

Effects of sonar on social behaviour



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SEA MAMMALS AND SONAR SYMPOSIUM

TNO innovation
for life

Social cetaceans depend on group-members

Access to females - Foraging - Alloparental care



Sociality can be major determinant of response

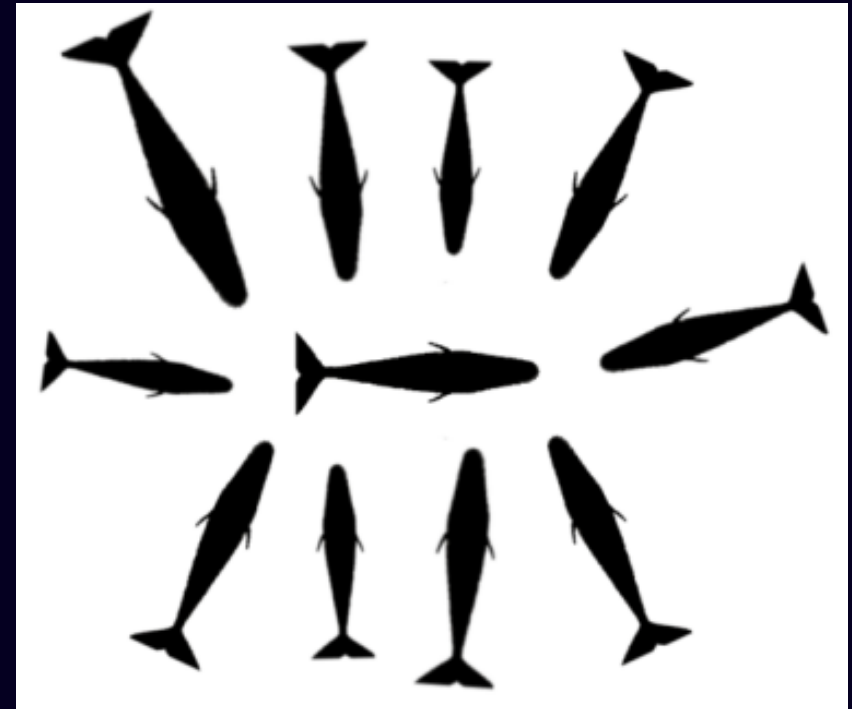
Natural threats & anthropogenic disturbance

Social animals:

Capability to respond in coordinated fashion

Significant reduction of disturbance-associated risk and cost to individuals

Response-tactic choice influenced by group-members



Sperm whales: predator defense



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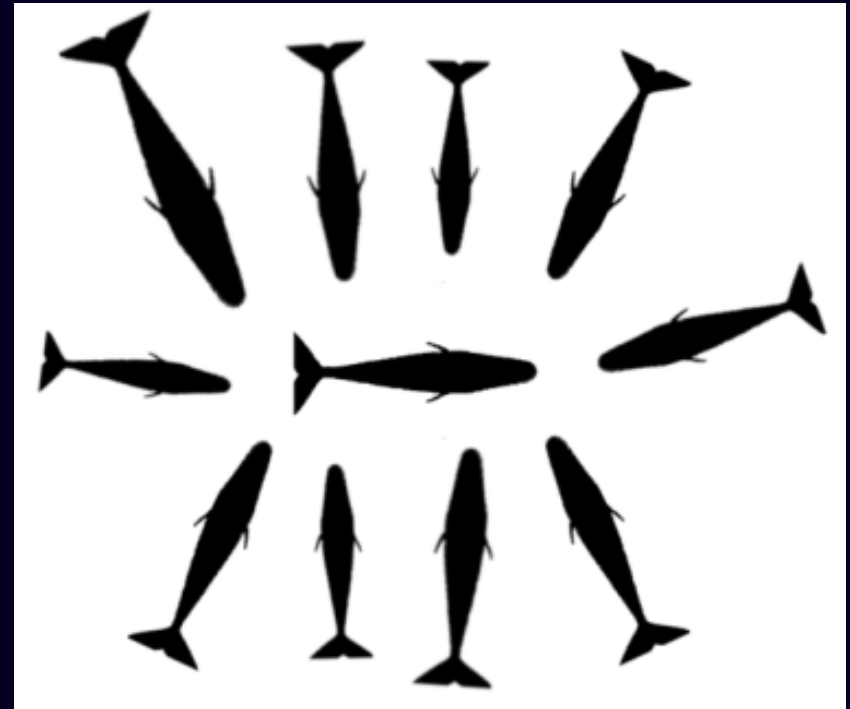
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*Role of sociality and choice of response tactic poorly understood
Biological significance?*






