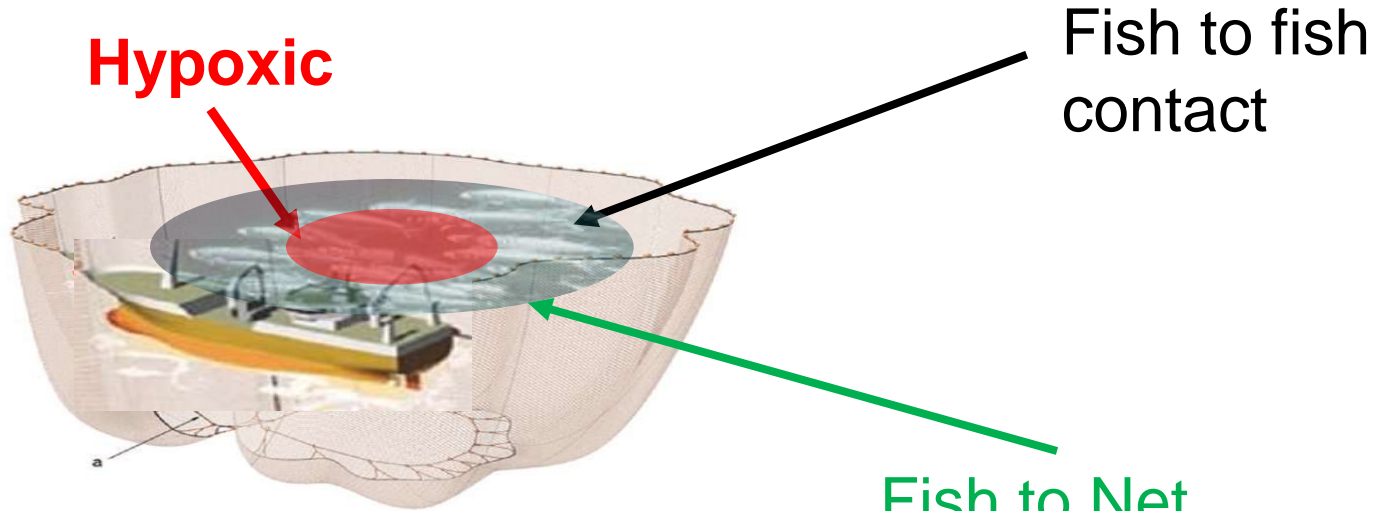
Damaging
Density

Net Volume = f(Time)





Capture: The Fishes' Perspective



Stressors

- confinement / crowding
- injuries
- hypoxia

Individual Deaths

Voluntary Density



Contained Density



Damaging Density

Stress Responses

Stressors

Physical
e.g. Injury,
Crowding.

