8 MOVEMENTS, MIGRATION AND SEASONALITY OF FISHERY

8.1 Seasonality of Fisheries

Reef fishing activity is at a minimum during the peak of the cyclone season from January to March. Bandaranaike and Hampton (1979) examined seasonality of reef fisheries through catch statistics of the Queensland Fisheries Board in Cairns, Innisfail, Townsville and Bowen. They concluded that sweetlip showed a distinct peak in production in September to November in Cairns, Townsville and Bowen but that no seasonal pattern was obvious at the Innisfail market. Similarly, a pronounced peak was observed in production of coral trout in all four markets during October to November. Unfortunately these two months generally provide the best weather of the year, complicating the interpretation of these peaks in production.

In a more recent analysis using data from newly introduced log-book system, Trainor (1991) examined seasonal trends in the commercial line fishery from January 1988 to August 1990. These data confirm the general trend observed by Bandaranike and Hampton, with peak catches during August to October and lowest catches in January-March (see Section 6).

8.2 Movements and Migration

Much of the available information on movement of the larger reef fish species is anecdotal and is summarised below. Tagging studies have been carried out as part of two GBRMPA consultancies (Beinssen 1989a, 1989b) and Melita Samoilys' MSc thesis in the Capricorn-Bunker Group. A report on an earlier tagging study carried out in the same area by GBRMPA was not available to us. A number of tagging studies which should considerably increase our understanding of movements and migrations are currently in progress (see below).

8.2.1 *Lethrinus* spp.

Very little is known of movements of *Lethrinus* spp.. Many fishermen, however, have inferred that *L. miniatus* is a very site-attached species that does not move between reefs or major areas of shoal. Some fishermen even claim to be able to identify individuals as coming from certain areas of reef. Beinssen (1989b) carried out studies of movements of a number of species along 4km of the northern reef slope of Heron Reef in September to October of 1989. This section of reef slope was divided into 8 contiguous blocks 500m long and fish caught in each block tagged in a characteristic pattern. Movement of fish among the blocks was studied over an average period (for each fish) of 3 weeks. Movements of the three major species derived from this study are given in Table 11. These data tend to confirm the particularly site-attached behaviour of *L. miniatus* even in comparison to *P. leopardus* and *L. adettii*.

Tidal movements of *L. miniatus* and *L. nebulosus* from outside of reefs into lagoons to feed at night have been reported to us (A. Schneider pers. comm.). Notable catches of *L. nebulosus* are often made in shallow water in winter (McPherson et al. 1988) but it is not known whether this represents movement of the fishes or simply changes in catchability. As indicated under **Distributions and Habitats**, *L. nebulosus* may undergo significant inshore-offshore developmental movements but clarification of this will depend on a better understanding of the distribution of juvenile fish.

Davies (pers. comm.) has recorded movement of *L. laticaudis* over a distance of 1.5 to 2km between Orpheus and Pelorus Islands.

8.2.2 *Lutjanus* spp.

Commercial fishermen in the Cairns region maintain that the larger *L. malabaricus* and *L. sebae* are present in deeper waters (>60m) during the summer, then move into shallower waters during the winter (McPherson et al. 1988). Other fishermen have indicated to us that *L. sebae* in more southern areas also move into relatively shallow areas in the coldest months of the year.

The recreational fishery for fingermark, *L. johnii*, is seasonal with large fish being caught primarily from December through the summer months. Fishermen have linked these catches to inshore spawning migrations and to seasonal occurrence of squid concentrations. Our preliminary underwater observations suggest, however, that fingermark are on the fishing grounds for most, if not all, the year and that the seasonality in the fishery may reflect changes in catchability rather than migrations or other movements.

Developmental migrations as fish grow older appear to occur in a number of *Lutjanus* spp. (see section on **Distributions and Habitats**). *L. argentimaculatus* is believed to move from estuaries to nearshore and midshelf reefs as it matures. Studies in progress (by Sheaves, Newman and Williams) suggest that similar movements may occur in *L. russelli*, *L. malabaricus* and *L. erythropterus* appear to use shallow nearshore areas as nursery grounds and move further offshore and deeper as they increase in size.

Davies (pers. comm.) has recorded movements of 1.5 to 2km for *Lutjanus carponotatus* between Orpheus and Pelorus Islands.

8.2.3 *Plectropomus* spp.

Fishermen from the Swains and off Townsville report that trout (of smaller size) tend to be most abundant in the shallows ((October to May) and in the deeper waters (larger fish) in the cooler months of June to September (G. Clarke, A. Schneider pers. comm.). On the basis of direct observations, Ayling (1989) reported that the number of trout in shallow waters of Davies Reef (off Townsville) in June to- September of 1989 was significantly down on counts earlier in the year. The fish remaining in the shallows were mostly small. 'Some of the large fish remaining on the reef were observed courting during the September trip and it was thought that many of the trout recorded on the reef in June and August had moved elsewhere for spawning activities'. Conversations with a commercial fisherman encountered on Bowden Reef on 28 September 1989 revealed that they had been having good catches of coral trout in deep (40m) reef associated with shoal areas around a number of reefs in the previous few weeks. They reported that the roe of the trout were all ripe and running. 'This suggests that the trout 'missing' from Davies in late September had moved out to deeper waters to spawn' (Ayling 1989). Mathew (1988) indicates a strong consensus among fishermen that trout spawn primarily in August to September but that some believe that spawning times vary with latitude.

