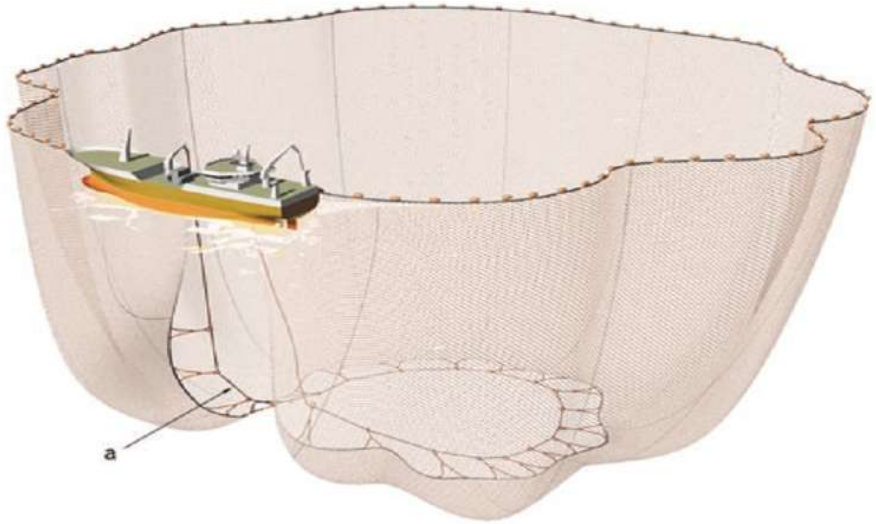

INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET

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 Rieucau, Neil Anders, Rachael Morgan, Kirsten Howard, Bjørn Totland, Jan Tore Øvredal & Aud Vold.

Forskningsrådet

CRISP

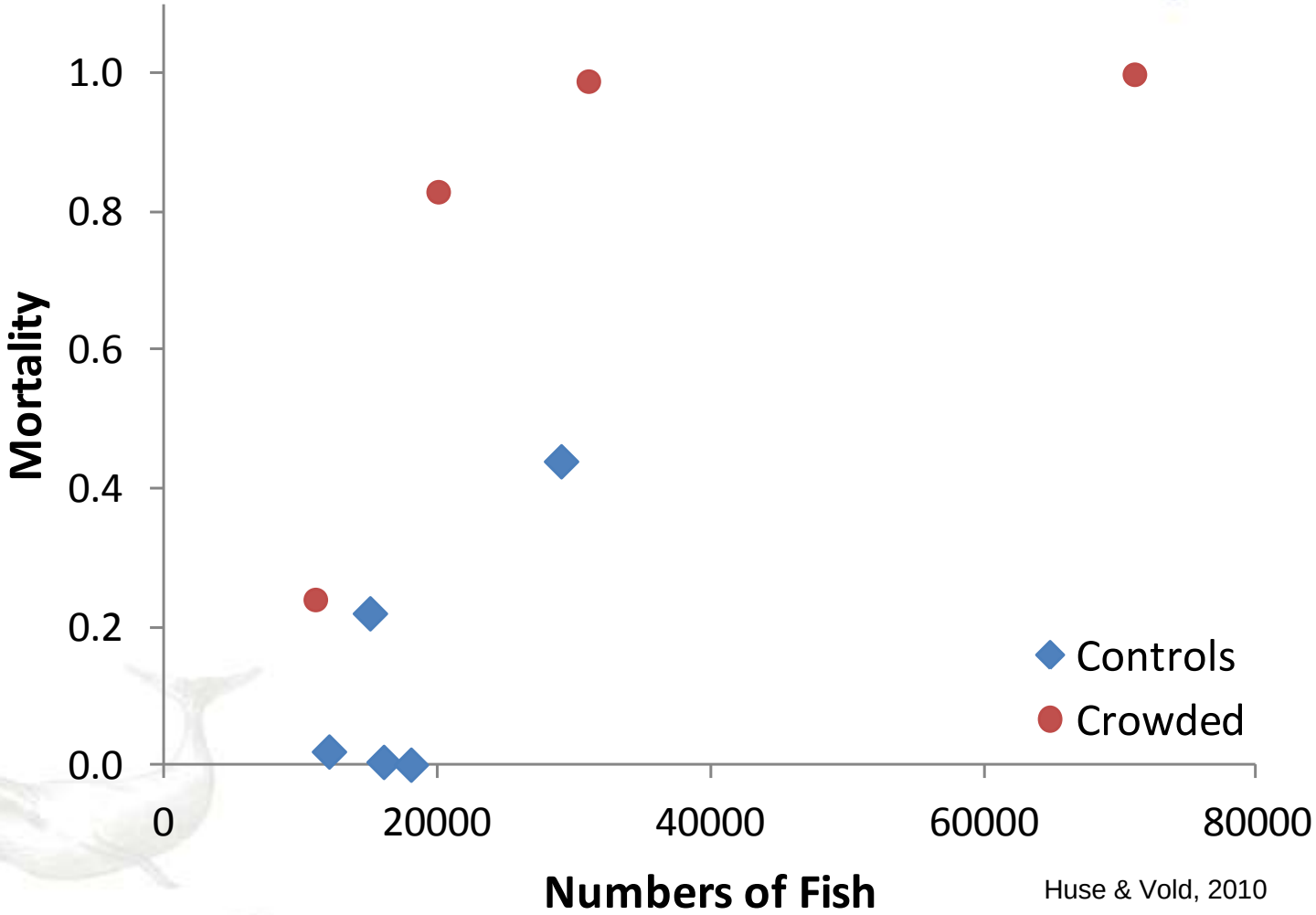
FHF
FISKERI- OG HAVBRUKSNÆRINGENS FORSKNINGSFOND

Introduction

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

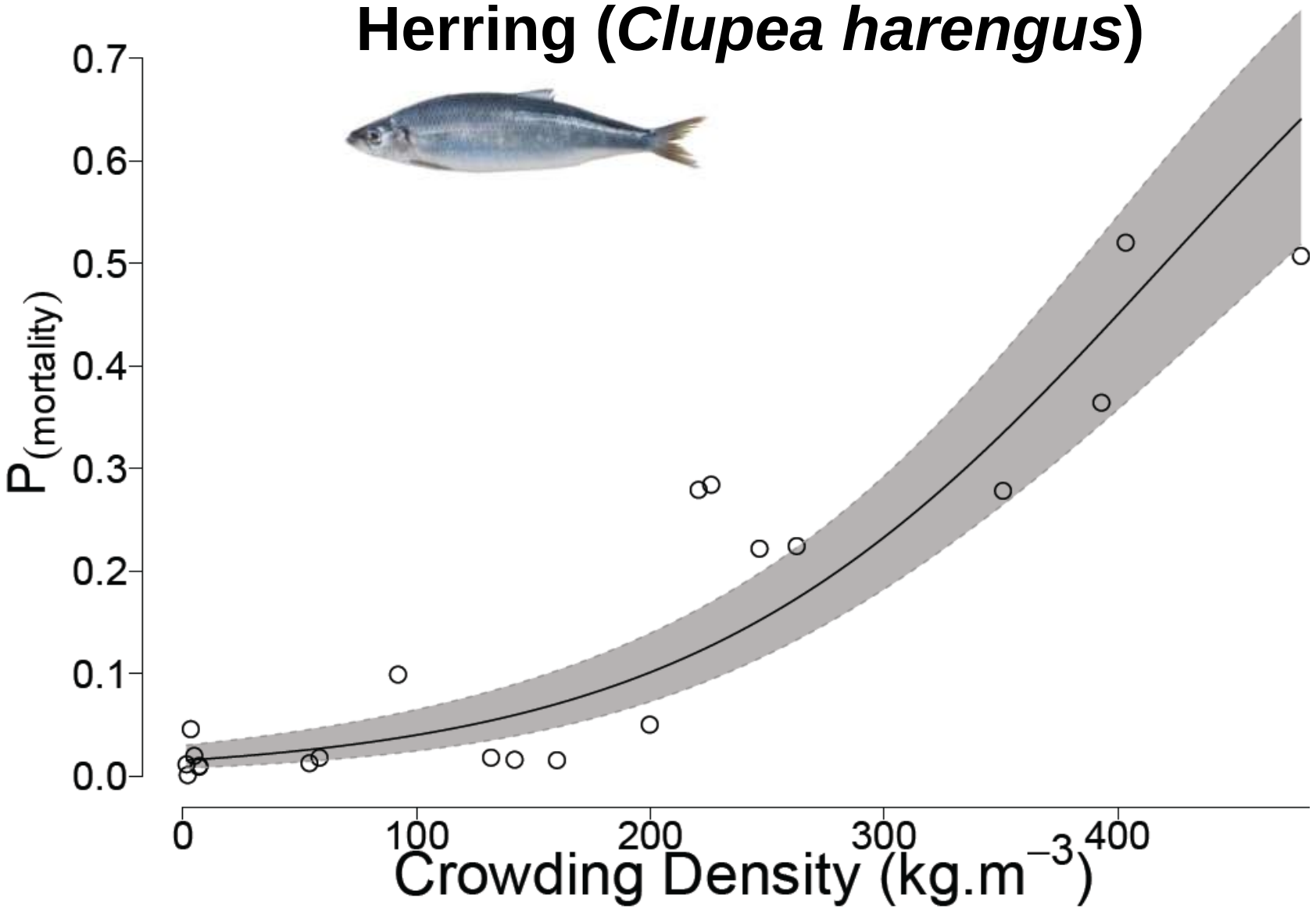
Slipping Mortality

Mackerel (*Scomber scombrus*)