Sperm whales: predator defense



3S: Explore social toothed whale response tactics and biological significance of behavioural responses



Comparison of magnitude and type of responses of long-finned pilot whales to:

	NAVAL SONAR	Powerful, approaching sound source	Anthropogenic, novel?
	TAGGING	Noise + targeted pursuit	Anthropogenic, novel?
	KILLER WHALE SOUNDS	Predator/Competitor presence	Natural, responses shaped by evolution



METHODS

Integration of visual observations of
group-level behavior



Parameters of group and vocal behaviour

Group size
Nr with 200 m
Distance to group

AGGREGATION



Group spacing
Surfacing synchrony

COORDINATION &
SYNCHRONY



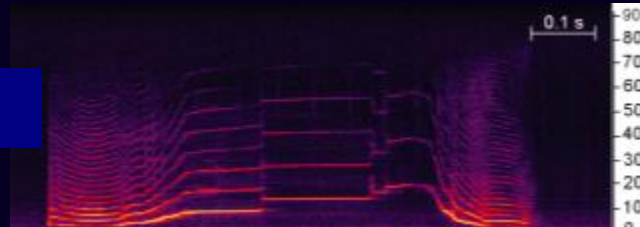
Logging

SURFACE ACTIVITY



Calling
Silence
Fully vocal

VOCAL BEHAVIOUR



TAG



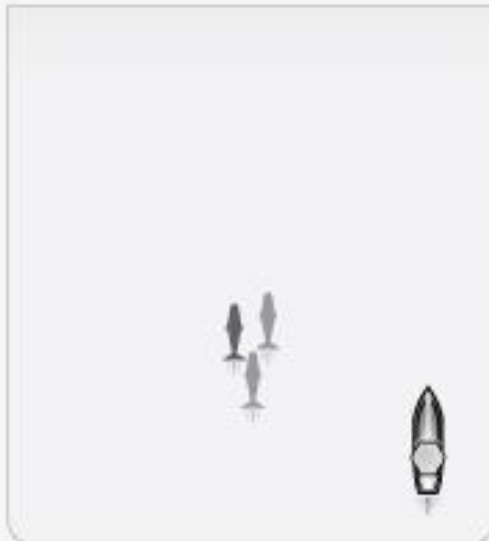
SONAR



KW



BASELINE



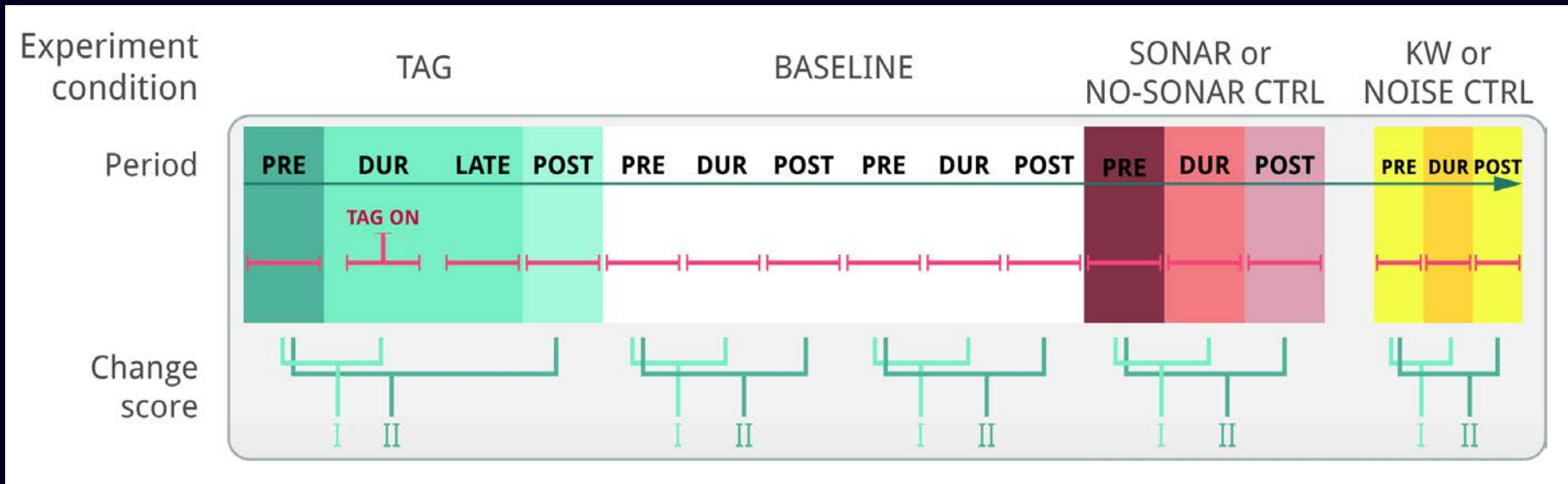
NO-SONAR CTRL



NOISE CTRL



Analysis of response: Change score



1. Define PRE, DURING and POST phases each condition
2. Calculate change scores

Does behaviour change during?

$$I = \text{CHANGE DURING} - \text{PRE}$$

Has it recovered post-exposure?

