Michel Kaiser and Andrew Pullin
Bangor University, UK

CEBC

Are temperate Marine Protected Areas Effective Tools for Sustainable Fisheries Management ?

Systematic Review 23
Centre for Evidence-Based Conservation
www.cebc.bangor.ac.uk

NATURAL ENVIRONMENT RESEARCH COUNCIL

The CEBC Goal: making environmental management more effective

- Focus on supporting decision-makers in policy and practice
- What works and what doesn't in the context of interventions?
- What are the likely impacts of new policy developments?
- What are the knowledge gaps/research priorities?

THE COCHRANE COLLABORATION

The reliable source of evidence in healthcare

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Cochrane Reviews on ISI!

Cochrane Colloquium!
Dublin, Ireland, 23-26 Oct. 2006
Previous Cochrane Colloquia

Collaboration for Environmental Evidence
systematic reviews for conservation & environmental management

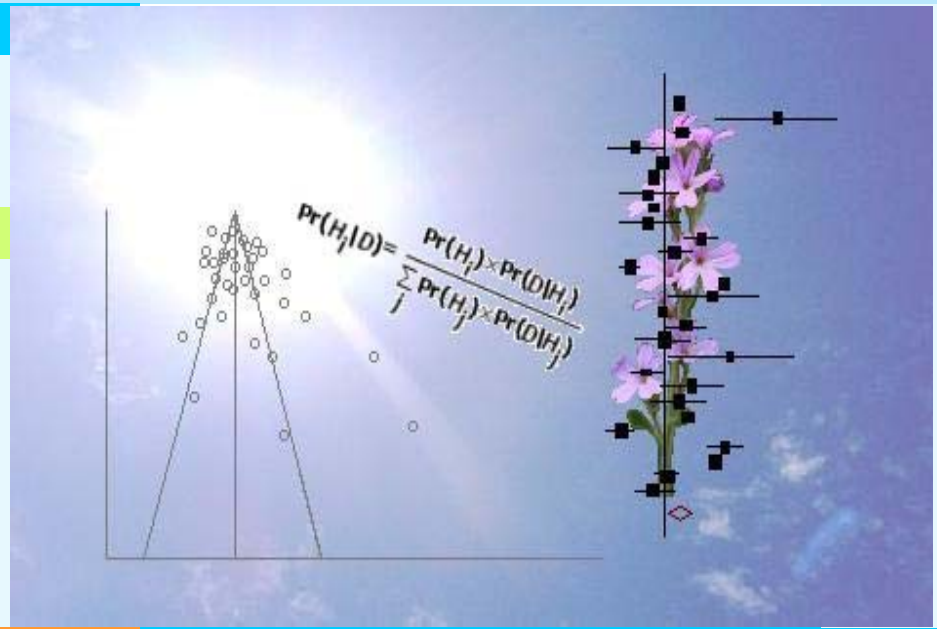
Welcome to the Collaboration for Environmental Evidence

CEE Home

- About CEE
- News and events
- Contact us

Resources - Get involved

- Introduction to systematic review
- Information for users
- Information for authors



Recently Added

Draft Protocol 32: effectiveness of plant introductions

Draft Protocol 31: Thinning of Spruce Stands and Survival of Spruce Seedlings

Library

- Library of Systematic Reviews
- Finalised Protocols
- Drafts for comment

Latest news...

Two new posts advertised at CEBC

CEE website goes live May 2007!
30th Draft protocol added to the site - in-stream wood placement and salmonids
Draft systematic review 13 available for consultation - salmonid stocking in lakes

www.environmentalevidence.org

Cochrane Review Groups

CEBC

Cochrane Acute Respiratory Infections Group
Cochrane Airways Group
Cochrane Anaesthesia Group
Cochrane Back Group
Cochrane Bone, Joint and Muscle Trauma Group
Cochrane Breast Cancer Group
Cochrane Colorectal Cancer Group
Cochrane Consumers and Communication Group
Cochrane Cystic Fibrosis and Genetic Disorders Group
Cochrane Dementia and Cognitive Improvement Group
Cochrane Depression, Anxiety and Neurosis Group
Cochrane Developmental, Psychosocial and Learning Problems Group
Cochrane Drugs and Alcohol Group
Cochrane Ear, Nose and Throat Disorders Group
Cochrane Effective Practice and Organisation of Care Group
Cochrane Epilepsy Group
Cochrane Eyes and Vision Group
Cochrane Fertility Regulation Group
Cochrane Gynaecological Cancer Group
Cochrane HIV/AIDS Group

