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Research on Fishes of the Great Barrier Reef

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GREAT BARRIER REEF MARINE PARK AUTHORITY

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RESEARCH ON FISHES OF THE GREAT BARRIER REEF

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SUMMARY

In spite of the amazing species richness and diversity, there has been relatively little research undertaken on fishes of the Great Barrier Reef. The majority of research published in the last 20 years on Great Barrier Reef fishes has been concerned with establishing diversity and species numbers, investigation of home range and territoriality phenomena in small species and reproductive/life history studies in relatively small, accessible species.

Despite the comprehensiveness of some of the work undertaken, and apart from some relatively recent work, the vast majority of the research undertaken to date is of a distinctively academic nature, of rather small relevance to the Great Barrier Reef Marine Park Authority's planning and management needs.

Keywords: Great Barrier Reef Marine Park Authority, reef fishes, fish research, coral reefs, Great Barrier Reef.

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1. INTRODUCTION

Published research on fishes of the Great Barrier Reef was surveyed to find out what information is known and how useful this information is to the planning and management role of the Great Barrier Reef Marine Park Authority.

2. SPECIES RICHNESS & DIVERSITY

The richness of the fish fauna of the Great Barrier Reef (Talbot, 1970; Goldman and Talbot, 1976) cannot be questioned. The Indo-Pacific Region, which is believed to be the centre of world shallow water marine speciation (Briggs, 1966) probably supports 6,000 to 7,000 fishes (Carcasson, 1977) of which about 850 species (representing about 197 genera and 84 families) can be found in the Capricorn Group (Ehrlich, 1975). Talbot and Anderson (1978) suggest, on this basis and extrapolating from known families, that at least 1,200 to 1,600 species might be found in the Lizard Island areas of the reef.

Examining fish diversity on a smaller scale, these same authors suggest that in a 20m radius of coral reef one might find 150 species of fish. The structure of these fish communities, however, differs both in species composition and diversity across and between reefs. Talbot and Anderson (1978) suggest that variation in at least three broad scales of habitat differences exists: broad zones reflecting the degree of wave action and depth,

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geographical variation in the same zone from north to south along the reef and from inshore to offshore, and patchiness within such a zone (variation in coral species, changes in substrate etc.). At One Tree Island reef, of 395 species so far collected, about half (188 species or 49%) were collected in only one of the five broad habitat zones defined by Talbot and Goldman (reef base, windward and leeward reef slopes, reef flat and lagoon). Only 7% (26 species) of the species were found in all zones (Goldman and Talbot, 1976). Obviously environmental variables such as physical complexity of the habitat, the amount of shelter, wave action and temperature are important (Talbot and Goldman, 1972, cited in Russell et al., 1974). However, there appears to be little published work on the relationship of environmental variables to the distribution of individual reef fish species.

Although the existence of diverse communities of fish on the reef has been demonstrated, very little appears to be known either about the establishment or maintenance of either the communities or their diversity. Talbot (1970) summarises the six main hypotheses proposed to explain increased diversity in tropical areas: longer time available, greater spatial heterogeneity, greater competition, heavier predation, greater climatic stability and greater productivity. These hypotheses are not mutually exclusive, but Talbot concludes after an examination of reef areas (One Tree Island reef, Tutia Reef) and ancient lakes (Lake Baikal), that the most plausible explanation of increased diversity is, to a large extent, the stability/time theory, although this does not preclude other factors.

Sale (1977) considered data from a large number of sources and concluded that reef fish tend to be food and habitat generalists, coexisting species displaying similar and overlapping requirements. Herbivorous fishes make up about 22% by weight and species of the fish community on coral reefs and are notably food generalists (Choat, 1969, cited in Sale, 1977); predatory and omnivorous species are somewhat more specialised in diet, with related species showing size and taxonomic partitioning of food, although differences are not great (Choat, 1969, cited in Goldman and Talbot, 1976).