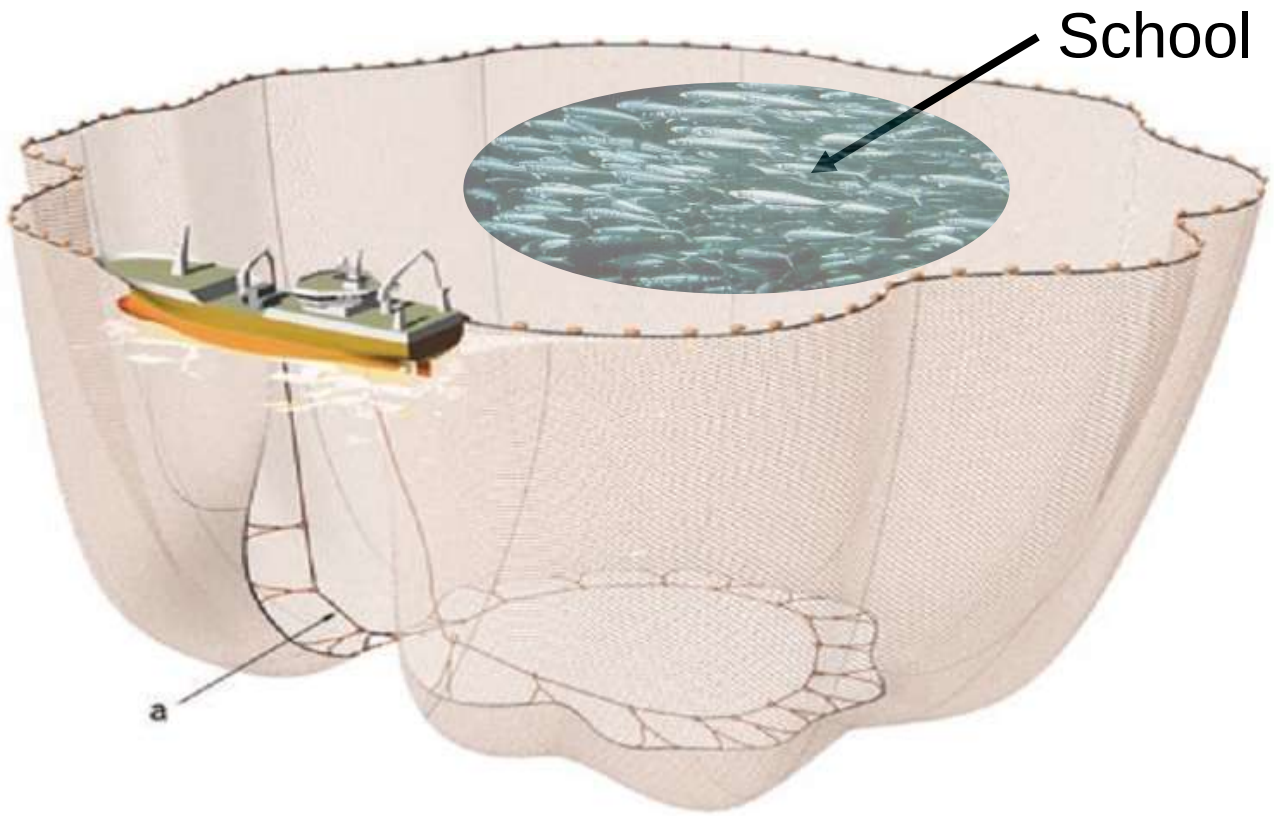


Huse & Vold, 2010

Slipping Mortality



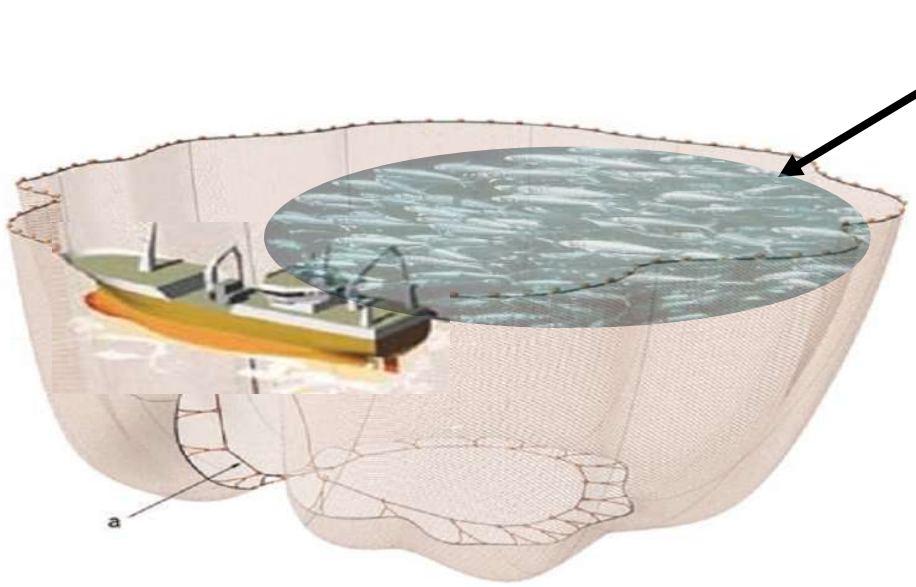
Capture: The Fishes' Perspective



Voluntary
Density

Net Volume = f(Time)

Capture: The Fishes' Perspective



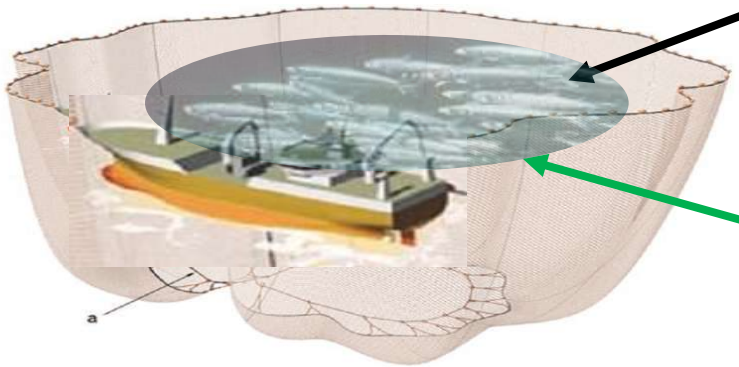
Voluntary Density

⇩

Contained Density

Net Volume = f(Time)

