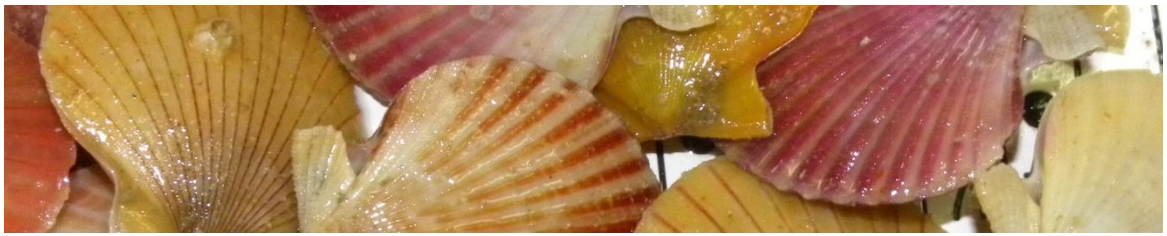
A systematic review and meta-analysis on the effects of mobile bottom fishing on the benthos



Dr. Kathryn Hughes
Prof. Michel Kaiser
Dr. Jan Hiddink

Trawling Best Practices Group
http://trawlingpractices.wordpress.com/

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1884

Trawling Best Practice Project

http://trawlingpractices.wordpress.com/

Trawling

Finding common ground on the scientific knowledge regarding best practices

HOME | STUDY COMMITTEE | PROJECT PROPOSAL | MEETINGS | DATASETS | RESULTS | COMMENTS | MEMBERS ONLY

Photo: Allan Hicks

One of the most contentious issues in management of marine fisheries is the use of mobile bottom contact gears, trawls and dredges. About 25% of world fish catch comes from the use of these gears and catch from trawls is an important element i food security in much of the world. At present, a continental shelf area approximately equivalent to 3 times the ar of Brazil is affected by mobile bottom contact gear. Trawls can dramatically

WHAT'S NEW

The report from the second meeting of the working group is now available click here

Funders…Thank You!

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Systematic Review: A tool for evidence based practice

- A method used commonly in medical science and only relatively recently in ecology
- Aims to summarise, appraise and communicate results and implications from a collection of primary research
- A systematic Review should be
  - Reliable
  - Repeatable
  - Robust

The 3 R's
Reducing the risk of bias

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Systematic Review

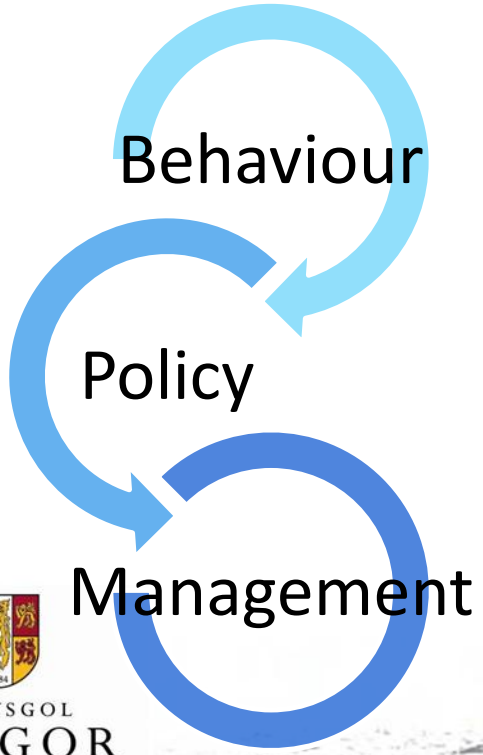
LIMITATIONS	ADVANTAGES
Need a well-defined question Need access to literature (incl. grey) Can be relatively costly	Can use all previous types of synthesis Can be updated Transparent, objective, repeatable: robust to criticism Formal methodology to follow Minimization of bias Systematic search and capture of evidence Critical appraisal of quality of evidence

Process Flow

Planning	Conducting	Reporting
• Question • Protocol	• Searching • Article Screening • Data Extraction • Critical Appraisal • Synthesis	• Final Review • Dissemination

Research Questions: Stakeholder Engagement…

- Stakeholder consultation
  - 1:1 discussion (WWF, MSC, industry groups)
  - Formal consultative process



- 108 separate questions
- 4 categories (ecosystem productivity; Direct effects; Operational; Management indicators)
- 22 questions were highlighted as answerable by the TBP project
- All 22 questions were used to shape the primary and secondary research questions for the systematic review

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Primary Research Question

To what extent does mobile bottom fishing affect the numerical abundance or counts, biomass and diversity of benthic biota?