$$II = \text{CHANGE POST} - \text{PRE}$$



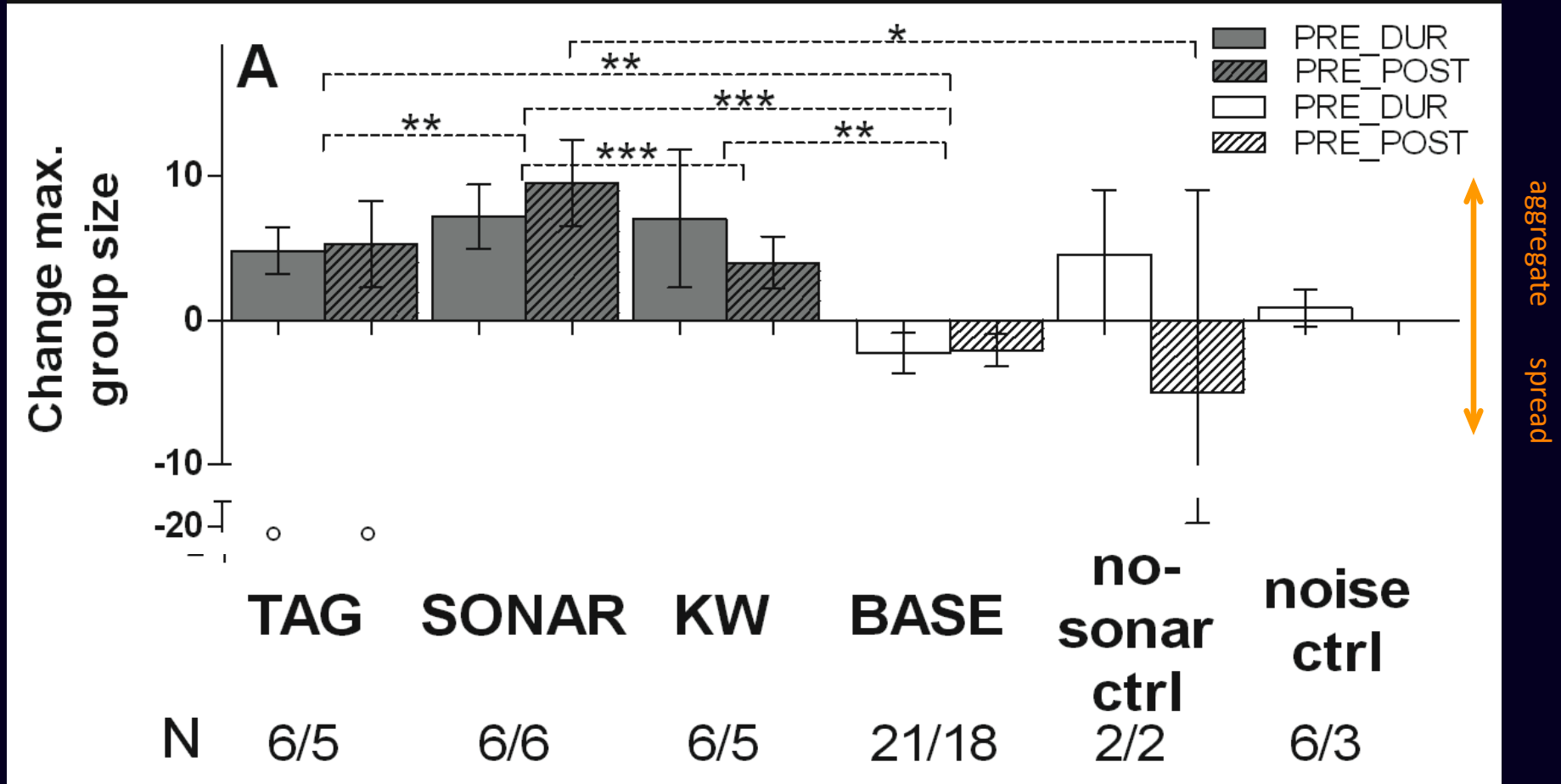
RESULTS

LF pilot whale social behavioural
