

Some Implications of proposed Marine Protected Areas (MPAs) in the Prince Edward Islands vicinity for the toothfish (*Dissostichus eleginoides*) fishery

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ABSTRACT

About half the legal fishing for toothfish around the Prince Edward Islands takes place within the MPAs for this region proposed in Nel (2006). Furthermore, the nominal CPUE outside these MPAs averages 13% less than the CPUE inside, so that curtailment of fishing inside these MPAs could compromise the viability of what is at present an economically marginal operation, with detrimental consequence for the deterrent that this legal fishing activity provides to IUU operations. It is unclear how the proposed MPAs could achieve their stated objectives of contributing to the recovery of the toothfish resource in the area, and of serving as a reference given the likely poor power to discriminate change indicated by illustrative statistical computations. Introduction of these MPAs might also compromise assessment and management approaches for the resource. Discussions between stakeholders should be held in the near future to decide whether a (possibly amended) proposal for MPAs in the region should be taken further, and if so how any consequent implications for assessment and management are best addressed.

INTRODUCTION

Nel (2006) details a proposal for a Marine Protected Area (MPA) in the vicinity of South Africa's Prince Edward Islands (PEI). This short paper has two objectives:

- a) to provide an initial appraisal of the implications of the proposal for the existing longline fishery for toothfish in the region; and
- b) to critique two of the four objectives offered by Nel (2006) for the proposal, specifically:
 - "2) to serve as a scientific reference point that can inform the future management of the area; and
 - 3) to contribute to the recovery of the Patagonian toothfish *Dissostichus eleginoides* which has been so over-exploited that its spawning biomass may be only a few percent of pre-exploitation levels just ten years ago (Brandão *et al.* 2002)".

ANALYSES

Fig.1 shows the positions and catch sizes of legally caught toothfish in the PEI EEZ since 1996, together with the current spatial stratification for CPUE standardisation, and also the proposed

areas (MPAs) within which restrictions on fishing would apply under the proposal set out in Nel (2006).

Two simple analyses are carried out to assess the potential impact of the proposal on the current fishery. First the annual proportions of the number of sets and of the catch (by mass) that are within the proposed MPAs are calculated (Fig. 2). Secondly, the annual ratios of the mean CPUE outside to inside these MPAs are computed, together with the associated standard errors (Fig. 3).

Then, to provide some insight into the potential of these MPAs to play the role of scientific reference points, the annual CPUEs from 2001 to 2005 in each of the three MPAs with past catches (see Fig. 4), together with the extent of their variability, are used to assess the power of continued fishing in those areas to detect change.

Note that for these initial computations, nominal rather than GLM-standardised CPUE information is used for simplicity. The choice of the period from 2001 for input to the power analysis is to exclude (for reasons of comparability) the period before the theft from the longlines by cetaceans stabilised together with the associated appreciable drop in CPUE.

IMPLICATIONS

The plot in Fig. 2 shows that that a substantial proportion of past fishing has taken place (and past catch been made) within the proposed MPAs – typically 50% each year. Furthermore Fig. 3 shows a tendency for CPUE outside the proposed MPAs to be less than that inside them. Ignoring the 2005 and 2006 ratios in that plot for reasons respectively of poor precision and incomplete data, the overall mean ratio is significantly less than 1 at 0.87 with a standard error of 0.04.

This suggests that under the proposal, unrestricted fishing can expect to achieve catch rates some 13% less than possible in the MPAs. Within the MPAs themselves, “standardised commercial fishing techniques” are to be used, possibly conducted by commercial rights holders (Nel 2006). Exactly what this entails has yet to be specified, but typically operations governed by experimental designs will yield lesser catch rates than commercial operations. Given that with catch rates reduced by cetacean theft, the current fishery is economically marginal (R. Ball, pers. commn), the question arises of whether it would remain viable were the MPA proposal in Nel (2006) to be implemented.

The results of the power analysis are provided for each proposed MPA in Table 1 in the form of effect sizes: the proportional change in CPUE for which there is an 80% probability of detection at the 5% level of significance after five years of monitoring. The calculations assume similar future to past levels of effort in each MPA. It is evident from this Table that only fairly large proportional changes (probably rather larger than would be both likely and of importance) are likely to be detectable.

