

EXECUTIVE SUMMARY

Surveys of abundances of demersal biota provide the empirical bases for assessing the biological status of the Great Barrier Reef, testing the success or failure of management strategies, investigating anthropogenic impacts on the reef, and contextualising fundamental research. The accuracy and precision of the data that arise from surveys will be at least partly a function of the survey methods¹. It is important, therefore, to thoroughly document the sampling characteristics of those methods. We sought to examine the relative biases and characteristics of precision of sampling several species of benthic organisms and demersal fish by visual surveys of belt (or strip) transects of a range of sizes. We also examined the biases arising from several procedures for counting organisms within transects.

Estimates of population densities of most poritid corals, chaetodontid and lethrinid fishes, and coral trout were affected significantly by the width of transect surveyed. Estimated densities were greater for narrow (4m wide) transects than for wider transects (12m & 20m wide). Estimated densities of chaetodons and poritid corals were also affected by transect length (20m, 60m, 100m), with estimates declining as transect length increased. Counts of small fishes within small transects (1-4m x 10-30m) were generally unaffected by the length or width of transects. The results were consistent over six sites on two reefs, which represented a diversity of habitat and exposure conditions.

The effects of transect size on estimated density were not caused by observers failing to count or over-counting fishes which migrated into or out of the transects whilst they were being surveyed. Nor did the results arise because of trends in abundances with either the depth of substratum surveyed or the time of day when counts were taken. The most likely explanation for changes in bias with changing transect size was systematic variation in the intensity with which transects were searched. Larger transects were searched far less intensively (time taken per unit area) than small transects. It is likely, therefore, that organisms were more likely to be overlooked in large transects than in small transects.

The method by which transects were counted did not affect estimated densities, although estimates differed systematically between two observers. Thorough training and periodic re-calibration of observers will be essential for the utility of data stemming from ongoing monitoring programmes.

The precision of estimates from shorter and, for some taxa, narrower transects was consistently poorer than from longer (and wider) transects. Precision of estimates varies with the number of replicates surveyed, and so it is useful to consider the comparative costs (time taken) of sampling sufficient transects of each size to achieve a standard precision. We refer to this measure as cost-efficiency. Cost-efficiency varied greatly among sites for transects of all sizes, and there was no consistent relationship between cost-efficiency and transect size for most taxa.

We recommend the use of 50m x 5m transects for the survey of many large, mobile fishes and discrete benthic organisms. Transects of this size are likely to provide the least biased estimates of density with the optimum balance of cost-efficiency and logistic convenience. For survey of several small fishes, we recommend transects of 20m x 2.5m, although there is little empirical reason to favour one transect size over the others we considered. It is important to note, however, that application of the methods we recommend to taxa other than those we considered should be preceded by thorough verification that the methods are appropriate for those other taxa.

We describe a set of procedures by which these transects can be surveyed efficiently by two-three divers and suggest that these methods provide a sound, well documented methodological basis for the further development of quantitative reef-wide monitoring.

¹ Provided that the sampling design is appropriate for the objectives being pursued.