

**Towards an assessment of natural and  
human use impacts on the marine  
environment of the Abrolhos Islands**

**Phase 1: Data consolidation and scoping**

**Final Report for FRDC Project 2000/166**

C. F. Chubb and K. Nardi

Cover photograph, Morely and Woodeds Island, Easter Group, Abrolhos Islands by Bill Bachman.



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# **2000/166 Towards an assessment of the natural and human use impacts on the marine environment of the Abrolhos Islands**

## **Phase 1: Data consolidation and scoping**

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### **1.0 Objectives**

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1. To collate existing research information relating to human use impacts and natural perturbations in Abrolhos marine habitats to provide a detailed overview of the status of current knowledge about the marine ecosystem at the Abrolhos Islands.
2. To conduct limited field work to determine the spatial and temporal distribution of commercial fishing and recreational activities and provide general descriptions/ground truthing of habitat/community types at the Abrolhos as baseline/background data for presentation at the workshop.
3. To conduct a scientific workshop including community representatives and technical experts to determine the objectives and formulate a dedicated research programme to provide quantitative monitoring data for use in the sustainable management of the Abrolhos Islands Fish Habitat Protection Area.

### **2.0 Non-technical summary**

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#### **Outcomes achieved**

This project has drawn together existing research data relating to natural and human impacts on the Abrolhos Islands marine habitats. It has surveyed current uses of these habitats and placed anthropogenic impacts within the context of natural perturbations. Through public forum presentation and debate, this work has allowed real issues, not perceptions, to surface and be addressed properly. This was achieved by defining a strategic programme of research through a scientific workshop process involving all community stakeholders. A two volume Fisheries Research Report (WA) summarizes current knowledge and details the workshop proceedings and strategic research plan.

This project was undertaken to examine the physical impacts of current human activity on Abrolhos marine habitats with a view to establishing research needs, including monitoring programmes for the future sustainable multi-use of Abrolhos marine resources. As a unique and generally little researched environment, it was seen as important to understand the anthropogenic impacts in the context of natural perturbations so that the area can be managed effectively with support from the whole community.

Existing research data were gathered from numerous government, university and independent sources and surveys were conducted to assess current anthropogenic activities. These included the four commercial fisheries operating at the Abrolhos: the western rock lobster (*Panulirus cyngus*) fishery; the saucer scallop (*Amusium balloti*) fishery; the wetline fishery for various species of finfish and aquaculture of the black-lipped pearl oyster (*Pinctada margaritifera*) and recreational activities, principally those of the charter boat industry. Data for the current distribution and intensity of human use were integrated with existing data on the distribution and biological sensitivity (fragility) of the wide range of habitat types found at the Abrolhos using Geographical Information Systems (GIS) software. These data were presented and discussed at a public forum and issues of importance to user groups were identified. Both data and issues were considered in a subsequent scientific workshop comprising representatives of all stakeholders and a strategic plan for future research was compiled. A two-volume Fisheries Research Report summarizing the existing information and current levels of anthropogenic activity (Vol. 1) and detailing the proceedings of the workshop (Vol. 2) has been published<sup>1</sup>.

The Abrolhos marine environment is impacted profoundly by the weather. The marine habitats are shaped by varying degrees of exposure to wave (swell) energy with the western windward areas of the island groups dominated by macro algae and lacking well-developed coral communities. In contrast, the eastern leeward lagoons support rich coral communities with high rates of reef accretion. Winter storms and summer cyclones cause significant physical disturbance of the reef system at the Abrolhos, eg removal of macroalgal stands, the breaking of fragile coral structures and, over time, changing the shapes of islands. Other natural impacts, such as coral predation by crown of thorns starfish (*Acanthaster planci*) and the snail *Drupella cornus* and coral bleaching appear to be minimal.

On average, 52% of the 1.2 million pot lifts in the Abrolhos rock lobster fishery occur in 0-20m depths. Rock lobster fishers spent much of their time fishing in areas where biological communities were robust and only about 11% of their shallow water effort occurred in fragile areas. The impact of potting was minor and the exposure brief (the Abrolhos rock lobster season lasts for 3.5 months) with the probability of localised disturbance in specific areas as distinct from widespread general damage. Abrolhos Islands' marine habitats are fished with a relatively low intensity of generally much less than 15 pots per hectare (ha). In each of the island groups, pots were estimated to disturb between 0.2% and 0.3% of the fragile habitat, with similar levels of disturbance (0.2% - 0.4%.) for moderately sensitive biological communities.

