

INTRODUCTION

The use of permanent spatial closures, or fisheries refugia, as a management technique for coral reef fisheries has recently received substantial attention (Russ 1991; Plan Development Team (PDT) 1990; Russ et al. 1994, DeMartini 1993). Marine refugia have often been invoked when more conventional techniques, such as effort or gear restrictions, have failed to achieve the desired management objectives, particularly in regions where the fisheries are subject to intense and unmanageable fishing pressure (e.g. Russ 1991; PDT 1990). In other cases, such as the Great Barrier Reef Marine Park, fisheries refugia have been used to separate potentially conflicting uses of the coral reef environment and its limited resources (e.g. extractive and nonextractive activities, such as fishing and SCUBA diving, respectively). The relative ease with which spatial boundaries may be defined in coral reef systems and their apparent isolation from each other, has prompted several authors to suggest that individual coral reefs may be ideal experimental units for manipulative experiments to investigate the effects of fishing on coral reef fish communities (Hilborn and Walters 1992; Walters 1986; Sainsbury 1988; Russ 1991).

A fundamental assumption underlying much of the theory of fisheries refugia is that there is limited exchange among individual spatial strata (reefs) (Hilborn and Walters 1992; Walters and Sainsbury 1990; Caddy 1993). In the light of the common perception of coral reef fish as sedentary, territorial animals, whose movements may be measured in the order of 10s to 100s of metres (Sale 1991), this assumption appears well justified. However, there is relatively little quantitative information available on the degree to which species of large reef fish commonly targeted by fisheries move within or among individual coral reefs (see appendix B of PDT 1990). A general feature of these studies is that the recapture effort is often unknown and the majority of the returns are recaptured shortly after release in close proximity to the release site. However, there are many examples of large scale movements of individual fish (10-100 km) and the existence of spawning migrations, particularly by large epinephiline groupers, has been widely documented (Manooch 1987; Johannes and Squire 1988; PDT 1990; Colin 1992).

In 1989 the Great Barrier Reef Marine Park Authority (GBRMPA) commissioned Professor Carl Walters and Dr Keith Sainsbury to develop and compare alternative experimental designs for a large scale manipulative experiment to investigate the effects of line and trawl fishing on the fish communities of the Great Barrier Reef. The design proposed by Walters and Sainsbury (1990), which incorporated line fishing treatments applied at a level of reef, assumes that the fish communities of individual reefs are independent. Walters and Sainsbury (1990) suggested that movement of adult fishes among individual reefs in excess of 25% yr⁻¹ would be sufficient to confound the effects of the proposed manipulation of fishing effort. Given the equivocal nature of the present information on the extent of inter-reef movement by large reef fish, they recommended that a tagging study, designed to estimate the rate of movement of target species among individual reefs within the experimental clusters, be performed as part of a pilot study preceding the main experimental program. This report presents the results, conclusions and recommendations of such a tagging study.

The main objective of this study was to determine the extent to which large reef fish, principally the common coral trout, *Plectropomus leopardus*, move among individual reefs. This was achieved through a large scale tagging study done on five reefs south of Innisfail, in the Cairns Section of the Great Barrier Reef Marine Park, from April 1992 to February 1994. The main aims of the study were to determine:

- i) what was the extent of movement among individual reefs;
- ii) what proportion of the population moved among reefs;
- iii) whether movement among reefs was related to the spawning season of *P. leopardus*.

Additional aims of the study included a comparison of two types of tag commonly used for reef fish on the Great Barrier Reef and the collection of catch composition, catch per unit effort and length frequency data for the dominant species in the Great Barrier Reef line fishery.

This study differed from previous studies of movement of large reef fish in two ways. Where logistically feasible, the tagging effort was spread across the entire area of each of the five reefs sampled, so that tagged fish were relatively evenly distributed through the population. Secondly, returns were obtained from the recreational and commercial fishing communities and from subsequent research tag-recovery exercises. This meant that, at least for the research returns, the recapture effort was known and, secondly, it also provided two independent data sources for estimates of rates of inter-reef movement which could be used to interpret potential biases in the tag return data.