Capture: The Fishes' Perspective



Fish to fish contact

Fish to Net contact

Voluntary Density

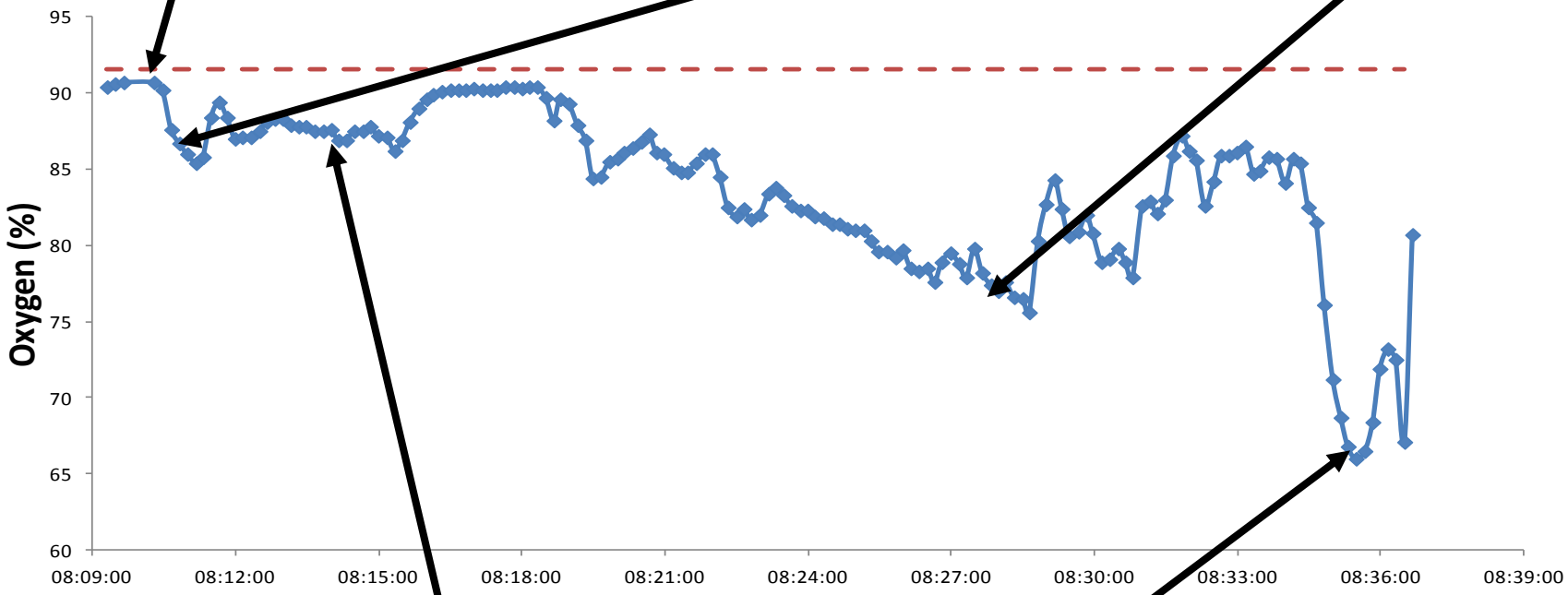
⇩

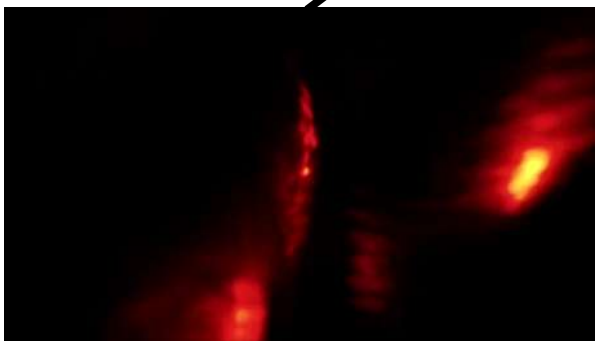
Contained Density

⇩

Damaging Density

Net Volume = f(Time)


Oxygen (%)
95
90
85
80
75
70
65
60
08:09:00
08:12:00
08:15:00
08:18:00
08:21:00
08:24:00
08:27:00
08:30:00
08:33:00
08:36:00
08:39:00



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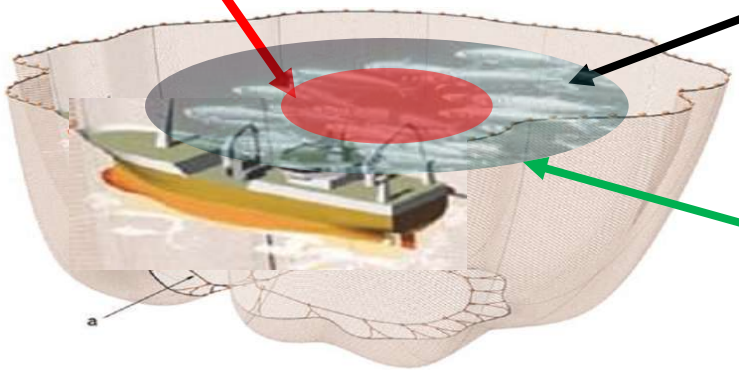


Stressors
- confinement / crowding
- injuries
- hypoxia

Individual Deaths

Voluntary Density

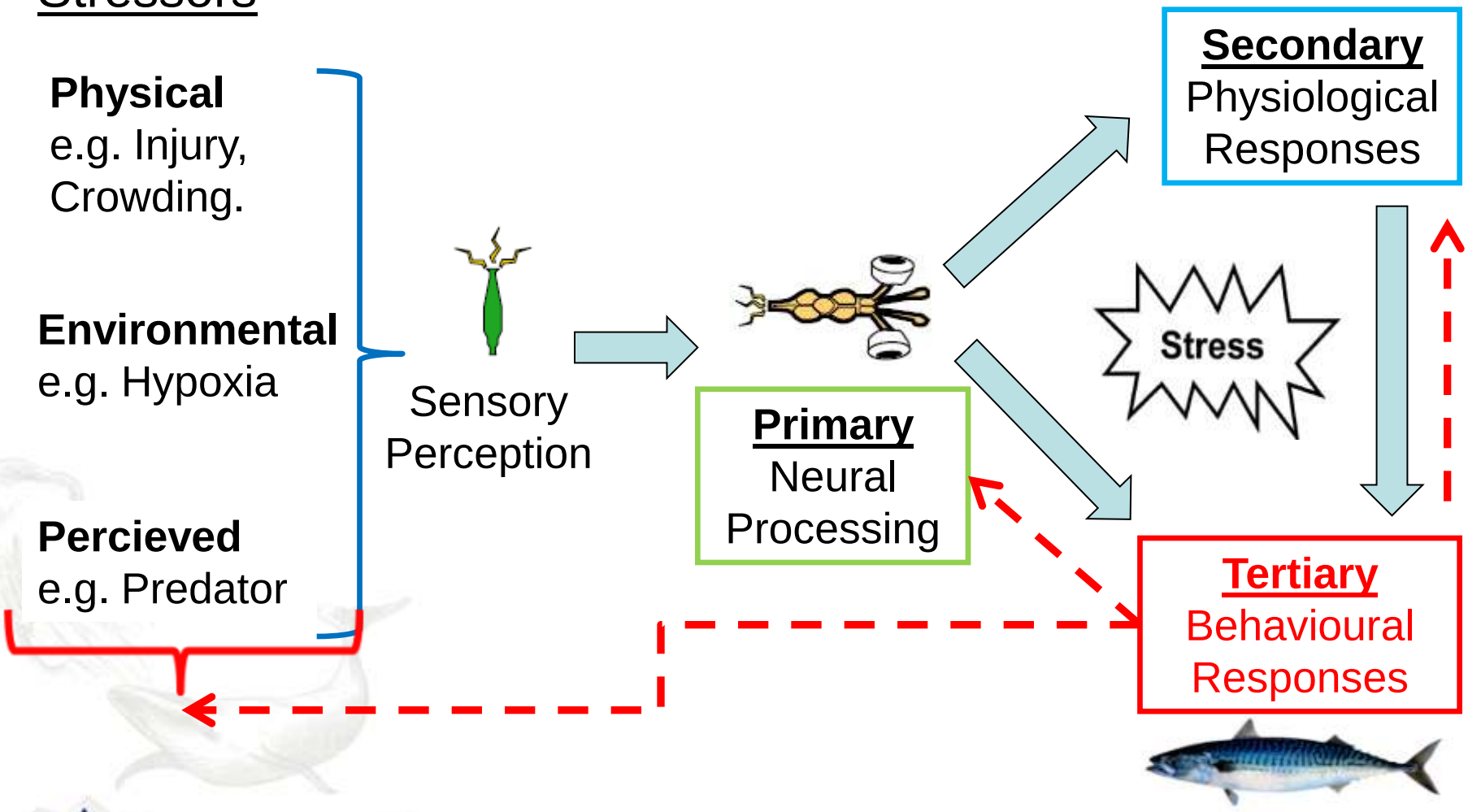
⇩

Contained Density

⇩

Damaging Density

Stress Responses



Adapted from Barton, 2002 and Horodysky et al, 2015

Behaviour

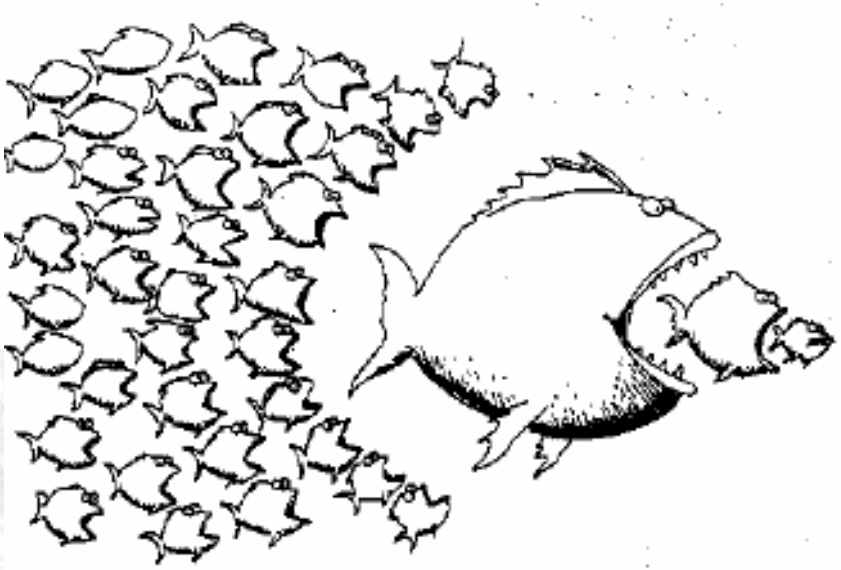
<u>Schooling = Individual Behavioural Rules</u>