QUESTIONS ARISING

A number of key questions arise from the above and related considerations.

- 1) In past and likely future practice, for reasons of cost the only realistic deterrent to IUU fishing of toothfish in the PEI EEZ is the presence of legal operators. If imposition of the MPAs proposed renders the legal fishery non-viable economically, would the interests of conservation of the toothfish resource in the region be compromised by rendering it more susceptible to IUU fishing (which would also not respect the MPAs)?

- 2) How would the MPAs “contribute to the recovery” (MPA objective 3 above) of the toothfish resource, given that TACs would presumably not be affected (though any proposal does need to confirm intentions on this front), and in the absence (to the authors’ knowledge) of indications of (sub-)stock structure at the scale of these areas, the effect of catches on the resource would be broadly independent of their location? It should also be noted that appraisal of the status of this toothfish resource has changed appreciably since the analyses of (Brandão *et al.* 2002) quoted in Nel (2006). While considerable uncertainties do still remain, taking catch-at-length composition data into account, particularly that forthcoming from the pot fishery, suggests the current status of the resource to be much better with spawning biomass some 40% of its average pre-exploitation level (which would be close to optimal) (Brandão and Butterworth 2006).
- 3) Would imposition of the MPAs proposed compromise current assessment of the resource by leading to a change in fishing behaviour (Field *et al.* 2006)? This could affect the catchability coefficient relating standardised CPUE to abundance, and in addition modify selectivity and hence the size structure of the catch. The last factor has implications for the OMP currently under development for this resource (Brandão and Butterworth 2007), in which the mean length of longlined fish seems set to play a key role that could be compromised by such a change.
- 4) Exactly how would the MPAs “serve as a scientific reference point that can inform the future management” (MPA objective 2 above)? While the concept is attractive in principle, concrete objectives need to be specified to allow a quantitative appraisal of their achievability. Given the relatively poor power evidenced by the illustrative example for which results are reported in Table 1, it cannot be taken for granted that such objectives will be achievable within a reasonable time frame.

CONCLUDING REMARKS

The questions above themselves beg the question of whether the MPA proposal in Nel (2006), at least in its present form, should be taken further forward. It would seem important for stakeholders to re-discuss this matter in the near future.

Allied to this, and particularly if some form of PEI MPA is to be pursued further, the implications for assessment and management approaches for the fishery need to be co-discussed. Issues that need to be addressed include:

- a) Should the spatial stratification used for CPUE standardisation be modified to dovetail with proposed MPA boundaries?
- b) How can adjustments be made for possible consequential changes in fishing strategy perhaps modifying the values of catchability and selectivity parameters in assessments?
- c) Exactly what are any MPAs intended to monitor, and would the data to be collected be likely to have sufficient information content for meaningful changes to be detectable?

Since the associated analyses would require a considerable investment of time, the strategic aspects of the matter indicated above require prior discussion and decision before further computations might be pursued.

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Table 1. Observed mean nominal CPUE for the five year period 2001 to 2005 (together with its standard error), and the estimated minimum effect size detectable with a probability of 80% (power) at a significance level of 5% in the next five years, assuming variance remains unchanged.

Proposed MPA	Observed mean CPUE over 2001–2005 period	Standard error	Effect size (as a proportion of the mean)
Africana II Rise (AR)	0.073	0.0095	0.590
Prince Edward Islands (PEI)	0.105	0.0148	0.636
Southwest Indian Ridge (SIR)	0.070	0.0126	0.809

