Review of European trials of barium sulfate and metal oxide nets

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BACKGROUND

- Many attempts at enhancing acoustic detectability of gillnets:
  - Many different materials, *e.g.* metal beads, air filled tubes, etc.
  - None fulfilled the two basic requirements:
    - Reduced bycatch
    - No negative effects on target catch
- 1999: acoustically reflective gillnets
  - Danish North Sea trial in 2000
  - UK North Sea trial in 2002-2003

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DANISH AND UK TRIALS

Danish trial in 2000

- One vessel in the Danish North Sea
- Cod/mixed species fishery
- September-October 2000
- Controlled experiment
- Iron oxide nets vs. nylon nets
- Full observer coverage
- Detailed catch data

UK trial in 2002-2003

- One vessel in the UK North Sea
- Skate fishery
- October 2002-September 2003
- Controlled experiment
- Barium sulphate nets vs. nylon nets
- Full observer coverage
- No catch data

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DANISH AND UK TRIALS

	DANISH TRIAL		UK TRIAL	
Net type	Nylon	Iron oxide	Nylon	BaSO4
Twine size (mm)	0.59	0.58	0.60	0.67
Twine colour	Green	Red-brown	Green	Blue
Mesh size (mm)	156	156	267	241
Hanging ratio	0.4	0.4	0.3	0.3
Float interval (m)	2.46	2.16	-	-

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RESULTS - Danish trial

NET TYPE	CATCH (numbers)		EFFORT (km*days)	CPUE (numbers/km*days)	
	Porpoises	Cod		Porpoises	Cod
Nylon	8	845	61	0.13	13.9
Iron oxide	0	685	68	0*	10.1*

* $P < 0.05$

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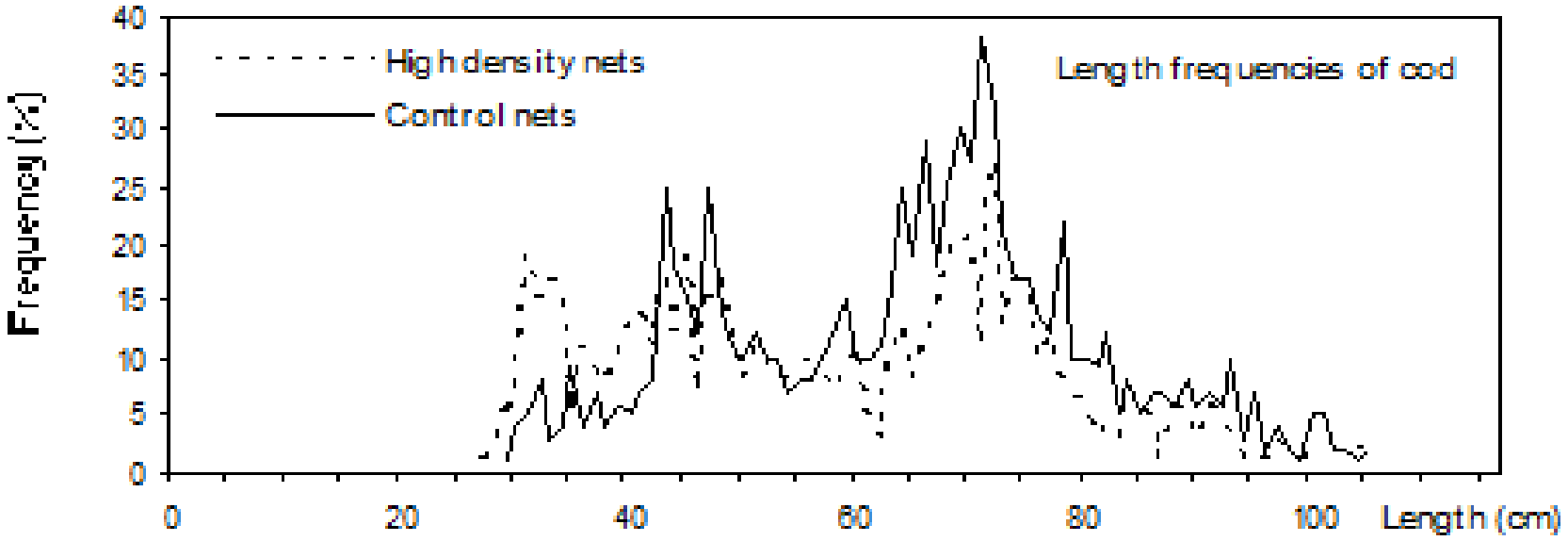
RESULTS - Danish trial