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

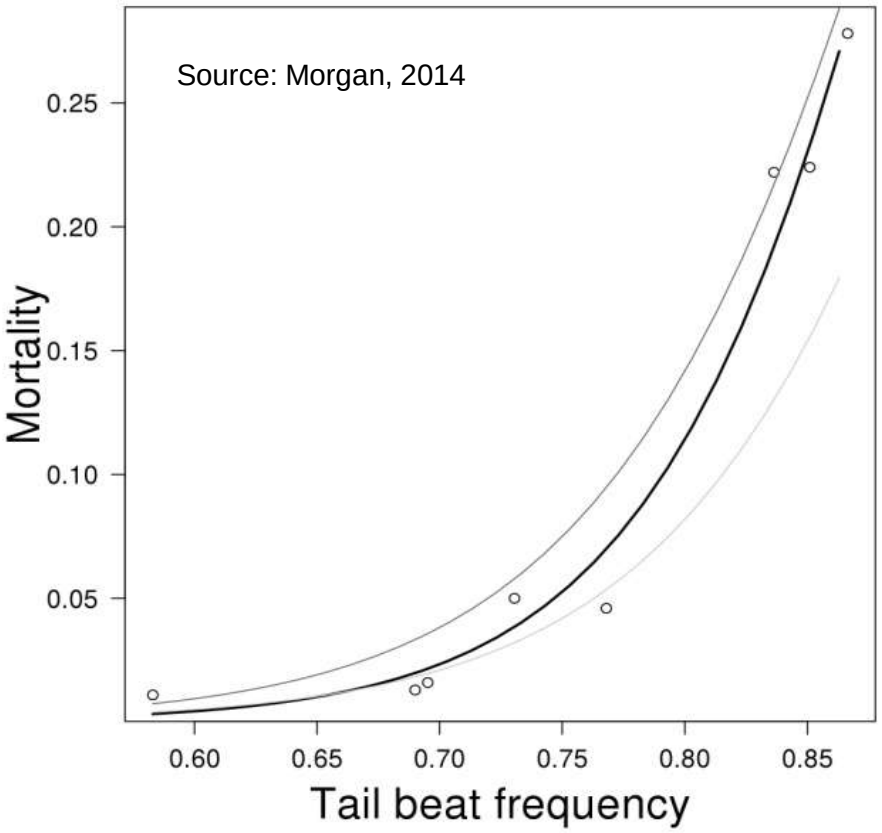
Individual Behaviour & Mortality

”Fight or Flight”

- Tail beat frequency (Morgan, 2014)



Source: Gary Larson

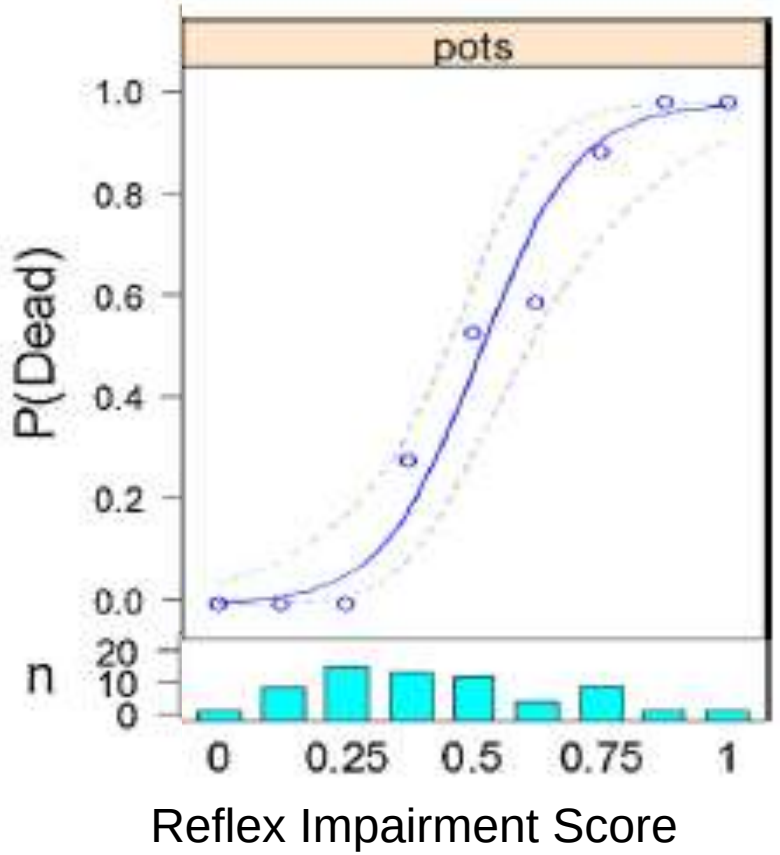


Individual Behaviour & Mortality

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

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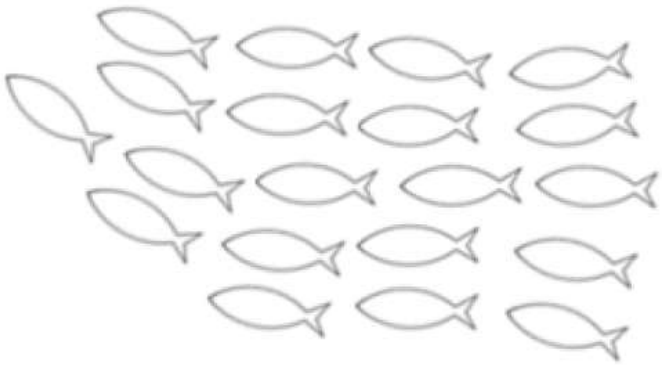
RedSlip