The scallop trawl fleet of up to 17 vessels operates over unconsolidated sediments both adjacent to and away from the Abrolhos Islands reef habitats and the season is short, generally lasting 2 to 3 weeks. The area trawled within this habitat can be markedly different from season to season in response to the distribution of the highly variable and patchy annual scallop recruitment. Trawling can occur close to demersal sponge "gardens" containing a variety of organisms and, occasionally, can impact on this habitat, but these areas are not targeted by the trawl fleet. The extent of any incidental damage was not quantified.

The wetline fleet is small and the number of days spent fishing within the Abrolhos Fish Habitat Protection Area was highly variable. The only direct impact of these vessels on marine habitats is through anchoring which occurs generally in unconsolidated sediments and so was considered insignificant.

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<sup>1</sup> Fisheries Research Report (WA) No. 134, Vols 1 & 2, 2002

Aquaculture at the Abrolhos Islands is confined to black-lipped pearl oyster culture. Minor issues surround this activity and principally are confined to the longline anchoring system using pins in reef top edges, and the remote possibility of broken longlines causing damage where they are sited over fragile habitats such as in the Pelsaert Group.

Recreational activities at the Abrolhos were undertaken by tourists, mainly comprising family and friends of rock lobster fishers; people on board private vessels; and charter boat customers. Presently, only rock lobster fishers' family and friends are allowed to stay on the islands during the season; all other tourism is boat based. Most recreational vessel anchorages are in unconsolidated sediments and of little concern, nevertheless, the possibility of anchoring in biologically sensitive communities is real but the extent to which this activity impacts upon these habitats is unknown. Environment Australia provided some funding for the installation of permanent moorings which have been sited to prevent disturbance to fragile habitats.

SCUBA diving is a popular activity with most dives restricted to a few popular dive sites in each island group. The conduct of divers underwater in relation to the collection of shells and coral, and the potential for divers to damage fragile communities by physical contact has not been quantified here. The education of recreational user groups, such as scuba divers, was seen as a priority. Although the impact of the activities of friends and relatives of rock lobster fishers on the marine habitats was not quantified, their impact is likely to be minimal since the vast majority use small vessels (aluminium dinghies with outboard motors) to visit islands, dive, fish or surf from. Recreational activity appears to have had little physical impact on the Abrolhos marine habitats but, nevertheless, needs to be quantified and monitored.

Conservation issues are an important consideration for the Abrolhos Islands' managers. Reef Observation Areas were established in each island group in 1994 and protect large areas of biologically diverse and visually interesting habitats. They have been very successful.

The physical disturbance of Abrolhos Islands marine habitats by humans is considered to be inconsequential when compared to natural damage inflicted by strong swells generated during storms and cyclones as part of the reef's natural cycle. Nevertheless, natural damage is periodic and most anthropogenic disturbance appears to be low level and isolated but some impacts may be persistent, and the effects of damage of this nature might be cumulative. The Abrolhos Islands reef systems are at high latitude and competition for space and light is intense between corals and macroalgae. This has led to the hypothesis that physical damage to fragile corals from human use might alter the delicate balance that exists in favour of macroalgae. Whether this has occurred over the more than 60 years humans have fished for rock lobsters and conducted other activities at the Abrolhos is unknown. However, recent comments by international and local experts indicate the Abrolhos marine habitats are in good condition suggesting well regulated human activities can be undertaken and the conservation values of the Abrolhos Islands can be maintained.

The strategic research plan focused on the immediate need to better understand ecosystem structure and processes and the impact of commercial fishing and to measure and monitor recreational use of the Abrolhos marine habitats.

The goals of the original proposal were achieved. The Fisheries Research Report "Towards an assessment of natural and human use impacts on the marine environment of the Abrolhos Islands: Volume 1 Summary of existing information and current levels of human use"

provides an overview of research conducted at the Islands to date. Furthermore, it provides a description of the existing human use activities at the Islands and places these impacts in their correct perspective against natural impacts. A strategic research and development plan (Volume 2 of the Research Report), which took into account issues raised by all stakeholders, will serve as a valuable tool for the future ecologically sustainable management of the unique and valuable Abrolhos Islands region.