Upcoming CEE review groups

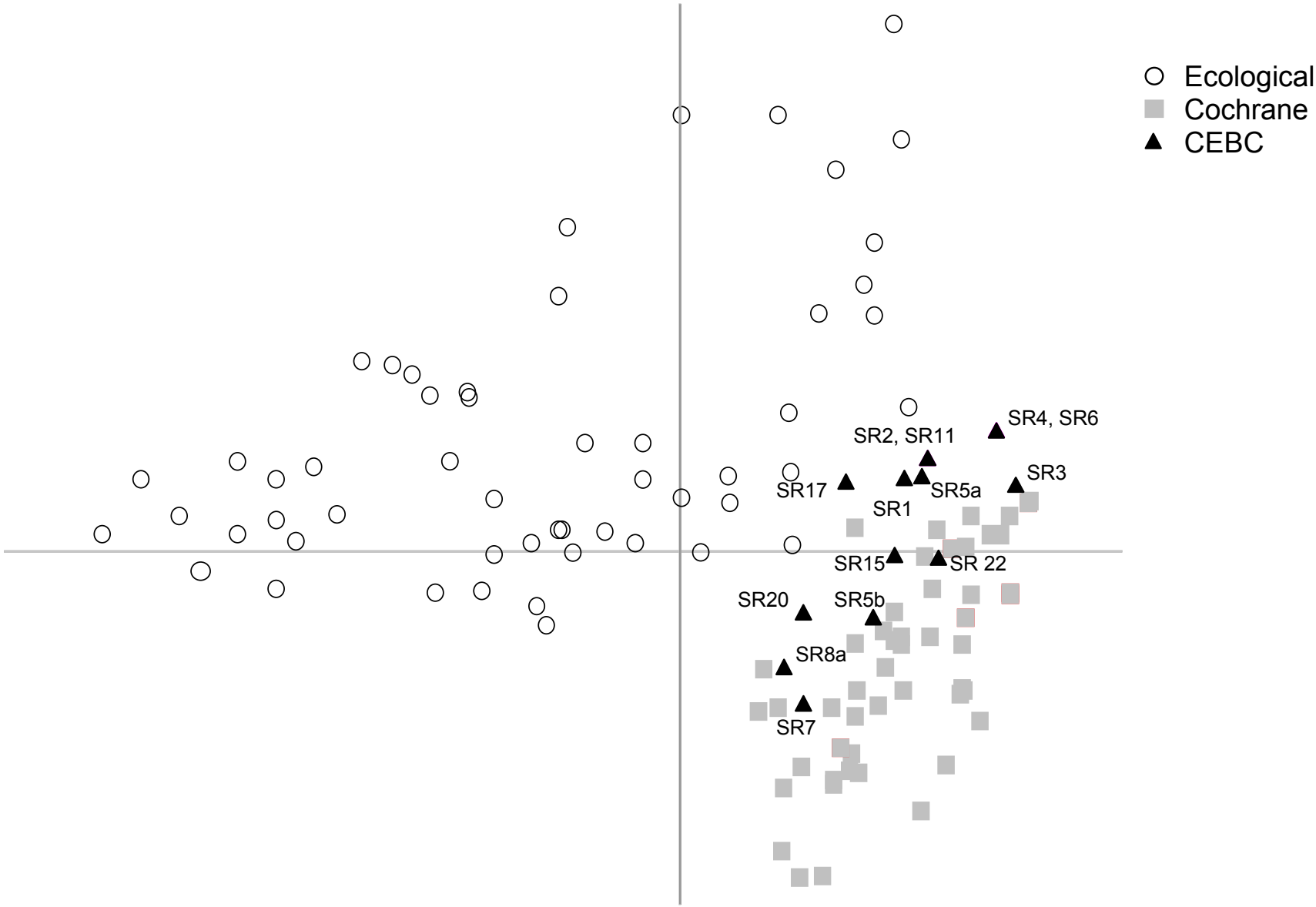
- Invasive species control
- Species re-introductions
- Impacts of aquaculture
- Biodiversity and ecosystem services
- Environment and public health
- Management of small populations
- Marine biodiversity conservation

Methodological development: Stages of a systematic review

- Formulating a question (stakeholder engagement)
- Generating a protocol (peer reviewed)
- Systematic searching
- Data selection
- Data quality assessment (critical appraisal)
- Data extraction
- Synthesis of data (meta-analysis)
- Implications

Guidelines now published as Pullin & Stewart 2006. Conserv. Biol.

Roberts, P.D., Stewart, G.B. & Pullin, A.S. (2006) Are review articles a reliable source of evidence to support conservation and environmental management? A comparison with medicine. *Biological Conservation* 132, 409-423.



DCA ordination of the three different classes of review.

SR 23 - Review Team

Are Marine Protected Areas Effective Tools for Sustainable Fisheries Management ?
I – temperate zone areas

Stewart, G.B., Côté, I.M., Kaiser, M.J., Halpern, B., Lester, S., Bayliss, H.R., Mengersson, K., & Pullin, A.S.