The availability of suitable living space appears to be the limiting factor for reef fish and according to Sale, its spatial and temporal unpredictability make competition for living space something of a lottery. Equilibrium communities are thus prevented from forming and the establishment and maintenance of diverse communities is continually fostered.

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Unpredictable larval dispersal and juvenile recruitment (Russell et al., 1974) may also contribute to the maintenance of diversity.

3. HOME RANGE AND TERRITORIALITY

Coral reef fish appear to exhibit a relatively close assocation with particular areas (Ehrlich, 1975; Talbot and Anderson, 1978). Work on home range and territoriality in Great Barrier Reef fishes has tended to concentrate on the smaller species, and as Talbot and Anderson point out, the available published evidence concerning larger fishes is very sparse; almost no research on home ranges of larger fishes has been conducted on the Great Barrier Reef.

Many of the smaller species are territorial. Fishes of the family Pomacentridae have been quite extensively studied in this area and many have been shown to display territoriality: *Pomacentrus flavicauda* Whitley (Low, 1971), *Abudefduf zonatus* (Cuvier and Valenciennes) = *A. biocellatus* (Quoy and Gaimard) (Keenleyside, 1972), *P. tripunctatus* Cuvier and Valenciennes (Sale, cited in Keenleyside, 1972), *A. lachrymatus* (Quoy and Gaimard), *P. apicalis* De Vis, *P. jenkinsi* Jordan and Everman, *P. dorsalis* Gill and *P. wardi* Whitley (Sale, 1974). Pomacentrid species occurring on the Great Barrier Reef, but studied elsewhere for example, species of the genus *Amphiprion*, also display territoriality (Allen 1972).

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In addition to territoriality, at least one Pomacentrid, *Dascyllus aruanus* (Linnaeus), has been shown to restrict its movements to a home range, although it does not defend the area (Sale, 1971).

Chaetontidae is another family of small fishes in which many species have been shown to display localisation to a distinct area. Territorial behaviour has been observed in *Chaetodon triangulum* (Cuvier and Valenciennes) and *Megaprotodon strigangulus* (Gmelin), and home range fidelity in *C. trifasciatus* Mungo Park (Reese, 1973). *C. auriga* Forskal individuals have been reported as using the same night roosting sites for over a year (Talbot and Anderson, 1978).

The only published work on movements of larger Great Barrier Reef fishes appears to be that of Goeden (1977) on coral trout, *Plectropoma maculatum* (Bloch). These fish are believed to be non-nomadic, partitioning the reef slope on which they live and searching an area ("home range") for short periods of time, the size of which corresponds to the age (length and weight) of the fish. Although coral trout partition the reef slope, a statistical attempt to demonstrate the same phenomenon for their prey species was unsuccessful (Bradbury and Goeden, 1974).

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Most of the available information on the movements of larger reef fish comes from studies on other coral reefs. Bardach (1958) examined home range fidelity and homing in groupers: *Epinephelus striatus* (Bloch), *E. guttatus* (Linnaeus), *Cephalopholis fulva* (Linnaeus), and *Mycteroperca* spp.; squirrel fish: *Holocentrus sp.;* parrot fish: *Scarus vetula* Bloch and Schneider, *Sparisoma viride* (Bonnaterre); and snapper: *Lutjanus griseus* (Linnaeus) in Bermuda. He found that squirrel fish showed fairly restricted movements, groupers ranged freely over a reef for periods of a few months before moving elsewhere, snapper also moved freely over a reef, at least in daytime, and parrot fishes appeared to move over larger areas, incorporating more than one reef.

The movements of surgeon fish (Acanthuridae) do not appear to have been examined at the Great Barrier Reef. Bardach (1958) found that the two species he examined in Bermuda Reefs *Acanthurus chirungus* (Bloch) and *A. bahianus* Cast appeared to be relatively permanent residents of fairly small areas of the reef environment. However, work summarised by Ehrlich (1975) suggests that Acanthurids display very variable behaviour with respect to movements; holding permanent or semi-permanent territories, temporary grazing territories or are non-territorial and school.