**KEYWORDS: Abrolhos Islands, natural variability, human activity, conservation, ecosystem management.**

### **3.0 Acknowledgements**

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## **4.0 Background**

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The Abrolhos Islands and their surrounding coral reef communities form one of Western Australia's most unique marine areas and in February 1999 were gazetted as Western Australia's first Fish Habitat Protection Area (FHPA) under the Fish Resources Management Act (1994). In addition, the islands and their surrounding reefs are listed in the Register of the National Estate. The future management of the Abrolhos Islands FHPA could provide a useful model for marine conservation and multiple resource use in other marine areas of Australia.

The management plan "Management of the Houtman Abrolhos System", released by the Minister for Fisheries in December 1998, acknowledges the uniqueness of the Abrolhos Islands and their important environmental, fishing, historical, cultural, scientific and tourism values. It addresses the needs of competing community interests in the area whilst providing long-term protection of the natural resource. The Minister for Fisheries released the "Aquaculture Plan for the Houtman Abrolhos Islands" in May 2000 which detailed a process to ensure that aquaculture is undertaken sensibly at the Abrolhos whilst retaining the area's unique features and maintaining the conservation and tourist values. This was followed by the release in April 2001 of the "Sustainable Tourism Plan for the Houtman Abrolhos Islands" which identified a tenet of encouraging environmentally sensitive, or nature-based tourism compatible with maintaining the Abrolhos system in an ecologically sound condition.

The waters of the Abrolhos have been fished extensively for the valued western rock lobster since the 1940s. Other commercial activities in the area include a trawl fishery for scallops, a minor wetline fishery for finfish and pearl aquaculture. Recreational pursuits include boating, fishing, scuba diving, bird watching and sight-seeing.

Whilst research programmes, such as fishery resource sustainability projects, have been coordinated by the Department of Fisheries in Western Australia, other opportunistic scientific and historical research has been undertaken on and around the islands. Such projects include geological studies, archaeological research on shipwrecks, seabird research, historical land use and anthropological studies, vegetation and terrestrial fauna surveys and a number of marine ecological studies. It is important to note that virtually no environmental impact studies have been conducted.



Interest from the aquaculture, recreational and tourist sectors is growing and, together with the existing activity by the commercial fishing sector, their potential impacts on Abrolhos marine habitats required investigation to distinguish these from naturally occurring perturbations. This understanding will enhance the ecologically sustainable management of this highly significant marine ecosystem.

## **5.0 Need**

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The management plan for the Houtman Abrolhos (Anon. 1998, Section 10.0) identified a number of objectives. In essence, these related to understanding human use impacts on the marine environment of the Abrolhos Islands, and the evaluation of the effectiveness of present and future management strategies to ensure ecologically sustainable multiple use of Western Australia's first Fish Habitat Protection Area. Also it is important to recognise the more general responsibilities that the State of Western Australia has with respect to Commonwealth legislation and policy and to the ongoing environmental management considerations that the conferring of certification by the Marine Stewardship Council on the western rock lobster fishery entails.

Specifically, within the context of the Abrolhos Islands management, a need was identified to quantify the physical impacts of current human activity on Abrolhos marine habitats and subsequently establish a research framework to support the ecologically sustainable management of this unique area. In addition, there was a need to place anthropogenic impacts within the context of natural disturbance. In order to assess such impacts and develop appropriate monitoring programmes, three objectives were set.

## **6.0 Methods**

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This project was organised into five components to achieve the objectives: the overview of historical research and current status of knowledge; the determination of ecological units and ground truthing; the survey of commercial and recreational user groups; the production of a research report summarizing current knowledge and levels of human use; and the facilitation of a scientific workshop (and subsequent publication of the proceedings) to determine the research requirements necessary for sustainable management of the Abrolhos Islands marine resources. Methods adopted for each component are detailed in Appendix 3 and summarised here. Appendices 1 and 2 are contained on the accompanying CD.