Image taken from:
"IESA-FAO.ORG; Water and Agriculture. Posted on 17.02.2014" Taken on 16.06.14
http://iesa-fao.org/macrozoobenthos-indicator-environmental-pollution.html

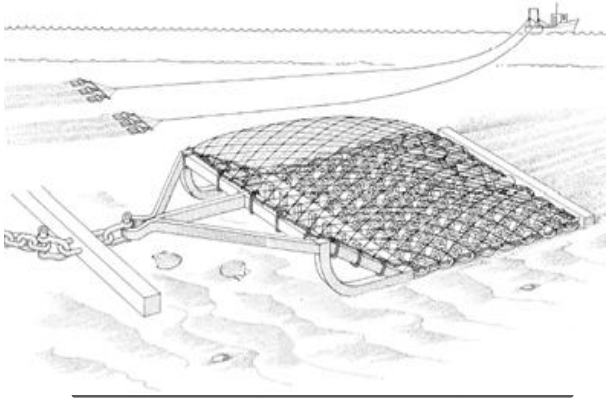
Secondary Research Questions

How does the following influence the effect mobile bottom fishing has on marine benthic biota…

1. Gear

2. Habitat

3. Gear x Habitat



Images of trawl gear taken from Jennings et al. 2001
© S. R. Jennings

Video From: Bangor University, Fisheries and Conservation Science Group – Harriet Solmonsen
http://fisheriesconservation.bangor.ac.uk/vidimg.php.en?menu=9&catid=10958&subid=0

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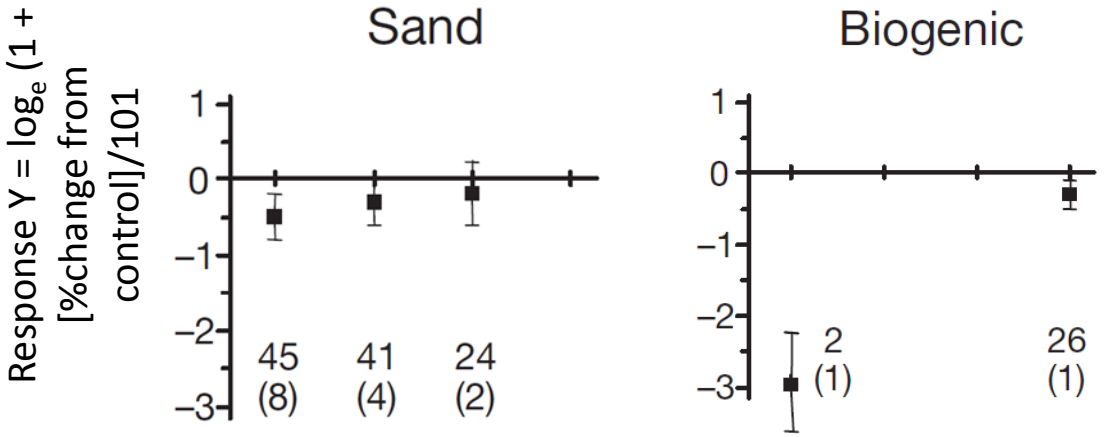
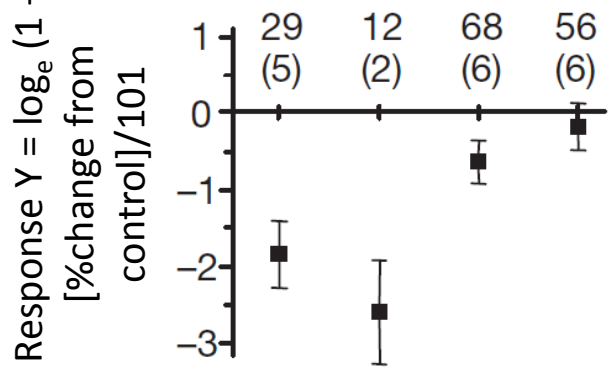
Secondary Research Questions:

Scallop Dredging



Intertidal Dredging



Taken from Kaiser *et al.* 2006

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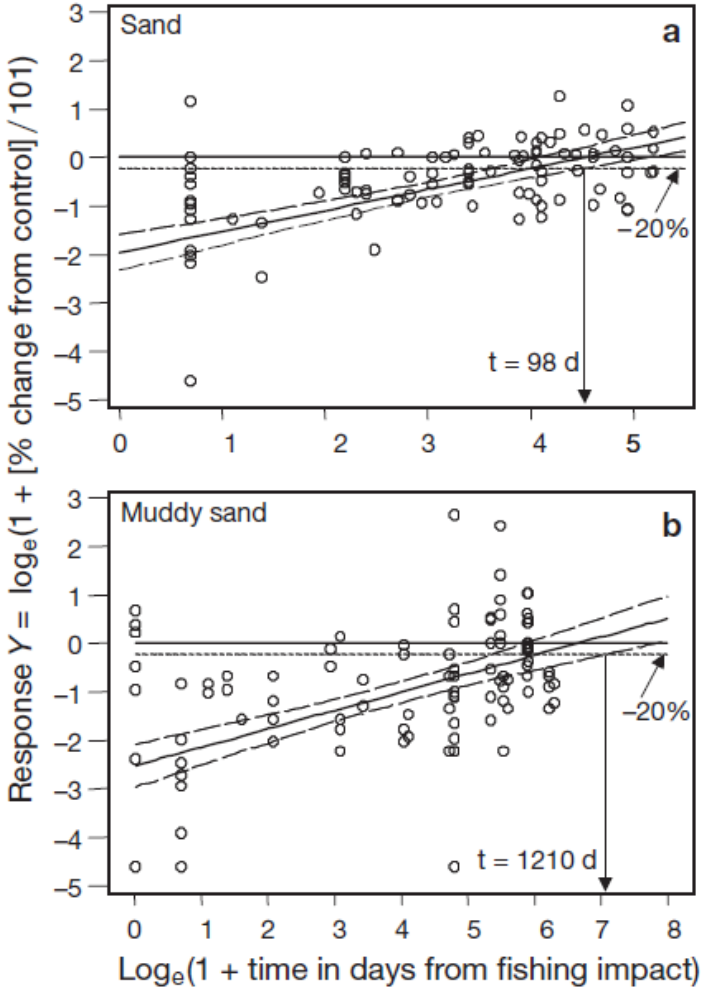
Secondary Research Questions:

4. How might species diversity affect the resilience (including recovery potential) of a community to bottom fishing activities?



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Search strategy

fauna OR *benth* OR scaveng* OR by$catch OR maerl OR coral* OR biota OR biogenic OR (hard AND bod*) OR (soft AND bod*) OR *flora* OR *invertebrate*

← Population

AND

trawl OR ((bottom OR mobile OR towed OR commercial OR benthic OR demersal) AND fishing) OR harvest* OR *dredg* OR digging OR (bait AND collect*) OR *raking OR scallop drag* OR dragging

← Intervention

AND

(experiment* OR comparative OR BACI OR ((differ* OR known OR gradient OR range OR vari* OR change OR contrasting OR distinct) AND (fishing OR trawling OR dredging OR dragging OR disturbance) AND (pressure OR level OR amount OR frequencies OR intensities OR histories)) OR ((trawled OR fished OR disturbed OR harvest* OR heavily OR within OR impact OR inside OR after OR following OR treatment OR trial) AND (un$trawled OR non$fished OR un$fished OR un$disturbed OR un$harvested OR non$harvested OR lightly OR outside OR before OR prior OR adjacent OR control OR reference OR protected OR MPA OR closed)))