Environmental
e.g. Hypoxia

Perceived
e.g. Predator

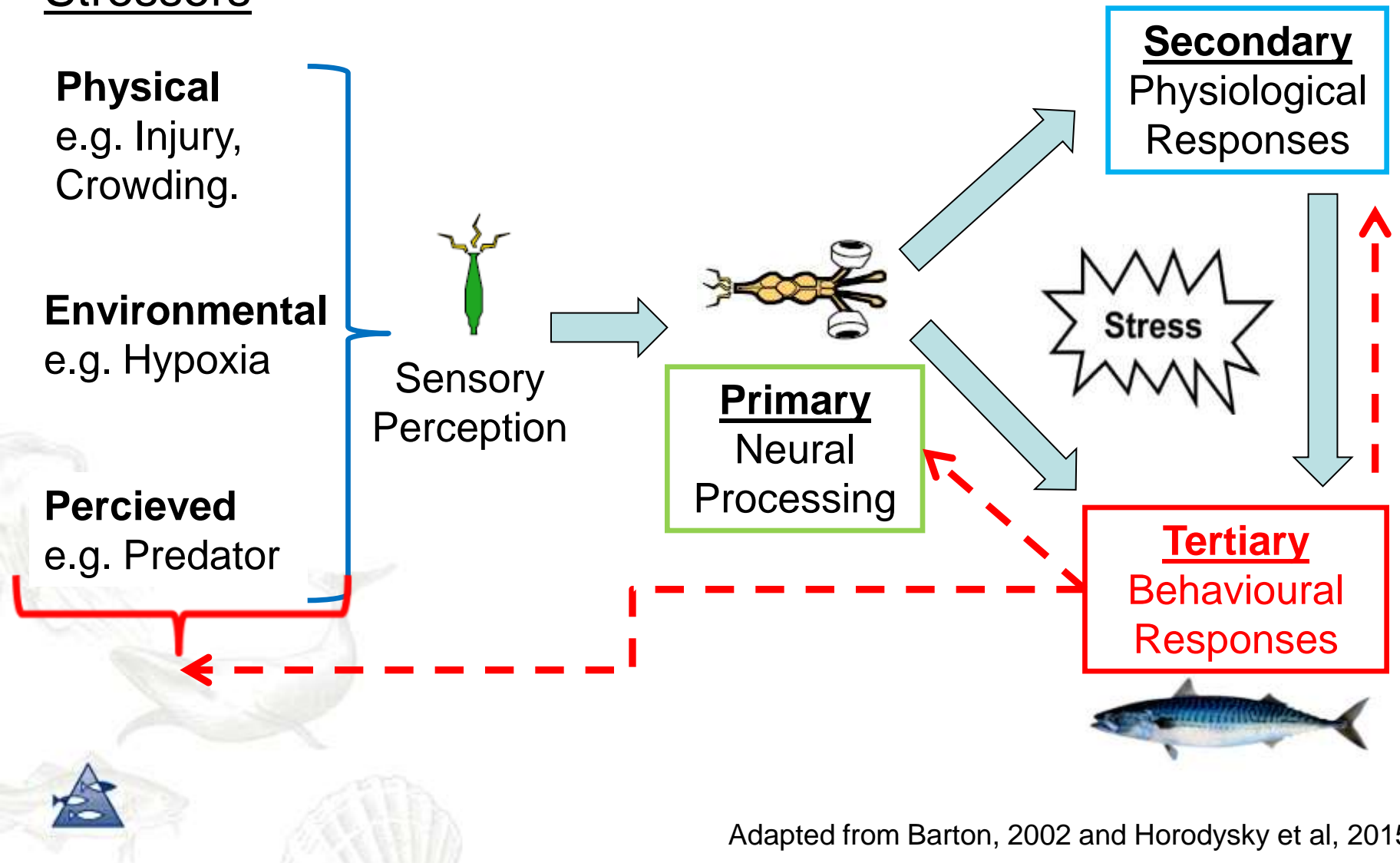
Sensory
Perception

Primary
Neural
Processing

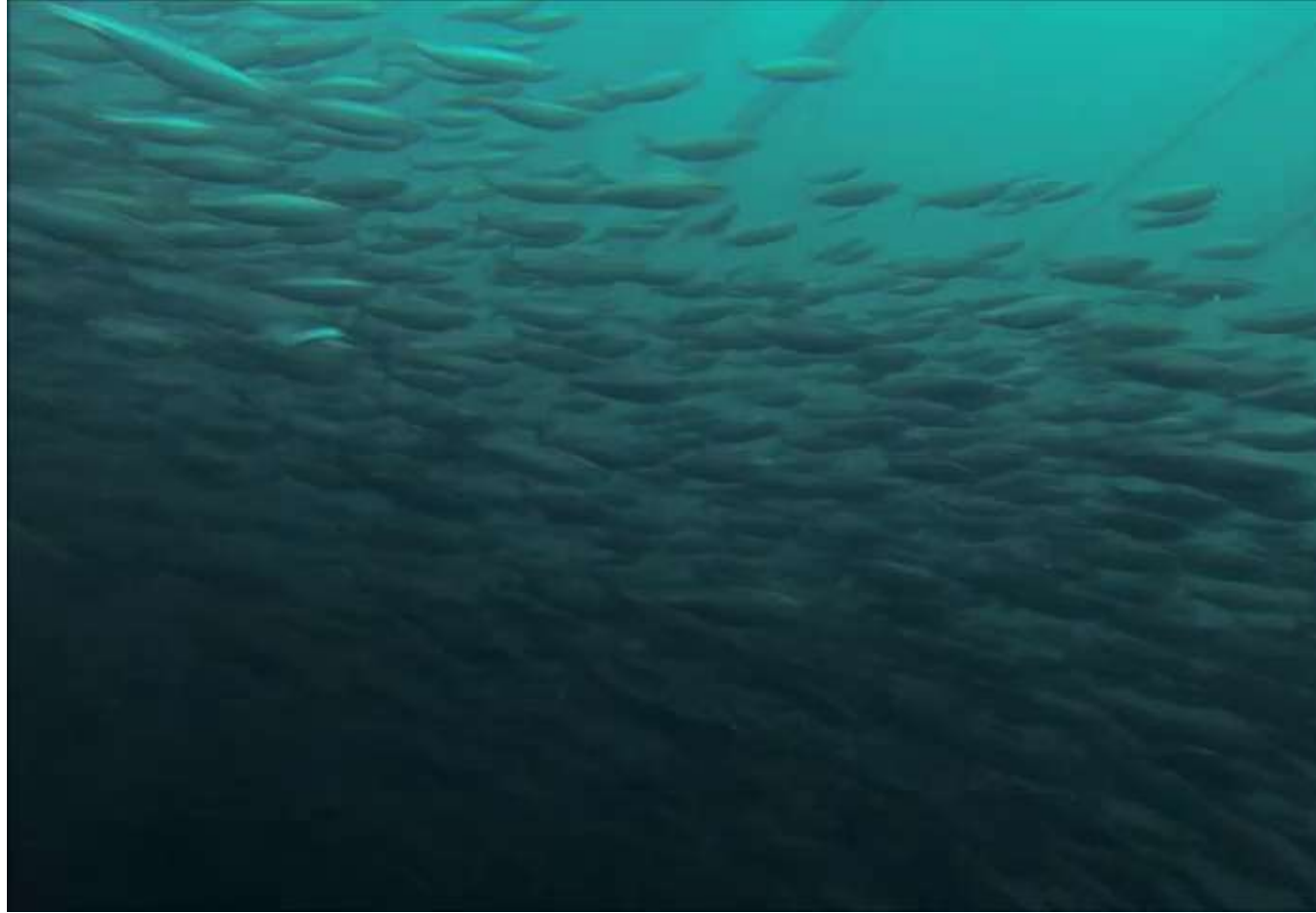
Secondary
Physiological
Responses

Stress

Tertiary
Behavioural
Responses



Behaviour



Schooling = Individual Behavioural Rules

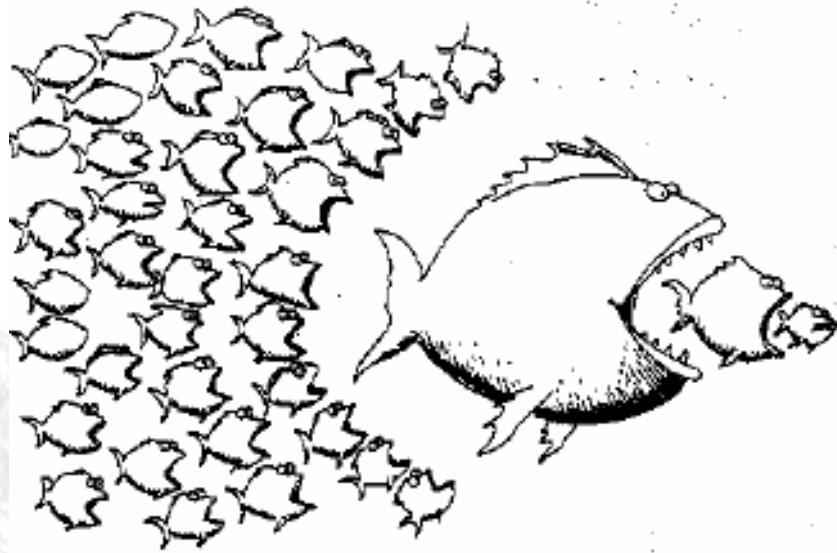
1. Fish to fish Distances (Min & Max)
2. Fish to fish Orientation (direction & speed)
3. Avoid hazards (predators & environmental conditions)



