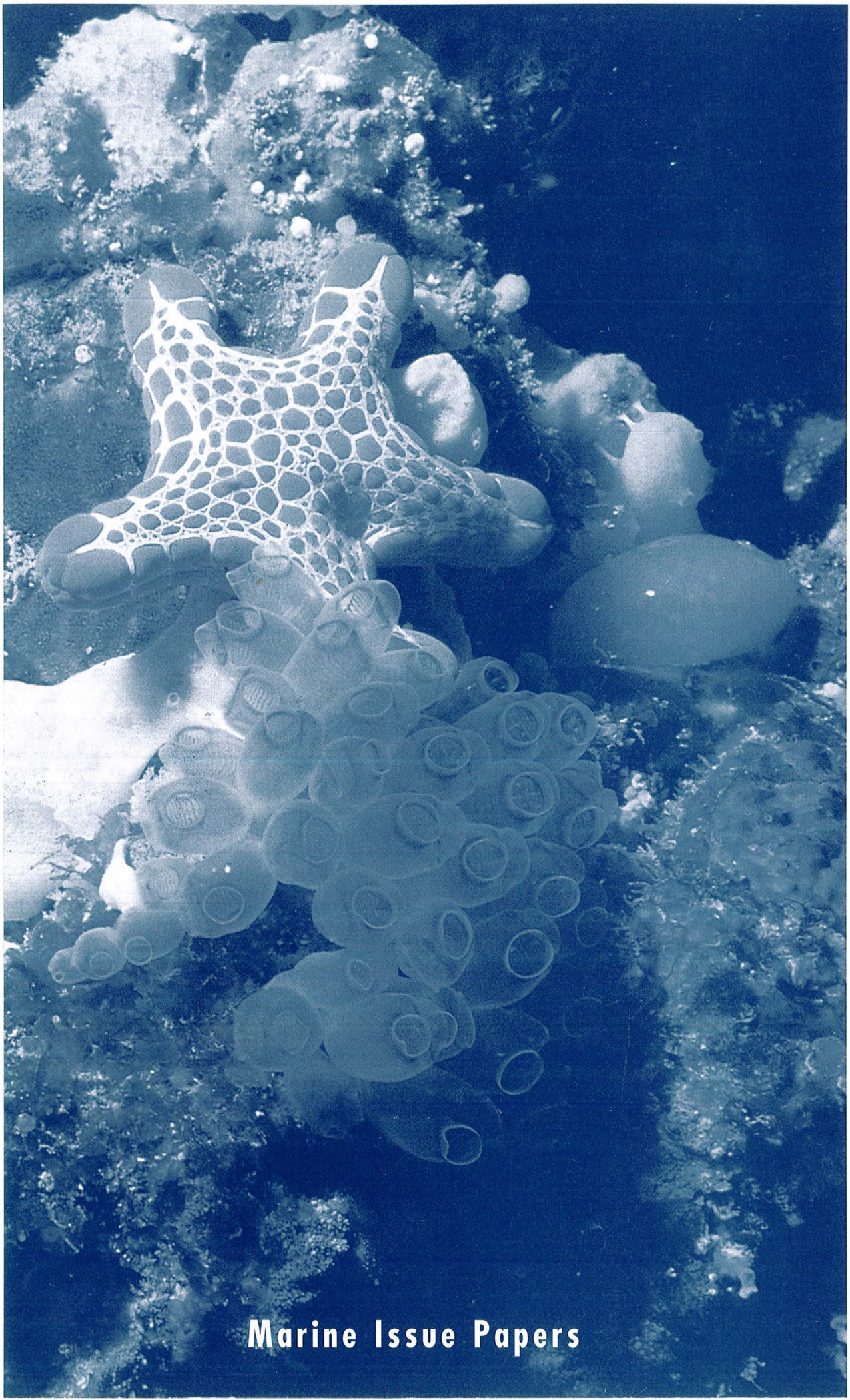
No-take Areas in Marine Management



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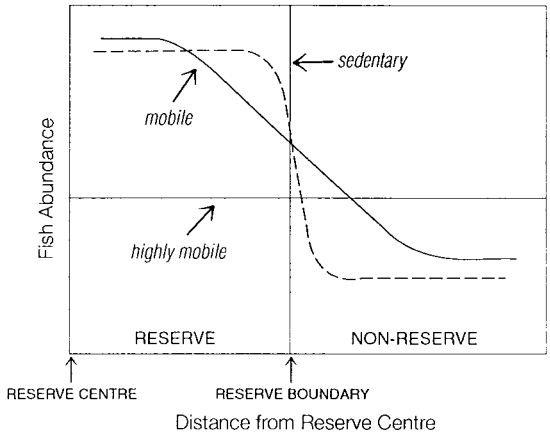
ERRATUM

Figure 8 on page 6 was incorrectly printed.
The correct version is below.