Johannes and Squire (1988) report on apparent spawning aggregations of *Plectropomus laevis*, *P. leopardus* and *P. areolatus*. These observations infer movement of fishes to join spawning aggregations but the distances from which these fish are drawn is unknown. *P. laevis* aggregations occur in 6-20m of water on the reef slope, near to, but not on, the bottom. Aggregations form off Cairns around late September or October and progressively later northwards. *P. leopardus* and *P. areolatus* are also reported to aggregate, often in multi-species groups, for several months around the end of the year (Johannes and Squire (1988). The depth of these aggregations is not given. A detailed study of spawning aggregations at Scott Reef (Samoilys, Squires, Bib - Northern Fisheries Centre) forms part of a QDPI-AIMS-JCU FIRDC project.

A tagging study of trout during the Boult Reef Experiment where fish were at liberty for up to 90 days confirm Beinssen's (1989b) Heron Reef study (Table 17) that movement of *P. leopardus* around a reef is very limited, albeit these studies do not include data on spawning aggregations.

Samoilys (1987) also carried out studies of movements of *P. leopardus* on Heron Reef. She found that short term movements of coral trout, measured by underwater tracking over a 15 minute period, revealed no patterning by time of day or tidal state. In general, size of area of movements increased with the size of fish but this was not consistent over two observation periods. In December/January a reduced area of movement in the larger sizes (>60cm TL) was measured compared to September/October ($26m^2$ vs $134m^2$). Samoilys suggested this change was due to pre-spawning behaviour.

Longer term movements were examined by Samoilys (1987) by capturing trout on lines, freeze branding them and resighting branded fish in underwater surveys. Of 101 fish branded, 59 were resighted. Of these 59 fish, 47 were resighted in the same (300m x 60m) site in which they were branded over a mean period of 142 days and up to a maximum of 289 days. [The maximum time periods reflected the durability of the tags rather than the total period of residency]. The other 12 fish were located at maximum distances of 0.4 to- 7.5km from where they were branded (up to 271 days after branding). Despite each individual being resighted up to six times, 7 of the 12 fish had moved a maximum distance of 0.8km or less. Three of the remaining five had moved maximum distances of 1.3km or less. The two fish that had moved the largest distances were resighted 7.0 and 7.5km away from where they were branded (on the same reef). There was no clear relationship between the maximum distance moved and the time between branding and resighting. Samoilys concluded that the large numbers of resightings in the same, approximately $2,000m^2$, sites was indicative of individuals returning repeatedly to one small area within a larger home range, rather than a home range of such small size. She believed, however, that the range of movements of coral trout are relatively confined and that individuals were ranging over approximate distances of 2km along the reef slope [sic].

Davies (pers. comm.) using tagging studies, has recorded movement of a *P. leopardus* over a distance of approximately 4km along the inside of Orpheus Is. The vast majority of recaptures indicate restricted movements over distances of 50 to 200m.

8.3 Movement Between Reefs

Beinssen (1989a) noted that during the Boult Reef Experiment, no tagged fish of any demersal species were returned from reefs other than that at which they were tagged and it was felt that inter-reef migration is 'unlikely to be significant'.

Davies (pers. comm.) reported movement of a *P. leopardus* 1.5 to 2km from Orpheus to Pelorus Islands.

Given that the GBRMPA's management strategy is based primarily on zoning of individual reefs, the extent of movement between reefs is a critical question for management. In the first successful (GBRMPA sponsored) tagging study of reef fish movements on the GBR 343 coral trout were tagged on reef slopes in the Capricorn-Bunkers. After eight months, 27 had been recaptured close to, or at the site of tagging. The remaining 4 were recaptured at other reefs, 12-28km away (W. Craik cited in Samoilys 1987). This study was based out of Heron Island and it is possible that many, if not all, movements between reefs were between Heron and Wistari Reefs which are only separated by a relatively shallow channel hundreds of metres across or between Heron and Sykes Reef which are joined by an extensive area of relatively shallow coral bottom (the original data are not available to us).

This raises the possibility of differential movement between groups of reefs depending on the 'inter-reefal' habitat type. This has implications for both appropriate management strategies and the design of large-scale experiments to examine the effects of management strategies (see for example Walters and Sainsbury 1990). We see an improved understanding of 'inter-reef' habitats, the dependence of reef fish upon them in general, and the significance and nature of inter-reef 'stepping stones' between reefs as a priority area for future research.

8.4 Studies in Progress

(i) Mark-release-recapture programs using fish traps are being carried out on Orpheus and Lizard Islands by JCU and on a number of reefs across the shelf in the central GBR by AIMS. These ongoing studies should greatly improve our knowledge of within-reef movements of the relevant species.

(ii) QDPI (NFRC) is carrying out intensive tagging, particularly of *P. leopardus*, around Sudbury Reef off Cairns, using line fishermen to sample rather than trapping. This program too should improve our knowledge of within-reef movements of fish.

No studies are specifically aiming to evaluate inter-reefal movements however this is likely to be a priority in the GBRMPA 'Effects of Fishing' program to begin in 1992.

Table 17 Distances moved by three species along northern reef slope of Heron Reef. Fish were caught by line and tagged, then observed in underwater surveys. Average time between release and observation was approximately 3 weeks. (From Beinssen 1989b).

	Distance Moved			
	0m	**>0-500 m**	**>500-1000 m**	**>1000-1500 m**
Plectromus leopardus	71%	17%	8%	4%
Lethrinus miniatus	93%	7%	0%	0%
Lutjanus adettii	78%	16%	6%	0%