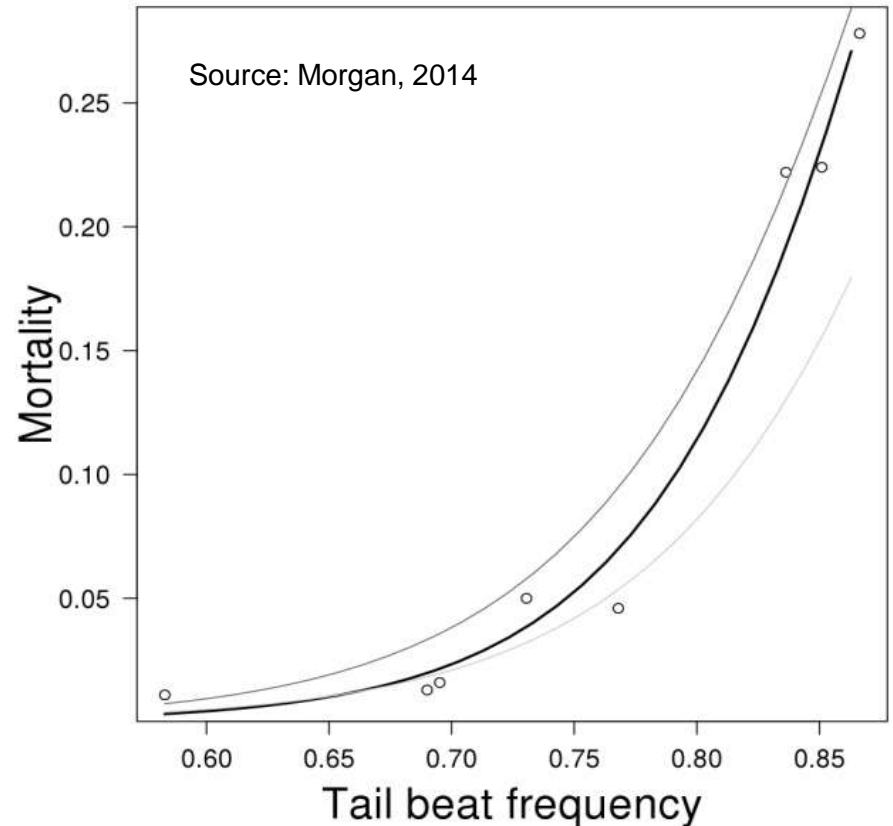
Individual Behaviour & Mortality

"Fight or Flight"

- Tail beat frequency (Morgan, 2014)



Source: Gary Larson



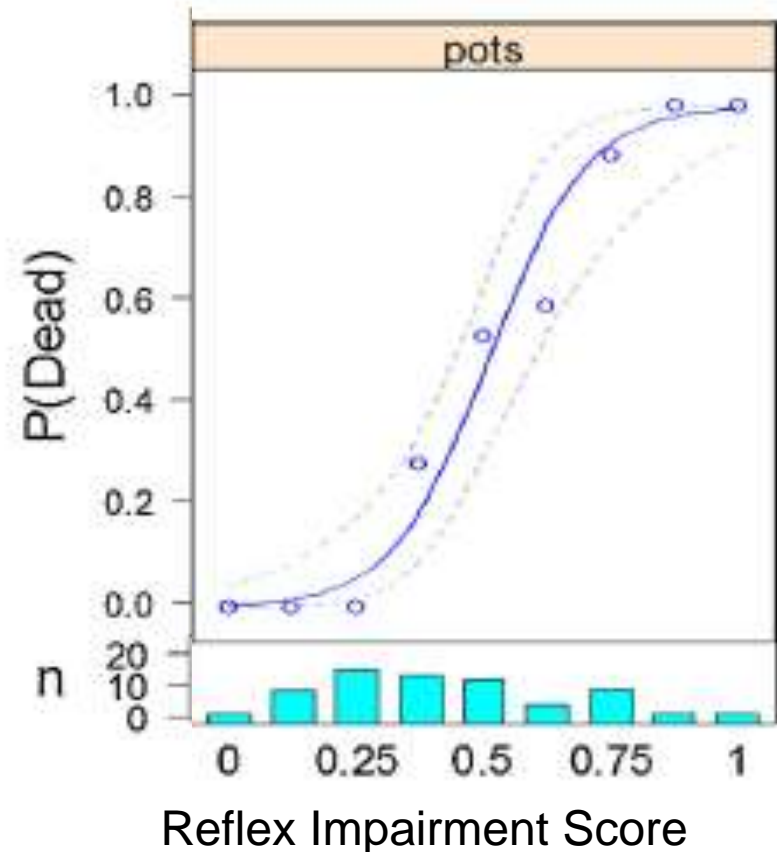
Individual Behaviour & Mortality

Impaired Behaviour / Reflexes

- Reflexes & Vitality (Davies, 2010)



Source: Gary Larson



Source: Humborstad et al, 2015



RedSlip

Objective

Reduce slipping mortality in mackerel purse seine fisheries by:

- a) improving the monitoring and control of the fishing operation; and
- b) improving the understanding of fish behaviour during capture.





RedSlip



Forskningsrådet

Objective

Reduce slipping mortality in mackerel purse seine fisheries by:

- a) improving the monitoring and control of the fishing operation;
and
- **b) improving the understanding of fish behaviour during capture.**