FIGURE 8. Hypothetical Effect of *No Take* Areas on Fish Abundance



(From Ratikin & Kramer, 1996)

'NO TAKE' AREAS IN WESTERN AUSTRALIA'S MULTIPLE-USE MARINE CONSERVATION RESERVE SYSTEM

A DISCUSSION PAPER

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PREFACE

The paper *No Take Areas in Western Australia's Multiple-Use Marine Conservation Reserve System* has been developed to provide the basis for more balanced discussion on this topic. The role of *No Take* areas remains one of the more contentious issues in the conservation and management of Australia's marine resources. The paper addresses this issue within the specific context of a statewide system of marine protected areas in Western Australia. However, much of it has a generic application to other marine jurisdictions. The paper will help narrow the traditional gap between conservation and fisheries interests in relation to this issue.

Comment on the paper has been sought from local and international reviewers. It has been discussed and reviewed at length by the Western Australian Marine Parks and Reserves Scientific Advisory Committee.

SUMMARY

No Take areas are an important tool for nature conservation and for achieving ecological sustainability. Significant benefits will result from their establishment within a multiple-use marine conservation reserve system. *No Take* areas should be considered as part, albeit an important part, of a mosaic of management tools which will help achieve the dual objectives of the marine conservation reserve system: biodiversity conservation and ecologically sustainable management of human activities. The size, location and number of *No Take* areas within a marine conservation reserve must be considered in relation to the projected level of use of other management mechanisms such as enforcement, biological monitoring and education. *No Take* areas may provide benefits to the management of commercial and recreational fisheries, particularly if these areas protect important breeding sites or prevent local depletion of target stocks, particularly sedentary species. The creation of *No Take* areas can also help marine managers to separate incompatible activities and reduce user conflicts.

There is a need for a habitat-based approach in selecting these areas if the ecological and management benefits of *No Take* areas are to be maximised. However, it should be acknowledged that socio-economic issues are likely to be a major influence when considering the size, location and number of *No Take* areas in the marine conservation reserve planning process. Ideally, *No Take* areas should be established through a proactive statutory community consultative process. This would be better than a reactive regulatory process implemented only after serious problems have arisen.

Globally, there is increasing interest in using *No Take* areas to protect critical ecosystems and to ensure sustainable usage for present and future generations. *No Take* areas are becoming more acceptable to an increasingly conservation-orientated general public, but the potential benefits need to be more extensively demonstrated to specific user groups, such as commercial and recreational fishers, who have traditionally opposed their establishment. To address these concerns and help change attitudes about *No Take* areas, better public awareness of the purposes and importance of these areas is needed.

INTRODUCTION

No Take areas in the marine environment can be used for conservation, resource management, education and recreation. *No Take* areas are clearly defined zones that are closed, permanently or temporarily, to all direct extractive or harvest activities, but are usually still open for non-extractive or low impact activities, such as tourism or research. Closures have the dual purpose of conserving representative examples of biodiversity and habitats, while protecting critical life stages and ecological processes. Other terms commonly used for marine *No Take* areas include "sanctuary", "conservation", "exclusion" or "no fishing" zones, "closed areas", "harvest refugia", "marine fishery reserves", "core areas" and "replenishment areas". *No Take* areas, as defined above, should not be confused with seasonal closure of areas to commercial or recreational fishing for fisheries management purposes.

A growing body of evidence indicates that *No Take* areas are needed to effectively protect the biodiversity of marine resources, while at the same time allowing for sustainable use of those resources in adjacent areas. *No Take* areas also have potential to be a useful tool for fisheries management, by preventing localised depletion of target species, particularly sedentary species, or by protecting spawning aggregations. From a nature conservation perspective, ecological benefits may include recovery of habitat complexity and quality, maintenance of species diversity and increased marine community stability. *No Take* areas should, however, be considered as part of a mosaic of complementary management tools that all contribute to the strategic objectives of marine biodiversity conservation and ecologically sustainable management of human activities. As well as the enforcement, biological monitoring and education programs typically associated with reserve management, other mechanisms to protect marine habitats include fisheries management plans, pollution control regulations and environmental management plans.

Excluding extractive activities from particular areas is often perceived to (and sometimes does) have negative impacts for some users. The creation of *No Take* areas is usually the topic that brings the greatest resistance from various user groups during the establishment of a marine conservation reserve. Thus it is important to inform commercial and recreational fishers, industry groups, tourism operators and the broader community about the purposes of these areas, and to involve them in the process of identifying candidate areas and developing appropriate management practices.

This discussion paper provides an overview of *No Take* areas from biodiversity conservation and, to a lesser extent, fisheries management perspectives and examines their role in the management of a multiple-use marine conservation reserve system in Western Australia (CALM 1994). The purpose of the paper is to improve understanding about the purposes of *No Take* areas in a way that can be clearly understood by all sectors of the community.