← Comparator

- 3 Websites
- 23 Databases
- 35 Specialist sources

} 61 sources

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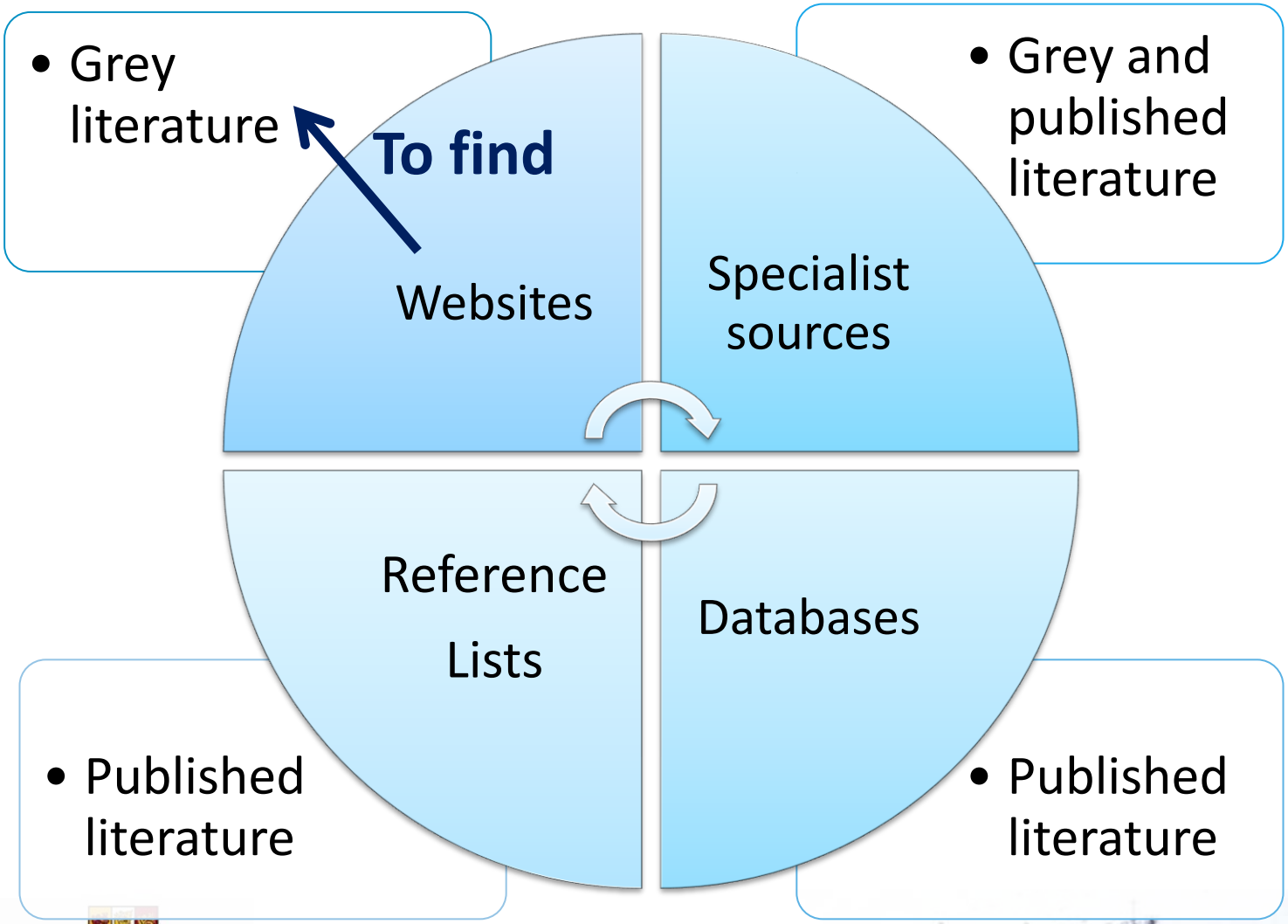
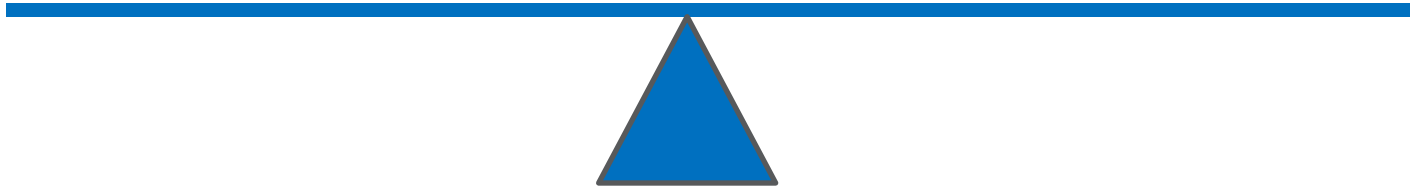
Search strategy



Search strategy

Sensitivity Specificity



- 98 different search “phrases” were tested for suitability using Web of Science
- Web of Science produced c. 20,000 references, all of which were exported
- Each website differs – adapt the search string accordingly
- Overall 7 different variations of the search string was used
- All searching must be recorded to ensure repeatability and transparency