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Ehrlich points out that very little is known of the movements of trevally (Carangidae) trumpet fish (Aulostomidae) squirrel fish (Holocentridae), lizard fish (Synodontidae), trigger fishes (Ballistidae), trunk fishes (Ostracionidae), puffers (Tetraodontidae), porcupine fishes (Diodontidae), cardinal fishes (Apogonidae), moray eels (Muraenidae), or of the small blennies (Blennioidei) and gobies (Gobioidei) although work on these latter two groups from temperate waters suggests some restriction of movement (Beebe, 1931; Stephens et al., 1970). Recent work by Lassig (1976) suggests that pairs and social groupings of four species of obligate coral dwelling gobies of the genus *Paragobiodon* may be very stable for long periods of time.

With respect to movements over shorter periods of time, only limited observations on diurnal-nocturnal movements of Great Barrier Reef fishes are available when compared with Hobson's (1965, 1972, 1973) rather extensive work on movements of reef fishes. About the only local work of this kind is that by Domm and Domm (1973) who examined the sequence of appearance at dawn and disappearance at dusk of reef fishes at the Hook Island Underwater Observatory. They found that there was a consistent order of disappearance of reef fishes at dusk. Fishes of the same family showed a tendency to disappear within relatively narrow time limits: labrids first, followed by schooling pomacentrids, chaetodontids, acanthurids, siganids and scarids. Large solitary pomacentrids showed more variability and tended to disappear last. This sequence was approximately reversed at dawn. Families tended to have closely related times of appearance or disappearance except in families in which there are small schooling species and large solitary species. In such families, the fish tended to disappear at different times.

4. COLONISATION AND RECRUITMENT

Recruitment to coral reefs is beginning to be recognised as strongly seasonal (Russell et al., 1974, 1977) with recruitment of juveniles at One Tree Island reaching a peak in January and February (though occurring throughout the period September to May) when temperatures are highest and primary production at its peak. This pattern appears to be consistent with data from other reefs in the southern end of the Great Barrier Reef and from artificial coral colonies set up at Heron Reef (Sale and Dybdahl, 1975).

At the northern end of the reef also, recruitment appears to be strongly seasonal with most settlement between October and May (Anderson and Talbot, unpublished data, cited in Russell et al., 1977). In general the available evidence is beginning to suggest

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that primary production in tropical waters is more seasonal than previously believed and that the breeding cycles of tropical fishes may be tied to these patterns.

In a study of recruitment at One Tree Island, 54 species involving 22 families representing the main groups of reef fish except the gobies and serranids were investigated (Russell _et al._, 1977). Both pelagic and demersal spawners were examined, and although there are considerable differences between these two groups in egg and larval periods (duration of life history stage, size at settlement, degree of parental care), almost all species have at least a short pelagic larval phase. While most species appear to have fairly long breeding seasons, recruitment is strongly seasonal, but does not appear to be constant from year to year and post-larval colonisers do not always remain as adults on the reef. Comparison of settlement on newly constructed and older artificial reefs suggested that the presence of adults and sub-adults on the older reefs may inhibit settlement. Aggressive exclusion may prevent over-exploitation of resources and may confer a degree of stability on the community as a whole. It may also result in greater dispersal of the species. Predation was also believed to have a significant effect on ultimate recruitment particularly in rough weather.

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Apparent randomness of recruitment was suggested to the authors by differences in species composition between replicate reefs. Opportunistic habitat selection by juveniles appeared to be indicated. A similar chance phenomenon, rather than a systematic partitioning of available space, is suggested for adult colonisation from a study of recruitment of artificial coral colonies (Sale and Dybdahl, 1975).