PURPOSES OF *NO TAKE* AREAS

From both nature conservation and fisheries management perspectives, the broad purposes of *No Take* areas are to:

- *protect biodiversity and ecological integrity;*
- *provide refuges that protect endangered, vulnerable or rare species and communities from over-exploitation;*
- *provide exploited areas with a source of larvae, spores and eggs;*
- *provide scientific control sites that form a basis for comparison, to examine the impacts of human activities in other areas;*
- *provide monitoring sites that allow scientists to*

investigate natural levels of change in undisturbed ecosystems;

- *manage for unpredictable cumulative impacts that may result from multiple-use of poorly understood environments;*
- *provide 'insurance' against population decline of vulnerable species by protecting core populations, spawning sites and nursery areas;*
- *create new, or enhance existing human activities, e.g. non-extractive, low impact activities such as passive recreation, scientific research and tourism; and*
- *separate incompatible activities and, in some cases reduce conflicts between users.*

POTENTIAL OUTCOMES OF ESTABLISHING *NO TAKE* AREAS

Creating *No Take* areas as part of a marine conservation reserve system can result in a number of outcomes. These may include:

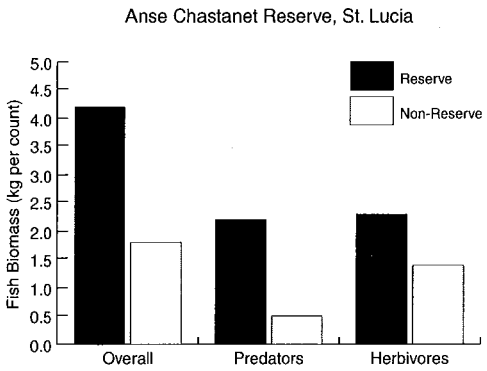
- *maintenance or recovery of species diversity, habitat complexity and quality;*
- *increased stability of biological communities;*
- *elimination of damage to critical habitats;*
- *increased local abundance, individual size and age, particularly of sedentary species;*
- *increased reproductive output of sedentary species spawning within the* No Take *area;*
- *maintenance of genetic diversity of stocks;*
- *enhanced recruitment inside and outside the* No Take *area;*
- *protection of recruitment where* No Take *areas cover nursery habitats for exploited species.*
- *provision of undisturbed control sites for monitoring impacts outside the* No Take *area;*
- *negative or positive cost implications for regulatory enforcement, education and user compliance programs;*
- *negative or positive implications in regard to user conflicts;*
- *improving public awareness and understanding;*
- *the creation of areas with intrinsic value as educational and tourism resources;*
- *reduction in yield from exploited stocks if large* No Take *areas are established; and*
- *redirection of commercial and recreational fishing effort if large* No Take *areas are established.*

EVIDENCE OF OUTCOMES OF ESTABLISHING *NO TAKE* AREAS

In recent years, a number of reviews have examined the effects of protection, particularly regarding the use of *No Take* areas as a fisheries management tool. Several of these reviews (Roberts & Polunin, 1991, 1993; Dugan & Davis, 1993; Baker et al., 1996; Bohnsack, 1996) provide evidence that benefits do occur after reservation of an area, with numerous reports of increased abundance and size of target species within the reserve (see Figures 1-5 for examples). These reports, from countries with a range of marine management controls, cover both temperate and tropical reef fishes as well as crustaceans, molluscs and echinoderms in a variety of habitats. Some of these studies have reported abundances of target species in *No Take* areas 2-25 times higher than those in surrounding fished areas (Dugan & Davis, 1993). Abundance of the New Zealand spiny lobster (*Jasus edwardsii*) in a New Zealand *No Take* marine reserve was 10 times higher than that of surrounding unprotected areas (Towns & Ballantine, 1993). Average size of individuals was also greater, and anecdotal evidence suggested that the local lobster fishery was enhanced, possibly through migration of a portion of the protected stock out of the reserve (Cole et al., 1990).

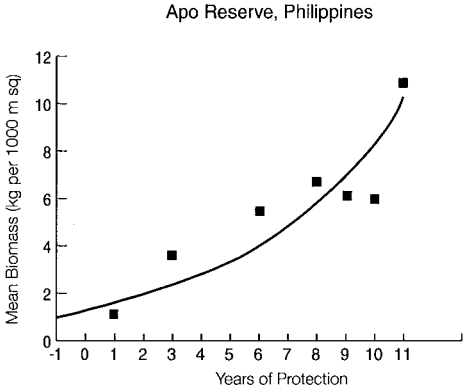
A recent Australian study of Tasmanian marine reserves (i.e.