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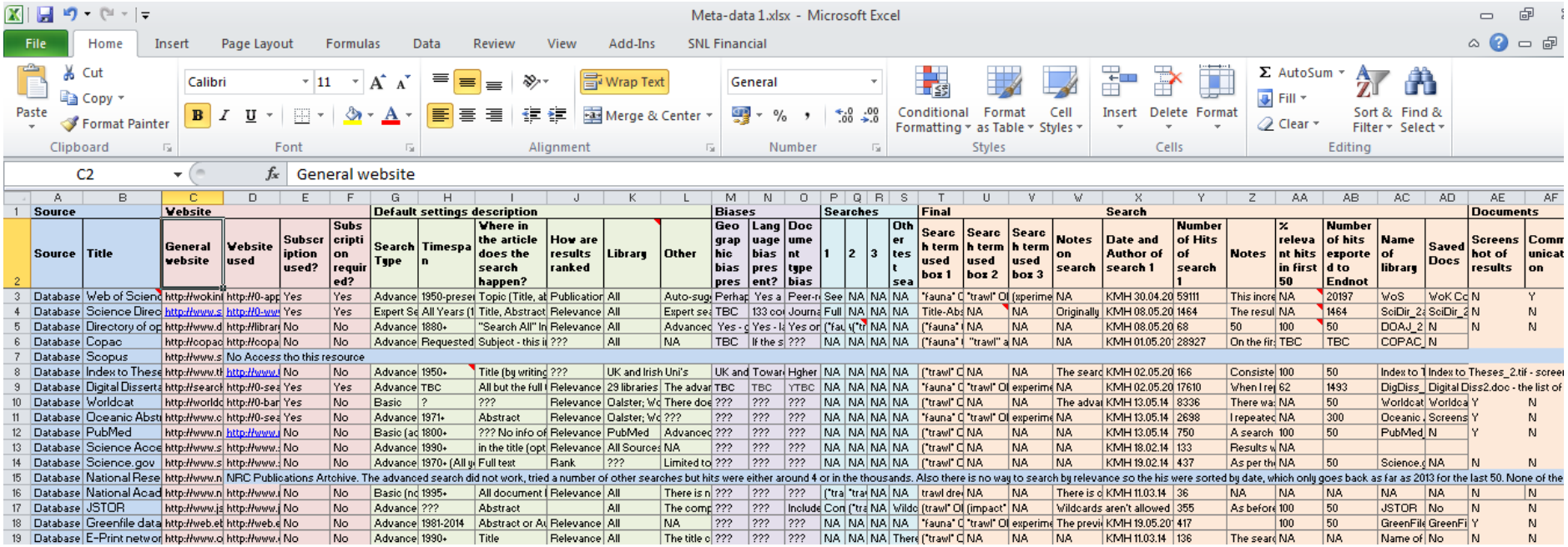
Search strategy



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2	Source	Title	General website	Website used	Subscription used?	Subscription required?	Search Type	Timespan	Where in the article does the search happen?	How are results ranked	Library	Other	Geographic bias present?	Language bias present?	Document type bias	1	2	3	Other test sea	Search term used box 1	Search term used box 2	Search term used box 3	Notes on search	Date and Author of search 1	Number of Hits of search 1	Notes	% relevant hits in first 50	Number of hits exported to Endnot	Name of library	Saved Docs	Screenshot of results	Communication
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15	Database	National Rese	http://www.n	NRC Publications Artchive. The advanced search did not work, tried a number of other searches but his were either around 4 or in the thousands. Also there is no way to search by relevance so the his were sorted by date, which only goes back as far as 2013 for the last 50. None of the																												
16	Database	National Acad	http://www.n	http://www.r	No	No	Basic (nc	1995+	All document	Relevance	All	There is n	???	???	???	("tra	"tra	NA	NA	trawl dre	NA	NA	There is c	KMH 11.03.14	36	NA	NA	NA	NA	NA	N	N
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- Repeatable
- Reliable
- Robust

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Inclusion/Exclusion Criteria

- Title
- Abstract
- Full Text

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Inclusion/Exclusion Criteria

Relevant subjects(s): Marine benthic biota (flora and fauna)

Types of exposure: Experimental or comparative bottom fishing activities

Types of comparator: No or less exposure to bottom fishing gear

Types of outcome: Measurable effect (i.e. change and no change are both effects, so non-significant results will be included) in a component of benthic biota (species, taxon, trophic group etc.)

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Inclusion/Exclusion Criteria

- The Kappa statistic – formal measure of agreement between reviewers
- Tests the level of consistency with the inclusion/exclusion criteria
- Applicable usually on the abstract and full text stage
- We have tested the kappa statistic also with the title stage