Hypothesis: School structure breaks down at potentially fatal crowding densities

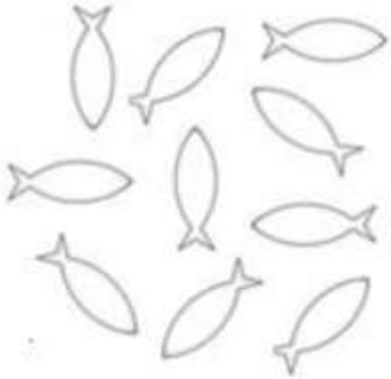
Schooling Behaviour

- Ordered structure
  - Polarised orientaion
  - Similar swimming speeds

Polarised ≡ Structured



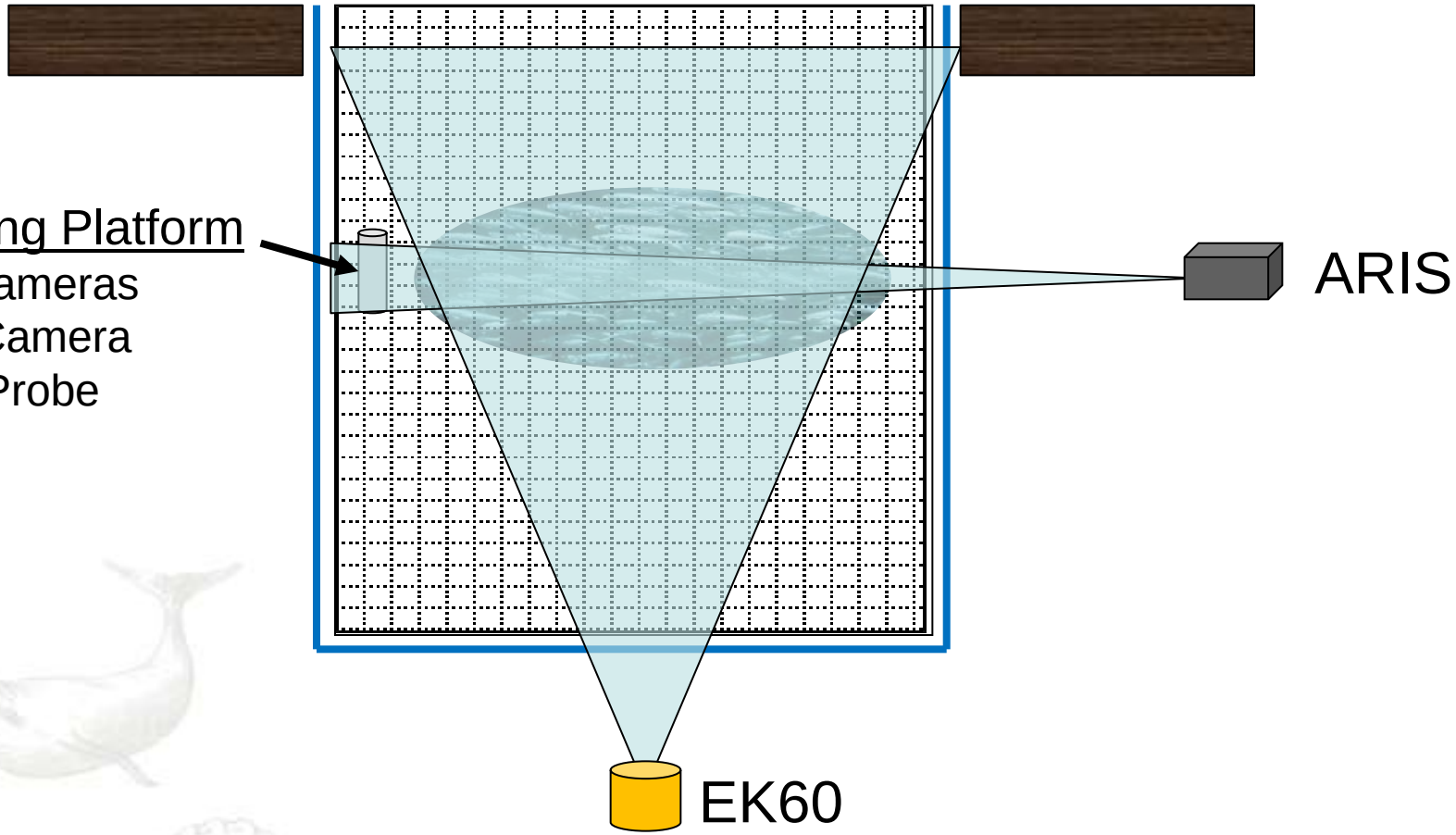
Depolarised ≡ Disrupted



Source: Morgan, 2014

RedSlip

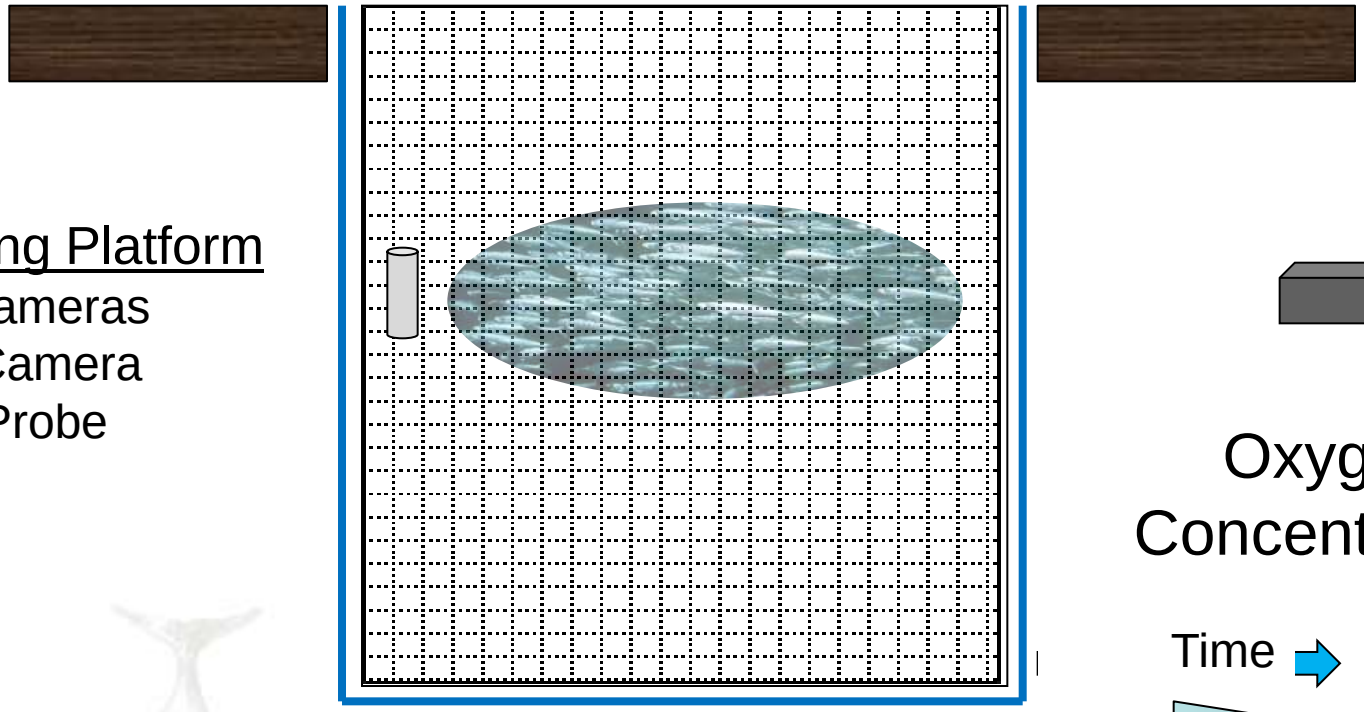
WP1: Net Pen Experiments



RedSlip

WP1: Net Pen Experiments

Crowding Density



Monitoring Platform
Stereo Cameras
Vertical Camera
Oxygen Probe
CTD

ARIS

Oxygen Concentration

Time

[Oxygen]