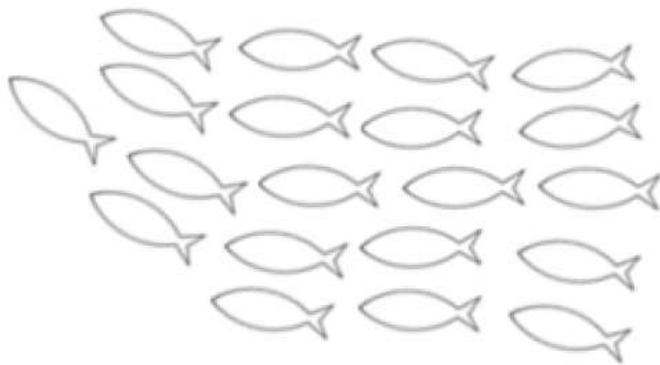


Hypothesis: School structure breaks down at potentially fatal crowding densities

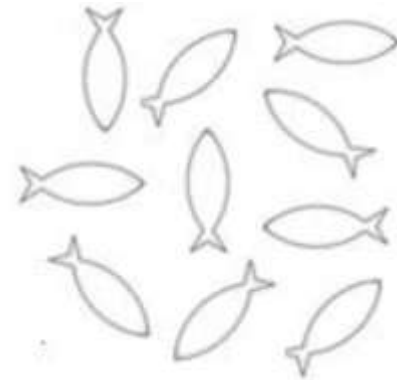
Schooling Behaviour

- Ordered structure
 - Polarised orientation
 - Similar swimming speeds

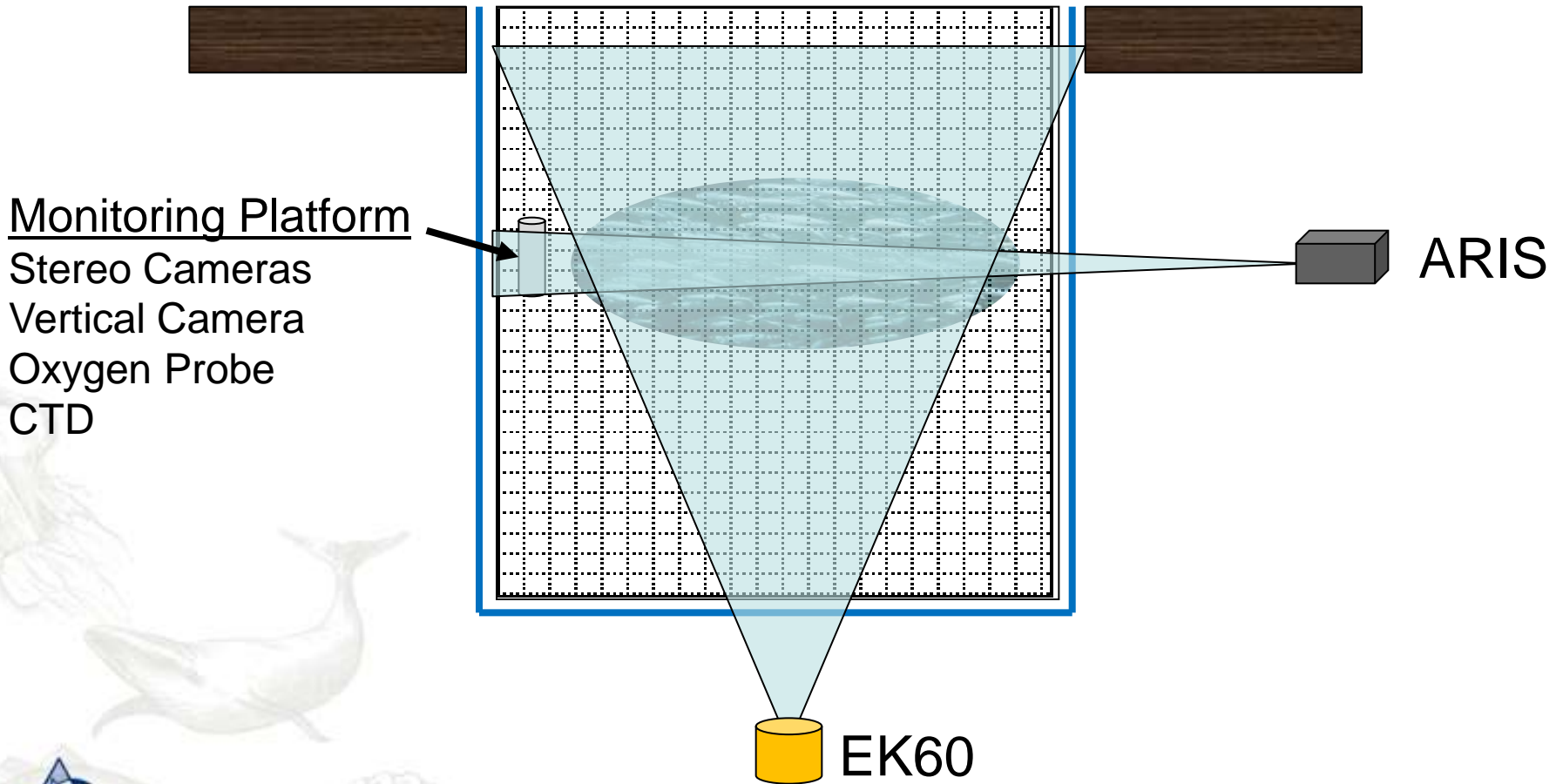
Polarised \equiv Structured



Depolarised \equiv Disrupted



WP1: Net Pen Experiments

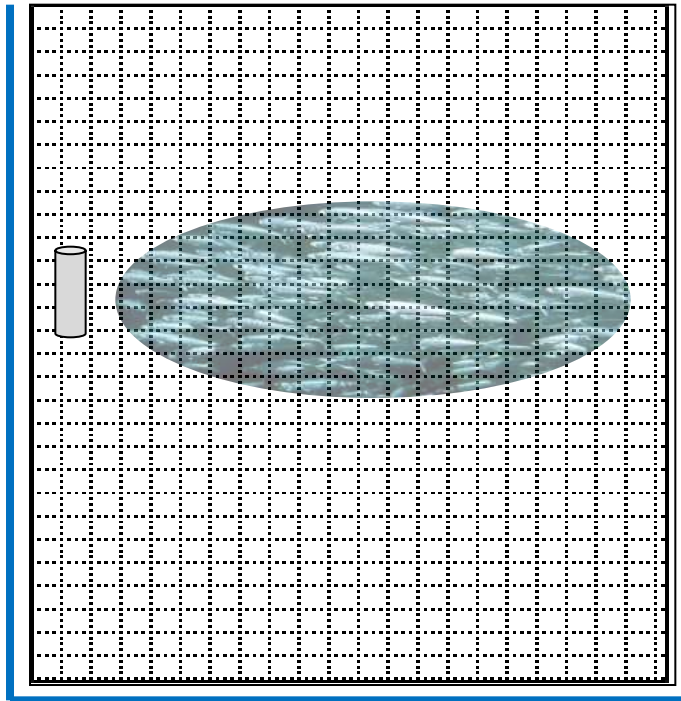


WP1: Net Pen Experiments

Crowding
Density

Monitoring Platform

Stereo Cameras
Vertical Camera
Oxygen Probe
CTD



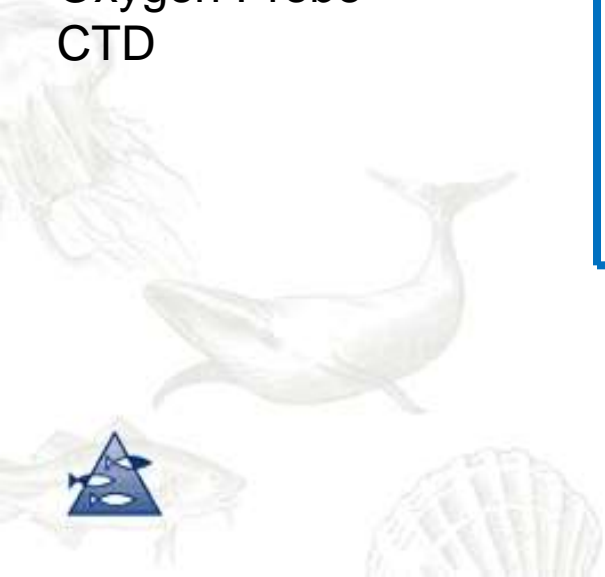
 ARIS

Oxygen
Concentration

Time →

[Oxygen]