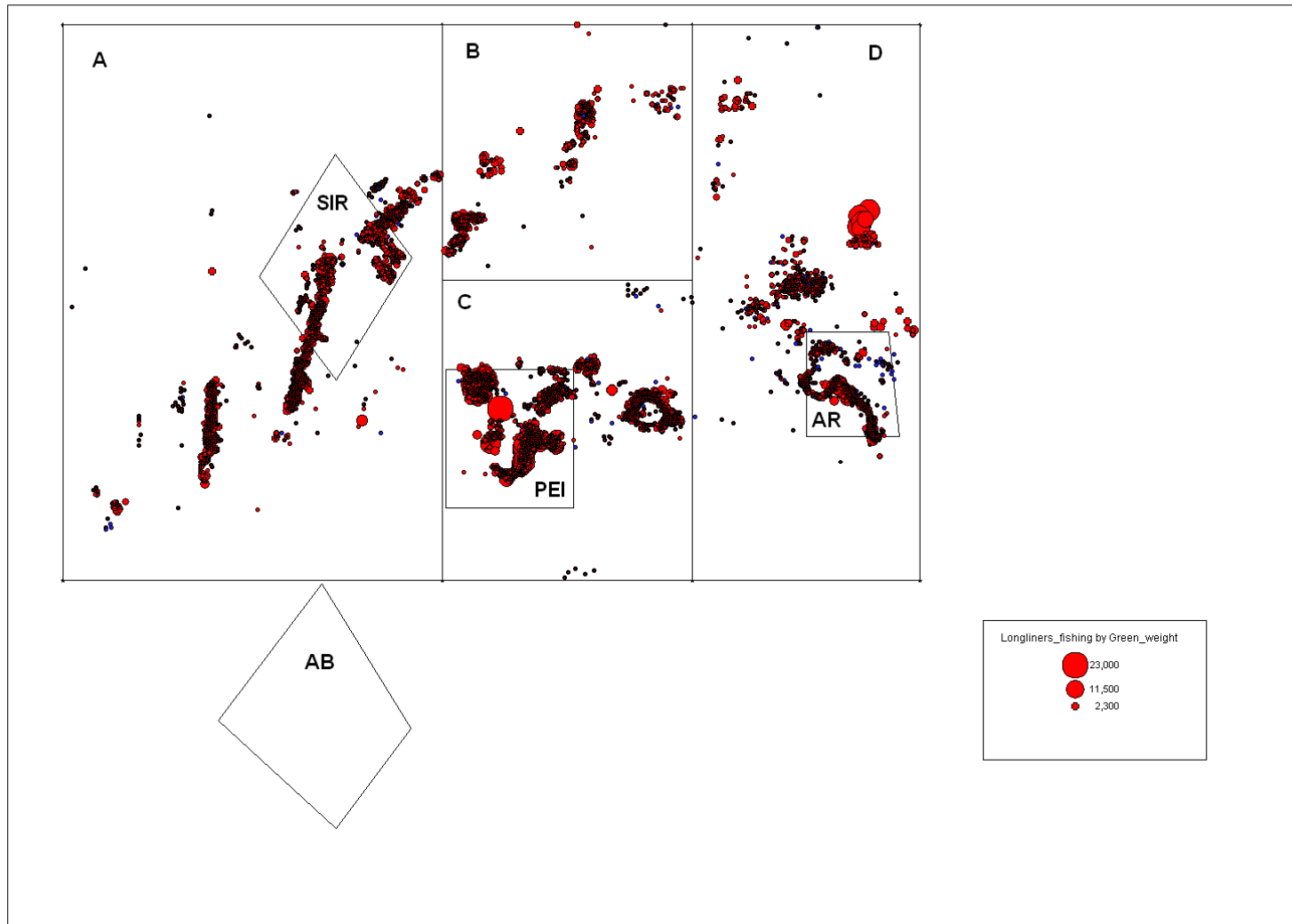


Figure 1. Positional information of toothfish sets in the Prince Edward Islands EEZ. The location of sets from 1996 to 2006 (where the size of the circle is proportional to the size of the catch) are shown with respect to the four designated areas (shown here as the rectangles A, B, C and D) that are used at present to standardise the CPUE, as well as with respect to the proposed restricted areas: Southwest Indian Ridge (SIR), Prince Edward Islands (PEI), Africana II Rise (AR) and Abyss (AB).