EK60

RedSlip

WP1: Net Pen Experiments

RedSlip

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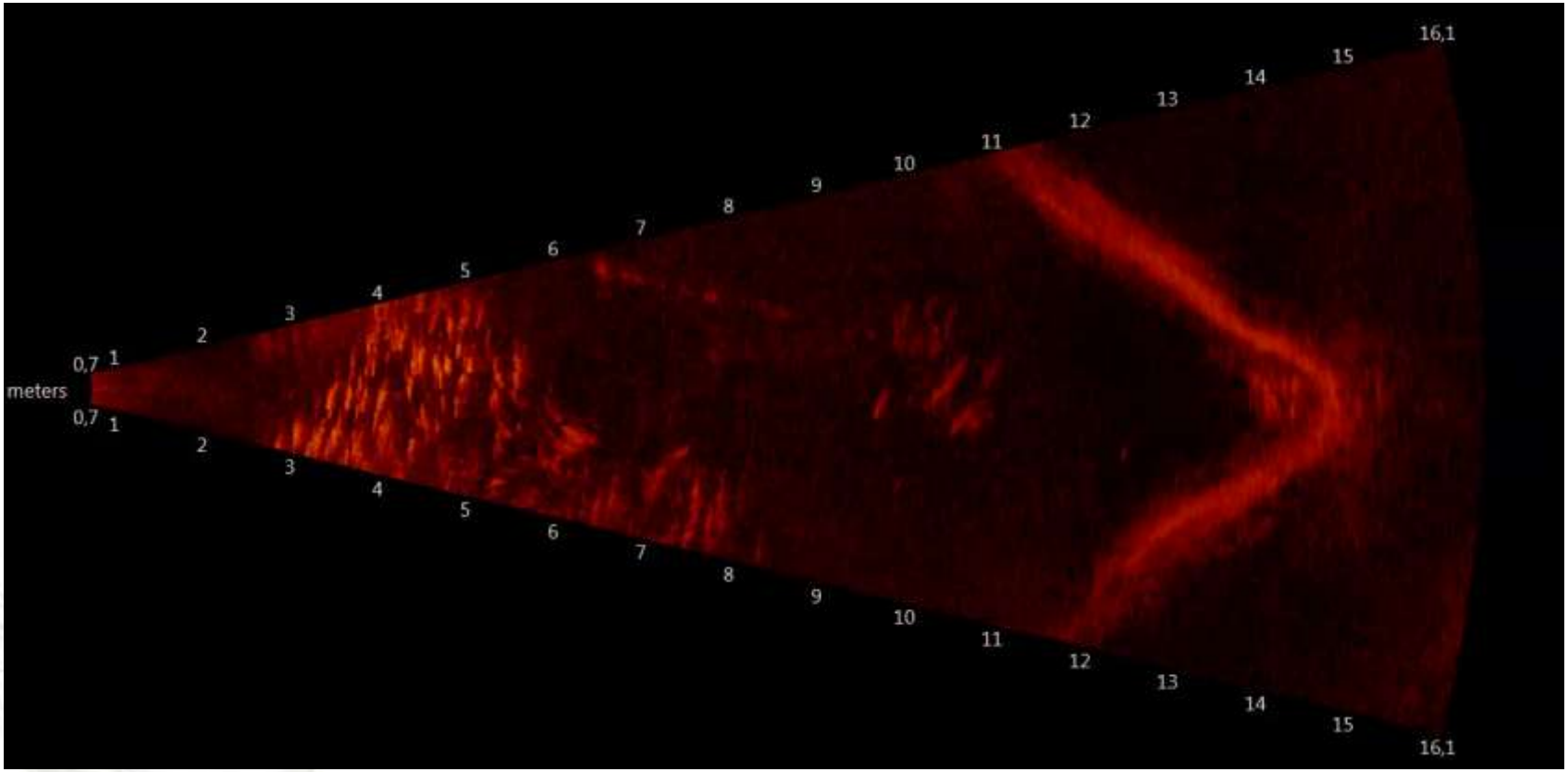
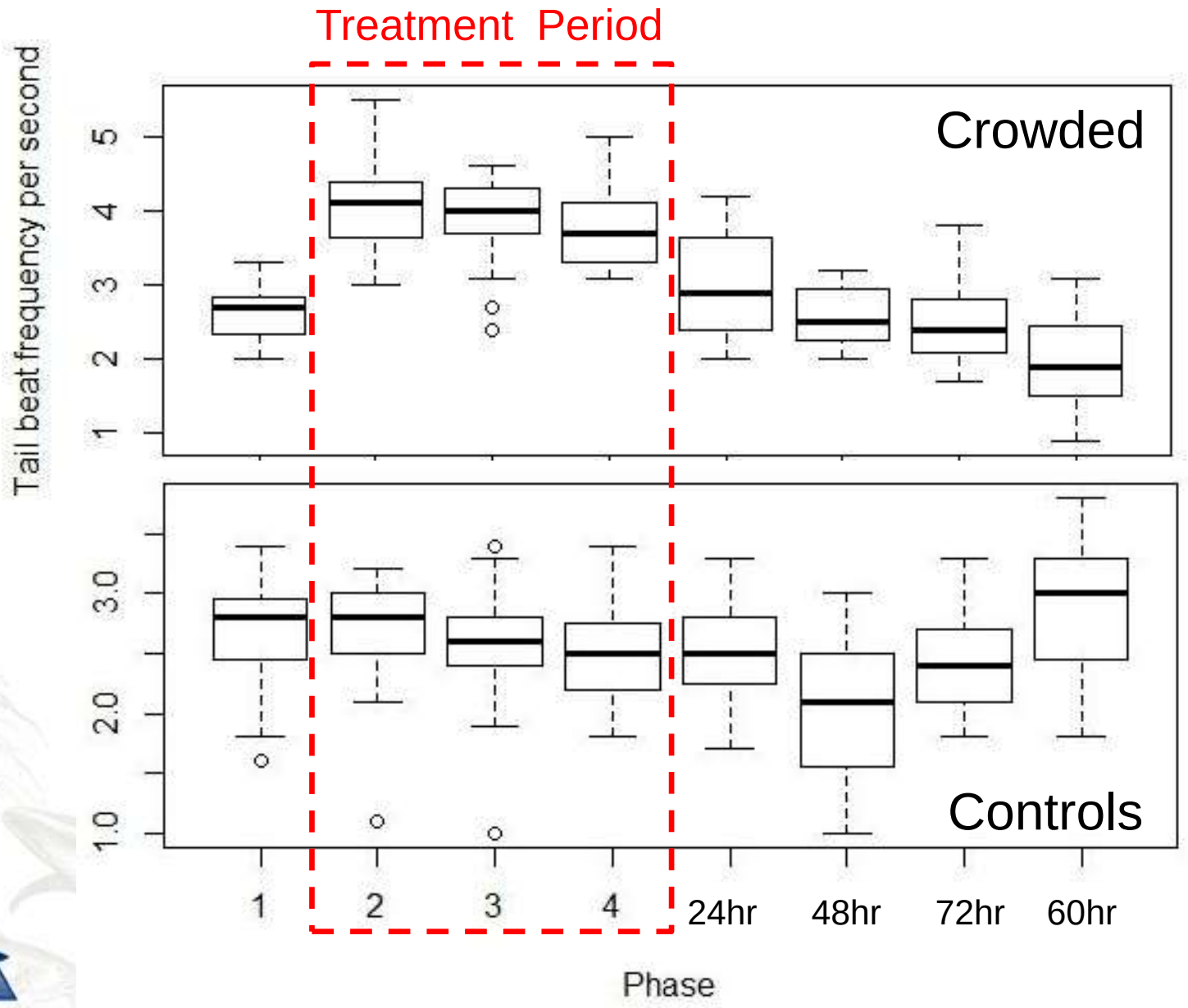


RedSlip


Treatment Period
Tail beat frequency per second
Crowded
Controls
1
2
3
4
24hr
48hr
72hr
60hr
Phase

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.

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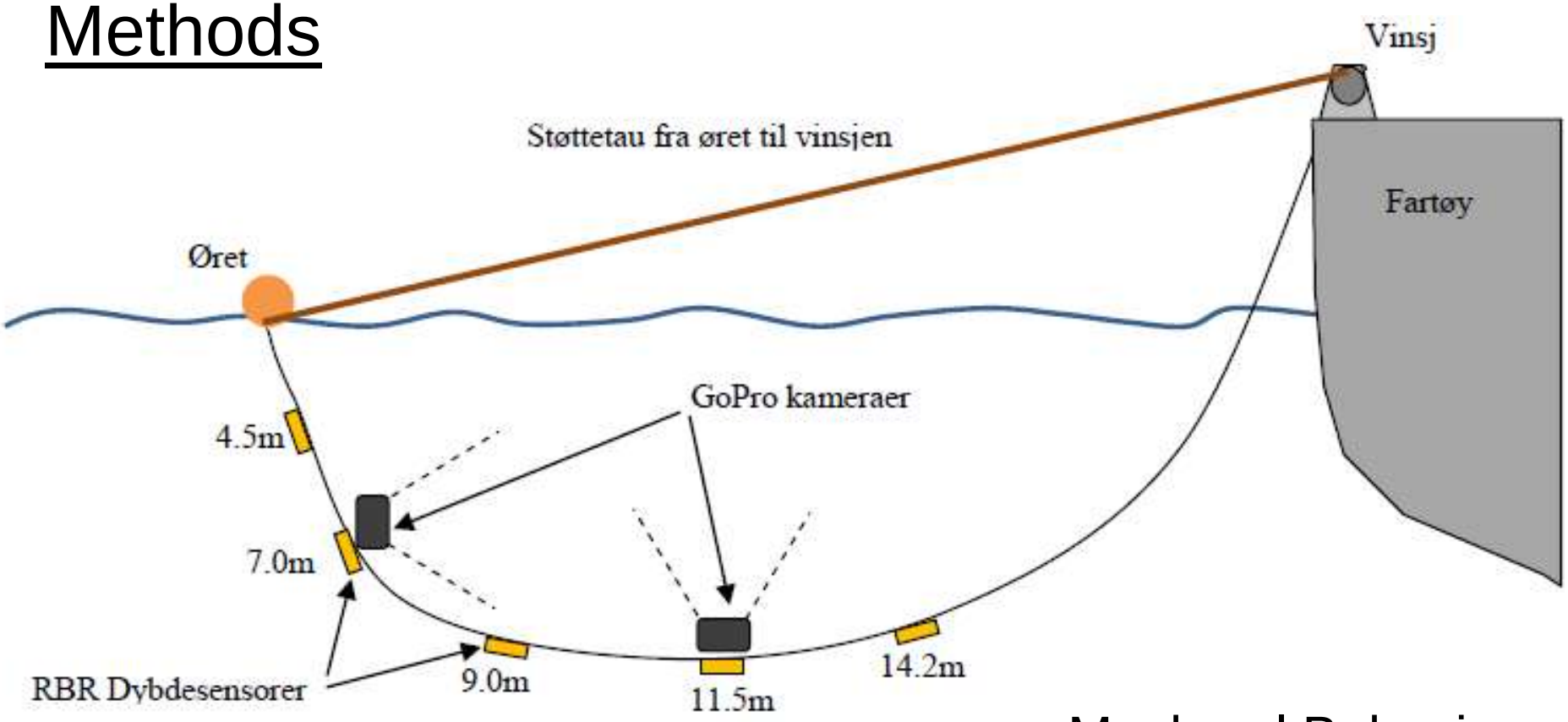
Slippingmetodikk