Draft available online in a week or so

Inclusion Criteria

- **Relevant subject(s):** All temperate marine taxa (with subgroups of conservation and/or commercial concern).
- **Types of intervention:** Implementation of fishing restrictions within MPA defined as geographically defined areas subject to fishing prohibition (no take).
- **Types of outcome:** Changes in abundance (density, biomass or species richness measures).

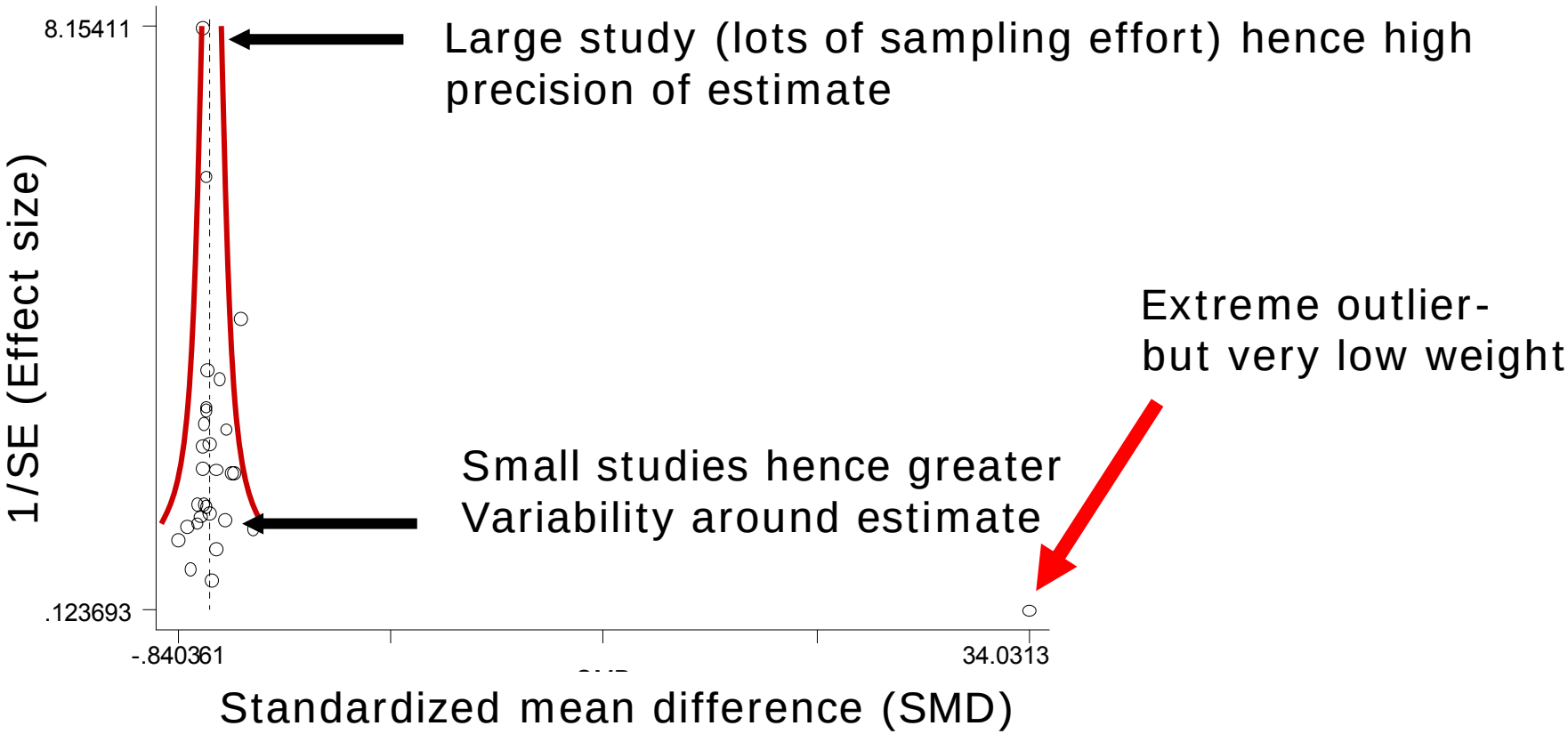
Review Statistics - Scope

- Search identified 3531 articles
- 34 studies on temperate MPAs provided data with a valid comparator
- Reporting on 30 independent MPAs
- year of establishment (1963 – 1998)
- size (0.01 – 300km^2)
- Depth (3 – 230m)
- number of taxa (1-202)