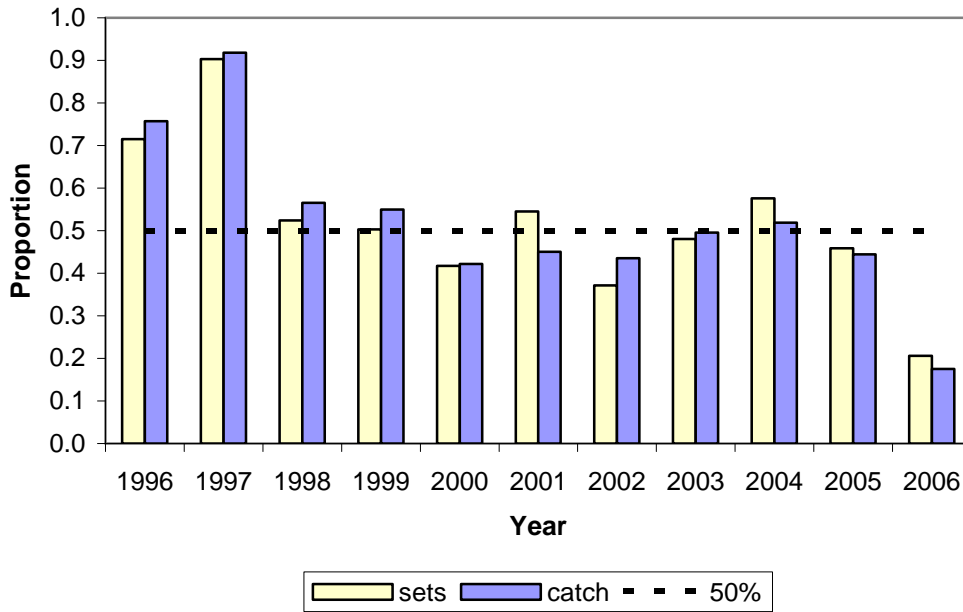


Figure 2. Annual proportion of number of sets and catch (by mass) in the proposed MPAs. The dashed line is at 50%. Note that the results for 2006 are unfinalised as data available extended only to April.

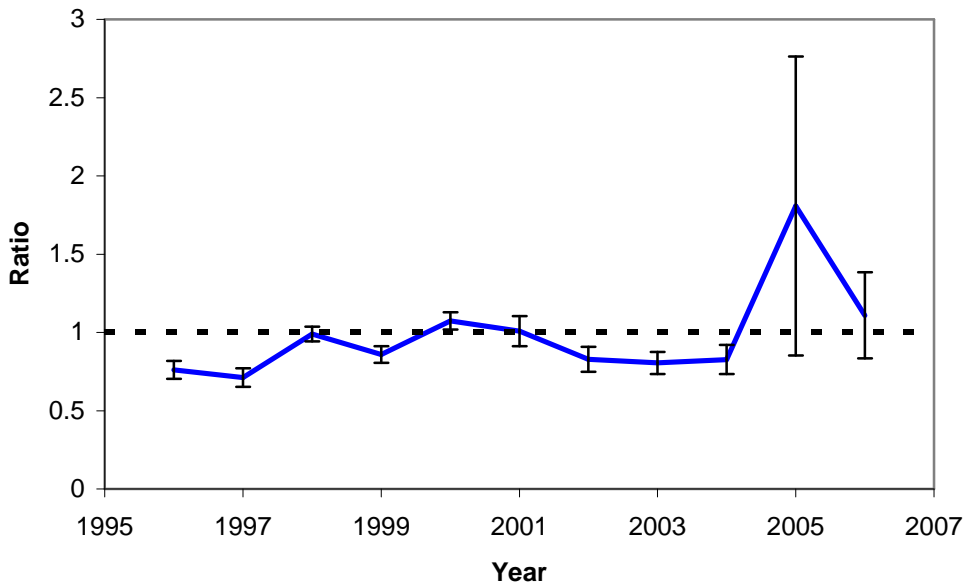


Figure 3. Ratio of the annual nominal CPUE outside of the proposed MPAs to the nominal CPUE inside the proposed MPAs. The bars show +/- one standard error bars for each ratio. Note that the result for 2006 is unfinalised as data available extended only to April.