### **6.1 Overview of historical research and current status**

Relevant organizations and individuals were contacted to ascertain the extent of published and unpublished information relating to hydrodynamic and meteorological events; the ecology of the Abrolhos Islands, its human use history and consequent physical impacts. Those contacted included the Department of Fisheries, the Department of Conservation and Land Management, the Bureau of Meteorology, the Department of Transport, the Australian Institute of Marine Science, the Great Barrier Reef Marine Park Authority, the Commonwealth Scientific and Industrial Research Organisation, the Western Australian Universities, the Western Australian Museum, and environmental consultants. Grey literature, such as consultant's reports, was used only when the author was known to be a

reputable scientist who has published in peer reviewed journals. Other publications such as Fisheries Management Papers and Fisheries Research Reports were subject to a rigorous internal review process prior to publication. Library and Internet searches were conducted to identify other research undertaken which might be relevant to the project. Information was collated to form part of the research report on the current status of knowledge of the Abrolhos Islands (Appendix 3). This information was presented to a workshop where other scientists had the opportunity to peer review the data and comment on the results and conclusions.

## **6.2 Determination of ecological units and ground truthing**

Thorough habitat mapping of the Abrolhos Islands was conducted by Hatcher *et al.* (1988) and Marine Science Associates (1995). Whilst these studies are complementary, each classified the habitats using different methods, the former from aerial photos (1:25,000) and extensive ground truthing and the latter from satellite imagery and limited ground truthing. Hatcher *et al.*'s (1988) classification system was used for this study since it provided the greatest detail (to depths of approx. 20 m) and covered the largest area. Section 3.1 in Appendix 3 provides a description of the hierarchical units of habitat classification. On a broad scale it includes 12 geomorphological units present in all island groups and, on the finest scale, 192 ecological units across all island groups.

The geomorphological units are based on the topography and composition of the substrata and can be categorised broadly as occurring from approximately west to east across each island group. They are:

- |                                  |                            |
|----------------------------------|----------------------------|
| 1. Exposed reef slope            | 7. Isolated patch reefs    |
| 2. Submerged limestone platform  | 8. Static sediments        |
| 3. Emergent limestone platform   | 9. Drowned doline field    |
| 4. Dissected limestone platforms | 10. Complex karst platform |
| 5. Back Reefs                    | 11. Storm rubble field     |
| 6. Mobile sediment sheets        | 12. Sheltered reef slope   |

The geomorphological units provide the most realistic grouping of benthic biological communities for the Abrolhos Islands (Hatcher *et al.* 1988). These substrata and their biological communities are shaped by their position in the general continuum of high-energy windward conditions in the west to the lower-energy leeward conditions in the east.

The fieldwork was conducted in January 2001 to ground truth and visually characterise the geomorphological units. It involved completing video transects 30 m in length and 2 m in width and noting the life-forms (according to English *et al.* (1997)) in each geomorphological unit across approximately west-east tracks arbitrarily selected across each island group. Two tracks were surveyed in the Wallabi and Pelsaert Groups and three in the Easter Group. The tracks were selected to represent the geomorphology of each group. The tracks were variable in length from 9.4 to 19.5 km with an average of twelve geomorphological units crossed by each track. The same geomorphological units may appear more than once along each track. Figure 3.1d-f in Appendix 3 shows the positions of each of the video transects in relation to the geomorphological units.

GIS was used to map habitat fragility (biological sensitivity) based upon the susceptibility to damage assigned to the most abundant group of organisms present in each of the 192 ecological units. Thus, each geomorphological unit in each island group contains defined areas of low, moderate and high sensitivity. In this report anthropogenic activity is related to its effect upon those areas of sensitivity within each geomorphological unit.

An analysis of the “life form” data from the video transects indicated little variability in habitat structure for some geomorphological units, eg. drowned dolines, exposed reef slopes, limestone pavements and sediments, but a greater variability in others, such as isolated patch reefs, sheltered reef slopes and complex karst platforms. The variations noted in the “life form” analysis were consistent with that seen in Hatcher *et al.*'s (1988) ecological units, and thus were accounted for by the use of the latter in determining biological sensitivity within geomorphological units.

### **6.3 Survey of commercial and recreational boating activity**

Information about human activities at the Abrolhos Islands was obtained through a series of interviews with the various professional and recreational user groups. These included the rock lobster, scallop, wetline and aquaculture industries and the recreational sector. The recreational sector was restricted mainly to charter boat operators but included members of yacht clubs and recreational fishing groups. Charter boat operators and other recreational users were asked to describe their activities in order to determine the frequency and types of uses made by the various groups.

