

Supplementary material

The influence of an offshore artificial reef on the abundance of fish in the surrounding pelagic environment

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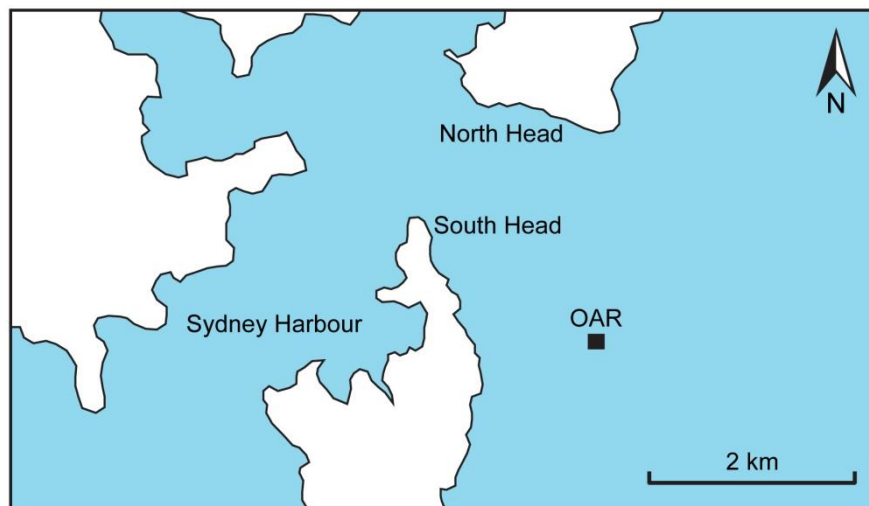


Fig. S1. The location of the offshore artificial reef (OAR).

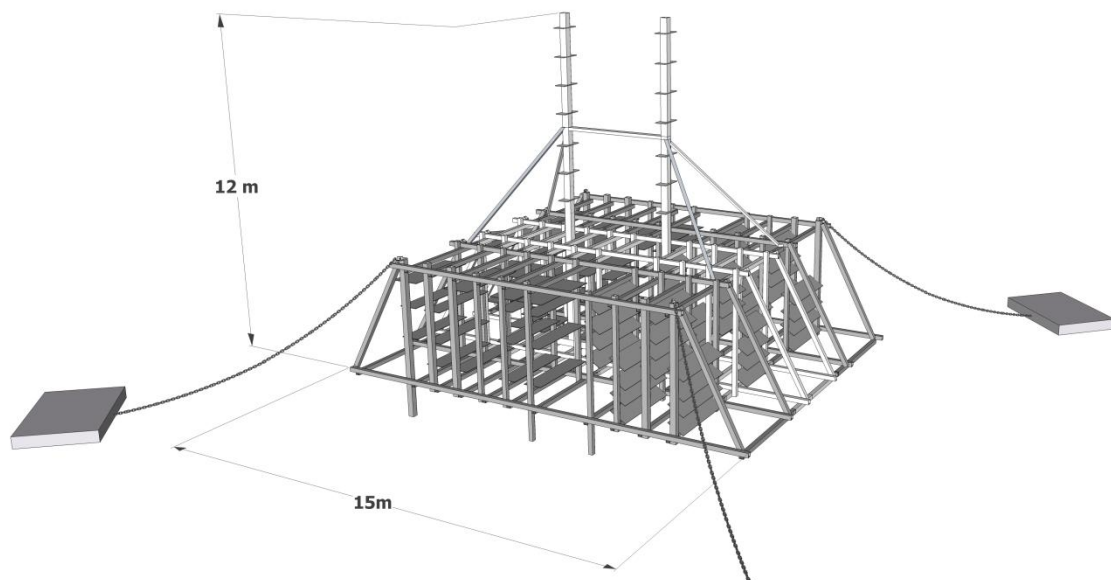


Fig. S2. An illustration of the offshore artificial reef (OAR) used in this study (image: New South Wales Department of Primary Industries). The structure is untreated steel, with 4-m-high base, and 8-m-high pillars. It is anchored in place with four concrete blocks.

Assessment of the pelagic BRUV

A *post hoc* power analysis showed that the difference in the average abundance of fish that could be detected with sufficient statistical power in this study was ~44 fish (total *MaxN*). This means that total *MaxN* had to be an average of 44 fish higher between distances before it could be detected with sufficient power. It is uncertain whether this effect size represents a likely biological response to an OAR, but it doesn't seem unreasonable given that schools of fish >100 individuals were sometimes observed. This effect size is quite large because of the gregarious and transient nature of some species

(e.g. *T. novazelandiae*), which created data with only a few observations of large abundance (Fabi *et al.* 2002). The power analysis revealed that removing *T. novazelandiae* from an analysis halves the detectable effect size to 21 total *MaxN*. This shows that future studies could benefit from analysing functional groups separately, particularly in the case of schooling species which can introduce a large amount of variation. The power analysis showed a much smaller effect size for the number of species, and any average increase in the assemblage of one species or more was likely to be detected.

Probably the best way to improve statistical power in this study environment is to reduce the variance between units. Therefore, studies should maximise the number of PBRUV deployments when focussing on assemblage abundance (total *MaxN*), but aim for fewer deployments soaked for longer than 45 min when focussing on the number of species, because species continued to be found after this duration. Previous work in an estuary has suggested that increasing deployment duration is more beneficial than increasing replicates in improving precision of *MaxN* (Gladstone *et al.* 2012). This will quickly become counter-productive, however, as accuracy is lost in favour of precision. This is because *MaxN* is taken from a single frame of video only, and there will be an increasing disparity between the abundance recorded (*MaxN*) and the actual abundance observed as deployment duration increases. In the current study, *MaxN* was largely determined by the first observation of a pelagic fish school, and subsequent detections of that species had little influence. For this reason, further research may benefit from identifying the *minimum* PBRUV duration required to estimate abundance in the target sampling area, and focus remaining effort on PBRUV replication.

In this study, abundance was standardised to turbidity, and to both turbidity and bait plume area. Standardising to bait plume area is sometimes used in BRUV studies (Sainte-Marie and Hargrave 1987; Heagney *et al.* 2007; Taylor *et al.* 2013), and a positive relationship is assumed for *MaxN* and current velocity (current determines the area of the bait plume). This study did not find a significant relationship between *MaxN* and current velocity, and current was identified as the variable with the least explanatory power. Until further research has discerned the relationship between current speed and abundance for baited cameras, it seems prudent to treat current velocity as a predictor variable rather than a quantitative measure of sampling effort in the pelagic environment. Comparing abundance estimates from baited and unbaited BRUVs could be useful in testing the importance of current velocity.

Considerations for future studies include: the trade-off between the number of PBRUV deployments and PBRUV duration; the robustness of the relationship between baited cameras and current velocity; and quantitatively coupling the PBRUV tool with other surveying methods such as sonar, visual census, or acoustic telemetry to address the large variability in the abundance of pelagic assemblages.

References

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