The suggestion of opportunistic habitat selection may be supported by apparent habitat changes with growth (Russell et al., 1974; Sale, 1969) and the work of Sale (1972, cited in Russell et al.,1974) which has shown that while a particular coral will provide shelter for a particular group of similar species, it is not possible to predict which of these species will successfully occupy that coral on any particular occasion. However, the effect of prior experience on habitat selection was demonstrated by Sale (1971) who provided a choice of three coral species to a group of juvenile *D. aruanus* collected from two of the test coral species. Significantly more fish were found on the coral from which they had been collected than from the other species of coral presented. Sale reports that juvenile fish naturally use fewer species of coral than adults but does not reconcile this with his experimental findings of prior experience on juvenile habitat preference. He investigated the patterns of use of space over time, of species guilds containing three territorial Pomacentrid species on rubble patches (Sale, 1975). As colonists, the three species showed similar space preferences and equivalent ability to enter spaces caused by mortality; their responses were not altered by the kind of species previously resident. On rubble patches, space requirements do not appear to differ, although the strategies for obtaining and holding it apparently do.

Where suitable corals are in short supply *D. aruanus* groups are effectively spaced thoughout the coral by agnostic behaviour, where the degree of aggressiveness appears to be related to the degree of crowding of the group. This probably serves to prevent the addition of juvenile colonists to groups which are more crowded than their neighbours and may well serve as a spacing mechanism (Sale, 1972).

The available evidence suggests that a fairly wide range of substrates is appropriate for settlement for at least some of the reef fishes and that, to a large extent, chance factors tend to determine which species (and individuals) are recruited at particular locations. This appears to agree with the findings of one of the few expermental studies of larval settlement and colonisation in which the fish were reared in a healthy state beyond the point of transformation. Marliave (1977) found for north temperate fish that the range of preferences for settling larvae of intertidal species corresponded to the adult niche breadth. Interestingly however, the preferred substrate for settlement, while always an element of the adult habitat, was not necessarily the preferred adult substrate. Tactile cues, light transmission, and in some species, other factors such as current speed and salinity influence settlement preferences and the importance of encountering the appropriate substrate before the end of the critical period was demonstrated.

5. REPRODUCTIVE BEHAVIOUR

A number of studies on reproductive behaviour have focused on the protogynous hermaphroditism of various kinds of coral reef fish. Protogynous hermaphroditism is currently known to occur in labrids (wrasses), scarids (parrot fish) serranids (groupers), parapercids (sand weevers) and Gobiidae (gobies), and, in some species results in the presence of two types of males in the population: "primary" males (males from hatching) and "secondary" males (derived from females)(Robertson, 1973a, 1973b; Robertson & Choat, 1974; Lassig, 1977; Goeden, 1977; Stroud, 1978). Frequently territoriality and/or home range phenomena are involved in the social behaviour (usually including a sex related hierachy) of these species and this behaviour is important in the control and maintenance of this form of hermaphroditism.

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Suggested benefits of this phenomenon are that the predominance of females increases fecundity and that only the best adapted "female" genotype becomes most widely spread throughout the population. Flexibility to cope with changed environmental conditions is provided and each individual may contribute more to subsequent generations by reproducing first as a female and subsequently as a male. Although a biased sex ratio is an inbreeding mechanism since it reduces the number of genotypes available for recombination, pelagic dispersal of eggs and/or larvae conteract this (Robertson, 1973a; 1973b; Robertson & Choat, 1974).

Other studies on the reproductive behaviour of reef fish have tended to focus on social and histological aspects of reproduction (territoriality, cooperative behaviour, parental care, nest building, gonadal indices etc.) in, primarily, commercially and recreationally unimportant species of fish (Choat, 1966; Robertson, 1973c; Keenleyside, 1973; Lassig, 1976; Stroud, 1978), although there are several exceptions in the work of Goeden (1977) on coral trout and Walker (1975) on Lethrinids.

Information on breeding seasons summarised by Russell et al., (1977) covering 19 species in four families suggests that most species have fairly lengthy breeding seasons and breed between October and May.