Review Statistics - Quality

- 31/34 studies were pseudo-replicated
- Original data extracted from each study and disaggregated as far as possible.
- Data synthesised using random effects meta-analysis based on standardised mean difference (Hedges d) and log response ratios

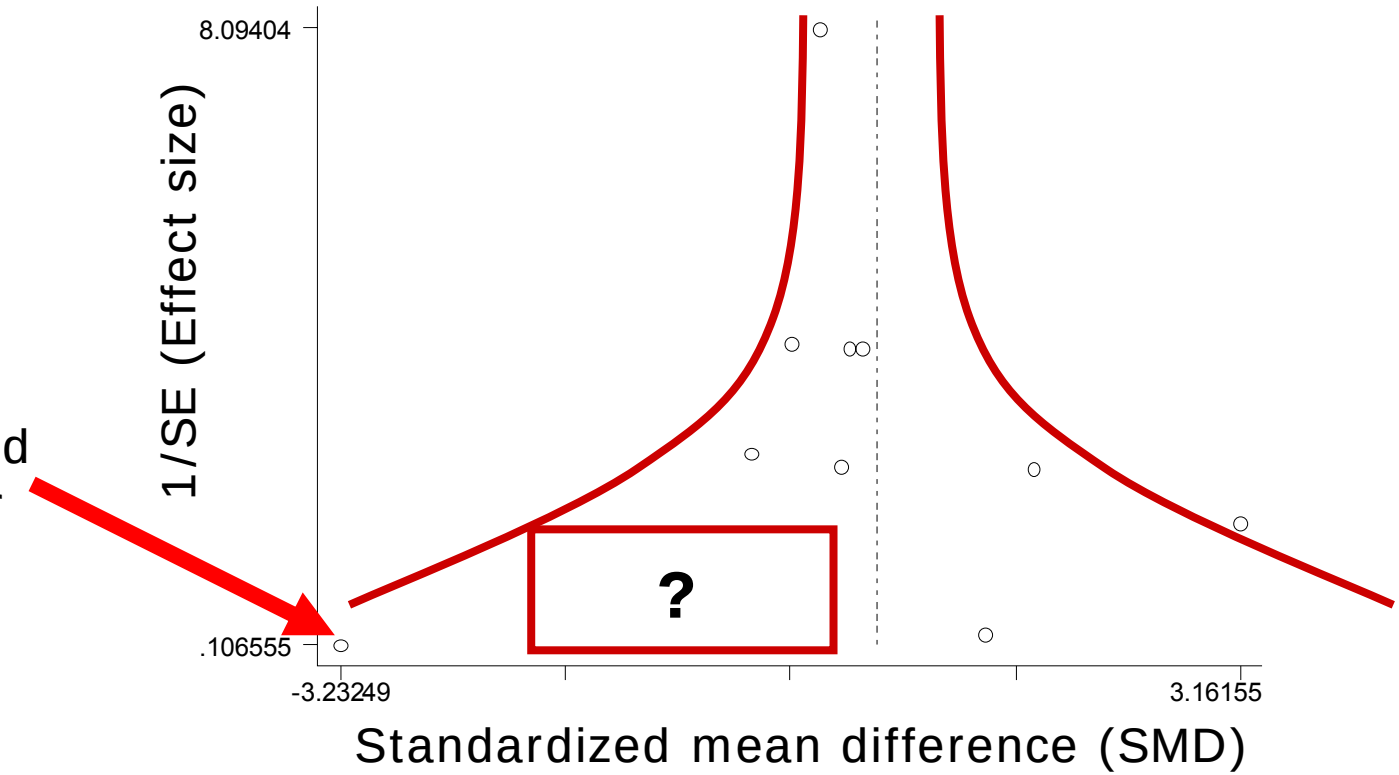
Density: pooled at reserve level



90% density-R maybe overestimate but 40% density-S is robust- at least a 40% difference in density is therefore conservative at reserve level

Biomass – pooled at reserve level

Small negative studies represented by only one outlier



>100% difference in biomass therefore probably an overestimate but a biologically significant difference exists

To summarise

Within MPAs the following increases are observed:

- Density by at least 40%
- Biomass (>100%) but associated with some uncertainty
- Species richness of between 27 - 68%

Fish Density – overall increase 57%

No significant differences in species level effects for:

Life-mode (benthopelagic, pelagic etc.)