FIGURE 1. Biomass of Commercial Fish Species



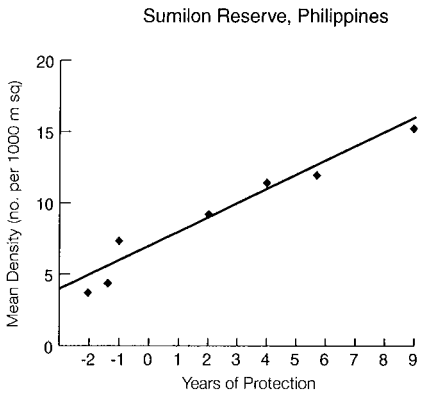
(From Roberts & Hawkins, 1997)

FIGURE 2. Biomass of Large Predatory Reef Fish



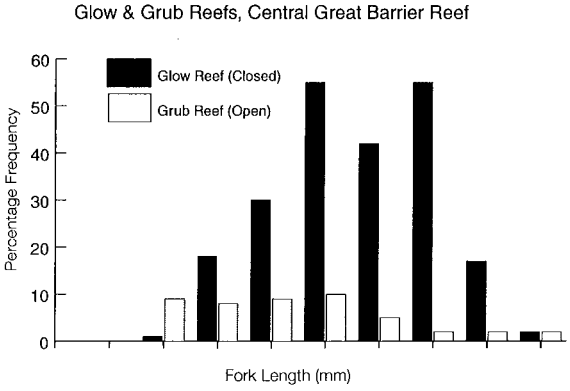
(From Russ & Alcala, 1996a)

FIGURE 3. Density of Large Predatory Reef Fish



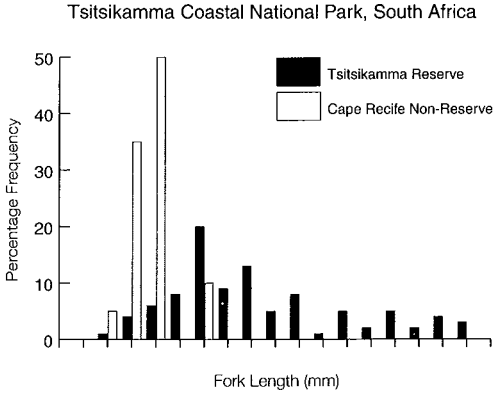
(From Russ & Alcala, 1996a)

FIGURE 4. Size Structure of Coral Trout



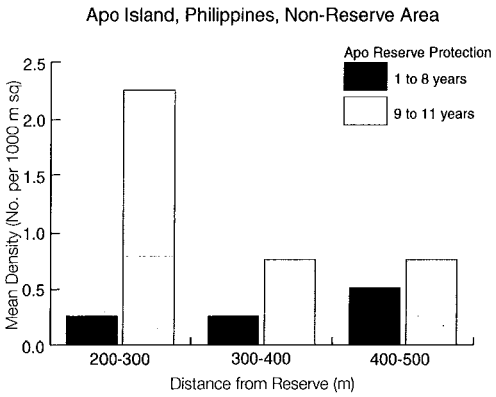
(From Ferreira & Russ, 1995)

FIGURE 5. Size Structure of Red Steenbras



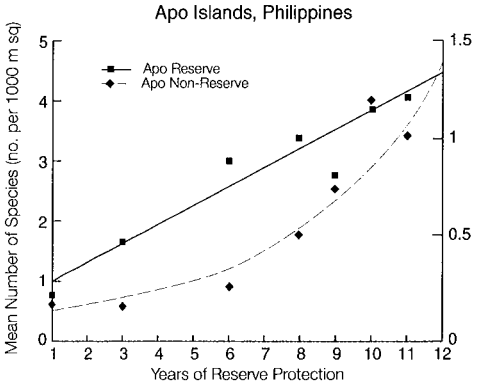
(From Buxton & Smale, 1989)

FIGURE 6. Density of Large Predatory Reef Fish



(From Russ & Alcala, 1996b)

FIGURE 7. Diversity of Large Predatory Reef Fish



(From Russ & Alcala, 1996b)

No Take areas) of different sizes by Edgar and Barrett (in press) is of particular relevance. In this study the largest reserve (7 km of coastline) proved the most effective at achieving species conservation and resource enhancement, with significant increases in the species richness of fish, invertebrates and algae. The densities of large fish and rock lobsters in this reserve increased significantly relative to external reference sites. Rock lobster biomass increased tenfold and the abundance of trumpeter increased a hundredfold. In the small reserves (1 km of coastline) lobsters above legal size became abundant while remaining rare outside.