- Target species CPUE reduction = 29 %
- Worse by weight
- Even worse by value

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RESULTS - UK trial

NET TYPE	CATCH (numbers)		HOLES	EFFORT (hauls)	CPUE (numbers/hauls)	
	Porpoises	Seals			Porpoises	Seals
Nylon	3	5	105	173	0.017	0.029
BaSO4	8	10	76	171	0.047	0.058
					P < 0.1	P < 0.2

Nylon vs. BaSO4:

- Bycatch probably not related to acoustic properties of nets
- Smaller mesh size and larger twine size of BaSO4 nets favours retention of bycatch

Danish trials vs. UK trials:

- Differences maybe related to mesh size (156 mm vs. 241-267 mm)

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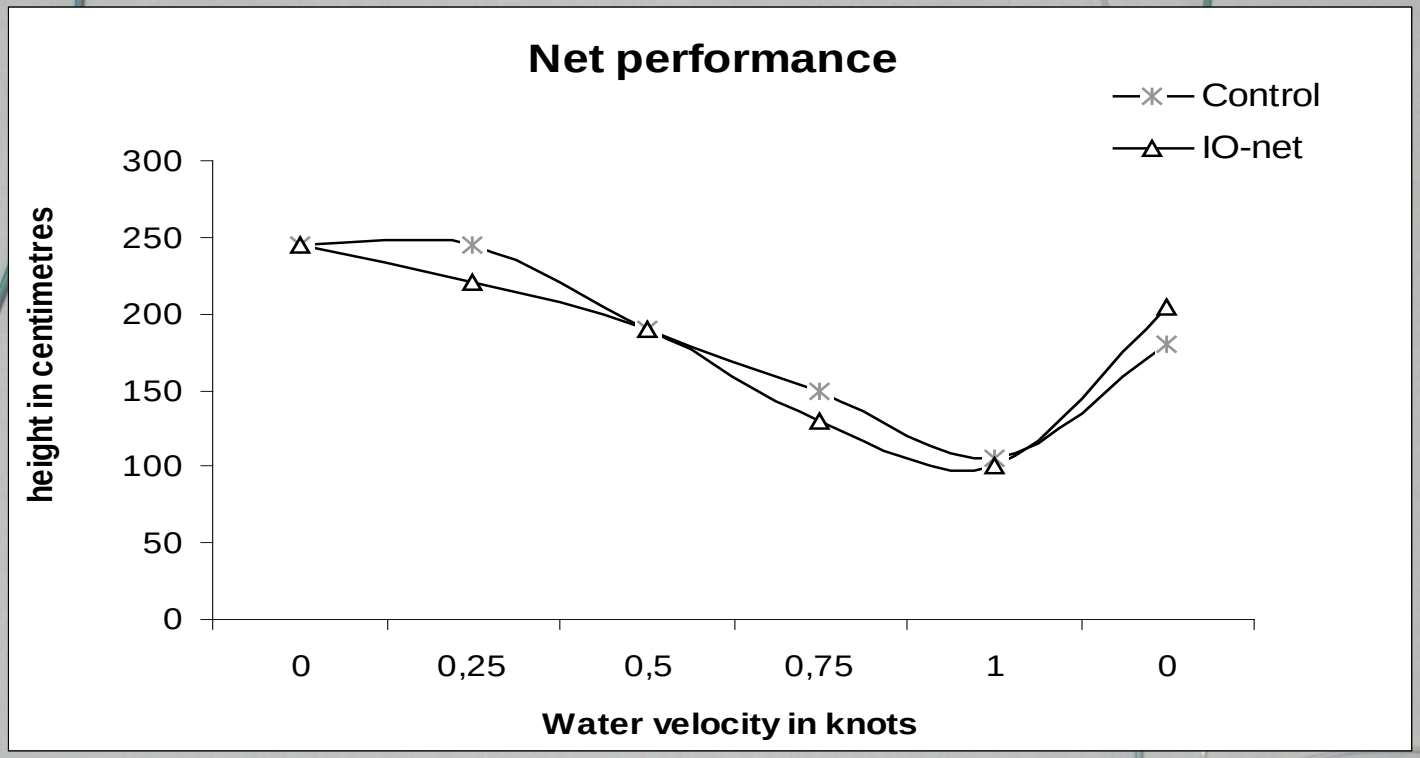
NET BEHAVIOUR AND STIFFNESS