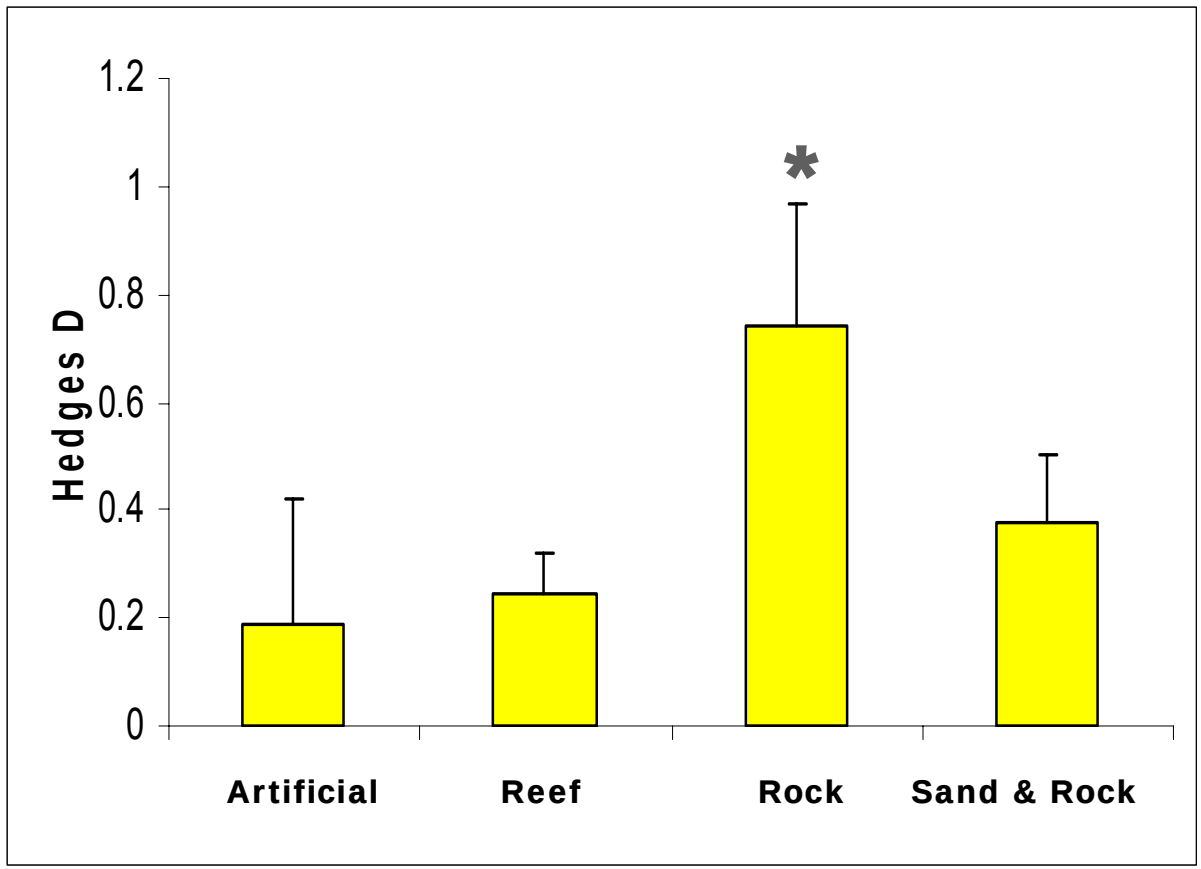
Utility (subsistence, commercial)

Mobility (migratory/non-migratory)

Life-history (resilience/size)