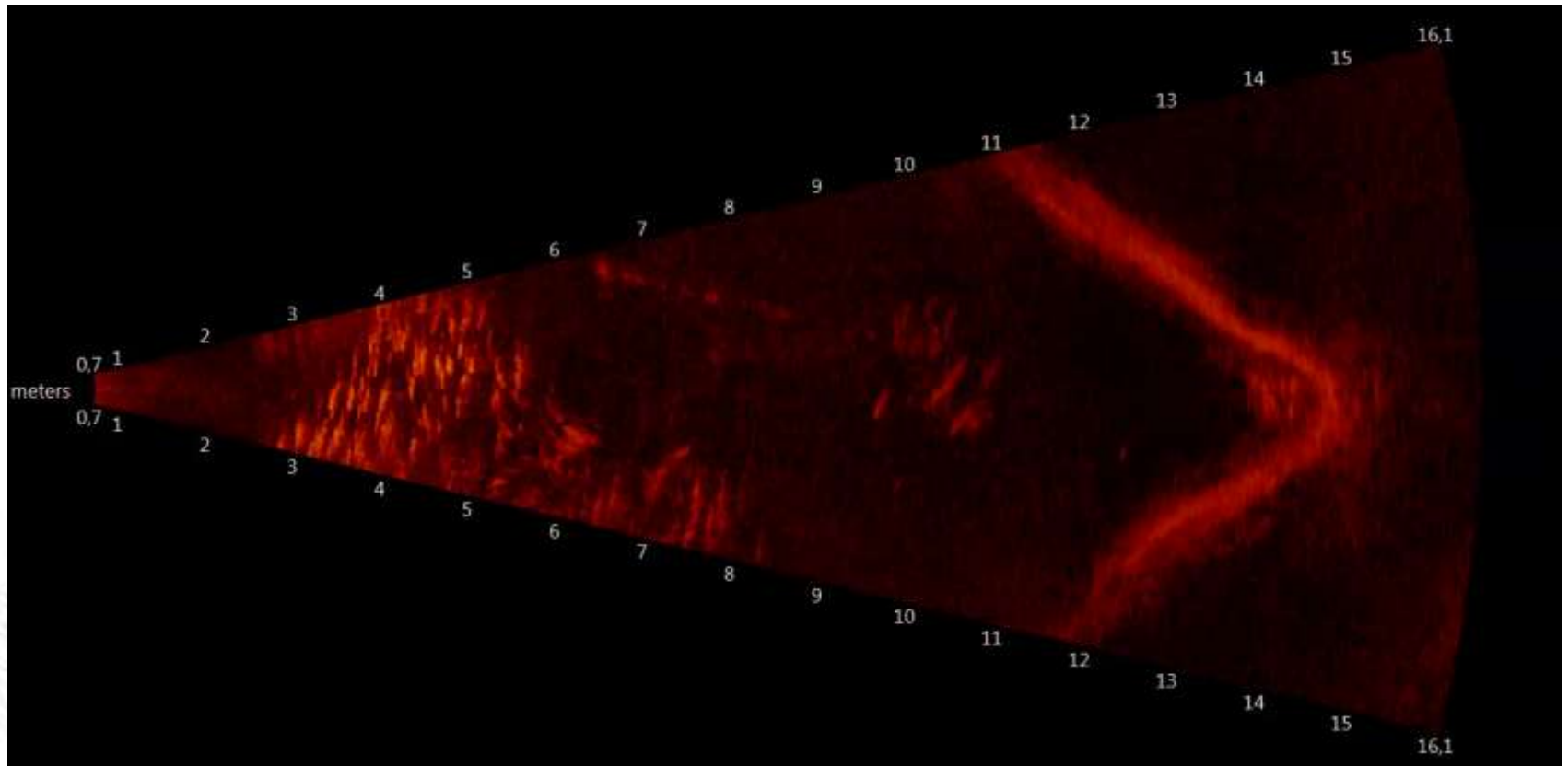
 EK60

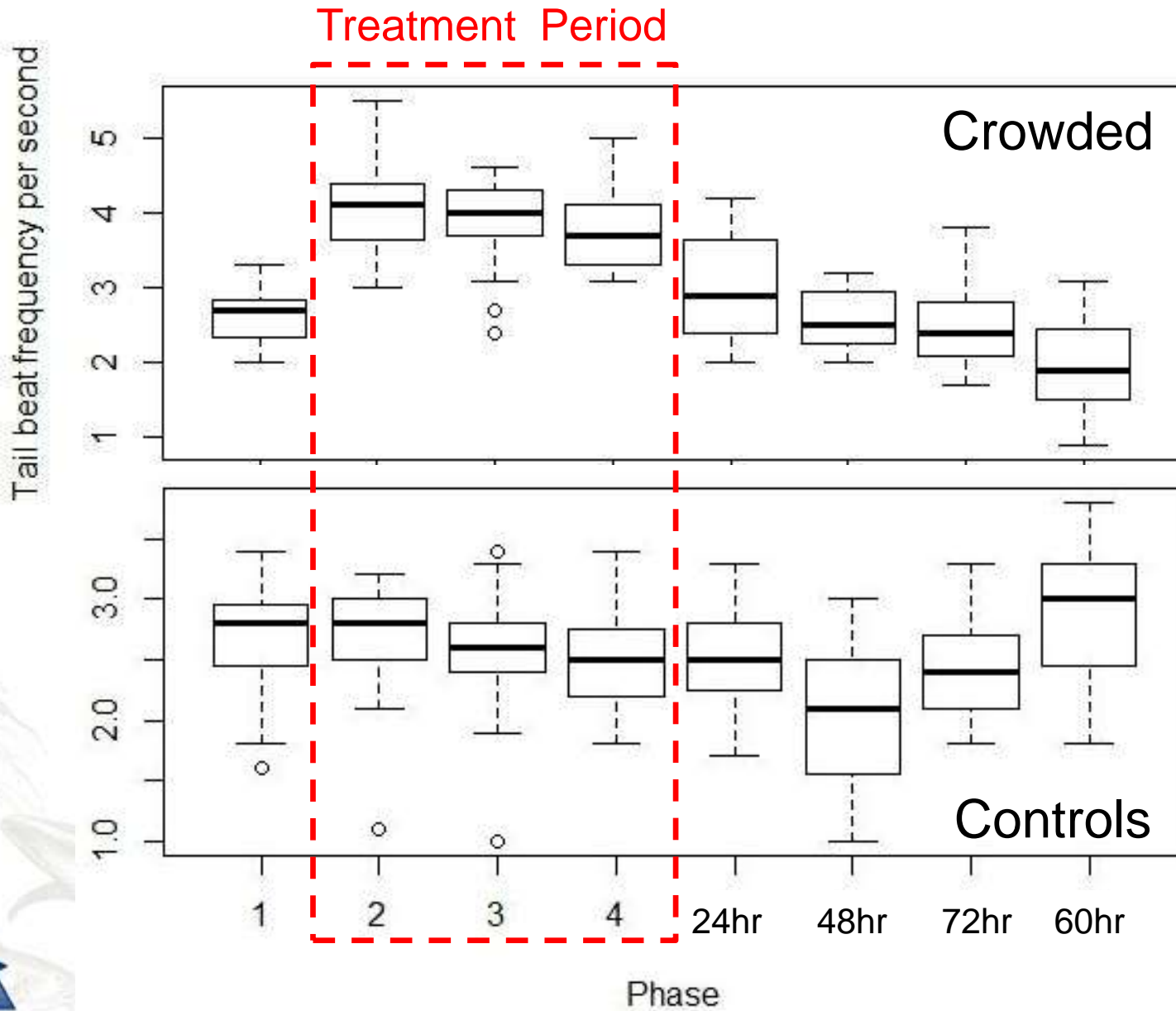


WP1: Net Pen Experiments



WP1: Net Pen Experiments





Slippingmetodikk

Objectives

To develop a standardized slipping method that is acceptable to the fleet and the authorities.