Interviews with rock lobster fishers primarily were to determine areas where pots were set and the proportion of annual fishing effort associated with each area averaged over the previous five seasons. It should be noted that rock lobster fishers at the Abrolhos fish consistently in areas that could be defined loosely as “territories”. Aerial surveys of rock lobster pot distributions were conducted at the Abrolhos Islands at the beginning and middle of the season to validate data from the interview process and to observe seasonal changes in the distribution of fishing effort. This study was restricted to <20 metres in depth because these are the areas considered to be most susceptible to the physical impacts from human activities. Flights were conducted on 15 and 16 March (start of season) and 11 May (middle of season) in 2001.

Scallop fishers provided information on trawling grounds and locations where boats were anchored and shells shucked. They were reluctant to provide exact detail of year to year variations in fishing grounds citing a view that this information may be used by management to restrict areas where trawling could occur.

Any commercial fishing vessel in Western Australia can wetline and, therefore, the spatial and temporal distribution of fishing effort and catch is extremely complex (Crowe *et al.* 1999), and the level of reporting is uncertain. At the Abrolhos Islands, the non-specialist wetline fleet operates in a broad range of locations, often in waters deeper than 20 m, ie not within the island groups themselves (Mr Mal MacRae, President of the Geraldton/Abrolhos Mid West Wetliners Association pers. comm.). For these reasons, this report focuses only upon the dedicated wetline fleet within the Abrolhos Islands.

Aquaculture ventures were documented from lease applications and recorded current activity. Section 3.2 in Appendix 3 provides, in greater detail, the methods used in the interviews and surveys.

## **6.4 Status report**

The results of the investigations in sections 1-3 above culminated in the production of the Department of Fisheries Research Report “Towards an assessment of the natural and human use impacts on the marine environment of the Abrolhos Islands: Volume 1 Summary of existing information and current levels of human use”. Where possible, human activity was related to the areas of biological sensitivity, herein referred to as fragility, within each geomorphological unit. A draft of the report was circulated as a working document to attendees at the workshop held in Geraldton on 12 and 13 July 2001. The document was finalised after taking into account comment received from workshop participants. The report is provided at Appendix 3 on the accompanying CD.

## **6.5 Scientific workshop**

A public forum and scientific workshop were held in Geraldton from 11 to 13 July 2001. On the first day (public forum), interested members of the public and invited representatives were presented with summaries of the contents of the status report and a list of the issues thought to be important. A representative cross section of all user groups and the general public was present and given an opportunity to comment on the research findings and raise issues for consideration at the “specialist” workshop conducted over the following day and a half on 12 and 13 July 2001 (see Appendix 4 for details of the proceedings).

The scientific workshop was attended by invited representatives of all user groups and assisted by the research and management expertise of the Australian Institute of Marine Science (AIMS), the Great Barrier Reef Marine Park Authority (GBRMPA) and the Department of Conservation and Land Management (CALM) (see Appendix 4 for a list of invitees). The objective of the workshop was to prepare a strategic research and development plan to ensure the provision of data vital to the sustainable multi-use management of the Abrolhos Islands well into the future.

The workshop comprised four sessions and addressed all issues aired at the public forum. The introductory session outlined the various legislative responsibilities of the managers, followed by the workshop objectives, the planned outcomes of the workshop and consideration of the agenda. The second session considered the natural and biological events impacting on the Abrolhos Islands and the research needed to fully understand those events. Session three explored the human-use impacts on the Abrolhos from the viewpoint of commercial fishing, current marine-based recreational activities and likely future tourist impacts, conservation uses and other uses such as oil and mineral exploration. The final session drew together the issues and needs and led to a strategic view of the research required for the management of the Abrolhos Islands system. The workshop proceedings form Volume 2 of the research report “Strategic Research and Development Plan” and are presented at Appendix 4 on the accompanying CD.

## **7.0 Results and discussion**

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The determination of the current status of research information relating to natural and human use physical impacts at the Abrolhos islands was achieved through the collation of data from an extremely wide range of sources both published and unpublished. This desk study, contact with many individuals and organizations and some field survey work provided the detail

required for the Fisheries Research Report (WA) “Towards an assessment of the natural and human use impacts on the marine environment of the Abrolhos Islands Vol. 1 Summary of existing information and current levels of human use” (Appendix 3).