response to sonar



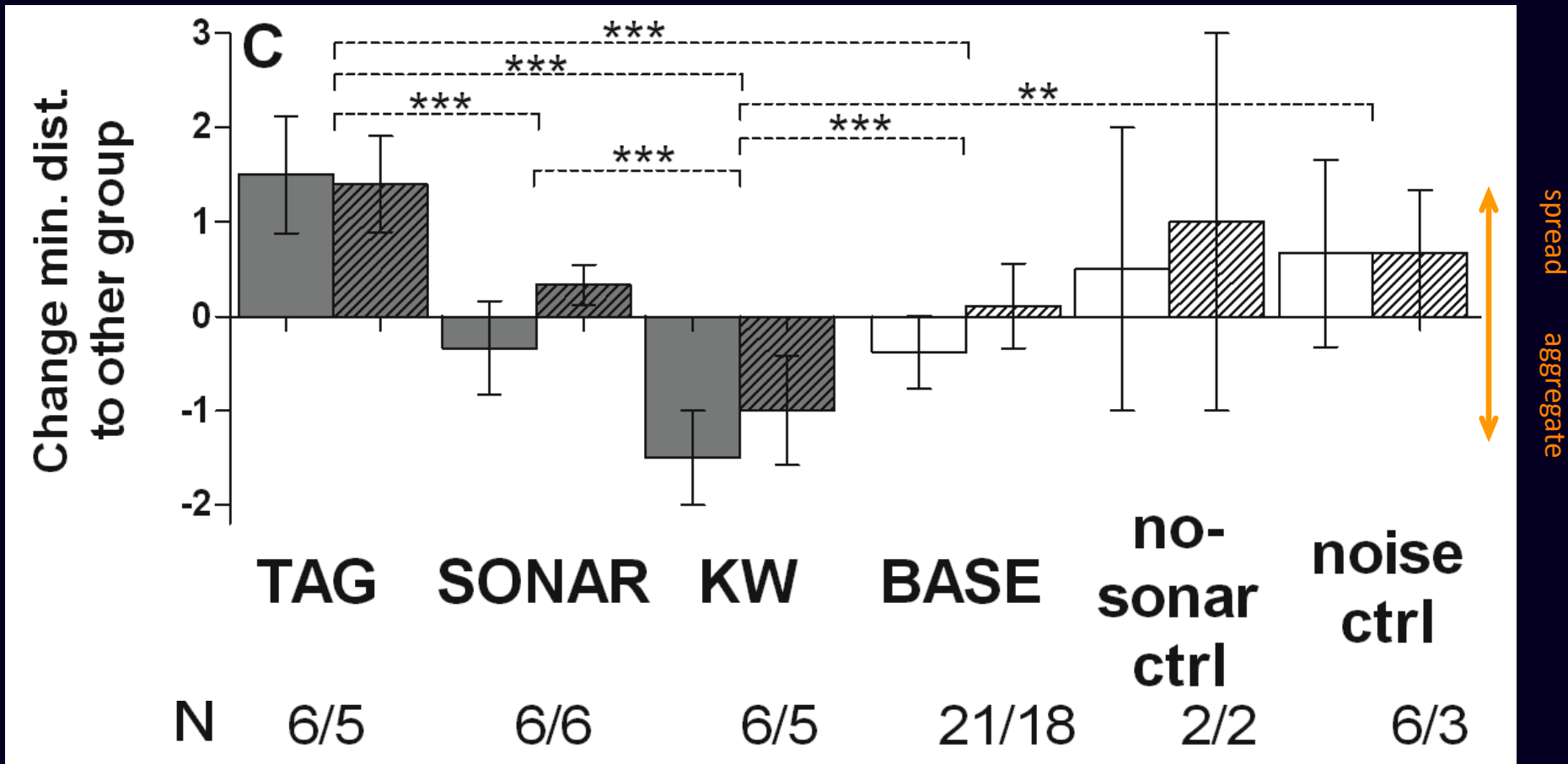
Increase group size during all 3 disturbance types