Secondary objectives:

1. Collect supplementary data on existing slipping methods using different segments of the fleet;
2. Draft a standard slipping methodology in close collaboration with industry and government administration based on previous projects and data;
3. Test the proposed method on board a number of vessels under normal fishing conditions;
4. Assess whether the new method safeguards the welfare of fish released from the net; and
5. Define a standard slipping methodology that can be approved by the authorities.



Slippingmetodikk

Objectives

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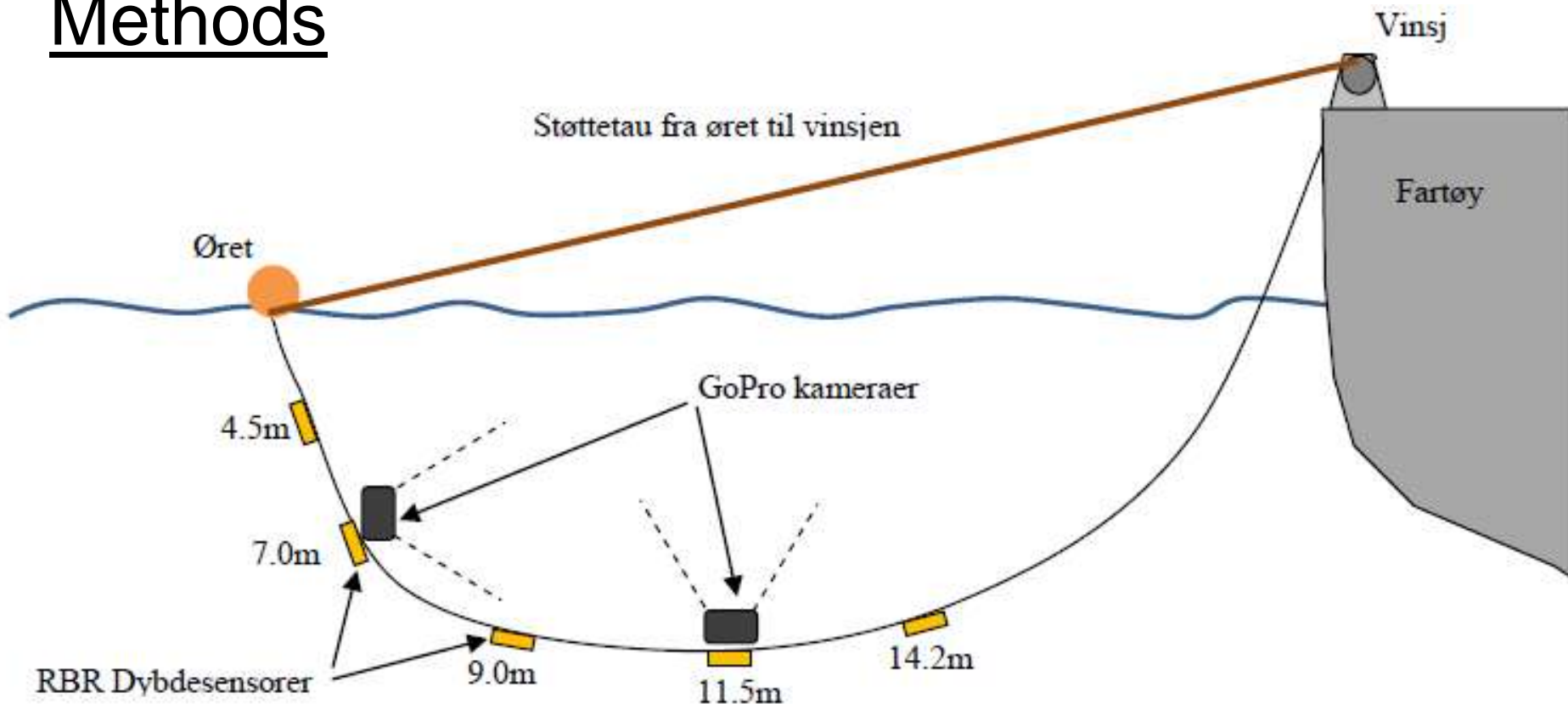
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Slippingmetodikk

Methods



Mackerel Behaviour
FV "Sjarmør"
FV "Fiskebas"
FV "Brennholm"