Methods



Mackerel Behaviour

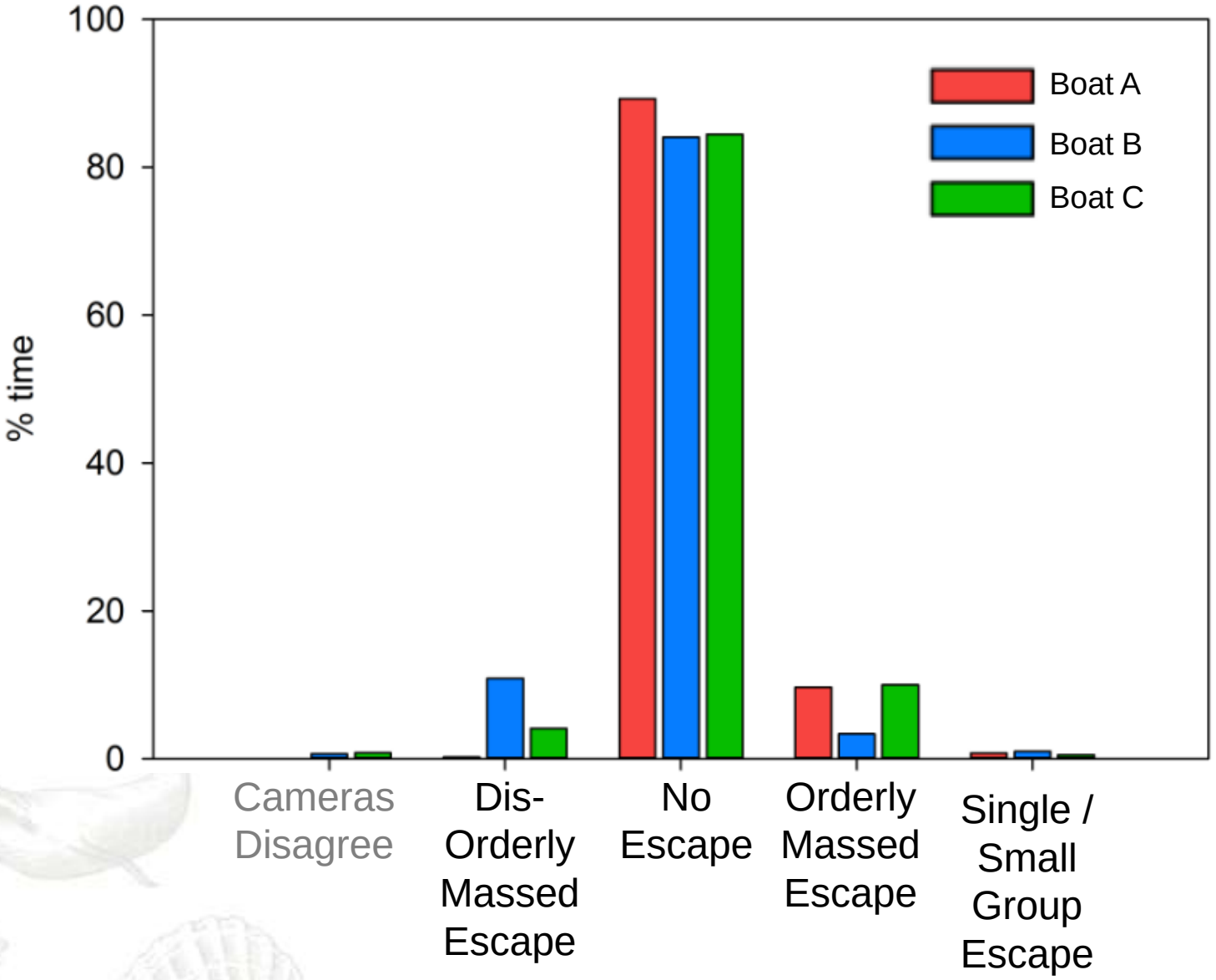
FV ”Sjarmør”
FV ”Fiskebas”
FV ”Brennholm”