A large quantity of information about the natural systems of the Abrolhos Islands was available from many sources but this is the first time that a comprehensive summary of such data has been collated in a single published document as a description of the marine environment of the Abrolhos Islands (see Section 4, Appendix 3). A current of tropical water, the Leeuwin Current, flows past and through the Abrolhos Islands. It is the Islands’ dominant physical oceanographic event with its strength affected by ENSO events in the Pacific Ocean. Average monthly temperatures in the shallow waters range from about 20-25°C with maxima and minima around April and September respectively. Cyclones affect the Abrolhos on an average of once every 5 years. No wave rider buoys were stationed at the Abrolhos but swell data from Jurien and Rottnest indicate average maxima for winter swells of about 6 metres. Winds are predominantly from the south east to south west with southerlies comprising over 40% of all winds. The average monthly maximum wind speed ranged from 50-60 km.h<sup>-1</sup>. Anecdotal information and observations made during this study indicate rainfall runoff is considerable and may provide nutrient input to the system from guano deposits on the islands. The Abrolhos Islands marine environments are shaped by these natural processes, as evidenced by the distribution of habitats across the system (Fig. 4.9, Appendix 3) and the changing shape of islands such as Beacon Island (see Section 5, Appendix 3).

Due to the highly variable nature of habitats across island groups, the issue of relating human use to habitat type was resolved by utilising existing mapping data by Hatcher *et al.* (1988) contained in an unpublished consultant’s report. Their mapping not only recognised geomorphological units based on the substrate types but also indicated levels of biological sensitivity (or fragility) within each geomorphological unit in each of the island groups based on the ecological units observed and mapped during their ground truthing process. Whilst Hatcher *et al.*, (1988) mapping relied upon tracings from aerial photographs, it was accurate enough to transfer to a GIS so that human activities could be related either to geomorphological units or areas of biological sensitivity (low, moderate or high) within geomorphological units. We chose to relate anthropogenic uses to the biological sensitivity for two reasons. The first was that the areas of each level of sensitivity in each geomorphological unit were at a similar resolution to the data gathered through the interview processes undertaken during this study. The second was that the three levels of sensitivity roughly equated to a scale of robustness from robust through to fragile habitats and so provided a sensible scale with which to assess human activities such as the spatial distribution of rock lobster pots during the fishing season. Thus, the provision of Hatcher *et al.*, (1988) previously unpublished geomorphological and sensitivity mapping together with composite colour satellite imagery of the Wallabi, Easter and Pelsaert Groups and representative underwater images of habitat types from this study provides for the first time an overview of the distribution of habitat types, robust to fragile, across the Abrolhos Islands (Figs 3.1a-c, Plates 3.1 – 3.12, Figs 6.3d-f, Figs 6.13a-c, Appendix 3). This now enables a rational debate about human use with respect to habitat types and potential damage to habitat.

Data gathered to describe human commercial use of the Abrolhos Islands marine habitats was based on quantitative data from Department of Fisheries records which vary in spatial resolution depending upon the fishery concerned. For example, scallop (*Amusium balloti*)

trawl effort is available from log books on a shot by shot basis with accurate position data for each shot, but it is confidential and only summary information such as the extent of the trawl grounds each season, may be published. This does not compromise this report since trawling generally occurs over a two to three week period on unconsolidated sediments and usually does not impact fragile habitat such as “garden bottom” (see Section 6.1.2, Appendix 3). However, this level of data may be used in conjunction with survey data in the future to delineate trawl grounds to protect the more fragile habitats. The sessile benthos (sponges, etc) of the waters of the Abrolhos Islands deeper than 30 m is poorly known and research relating to the recovery and reattachment of sessile organisms following disturbance is unknown and in need of investigation (Dr. Jane Fromont, Curator of Marine Invertebrates, Western Australian Museum pers. comm.). Existing aquaculture enterprises focus solely upon the culture of black-lipped pearl oyster and spatial extent and shell quota are known exactly (see Section 6.1.5, Appendix 3). At the other extreme, specialist wetline fishing depends entirely upon the weather conditions and target species and so fishing effort from a small number of vessels is expended over an extensive range of locations and reported on a 20' (lat.) x approx 1° (long.) block basis (see Section 6.1.3, Appendix 3).