6. GENETICS

The genetic discreteness of population is an important aspect of population dynamics of reef fish, about which we know very little. Since most larvae (and/or eggs) have at least a brief pelagic stage, there is evidently time for some dispersal. Talbot and Anderson (1978) point out that a three knot drift over 14 days gives 1,000 mile of range for a developing egg and larval fish before settling. However, this assumes direct and unimpeded drift and does not take account of gyres, counter-currents, changes in wind direction, deep eddies etc., all of which may result in a great reduction in the distance of, and an unpredictable direction of, dispersal of eggs and larvae. If planktonic stages are estimated as lasting from approximately four to six weeks, there exists a theoretical mechanism for widespread dispersal. However, Southward (1953) pointed out that even though a British intertidal spcies of barnacle has a pelagic larval stage of three to four weeks, it has not crossed the 30 to 40 mile channel between Britain and Ireland. Thus a pelagic life history stage and theoretical straight line drift calculations cannot be assumed to indicate widespread dispersal. There is some evidence to suggest that inshore and offshore ichthyoplankton of the Townsville area do not mix (Milward, 1978) and Creswell's findings on the eddying

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circulation of the south east Australian current (Provis, 1978), contrary to historical belief, suggests that caution be exercised in discussion and assumptions relating to larval dispersal.

Work of Soule (cited in Erhlich, 1975) on the population genetics of some of the fishes of the Great Barrier Reef is beginning to provide some information on the degree of genetic differentiation in reef fish populations. *Acanthrochromis polyacanthus* (Bleeker), which has no pelagic larval stage, shows striking phenetic differentiation between populations. Genetic studies revealed similarly striking genetic differentiation; different gene frequencies were found in different populations and many alleles were found to be unique to one or a few populations. In contrast *D. aruanus*, which has pelagic larvae, shows virtually identical allele frequencies over a 4,000 km transect from the southern part of the Great Barrier Reef to Madang in Papua New Guinea. *P. wardi* which also has pelagic larvae, shows a similar pattern to *D. aruanus*.

It thus appears that some fish with pelagic larvae, e.g. Pomacentrids, show very little allelic differentiation over 3,000 to 5,000 km unless there is emergent land between. Although most species have a pelagic larval stage, the Pomacentrids are demersal spawners and the larvae of at least some Pomacentrid species remain closer to the reef than larvae of pelagic spawners. The degree of genetic differentiation between populations thus appears to be at least partially related to the duration of the pelagic stage in the life cycle.

In this respect, most species are pelagic spawners (Carangidae, Chaetodontidae, Scorpaenidae, Lutjanidae, Nemipteridae, Gerridae, Pomadasyidae, Lethrinidae, Mullidae, Pempheridae*, Cirrhitidae*, Siganidae and Ostraciontidae (Russell _et al._, 1977). Most of the information on the spawning of blennies and gobies comes from temperate waters and, in some cases, there is evidence of demersal spawning with some parental care, although the larvae are pelagic (Marliave, 1976; Schultz and De Lacy, 1932). Apogonidae, Pomacentridae, Balistidae and Tetraodontidae are known demersal spawners (Russell _et al._, 1977).

7. OTHER AREAS OF RESEARCH

Research on a smaller scale has been conducted in a variety of other areas. Rohde (1977, 1978) has undertaken much of the little work which has been conducted on parasites of Great Barrier Reef fishes. In a study of Monogenean gill parasites of 74 species (27 families)

* presumed pelagic spawners

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of fish in the Capricorn Bunker Group and 54 species (9 families) of fish from Lizard Island, he showed that the number of Monogenea species, which represents only a small percentage of the parasite fauna, is much larger than the number of fish species in the region since the majority of fish species studied each carry several species of Monogenea. The number of Monogenea species was also found to increase faster than the number of fish species towards the Equator (Rohde, 1977). Composite data from a number of surveys (including Lizard Island and Heron Island) of Monogenea and Digenetic trematodes showed that host specificity of the Digenea increased from cold to warm seas, but this is not the case for Monogenea (Rohde,1978). The difference is explained in terms of life history strategies, such that Monogenea are K-strategists, showing a high degree of host and site specificity to facilitate mating in low density situations while Digenea are r-strategists, infecting many hosts and showing reduced specificity in cold temperate seas because of more ecologically uniform and widespread host distribution.