STIFFNESS	Nylon	Iron oxide
E-module	784 MPa	2617 MPa

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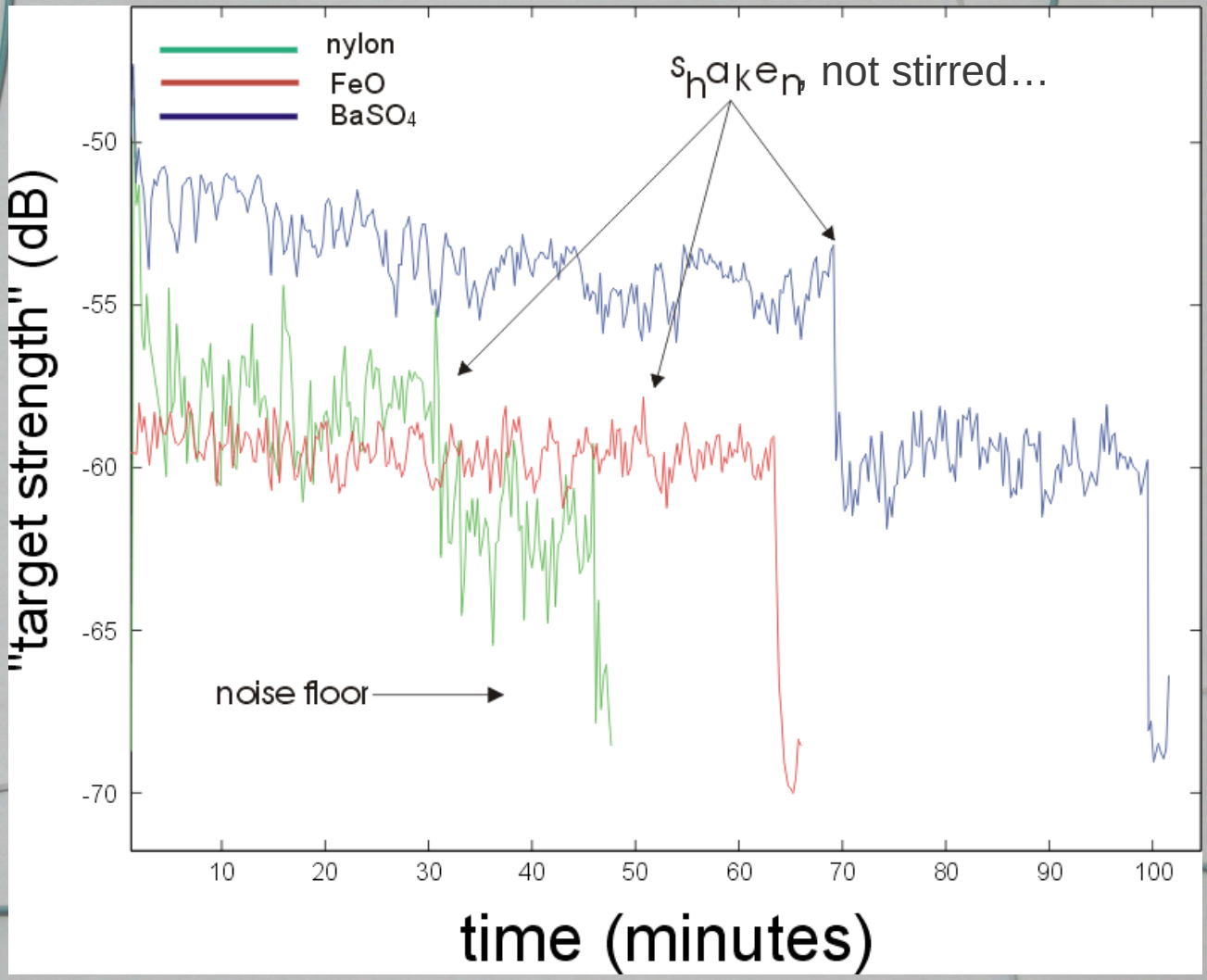
TARGET STRENGTH



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CONCLUSION

MECHANICAL PROPERTIES of the nets	DIFFERENT	CAUSE of differences in catch
Hanging ratio	NO	NO
Mesh size	NO	NO
Twine size	NO	NO
Target strength	NO	NO
Specific gravity	YES	NO
Colour	YES	NO
Stiffness	YES	YES

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BYCATCH HYPOTHESES

1. Porpoise cannot detect nylon gillnets at sufficient distance to avoid entanglement
2. Porpoises do not use their sonar all the time
3. Porpoises detect the nets but do not perceive them as an obstacle
4. Porpoises are distracted in the vicinity of the nets