0.4 – 0.59	**FAIR AGREEMENT**
0.6 – 0.74	**GOOD AGREEMENT**
0.75 +	**EXCELLENT AGREEMENT**

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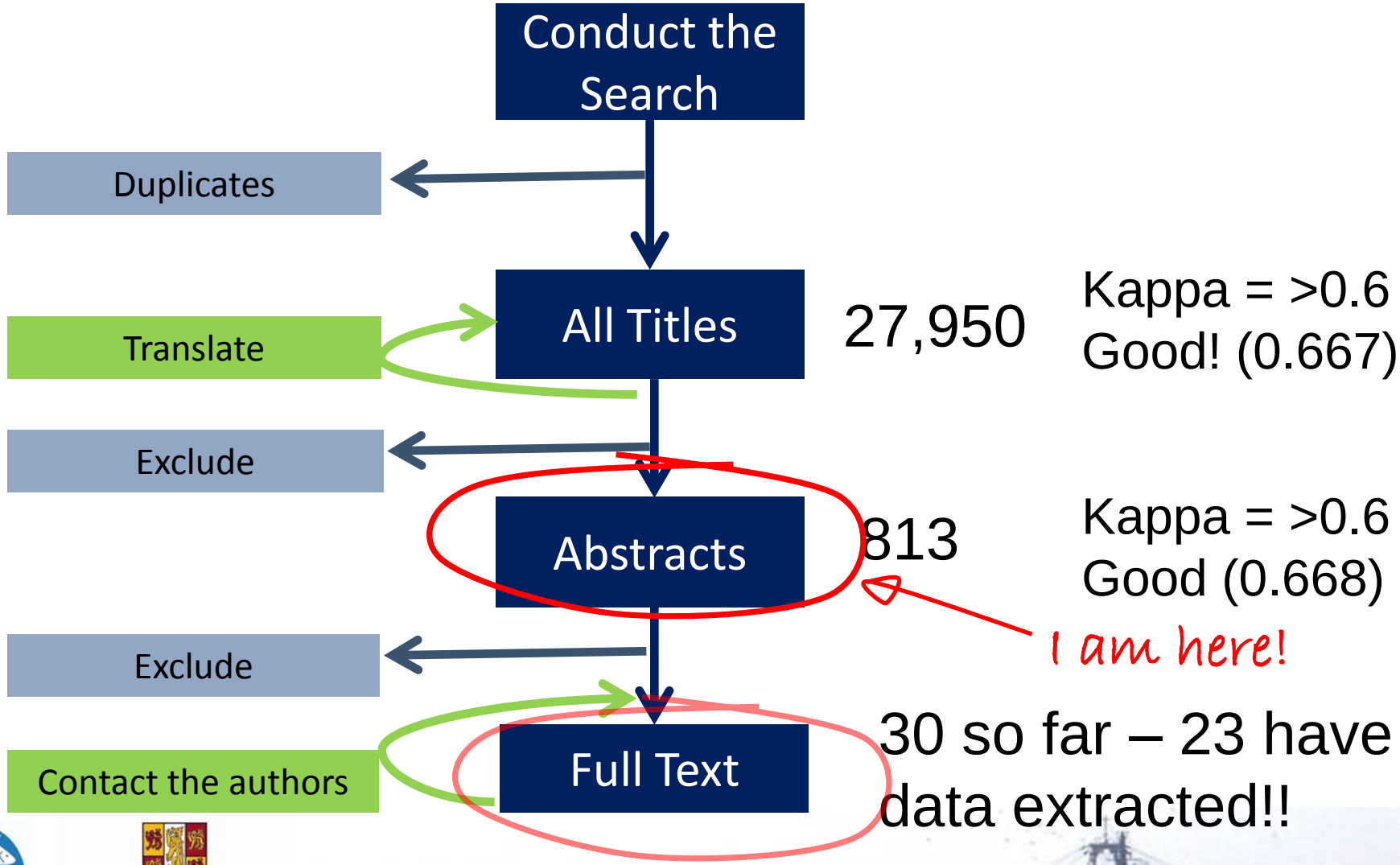
Inclusion/Exclusion Criteria



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Vol. 306: 63–78, 2006 | MARINE ECOLOGY PROGRESS SERIES
Mar Ecol Prog Ser

Impacts of otter trawlin

ISSN: 0001-5113
AADRAY

ACTA ADRIAT.,
47 (2): 183 - 193, 2006

UDC: 639.2 (450) (262.3)

Large-scale re

Seabed morphology, sediment grain size, and macrobenthic

ffected by fishing

Vol. 430: 241–255, 2011
doi: 10.3354/meps08956

MARINE ECOLOGY PROGRESS SERIES
Mar Ecol Prog Ser

Published May 26

Contribution to the Theme Section 'Evolutic

Ecological Applications, 19(3), 2009, pp. 761–773

Effects of demersa
southern Africa:

L. J. Atki

[1]Marine Research Institute, and [2]Zoology
[3]Department of Envi

2040 SE Marine Sci
Newport, Oregon 9

[2] Alaskan Observers, I
130 Nickerson, #20
Seattle, Washington

Effects of ex

Trawl disturbance on benthic communities: chronic effects and experimental predictions

HILMAR HINZ,[1] VIRGINIA PRIETO, AND MICHEL J. KAISER

School of Ocean Sciences, University of Wales, Bangor, Menai Bridge, Anglesey, LL59 5AB United Kingdom

Abstract. Bottom trawling has widespread impacts on benthic communities and habitats. While the direct impacts of trawl disturbances on benthic communities have been extensively studied, the consequences from long-term chronic disturbances are less well understood. The

Western Bank, northwest Atlantic Ocean

Ellen L.R. Kenchington [a,*], Kent D. Gilkinson [b], Kevin G. MacIsaac [a],
Cynthia Bourbonnais-Boyce [a], Trevor J. Kenchington [a],
Stephen J. Smith [a], Donald C. Gordon Jr. [a]

l and Agriculture, Isle of
nd Coastal Studies Ltd.

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Critical Appraisal

Design – (BACI, CI…)
Outcome measures – appropriate and accurate?
Baselines measure – appropriate and present?
Comparator – suitable and present?
Randomisation – between treatments
Heterogeneity – were the groups being compared fundamentally different in essence?
Level of replication – is this suitable, are replications confounded

Internal Validity – Study Quality
External validity – Generalisability

Understand potential bias, how this impacts the effect shown in the study and assess the impact on the overall conclusions

Gold Standard not always achieved – compromise is often necessary
Bias does not mean poor research

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Critical Appraisal

Table 3 Variables assessed and criteria used for critical appraisal of included studies

		Low Susceptibility to Bias	High Susceptibility to Bias
Study design	Study season, length	Long (>3 months) study period, multiple seasons	Short (<3 months) study period, winter measurement
	Intervention timescale	Long-term intervention maintained for multiple years	Intervention in place for <2 years
	Replication, randomisation	Replication at level of intervention, large sample size (>3), some degree of randomisation in sample selection	Pseudoreplicated, low sample size (<3), no randomisation
	Control matching	Control and treatment/exposure samples well-matched (i.e. close in proximity but low chance of spillover effects)	No evidence of matching, potentially influential differences between treatment and control
	Clarity and detail of methods	General study design very clear and repeatable	Some missing information
Specific methodology	Eddy covariance measurement details	Full description of methodology, accounting for wind direction/speed	Some missing methodological detail, no accounting for wind direction/speed
	Flux chamber measurement details	Full description of methodology, measurement disturbance mitigation measures	Some missing methodological detail, no mitigation for measurement disturbance
	Soil porewater/air measurement details	Full description of methodology, representative sampling	Some missing methodological detail, sampling unlikely to be representative of variability in environment
	Surface water measurement details	Full description of methodology, representative sampling	Some missing methodological detail, sampling unlikely to be representative of variability in environment
Bias	Potential measurement bias	Measurement bias unlikely or evidently not present	Bias likely as a result of methodology
	Presence of confounders	No obvious confounders stated or evident, or stated but adequately accounted for	Confounders stated and unaccounted for or likely to be present

Unclear classification given to any study where substantial details within the methods are either unclear of missing.