Several general biological studies in particular species of families have been undertaken. Endean (1961) reports a comprehensive investigation of the venom apparatus and venom of the stone fish *(Synanceja trachynis* Richardson), with associated data on behaviour, distribution and habitat. Schooling behaviour, reproductive behaviour, feeding and colouration of parrot fish (Scaridae) were investigated by Choat (1966) and general biological studies of coral trout, sand weevers (Parapercidae) and emperors (Lethrinidae) have been undertaken (Goeden, 1977; Stroud, 1978; Walker, 1975).

Specific topics of investigation include the reasons for the bright colours of coral reef fish. Perhaps surprisingly, they do not appear to be designed to advertise territories and ward off intra- and interspecific attacks (Ehrlich *et al*., 1977). Investigation of the biotic relationships in a small community of dissimilar organisms, characteristic of coral reefs, showed that a system of identifiable "signals" between the crab, shrimp and two fish, maintained the integrity of the community (Lassig, 1976).

Indirect effects on coral growth by aggressive herbivorous fish defending larger territories than they require to support their own food needs have been demonstrated (Potts, 1977). The growth of uneaten filamentous algae may not only affect coral growth, but may also have an effect on larval settlement.

Limited investigations have been undertaken in the area of trophic levels and biomass. At One Tree Island reef, Goldman and Talbot (1976) divided fish into four feeding categories and calculated their relative proportions by biomass. This resulted in 10% planktivores, 18% grazers, 18% benthic invertebrate feeders and 54% piscivores. However, the authors point out that this apparent reversal of the trophic pyramid (with carnivores contributing more than three times the biomass of grazers) results from consideration of only part of the reef fauna.

8. CONCLUSIONS

While much of the work which has been undertaken on Great Barrier Reef fishes is quite comprehensive, it tends to have little relevance as far as management of reef fishes, which are of commercial or recreational importance, is concerned. The following section presents a description of fish research which would be desirable from the planning and management role of the Authority.

9. RECOMMENDATIONS: AREAS OF RESEARCH RELEVANT TO THE GREAT BARRIER REEF MARINE PARK AUTHORITY

9.1 Population estimation

An area of research which should be given highest priority, whether conducted by the Great Barrier Reef Marine Park Authority or another organisation, is the relationship between visual estimates of fish populations

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(even if this only for recreationally important reef fish) and the populations that are actually present on the reef, as assessed by more conventionally accepted methods of population estimation e.g. mark recapture techniques, rotenone sampling, static observation etc.

Detailed mark-recapture work in association with visual estimates, would not only provide information for population estimation, but with a little more effort involved, could also provide information on normal movements of reef fish.

A comparison of the results from SCUBA counts and poisoning in restricted areas would provide a measure of the accuracy of visual estimations. Whatever visual technique is used, and some comparison of these should be undertaken, a check on the accuracy of the method using some method of killing the fish is essential initially. Subsequent development of a system of sequential visual counts may provide a method of population estimation which satisfies elementary conditions of accuracy and repeatability.

Unless an attempt is made to validate, in a scientifically acceptable manner, the population estimates from visual techniques, no credence can be placed on any conclusions which may be drawn from such techniques. While the reluctance to kill fish to validate visual estimates may be admirable to the conservationist, the failure to do so when it is the only reliable method of validating a technique is negligent and may result in inappropriate, misinformed management decisions having a far more deleterious effect on reef populations than the controlled sampling of a limited number of populations.

Associated with investigation of population sizes, investigation of the age and population of structure of reef fish populations should be undertaken, both on fished and "unfished" reefs. This would provide an indication of the effect of fishing on the age structure of fish populations which may have important implications for management involving minimum size limits, catch limits etc. Feasible ageing methods may have to be developed.