Orderly Massed Escape



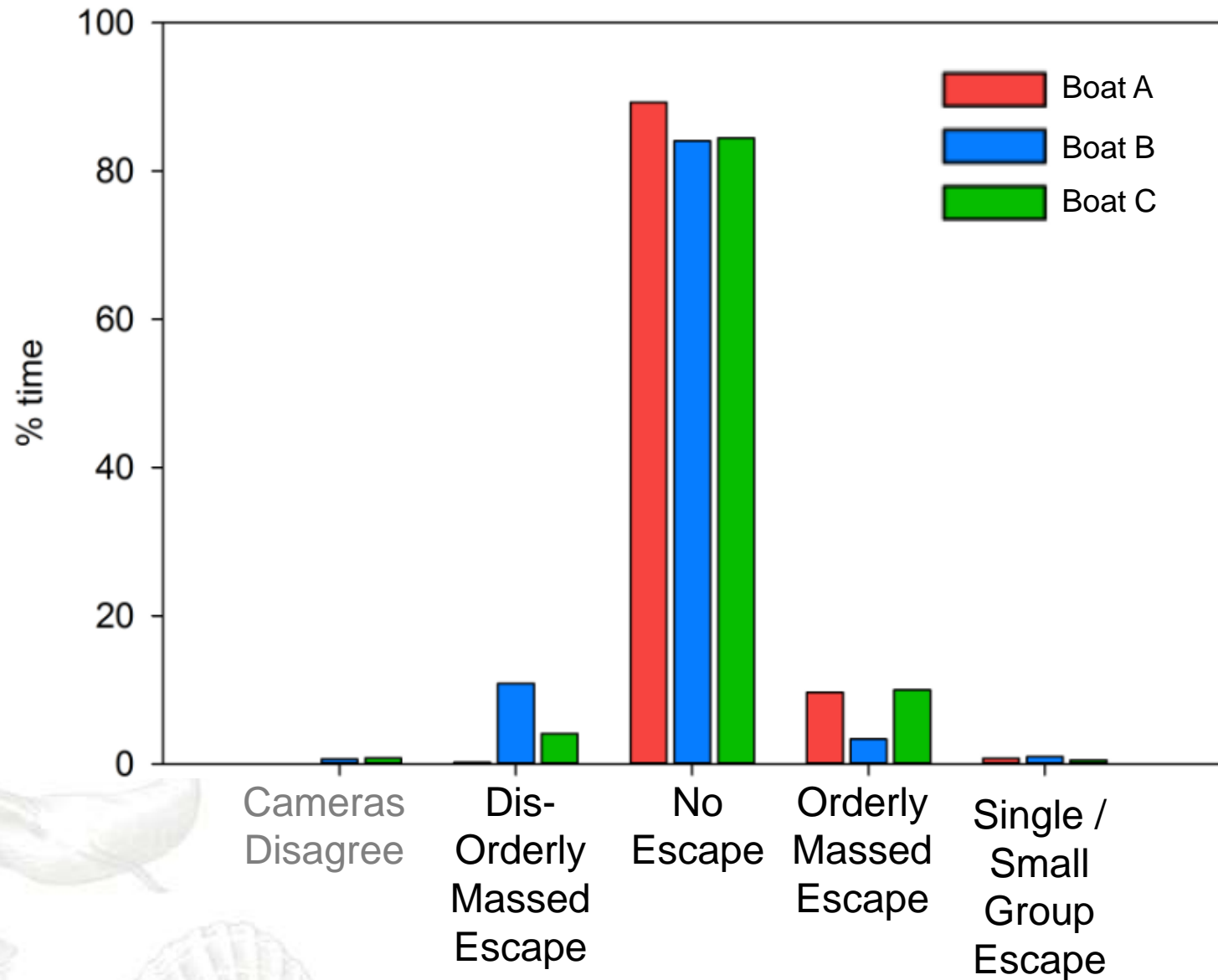
Orderly Massed Escape 2



Dis-orderly Massed Escape



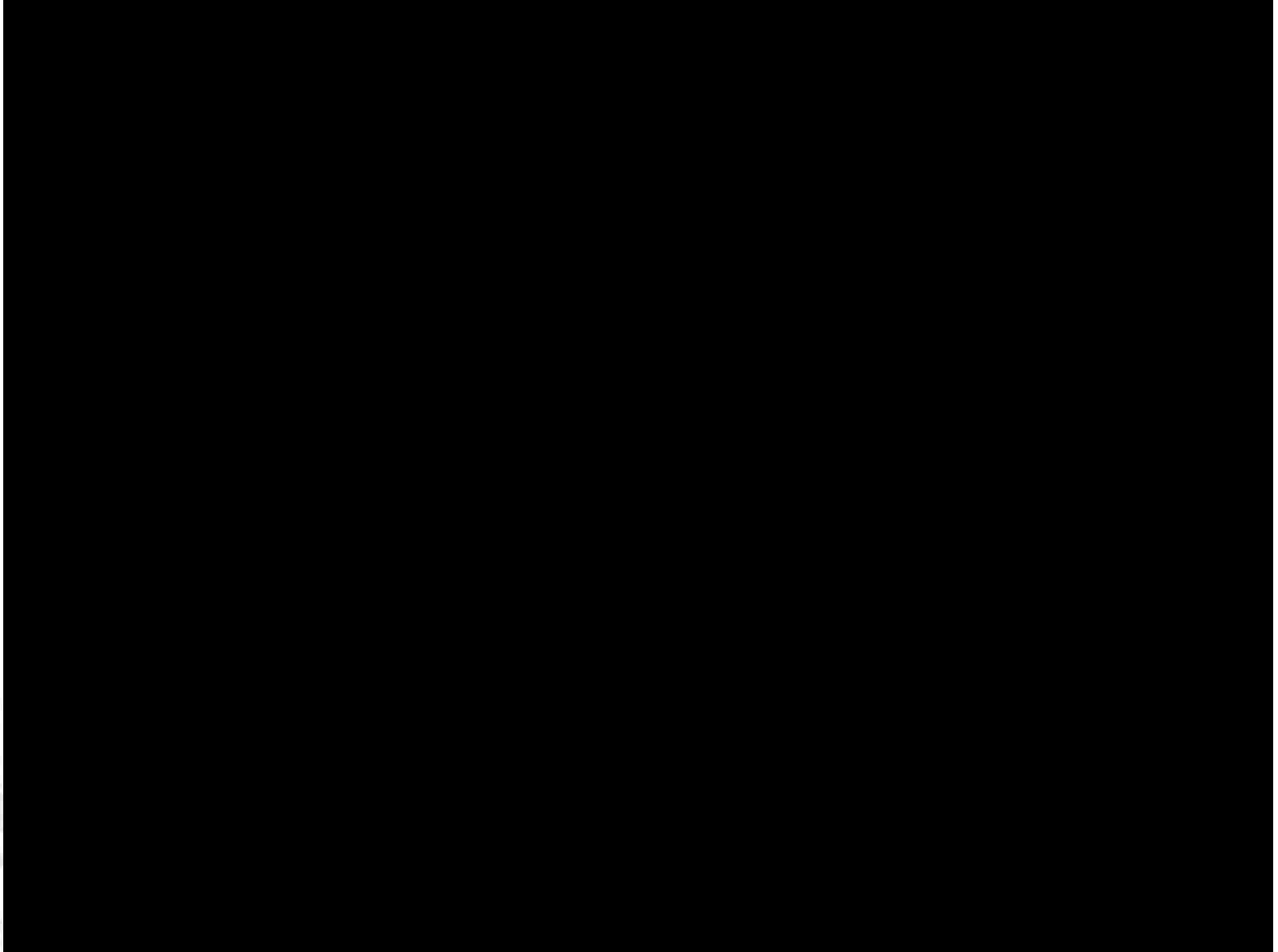
Slippingmetodikk



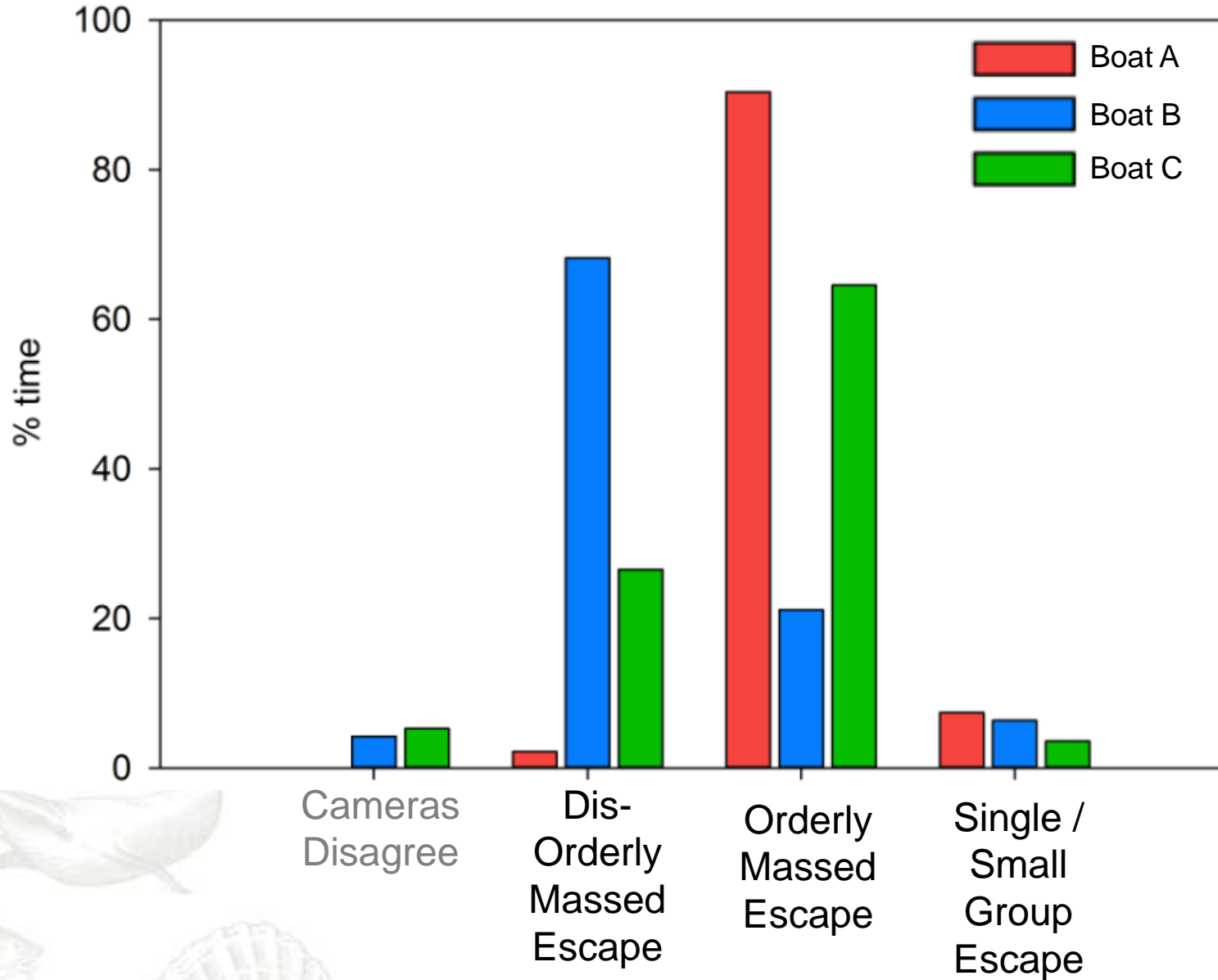
Reluctant to Escape



Return to Net

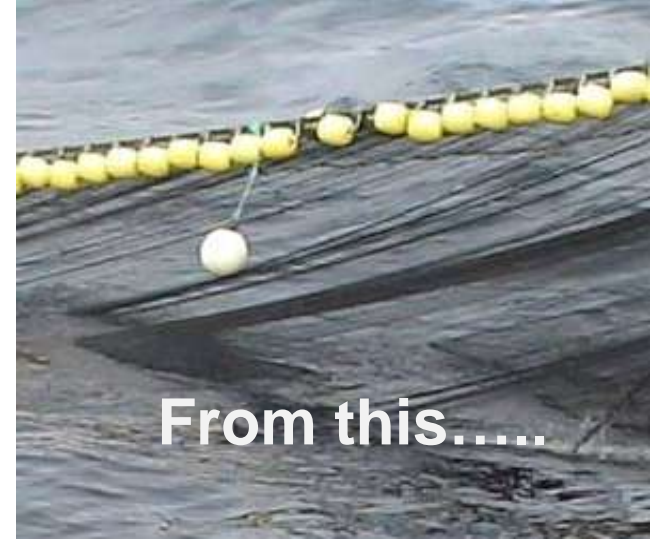


Slippingmetodikk



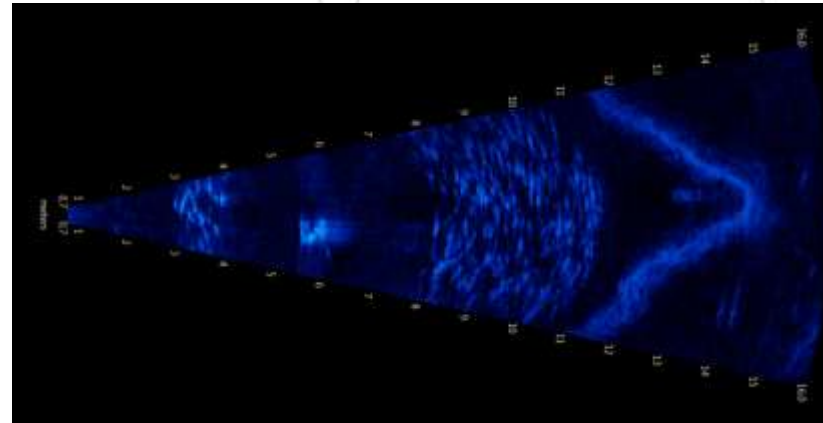
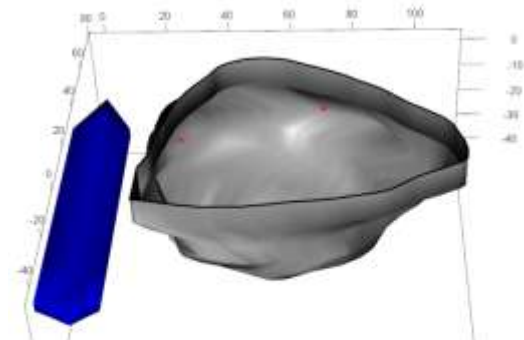
Future Research ...

- RedSlip: develop behavioural metrics
 - define safe release thresholds
- Slippingmetodikk: continue analysis of release behaviours
 - indentify best slipping practices
- Develop tools to enable behavioural monitoring during the whole capture process
 - Including Vitality Assessment
- Integrate behavioural metrics with net monitoring
 - develop improved catch control protocols



From this.....

... to this?



Thank you!



Slipping Mitigation Research Programme