Haddaway et al. 2014 Environmental Evidence 3: 5

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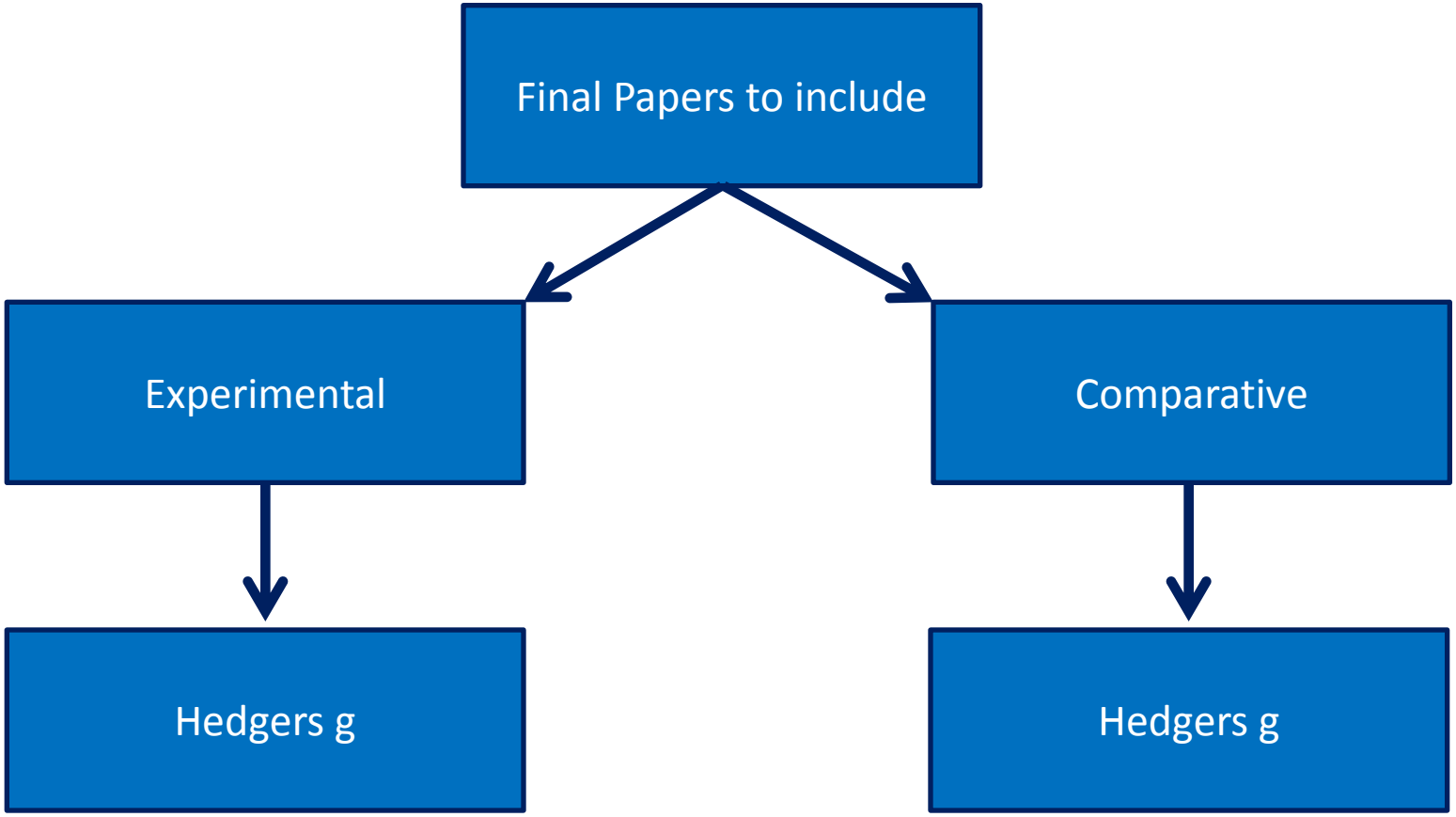
Analysis


Final Papers to include
Experimental
Comparative
Hedgers g
Hedgers g

Analysis…Effect size

$$d = \frac{\overline{x_1} - \overline{x_2}}{S_{within}}$$

$$S_{within} = \sqrt{\frac{(n_1 - 1)\,S^2 + (n_2 - 1)S^2}{n_{1+}\, n_2 - 2}}$$

$$Vd = \frac{n_1 + n_2}{n_1 n_2} + \frac{d^2}{2(n_1 + n_2)}$$

$$SEd = \sqrt{Vd}$$

$\overline{x_1}$ Sample mean (control)

$\overline{x_2}$ Sample mean (treatment)

n_1 Sample size (control)

n_2 Sample size (treatment)

S_1 Std Dev (control)

S_2 Std Dev (treatment)

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Analysis…Effect size

Hedgers g – Correction factor for small sample sizes “J”

$$J = 1 - \frac{3}{4df - 1}$$

$$g = J \times d$$

$$Vg = J^2 \times Vd$$

$$SEg = \sqrt{Vg}$$

Summary

Planning	Conducting	Reporting
~~•Question~~ ~~•Protocol~~	~~•Searching~~ •Article Screening •Data Extraction •Critical Appraisal •Synthesis	•Final Review •Dissemination

Summary

- A systematic review and meta-analysis is a timely update from previous reviews (Collie et al. 2000 & Kaiser et al. 2006)
- Experimental AND comparative studies will be used
- The whole process is repeatable, reliable and robust and transparency is paramount throughout
- Stakeholders have been involved in the question formulation
- SR & MA is an appropriate method for summarising large bodies of information the results of which can be used as a management tool for decision making in policy and management

Funders…Thank You!

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