Orderly Massed Escape

Orderly Massed Escape 2

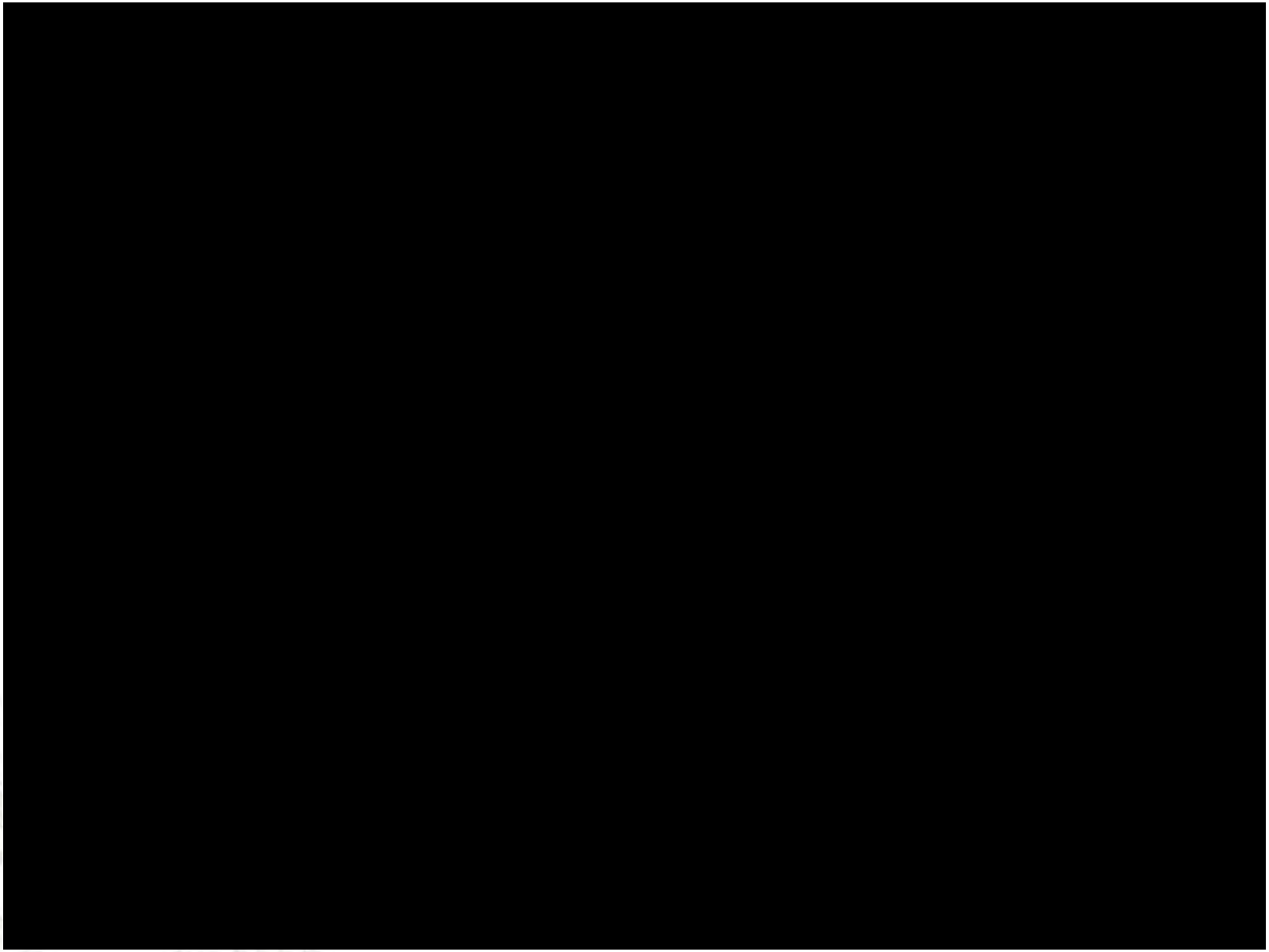
Dis-orderly Massed Escape

Slippingmetodikk

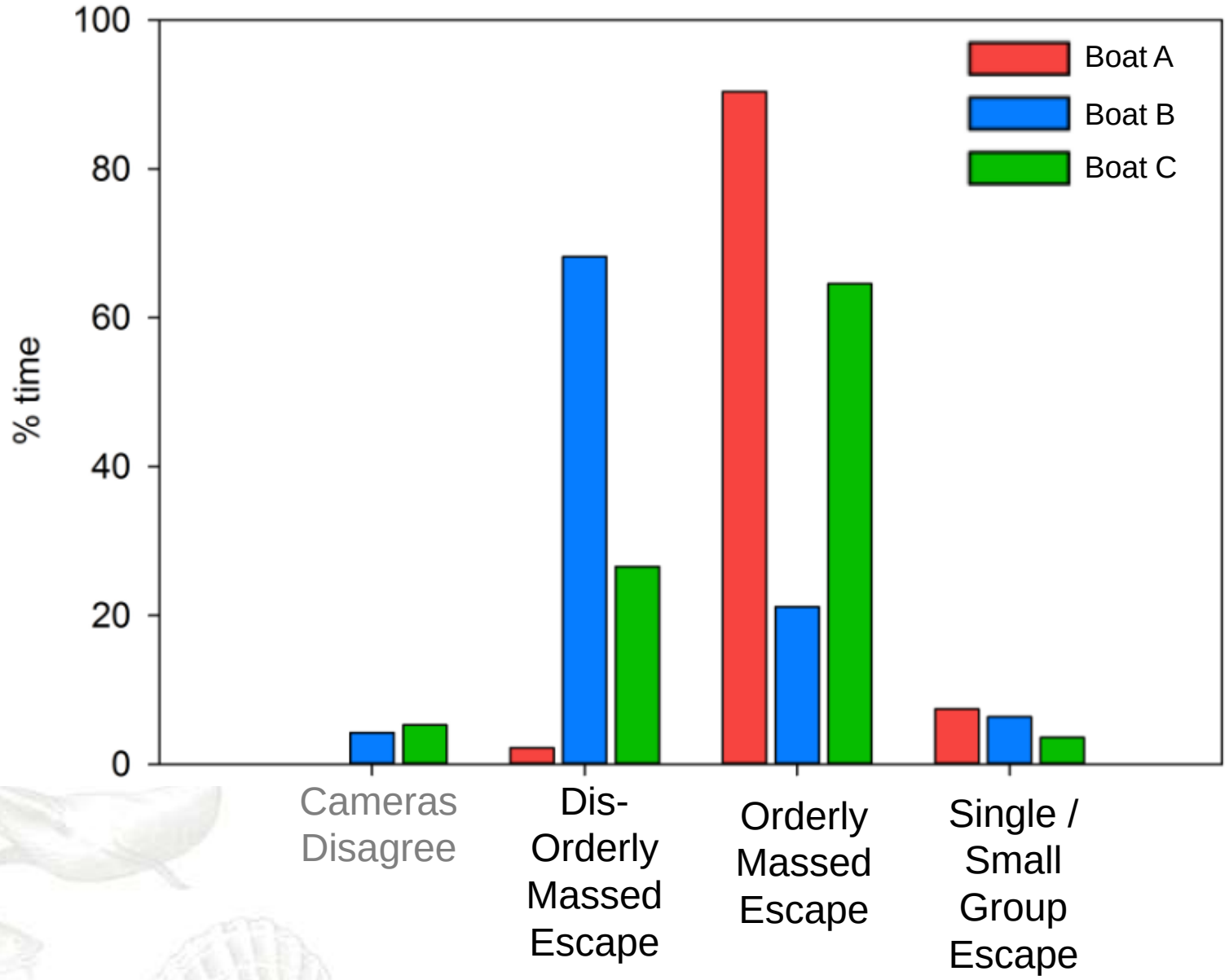


Reluctant to Escape

Return to Net

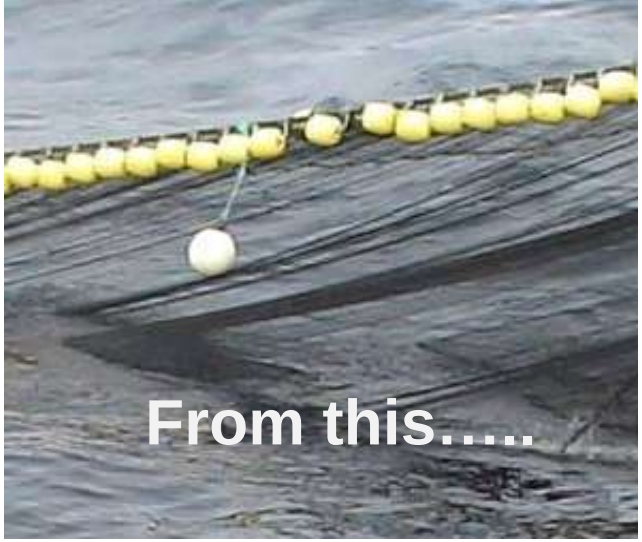


Slippingmetodikk

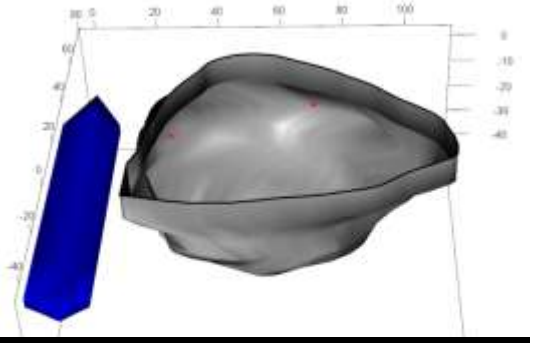


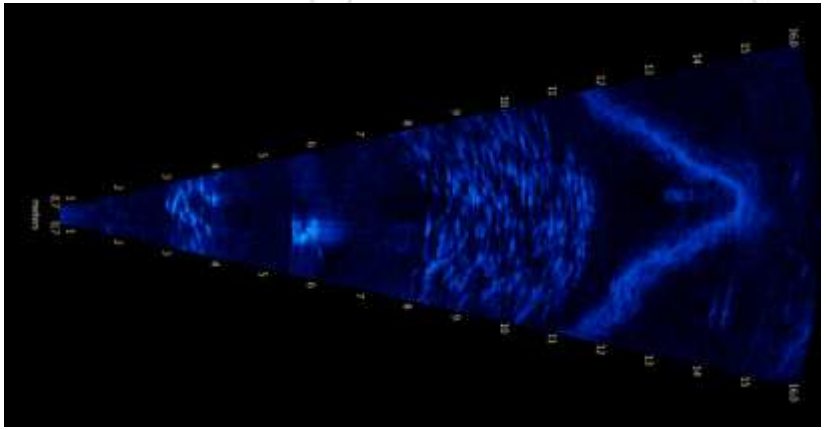
Future Research …

- 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



… to this?





Thank you!

Slipping Mitigation Research Programme

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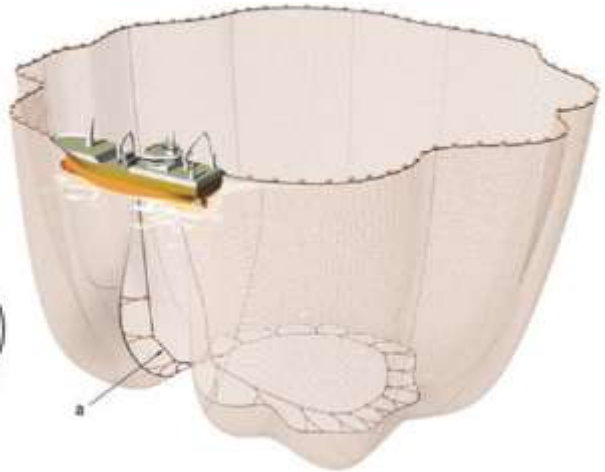
DIRECTORATE OF FISHERIES

Forskningsrådet



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UNIVERSITAS BERGENSIS

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NORGES RÅFISKLAG

cmr Instrumentation

SINTEF

Nofima

Egersund Group
Fishing · Aquaculture · Trade

SIMRAD

SCANTROL

NERGÅRD