



# Policy Brief

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## THE BIODIVERSITY IMPACT OF MARINE RESERVES IN TEMPERATE ZONES: A SYSTEMATIC REVIEW

### Background

Marine protected areas (MPAs) are rapidly becoming mainstream policy vehicles for safeguarding fish stocks and protecting species and habitats of national and international importance. The UK government, for example, has recently announced plans to create an 'ecologically coherent network' of marine protected areas by 2012, and other nations have also pledged similar commitments.

Thus, protected areas now exist in a multitude of coastal and offshore habitats, in temperate and tropical areas, from coral reefs to seagrass meadows; and have been designed to safeguard a diverse variety of species from invertebrates to whales, as well as target fish species of high commercial interest.

However, whilst MPAs are already widely established, decisions as to the design and location of reserves have traditionally been driven by political or social influences. Furthermore, research findings thus far have indicated considerable variation in the ecological effects of MPAs.

Consequently, the Centre for Evidence-Based Conservation (CEBC) conducted a systematic review to examine the biodiversity impact of marine reserves in temperate zones.

### Policy-relevant outcomes

- The results of this review broadly indicate positive impacts of marine reserve establishment on the density, biomass and species richness of marine biota (see Box 1 overleaf), however a widespread lack of information on the baseline conditions prior to reserve establishment means that these findings must be treated with caution.
- The establishment of improved integrated, experimental monitoring programs is essential.

Studies offering 'snap shots' in time and space may provide an indication of the impacts of reserve creation, but do not allow the possibility that observed differences are merely due to spatial or temporal differences to be discounted.

- For monitoring programs to be truly effective, they must:
  - ⇒ record information on the baseline condition
  - ⇒ include a range of species from all trophic levels
  - ⇒ incorporate measures of resource-use intensity.



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- It is also vitally important that programs are both collaborative and standardised in their approach, so that data are comparable across a large number of sites. Programs should therefore:
  - ⇒ measure the same set of reserve characteristics and biological outcomes
  - ⇒ use standardised methodologies for the measurement of these characteristics.
- These standards must be applied to large numbers of marine reserves if small effects are to be accurately detected.
- A number of significant knowledge gaps in the evidence base exist:
  - ⇒ Marine reserves in sand and mud habitats are unstudied, as are algae, invertebrates and the commercially important, highly

migratory, northern hemisphere fish species.

⇒ Existing studies report differentially on taxa and outcome measures, with data on species richness and biomass being particularly limited.

### Box 1. A summary of review findings

Analysis revealed the following statistically significant results (note: figures quoted are 95% confidence limits):

- The density of marine biota is 23% to 196% higher within marine reserve no take zones than outside these zones.
- Gains in biomass within no take areas are 20% to 422%, but the uncertainty evident in these results is due to lower sample sizes.
- Species richness within marine reserves is 10% to 130% higher within no take areas than outside reserves, although this too is based on a small sample.
- Fish species density is 35% to 81% higher in marine reserves than in adjacent areas.

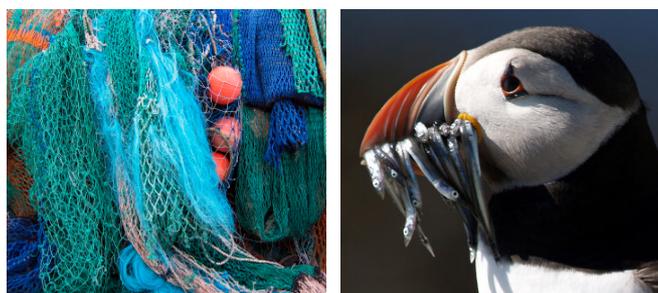
### Methodological Approach

The Centre for Evidence-Based Conservation undertakes systematic reviews (Box 2) in collaboration with subject experts and the user community. In this review we examined the impacts of establishing temperate zone marine reserves on the density, biomass and species and outcome measures, with data on species richness and biomass being particularly limited. The review also sought to determine whether impacts differ



in relation to reserve features, such as size, and organism characteristics, including taxon. Marine reserves, or 'no-take' areas, where fishing is prohibited, were chosen as the focus of this review for two reasons: of all types of marine protected area these are arguably the most studied, but also because this allows the elimination of the potentially confounding influence of varying protection level.

Of over 3500 references examined, approximately 1% presented data on temperate no-take areas that fulfilled all review inclusion criteria. For a detailed description and full breakdown of the 34 studies accepted into the final review, please refer to review report (Stewart *et al.* 2008).



### Box 2. What is a systematic review?

Systematic review is an established technique, recently applied to environmental management, used to accumulate, appraise and synthesise the results of primary research studies addressing a specific question. This may include "meta-analysis", a statistical synthesis of the data from comparable studies, used to increase statistical power and generate a quantitative summary of the pooled result.

The systematic review approach is a more rigorous and objective alternative to a traditional narrative review with transparent and repeatable methodology. It seeks to find all the available published and unpublished evidence on the subject of concern.

The purpose of a systematic review is to provide policy-makers and practitioners with the best available evidence on a subject, in order to support decision-making. Systematic reviews can also be used to highlight knowledge gaps and to promote further original research.

**Prepared by:** Lisette Buyung-Ali, CEBC. **Please note:** the opinions expressed in this document are those of the Centre for Evidence-Based Conservation and do not necessarily reflect the views of any persons or other organisations involved in the review.

### More Information

The Centre for Evidence-Based Conservation ([www.cebc.bangor.ac.uk](http://www.cebc.bangor.ac.uk)) is the first Research and Dissemination Unit undertaking systematic reviews in the environmental management and conservation sectors. Based at Bangor University, it serves the growing Library of Environmental Evidence, a reliable source of evidence for improving environmental stewardship ([www.environmentalevidence.org](http://www.environmentalevidence.org))

Centre for Evidence-Based Conservation, School of the Environment and Natural Resources, Bangor University, Deiniol Road, Bangor. LL57 2UW. UK. Tel. 01248 382953.

Full Systematic Review:

Stewart, G.B., Côté, I.M., Kaiser, M.J., Halpern, B.S., Lester, S.E., Bayliss, H.R., Mengersen, K., & Pullin, A.S. (2008). Are marine protected areas effective tools for sustainable fisheries management? I. Biodiversity impact of marine reserves in temperate zones. Systematic Review No. 23. Online at [www.environmentalevidence.org/Documents/SR23.pdf](http://www.environmentalevidence.org/Documents/SR23.pdf)