Changes larger than during baseline, strongest during sonar






Groups aggregate during KW, but move apart during TAG

Changes larger than during baseline, no response during sonar



Summary of responses

<p>TAGGING Noise + targeted pursuit</p>		<p>Increase group size & synchrony Reduce surface resting Can become silent Other groups move away</p>
<p>KILLER WHALE PB Predator/competitor</p>		<p>Strong aggregation¹ Increase calling (post)</p>
<p>SONAR Powerful, approaching sound source</p>		<p>Increase group size Increase surface resting</p>



Conclusions and Discussion

Response-tactics and biological significance



Unifying characteristic: increase cohesion

- All 3 disturbance types result in enhanced social cohesion
 - Reduce risk of loss of group coordination
 - Mechanism to maintain cohesion is disturbance-specific
 - Driver of response-tactics?
-



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Disturbance-specific responses

Natural disturbance

- KW sounds: mobbing-type response¹

Adaptive?
Yes: shaped by
evolution

Anthropogenic disturbance

- Tagging: within-group increase of cohesion
and synchrony
- Sonar: surface-convening response

?

?





Biological significance of sonar response?

Responses to naval sonar¹

- relatively high avoidance threshold (RL 179 dB)
- preference for surface
- surface strategy ≠ reduced SEL
- synchronous surfacing w sonar pulse
- increase group cohesion & logging
- no evidence for cryptic behaviours (e.g. silencing)
- vocal matching





Biological significance of sonar response?

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Sonar response-tactic

- Do not *a priori* want to get away, or hide from
- But: unpredictable (source path, level), novel
- Perceive as risk of potential loss of coordination (masking, disorientation)
- Aggregate at surface
 1. Use visual cues
 2. Anticipatory response:
 - Potential for stronger response, if necessary, without losing social cohesion
- Implications: lost foraging opportunities, especially during extended exposures



Consistent across studied toothed whales

Disturbance-specific & maintain/increase social cohesion



Funded by



Thank you for your attention

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