But

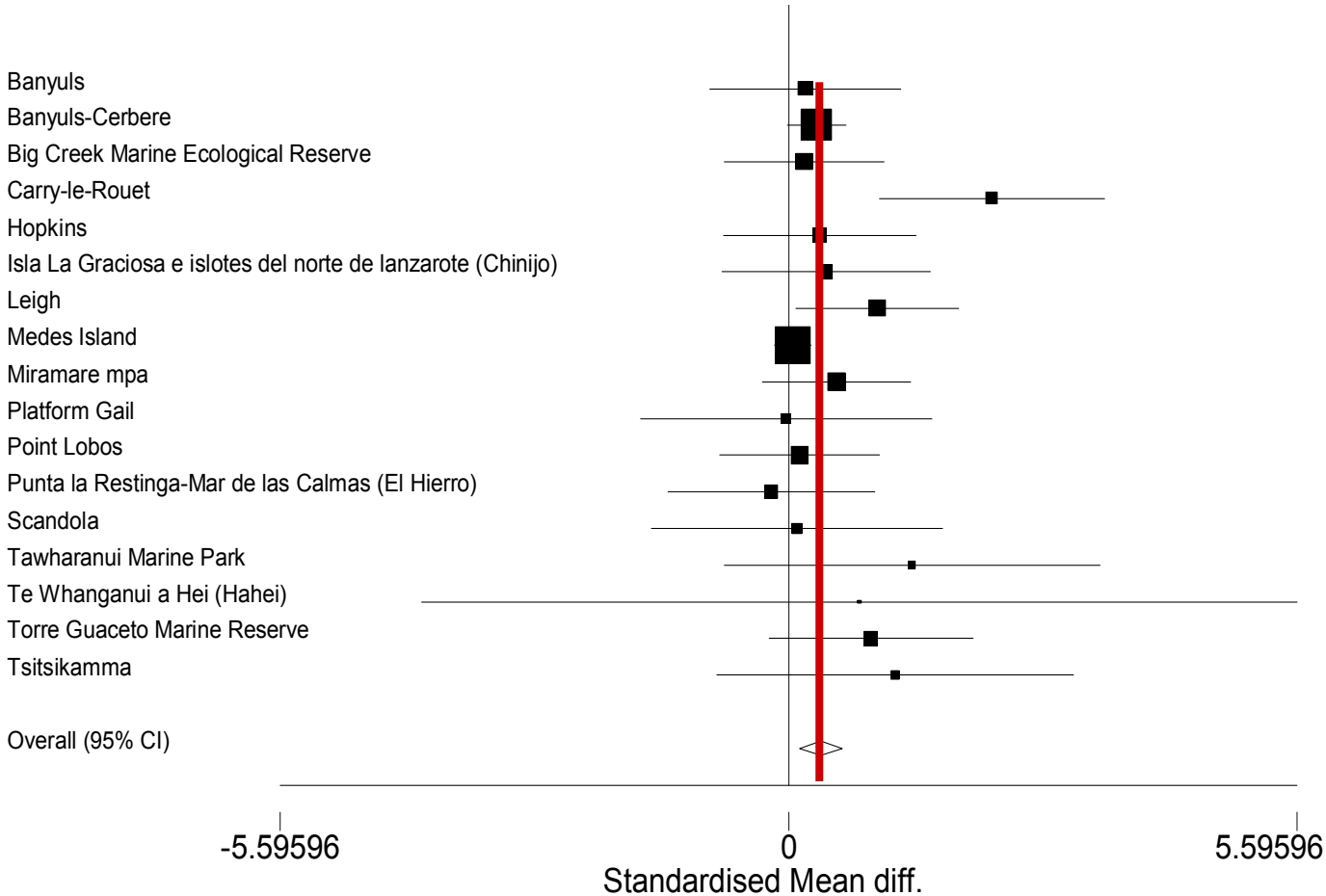
Strong habitat effect



Species - reserve level interactions

Fish have a density effect size of 0.3

Invertebrates and algae have small non-significant effects when species within a reserve are pooled