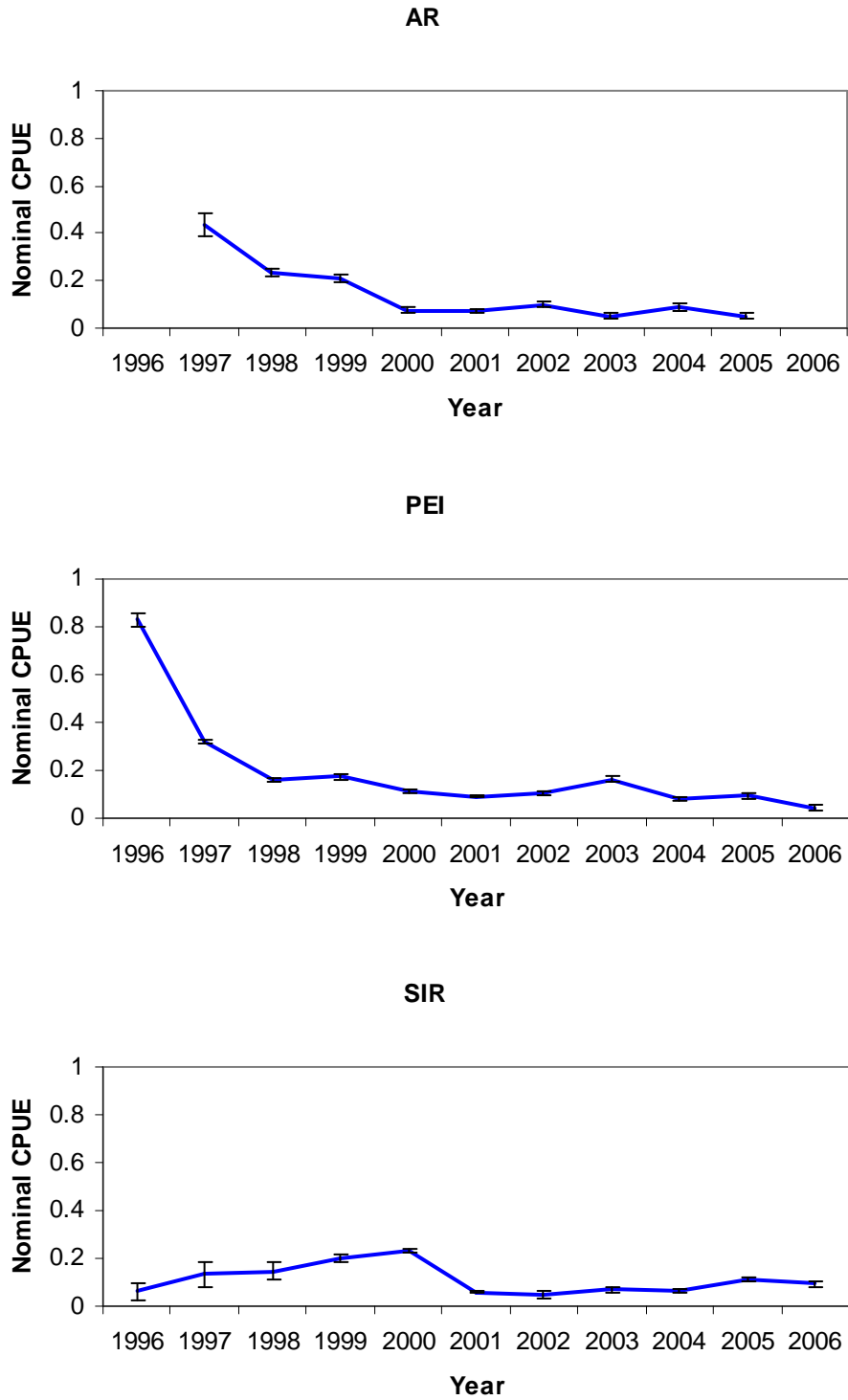


Figure 4. Nominal CPUE for three of the proposed MPAs together with their standard errors. No fishing takes place in the fourth area (Abyss). Note that the result for 2006 is unfinalised as data available extended only to April.