9.2 Reproductive Biology

Studies of the reproductive biology of commercially and recreationally important species of fish are fairly essential if protogynous hermaphroditism is a common characteristic of reef fish. If minimum size limits of fish are maintained and if sex reversal generally occurs at a size above the minimum size limit, the numbers of males in the population may become vanishingly small. Whether when local populations are heavily fished (and the larger fish removed), the size at which this occurs is lowered, is unknown. However, the effect of fishing on this phenomenon, which may be extremely widespread in coral reef fish, may be very significant in that it

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may be more desirable to restrict the taking of large fish and encourage the taking of smaller fish.

9.3 Migrations and Movements

One of the most important areas where research is required is that involving delineation of the movements undertaken by species of fish involved in commercial and recreational fisheries, e.g. sweetlip, red emperor, spangled emperor, coral trout, etc. There is a dearth of information on the daily movements and migrations of these larger fish so that it is not known whether they restrict their movements to very small areas of one reef, range widely over many reefs, show tidally or diurnally related movements, etc.

The majority of work conducted on home range of fish on the Great Barrier Reef has been concerned with small but relatively unimportant (as far as the fishing public is concerned) fish, and the published data from fish on other coral reefs (e.g. Bardach's rather brief experiments) suggests that the situation for large fish may be quite different from that for small fish. Data from rockfish and cunners from north temperate waters however suggests that movements may be quite limited. Until the range of movements is known with any certainty for the fish in question, the effects of heavy fishing on the population of a particular reef must be largely guessed at.

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Heavy fishing of species which display restricted home ranges (and even territoriality) would appear to result in a much more rapid depletion of the resource, and very possibly, an extremely slow recovery compared with the fishing of wide ranging species. The latter are not so readily accessible, would be less easy to eliminate from a reef and may well show a faster recovery if populations do reach low levels.

9.4 Pelagic Dispersal Phases.

While this is a major undertaking, it would be highly desirable from the Great Barrier Reef Marine Park Authority's point of view to obtain information on larval dispersal of recreationally and commercially important species (or at least families) of fish. While this may need to be preceded by taxonomic work to allow larval identification, extensive series (both spatially and temporally) of plankton tows, concurrent with information on specific spawning times of fish in different areas may begin to provide some indication of the degree of dispersal possible during the pelagic phase of the life cycle of those fishes. Encouragement of oceanographic research in this area would also be of value to the Authority, particularly in view of Creswell's recent findings on the south eastern Australian current system, which challenge long accepted theories of oceanographic circulation patterns in this area.

While I realise the enormity of this task and more importantly that there is little predictive value to be obtained from such work, in view of the difficulty of establishing a relationship between adult spawning stock and recruitment, a pattern of possible dispersal might begin to be established which might aid in suggesting minimum required boundaries for relatively self sustaining groups of populations. This work could be particularly useful in connection with electrophoretic studies of allelic differentiation between populations, although caution should be used in interpretation of the latter since only a minute fraction of the genome is ever sampled.

As an initial step in this regard, comparison of inshore (including around islands) and offshore larval fish distribution in smaller areas (e.g. the Capricorn Bunker group) might be undertaken and taken in conjunction with information on larval age and adult spawning times may provide some information on species dispersal and the potential for recruitment to reefs where the fish populations have been reduced.

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APPENDIX II
DOCUMENT CONTROL DATA

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4. Author(s) and affiliations if from different establishments.
   Wendy Craik

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5. Summary:

In spite of the amazing species richness and diversity, there has been relatively little research undertaken on fishes of the Great Barrier Reef. the majority of research published in the last 20 years on Great Barrier Reef fishes has been concerned with establishing diversity and species numbers, investigation of home range and territoriality phenomena in small species and reproductive/life history studies in relatively small, accessible species.

Despite the comprehensiveness of some of the work undertaken, and apart from some relatively recent work, the vast majority of the research undertaken to date is of a distinctively academic nature, of rather small relevance to the Great Barrier Reef Marine Park Authority's planning and management needs.

6. Keywords: Great Barrier Reef Marine Park Authority, reef fishes, fish research, coral reefs, Great Barrier Reef.

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7. Descriptors

8. Library Numbers