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BYCATCH HYPOTHESIS 1

Porpoise cannot detect nylon gillnets at sufficient distance to avoid entanglement

- Hatakeyama & Soeda (1990)
  - estimated 2 m detection distance
- Kastelein *et al.* (2000)
  - estimated 3-6 m detection distance
- Mooney *et al.* (2004)
  - estimated 3-5 m detection distance
- Villadsgaard, Wahlberg & Tougaard (2007)
  - estimated harbour porpoise SL ≈ 205 dB
  - corresponds to 13-26 m detection distance

- **Conclusion: Hypothesis 1 can be rejected**

Detection Distance

is a function of:

Source Level

Ambient noise

Target Strength

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BYCATCH HYPOTHESIS 2

Porpoises do not use their sonar all the time

- Verfuss *et al.* (2005)
  - in captivity
  - sonar used continuously
  - in daylight & good visibility
- Akamatsu *et al.* (2007)
  - in the wild
  - 90 % silent periods < 20 s
  - 4 % silent periods >50 s
  - scanning ahead c. 50 m
  - 148 dB threshold
- **Conclusion: Hypothesis 2 can probably be rejected, but more studies of animals in the wild are needed**

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BYCATCH HYPOTHESES 3 and 4

Porpoises do not perceive the nets as an obstacle

and/or

Porpoises are distracted in the vicinity of the nets

- Kastelein *et al.* (1995)

- If true, will it help to increase TS and how much is needed ?
  - TS of a 20 cm herring is -40 dB
  - TS of a 25 cm herring is -38 dB
  - This corresponds to a nylon twine diameter of 1.5 – 2 mm
  - Alternatively, with a twine diameter of 0.58 the net needs to be made of steel

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RESEARCH NEEDS

- We need to know why porpoises are caught in gillnets
  - Studies of fine-scale behaviour of porpoises around gillnets
  - Direct observations of bycatch
- We also need studies of :
  - Acoustic behaviour in the wild, *e.g.* using data loggers on animals
  - Detection experiments in noise

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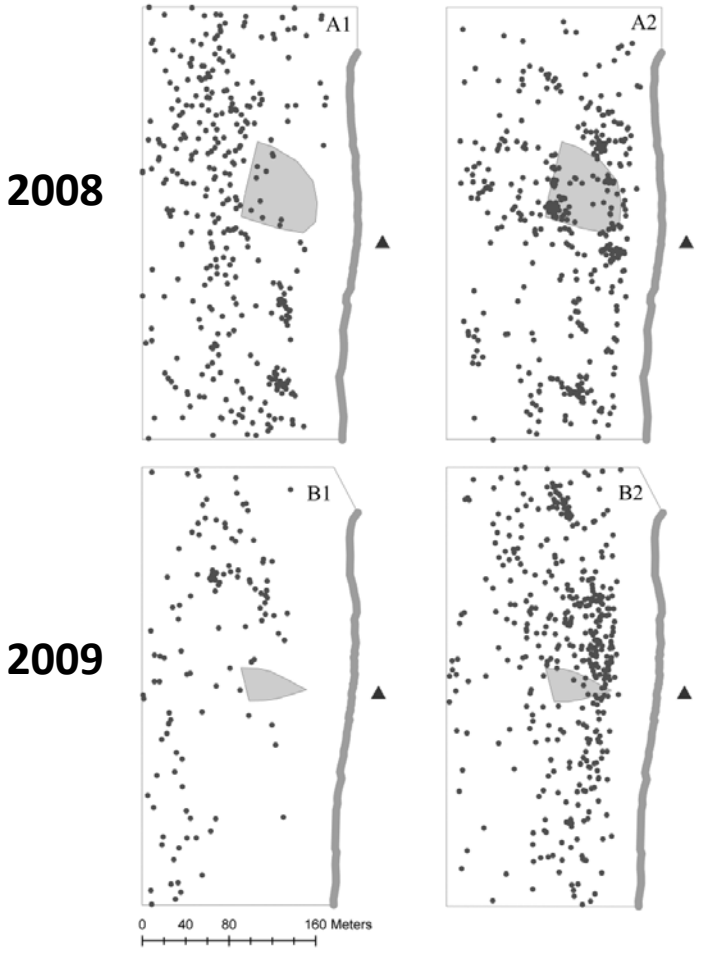
Porpoise behaviour around gillnets

from Nielsen *et al.* In press in MEPS



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