Establishing a *No Take* area may enhance populations in adjacent waters, through a 'spill-over' effect (emigration of adult stages) or through increased larval dispersal and recruitment to surrounding areas. To date, few studies have investigated these potential benefits, so there is limited

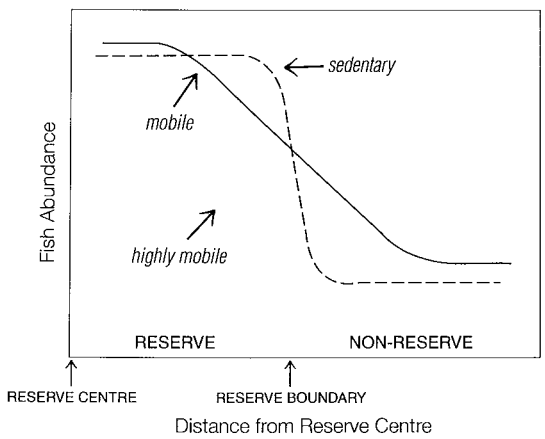
information available to demonstrate that the export of adult and/or larval stages from a protected area directly promotes the recovery or enhancement of exploited populations in surrounding areas.

Two studies in the Philippines, however, have provided some evidence to support the hypothesis that fish yields can improve. Alcala & Russ (1990) examined fishing yields from coral reefs at Sumilon Island when 25% of the reef habitat was closed to fishing, compared to yields during a period when the entire reef was fished. They found that closing this proportion of the total reef habitat to fishing resulted in catches for the entire island that were 54% higher than catches obtained when the whole reef area was fished. Another study at Apo Island, where 10% of the coral reef was set aside as an unfished reserve in 1982, has provided evidence that, as density and diversity of large predatory fish have increased within the reserve over time, these fish began to move out into the surrounding fished area (Russ & Alcala, 1996b; Figures 6 & 7).

Further evidence of emigration of adults comes from a study in the De Hoop Marine Reserve in South Africa, which implied that the unharvested reserve population of the galjoen (*Coracinus capensis*), a surf zone fish heavily exploited by recreational fishers, was restocking adjacent exploited areas with adult fish (Attwood & Bennett, 1994).

It is generally thought that *No Take* areas, unless they are extremely large, do not provide much protection to highly mobile or migratory species, because these species can readily move across protected area boundaries (see Rakitin & Kramer, 1996; Figure 8). Similarly, species which migrate offshore to spawn are unlikely to have their breeding stocks enhanced by *No Take* areas, if these areas are located in nearshore coastal waters.

FIGURE 8. Hypothetical Effect of *No Take* Areas on Fish Abundance



(From Ratikin & Kramer, 1996)

There is some evidence that *No Take* areas have been successful in managing seabed fisheries, particularly for some sedentary, site-attached species with restricted spatial movements and larval dispersal. Baker et al. (1996) concluded that marine fishery reserves could have a number of specific benefits for abalone fisheries, including:

- *increased abundance, size, biomass and/or density of abalone in the reserves;*
- *protection of aggregating adults and critical spawning densities;*
- *improved population spawning potential and recruitment;*
- *more effective control and monitoring of fishing effort;*
- *improved monitoring of abalone stocks; and*
- *proactive management to avert further fishery declines.*

Wells & Keesing (1990) found that densities and mean size of Roe's abalone (*Haliotis roei*) were substantially lower on a heavily-fished, intertidal reef platform at Trigg, in the Perth metropolitan area, than on an intertidal platform three kilometres north at Waterman, which has been protected largely as a *No Take* (apart from line fishing) Reef Observation Area (ROA) by Fisheries WA since 1967-68. This protected population, as a result of higher densities and fecundity, is likely to be contributing more abalone larvae per unit area of reef than the exploited populations on adjacent reef platforms

There is also some evidence that the diversity of biological communities on the Waterman ROA reef platforms has been maintained or enhanced as a result of its protected status. A survey of reef communities in the Marmion Marine Park, carried out before reservation in 1987, showed that a site within the ROA had a community diversity and species richness similar to that of shallow, offshore sites on the Marmion Reef/Three Mile Reef complex (Simpson & Ottaway, 1986). The ROA site was the only nearshore intertidal reef platform (of a total of 11 nearshore reef platform sites) that was found to be as diverse as the offshore reef sites. This was considered to be related to the lower intensity of human pressure within the protected area and demonstrates that areas protected largely as *No Take* areas can also effectively maintain or enhance biodiversity.

The examples given above relate to the ecological benefits of *No Take* areas. These ecological benefits, in turn, create significant social benefits as the highly accessible reef platform of the Watermans ROA is now a popular site for marine education and nature appreciation.

No Take areas are rarely established without controversy and some community opposition, particularly from commercial and recreational fishers. Because Western Australia's marine environment is in a generally healthy condition it is often considered that there is no need for protection. This assumes that reservation is introduced solely to address threats and ignores the positive conservation, social and economic benefits of protecting significant or pristine areas. It is also desirable to establish *No Take* areas

before problems emerge rather than afterwards (i.e. as a precautionary management approach).