In between these extremes falls the data from the western rock lobster industry which for the Abrolhos Islands are recorded at a 10' (lat.) by 30' (long.) transect by 10 fathom depth category resolution (voluntary log book data). However, that level of resolution was insufficient to examine the distribution of potting with respect to fragile habitats on a much smaller scale. So for the rock lobster fishery and other commercial groups, interviews were conducted to ascertain additional information on effort distribution. For the lobster fishery aerial surveys of pot distributions in the shallow waters of the island groups were flown. These complementary data allowed a relatively robust assessment of the impacts of fishing on Abrolhos marine habitats. Given the existence of some quantitative historical survey data or some semi-quantitative information from interviews in the current study, some perspective on changes in effort distribution were possible for the lobster and scallop fisheries (Figs 6.10a-c, 6.11, Appendix 3).

On the basis of quantitative and semi-quantitative data collated in this study, it was possible to provide a judgement about the effects of human commercial fishing activities upon the marine habitats of the Abrolhos Islands relative to natural impacts. First it is important to note that only a very small proportion of the Abrolhos marine habitats are fragile and these tend to be on the eastern sections of the island groups. Wetlining and pearl aquaculture were considered to have little impact on the marine habitats of the Abrolhos Islands. Wetlining is conducted by a very small fleet whose only impact is through anchoring, predominantly in unconsolidated sediments. Minor issues surround the aquaculture of black-lipped pearl oysters and principally are confined to the longline anchoring system using pins in reef top edges, and the remote possibility of broken longlines causing damage where they are sited over fragile habitats such as in the Pelsaert Group. The Abrolhos Islands contain a small number of pearl oyster farms, a small area under cultivation and stocking densities of 1000–1200 shell per ha. Very limited data for the Abrolhos Islands indicates chlorophyll concentrations were generally less than  $0.1\mu\text{g.l}^{-1}$ . Given the large volume of water and high flow rates through the Abrolhos system, it is unlikely that reductions in concentrations of phytoplankton and the input of wastes from black-lipped pearl oysters will have any measurable effect on the ecosystem. The same species, stocked at similar densities in a French Polynesian lagoon, where chlorophyll concentrations ranged from  $0.05 - 0.46\mu\text{g.l}^{-1}$ , consumed 0.24% of the gross primary production on a daily basis (Niquil *et al.* 2001).

The two large commercial fisheries also are considered not to impact greatly on the biologically sensitive habitats since the target species (rock lobsters and scallops) are not abundant in them. The trawl fleet does not impact heavily on “garden bottom” in its two to three week season and the rock lobster fleet expends most of its shallow water ( $\leq 20$  m) effort ( $> 94\%$  in the Wallabi and Easter groups and  $> 76\%$  in the Pelsaert Group) in areas having low or moderate fragility. There is a slight shift of effort into the more fragile areas later in the lobster season as densities of legal animals were reduced in the other habitats and catch rates declined there (Tables 6.3a, b, Appendix 3). The shallow water effort accounted for an average of 52% of the approximately 1.2 million potlifts per season in the Abrolhos Management Zone.

Habitat around and within the reef perimeters of the Abrolhos Islands is fished by rock lobster fishers with a relatively low intensity of generally much less than 15 pots per hectare (ha) during the 3.5 month season (Figs 6.7, 6.8 and 6.9, Appendix 3). Using the assumption that a rock lobster pot disturbed an area of 4 sq. metres every time it was deployed (indicating a “worst case” scenario), the percentage surface area of fragile habitat disturbed by rock lobster potting was estimated at between 0.2% and 0.3% of the habitat. The estimates for moderately sensitive biological communities were between 0.2% and 0.4% (Table 6.5, Appendix 3). These calculations are in need of further examination given they were based on surface area whereas coral reefs are three-dimensional. Nevertheless, the potting densities are a real and accurate measure from actual pot counts during the aerial surveys. Thus the impact of potting appears to be minor and the exposure brief (3.5 months) with the probability of localised disturbance in specific areas as distinct from the perception of widespread general damage.

There are virtually no quantitative data collected by any organization that allow an accurate assessment of numbers of tourists to the Abrolhos Islands or their activities. For example, yacht clubs have no records of where their members sail. Other recreational boating activities (except charter boat activities) are not recorded anywhere and visits by family and friends of commercial users of the Abrolhos are not documented. Anecdotal information suggests that the number of private recreational vessels, which visit the Abrolhos each year, is small. This is probably a result of the Abrolhos’ remoteness from the coast and weather patterns. Friends and family of commercial fishers, were infrequent visitors except during holiday periods, particularly at Easter when peak numbers visit the Abrolhos Islands. These people either sight-see, fish, dive, surf or visit islands usually using outboard powered aluminium dinghies (see Section 6.2, Appendix 3). The combined number of commercial and recreational power vessels visiting the Abrolhos each year is unlikely to exceed 300 with most activity occurring during the 3.5 month lobster season. Issues of hydrocarbon leakage and emission and sewerage from boat crews are likely to be minimal and probably unmeasurable.