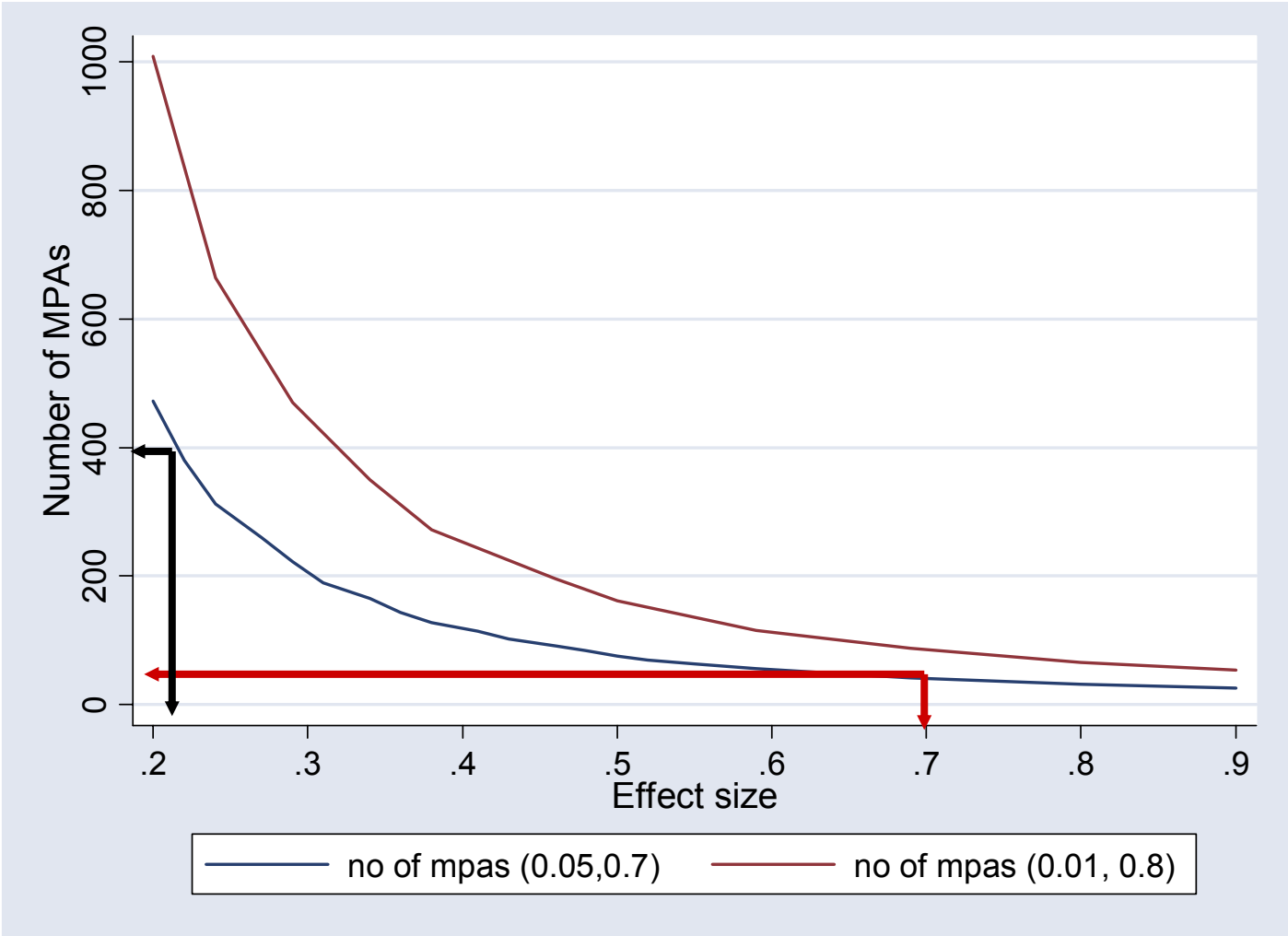
Taxonomic variation

Pooling fish species within genera results in an increased effect size equating to an 86% difference in density

Ray photo: Bill Sanderson

Power analysis – setting objectives

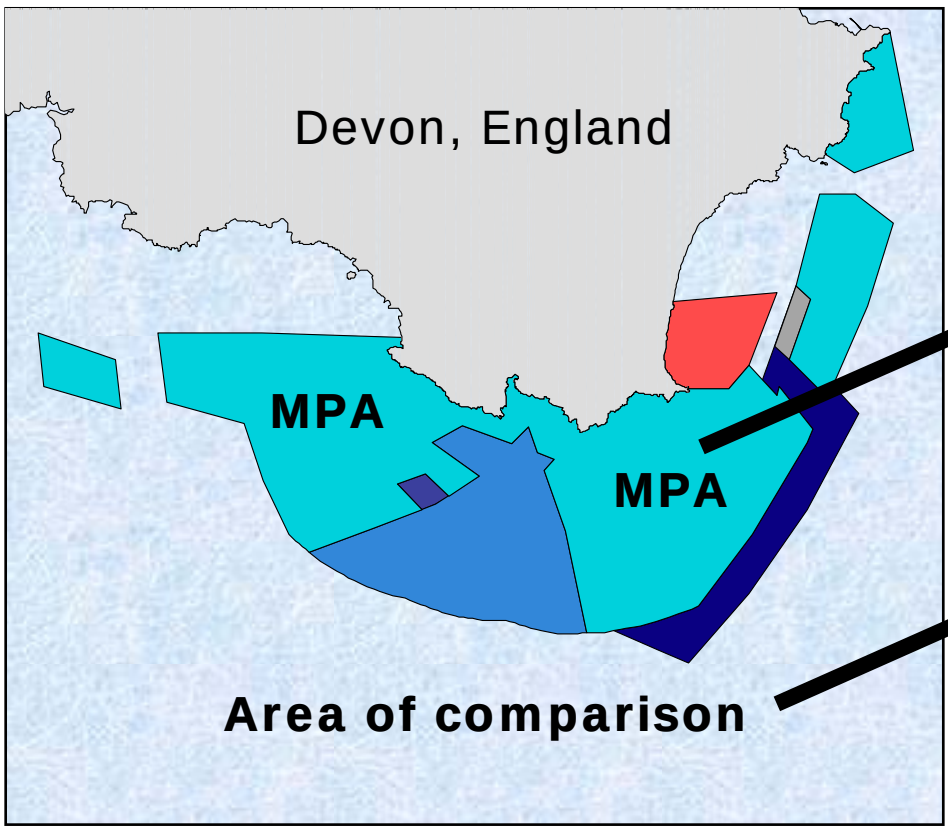
30 mpas are just enough to show big effects. To examine small effects (<0.2) such as the difference between mpas and controls for pelagic or bentho-pelagic fish >400 MPAs needed.