Another common objection of fishers is that *No Take* areas 'lock away' fisheries resources by restricting access to fishing grounds and redirect fishing effort to adjacent areas. The net effect of this is perceived to result in reduced yield to individual fishers. This position reflects the general belief among fishers that the loss of 'estate' or area within which they can fish equates directly to loss of fishing production. There is little scientific evidence to support the position that overall yields are significantly reduced as a result of the establishment of *No Take* areas, particularly when *No Take* areas are often a small percentage of the total area of the fishing grounds. In addition, the number, size, shape and location of *No Take* areas in Western Australian marine conservation reserves are determined through a rigorous public consultation process, to ensure that all stakeholders have their say and social (e.g. amenity) and economic values are not impacted unnecessarily. For example, the exclusion of narrow shoreline strips from the lagoon sanctuary zones in Ningaloo Marine Park to allow beach fishing has been used to minimise negative impacts on recreational fishers without compromising the ecological functions of these zones. As outlined above, there is more evidence to suggest that the potential benefits, in terms of enhanced fishing outside these areas, could outweigh the perceived detrimental impacts of restricted access. In the Sumilon Reserve in the Philippines, increased catches in non-reserve areas more than compensated for the reduction in fishable area resulting from the establishment of the *No Take* reserve (Alcala & Russ, 1990). Although the above is clearly a localised example of extreme over-fishing, it provides some quantitative evidence of the benefit of *No Take* areas. The creation of *No Take* areas can also lead to the development of replacement activities that can have significant social (e.g. nature appreciation in undisturbed areas) and economic (e.g. tourism) benefits.

A further objection to establishing *No Take* areas is that there is often a lack of sufficient biological information to justify any action (Bohnsack, 1996). How can it be demonstrated that *No Take* areas are effective? This can only be done through long-term monitoring, both biological and social. If possible, this must be initiated prior to protection of an area, to provide baseline information from which a 'before' and 'after' picture can be determined. Monitoring must be designed to establish levels of natural variability in biological systems, which will make it easier to understand the significance of short-term effects, or the long-term implications of human activities. This means monitoring must be sustained and long-term, as it may take decades to acquire some of the necessary information.

An alternative approach is simply to accept that marine reserves and *No Take* areas are integral to a precautionary approach to marine management, that their establishment provides some measure of 'insurance', and that no further justification is required.

Other major concerns of fisheries managers relate to the potential increased costs of enforcement and education. This is true in some cases also for commercial fishers, particularly if fisheries management is based on cost recovery (as it is in Western Australia). Additional costs to fisheries management agencies may result following the establishment of *No Take* areas in some marine conservation reserves. However, if *No Take* areas are a small percentage of the total fishing grounds, these costs are unlikely to be significant compared to the total cost of fisheries management over the whole fishery. In other reserves the establishment of *No Take* areas may in fact reduce costs as a result of a more simplified management regime. In Western Australia, enforcement costs of zoning schemes in marine conservation reserves are primarily the responsibility of the Department of Conservation and Land Management and are not passed on to commercial fishers. Furthermore, collaborative enforcement, complementary education and monitoring programs and other activities associated with marine reserve management are likely to allow economies between marine management agencies which could offset any additional costs that could occur.

STATUTORY BASIS FOR *NO TAKE* AREAS

In Western Australia, multiple-use marine conservation reserves are established under the *Conservation and Land Management Act 1984* (CALM Act) and under special legislation, such as the *Rottnest Island Authority Act 1987*, under which the Rottnest Island Reserve (which includes a marine component) was created. Fish Habitat Protection Areas (FHPA) can also be established under *Fish Resources Management Act 1994* (FRMA) regulations.

CALM Act marine conservation reserves are created by an Order of the Governor and vested in (i.e. 'owned' by) the Marine Parks and Reserves Authority. Within the marine conservation reserve system there is the provision for the creation of two types of *No Take* area, which have the most clearly defined purposes and the highest level of protection.

Marine Nature Reserves are created primarily for conservation and scientific research. No recreational or commercial fishing, aquaculture, pearling, petroleum exploration or production is allowed in these areas. Low impact recreation and tourism may be permitted.

Sanctuary Zones form one of four kinds of statutory management zones which may be established within marine parks. They are 'look but don't take' areas managed solely for nature conservation and low impact recreation and tourism. No recreational or commercial fishing, aquaculture, pearling, petroleum exploration or production is allowed in sanctuary zones.

Marine nature reserves are designed to protect a particularly significant ecosystem or habitat, such as the stromatolites in Hamelin Pool Marine Nature Reserve at Shark Bay. Currently, this is the only marine nature reserve

in the State, in addition to six marine parks (Rowley Shoals, Ningaloo, Shark Bay, Marmion, Swan Estuary and Shoalwater Islands). At present there are a total of 19 declared sanctuary zones in marine parks, with Ningaloo and Shark Bay Marine Parks containing eight each, and Marmion Marine Park containing three. An additional five sanctuary zones have been proposed, two in the Rowley Shoals Marine Park and three in the Shoalwater Islands Marine Park.