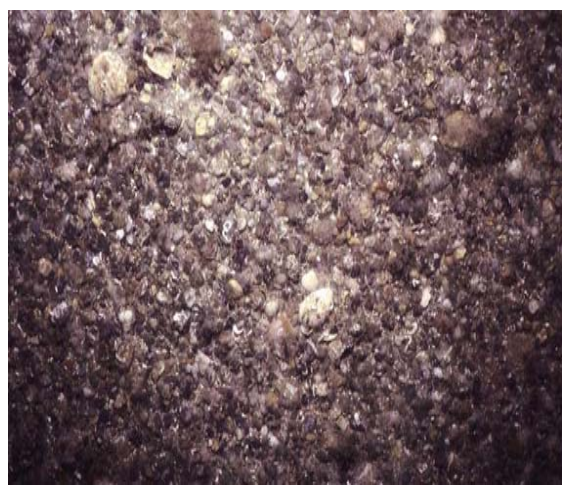


Critical knowledge gaps (among many)

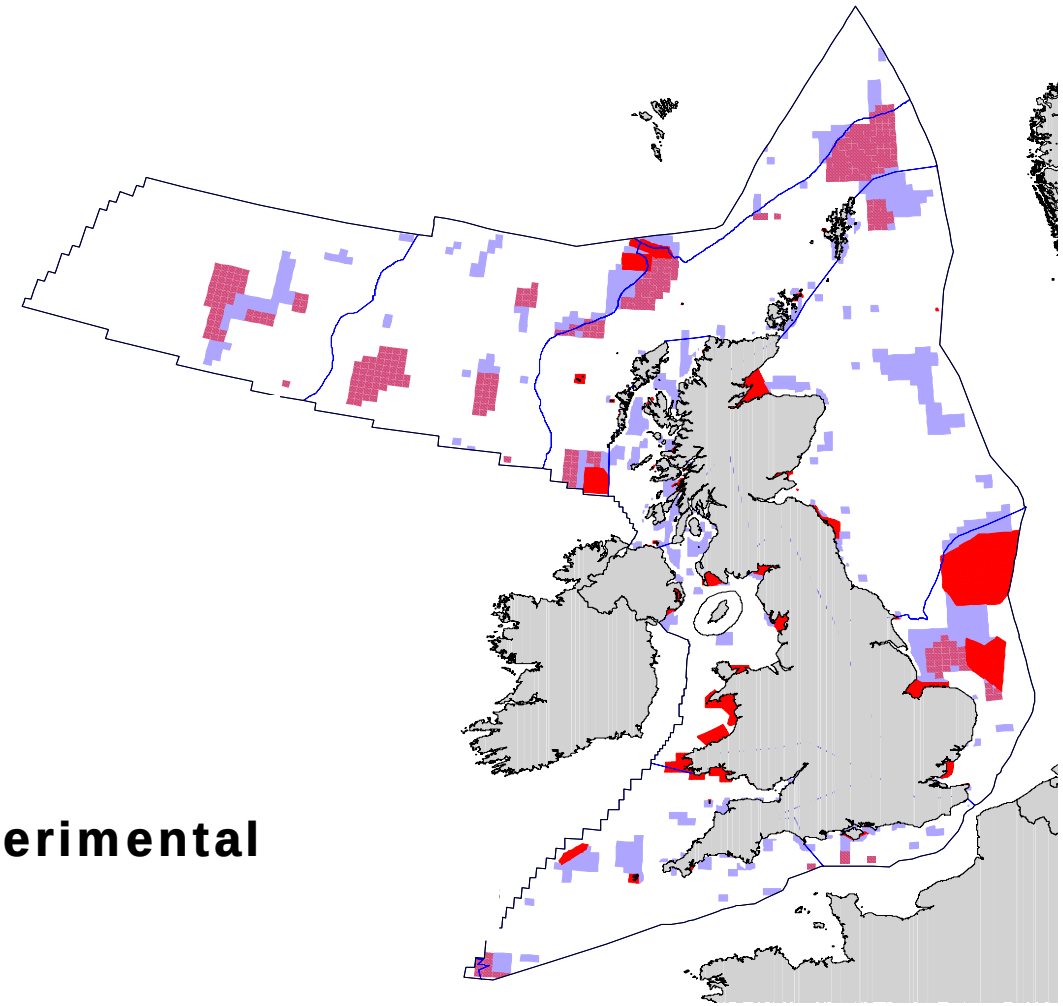
- Soft sediment systems (no studies on sand alone or on mud)
- No information on spillover effects (one study explicitly examined change in effect with distance)
- Distinguishing confounding habitat effects from MPA effects difficult because of lack of BACI data

Confounding habitat effects





MPAs – a large-scale experiment



Multiple replicate sites

Representative

Resilience

We should approach management in an experimental manner

i.e. adaptive