The establishment of marine nature reserves and sanctuary zones under the CALM Act requires extensive statutory consultative and management planning processes that involve all stakeholders, as reservation has the effect of precluding extractive activities such as fishing.

There are also a number of marine areas that are afforded statutory protection under the FRMA. For example, significant reef areas in the Abrolhos Islands FHPA have been designated as Reef Observation Areas for scientific, recreation and tourism purposes. All extractive activities, excluding commercial rock lobster fishing, are prohibited in these areas. The marine component of the Rottnest Island Reserve contains two small *No Take* areas, where all marine plants and animals are totally protected by FRMA regulations. Furthermore, under FRMA closures, large areas of the Western Australian coastline are closed to specific fishing activities because of potential impacts on important fish habitats, nursery areas and breeding sites. For example, all significant seagrass meadows are protected from trawling. Although many of the above examples are primarily fisheries management mechanisms, these statutory controls have significant secondary benefits to marine biodiversity conservation.

PRINCIPLES OF ESTABLISHING *NO TAKE* AREAS

The following principles should be adopted when establishing *No Take* areas within the framework of multiple-use marine conservation reserves in Western Australia:

- No Take *areas should protect all species in the ecosystem from extractive use;*
- *conservation, scientific, social and economic values must be considered;*
- No Take *areas should ideally be created before, rather than after, problems arise;*
- *public access and use must be equitable - different interests must be equally catered for in the selection and design of* No Take *areas;*
- *the steps used to define and implement any* No Take *areas should be technically defensible, transparent and accountable, and must include comprehensive and meaningful public consultation; and*
- *potential benefits and impacts on users should be identified in the consultation process.*

The type, location and size of *No Take* areas can only be decided after the biological, economic and social values of the proposed areas have been assessed. This information must feed into a stakeholder and community consultation process, to enable those whose interests may be affected by a reservation or zoning proposal to be fully informed about its implications at the outset. The 1997 amendments to the marine reserve provisions of the CALM Act, extended the minimum period for public submissions on marine conservation reserve indicative management plans from two to three months. Under fisheries legislation, persons affected by the declaration of CALM Act marine reserves, particularly where *No Take* areas are involved, may also be entitled to compensation.

SELECTION AND DESIGN CRITERIA FOR ESTABLISHING *NO TAKE* AREAS

As *No Take* areas must serve one or more of the purposes listed above, a number of criteria should be applied when selecting these areas. The purpose/s of the *No Take* area should be clearly defined and, where possible, the selection and design criteria should also address both nature conservation and fisheries management objectives. Criteria should include the following ecological and social guidelines:

- *all ecologically important species and communities must be adequately represented;*
- No Take *areas must protect minimum viable populations and critical life history stages of relevant species;*
- *the total number and size of* No Take *areas must be relevant to their defined purpose/s;*
- No Take *areas should 'spread the risk' - i.e. the locations must take into account past, current and future threats;*
- *habitat distribution, oceanographic factors and coastal topography must be taken into account;*
- No Take *areas must be cost-effective to manage in relation to biological monitoring and regulatory enforcement;*
- *short and long-term economic impacts must be considered;*
- *negative interference with other values must be minimised; and*
- No Take *areas should be ideally acceptable to all stakeholders.*

Considerable information is required to determine the optimum number and size of *No Take* areas within a marine conservation reserve. Obviously, the total area and location of *No Take* areas will relate to their defined purposes. The distribution of key communities and the life history traits, feeding biology, population size, dispersal abilities, reproductive potential and movement patterns of species have to be considered. If *No Take* areas are also being used to assist fisheries management, it is important to identify the target species to be managed and the life history stages being protected (e.g. in nursery or breeding areas). In determining the appropriate size of *No Take* areas, too little area will provide insufficient protection, but too much area could unnecessarily limit fishing activities.

A network of several small *No Take* areas may be the most appropriate strategy, given the high dispersal capabilities of many marine species. Several small *No Take* areas may address the above design criteria better than a single large area. This option may be more socially acceptable as well. The size and number of *No Take* areas will also relate to the overall size of the marine reserve within which they are being established. What proportion of the habitat/biodiversity or target species stock should be incorporated into a network of *No Take* areas for optimum benefit? The areas protected through *No Take* reserves in the marine environment range from as low as 2%, up to 30% in some cases. The suggested goal of the *No Take* marine reserves network in New Zealand is to protect at least 10% of continental shelf waters (Ballantine, 1991). *No Take* areas within the Florida Keys National Marine Sanctuary will ultimately cover 6-8% of the shelf (Bohnsack, 1996). The three sanctuary zones proposed for the Shoalwater Islands Marine Park cover 5% of the total area of the park. The Ningaloo Marine Park sanctuary zones cover approximately 20% of the lagoonal waters of the park. In the Caribbean very small *No Take* areas, such as the Anse Chastanet Reserve in St Lucia (which is only 2.6 hectares in total area), have been remarkably effective in enhancing local stocks of some fish species (Roberts & Hawkins, 1997; see Figure 1).

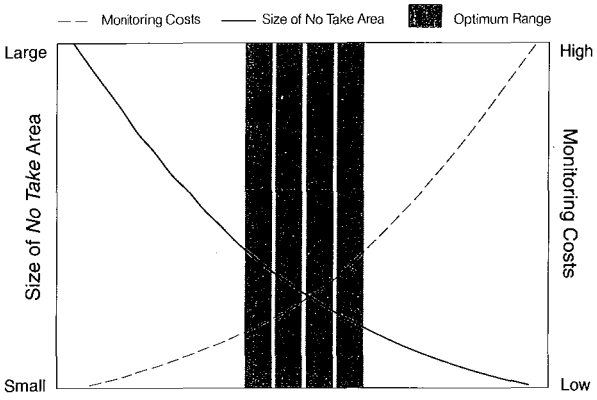
Management issues must also be considered in the design of *No Take* areas. Number, size and location interact with the key management activities of enforcement and biological monitoring, the latter being a particularly costly but important component of best-practice natural resource management. If the total extent of *No Take* areas is a large proportion of the overall reserve size, then less intensive biological monitoring, but more enforcement, is required to ensure human activities are sustainable. Conversely, as the size of *No Take* areas decreases in relation to the overall reserve size the requirement for monitoring increases (Figure 9) and enforcement requirements decrease. The optimum situation from a management perspective is where the total size of *No Take* areas and the level of enforcement and biological monitoring in a reserve achieve an appropriate balance and, collectively, are reconciled with the current and projected human usage over the proposed management timeframe.

TENURE OF *NO TAKE* AREAS

The full range of benefits of *No Take* area will not flow immediately following their establishment. Because of this, *No Take* areas must have sufficient security of tenure to ensure that longer term benefits occur and that the resources needed to undertake long-term monitoring (to demonstrate their effectiveness) are not wasted. All existing marine conservation reserves in Western Australia are Class 'A' reserves, which means that they have significant legislative standing; reservation of these areas cannot be reversed

FIGURE 9. Design of No Take Areas

Interaction between Size of *No Take* Area and Monitoring Costs



without an Order of the Governor. The purpose of reservation or boundaries of a marine nature reserve, marine park or marine management area cannot be changed without an Act or Resolution passed by both Houses of Parliament. The agreement of the Minister for Fisheries and the Minister for Mines is required before management zones within marine parks, such as sanctuary zones, can be formally established. Cancellation or zone amendment also requires their approval. Any proposed changes to sanctuary zones must, unless addressed in a management plan, be publicised and an opportunity given for public comment on the proposed changes.

CONCLUSIONS

No Take areas are an important tool for nature conservation and ecological sustainability. Significant benefits will result from their establishment within a multiple-use marine conservation reserve system. *No Take* areas should be considered as part, albeit an important part, of a mosaic of management tools which will help achieve the dual objectives of the marine conservation reserve system of biodiversity conservation and sustainable management of human activities. The size, location and number of *No Take* areas must be considered in relation to the projected level of use of other management mechanisms such as enforcement, biological monitoring and education. *No Take* areas may also provide benefits to the management of exploited fish stocks, particularly if these areas are used to protect important breeding sites or prevent local depletion of target species, particularly sedentary species. The creation of *No Take* areas can also help marine managers to separate incompatible activities and reduce user conflicts.

The reasoning behind *No Take* areas is the simple concept that natural systems can maintain themselves if protected

from human interference. Statutory *No Take* areas also serve to re-establish natural refuges from fishing. These locations, previously too deep, remote, or difficult to find and fish, have become less effective in protecting stocks, as a result of increased fishing effort and improved technology (Bohnsack, 1994).

There is a need for a habitat-based approach in selecting these areas if the ecological and management benefits of *No Take* areas are to be maximised. However, it should be acknowledged that socio-economic issues are likely to be a major influence when considering the size, location and number of *No Take* areas in the marine conservation reserve planning process. Long-term monitoring, ideally initiated prior to the creation of a *No Take* area, is important if the 'full' biological effects of protection are to be measured.

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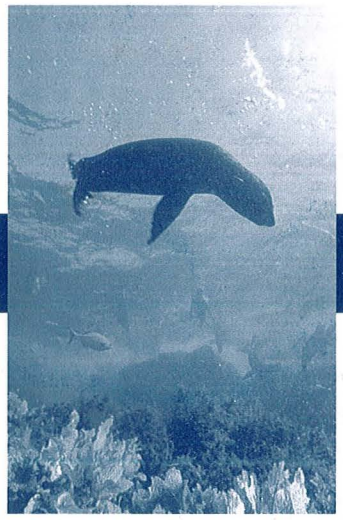

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