Assessment of physical impacts on Abrolhos Islands marine habitats from tourism and recreation relied heavily on data drawn from interviews with charter boat operators. Charter boat activities centred around SCUBA diving and some fishing often occurring at the same locations. Charter boats averaged 150 trips per year carrying a total of about 1600 tourists. Diver visits to each group were estimated to be about 1600 for the Wallabi Group and averaged around 2500 for the Easter and Pelsaert Groups (Table 6.5, Appendix 3). Most recreational activities associated with charter boats were concentrated in the eastern part of the Abrolhos Islands where coral communities tend to be visually more exciting. The main

issues are damage from anchors and SCUBA divers. At each island group, a large number of sites for these forms of recreation were identified, but it is only at the popular locations (3-5 in each island group) that the potential for major impacts occurs. At these locations, the potential for damage is being reduced by the introduction of permanent moorings and the development of an education-awareness programme for SCUBA divers. Thus, recreational activity is unlikely to have had or will have a major physical impact on Abrolhos marine habitats assuming appropriate management of these activities (see Section 6.2, Appendix 3). The physical disturbance of Abrolhos Islands' marine habitats by humans is likely to be inconsequential when compared to natural damage. Commercial fishing activities are focussed generally in habitats of low to moderate sensitivity and the fishing seasons are short. Recreational activities are concentrated in the more protected central and eastern parts but only a few popular locations, representing a minor fraction of fragile habitat, are visited frequently for recreational pursuits such as SCUBA diving. Strong swells generated during storms and cyclones which produce "wave-shock" from unusual directions may severely affect the coral reef assemblages in the more protected habitats of the Abrolhos. This is a feature of the reef's natural cycle. A manifestation of this process are the eastern islands most of which are composed of storm and cyclone generated coral rubble which accretes and erodes according to weather influences. Nevertheless, natural damage is periodic and anthropogenic disturbance is low level and isolated but some impacts may be persistent, and the effects of damage of this nature might be cumulative. A better understanding of the effects of humans through monitoring programmes is necessary to ensure anthropogenic effects are indeed minimal. However, humans have been utilising the marine environment for over a century and the rock lobster industry has been active for much of that time. One may conclude that if anthropogenic impacts had been significant then comments like "the area was pristine and the unusually fragile coral reefs were in as good a condition as any I have seen" by ecology expert Professor Paul Dayton from Scripps Institute of Oceanography (Zekulich 1998) would not be possible.

Conservation issues are an important consideration for the Abrolhos Islands. Reef Observation Areas (ROAs) were established in the Abrolhos in 1994 for conservation and biodiversity reference area use (Figure 6.13a-c, Appendix 3). These ROAs, covering large areas of biologically diverse and visually interesting habitats, have been very successful (Nardi 1999) and are used frequently by snorkelling and SCUBA diving visitors.

A public meeting was held on 11 July 2001, to provide a forum for disseminating current knowledge accumulated in this study to members of the public and stakeholders in the Abrolhos region. The invitation only scientific workshop, held over a day and a half on 12 and 13 July, led to the production of a strategic plan of research to address the issues raised during the forum (Appendix 4). The research plan highlights proposed research aims in four broad categories (Table 2, Appendix 4):

- Ecosystem structure
- Ecosystem processes
- Measurement and monitoring of impacts and uses
- Environmental impact assessments.

In July of 2002, the strategic research plan was presented by the Honourable Kim Chance MLC, Minister for Agriculture, Forestry and Fisheries to the Abrolhos Islands Management Advisory Committee for their formal prioritisation of the projects. Once these priorities



are known, all members of the scientific community throughout Australia will have the opportunity to use the strategic plan as a blueprint for seeking research funding and contributing to the knowledge base in priority areas.

Extractive and non-extractive human activities at the Abrolhos will incur the likelihood of some physical disturbance to fragile biological communities. This can be minimised with the implementation of appropriate education and management strategies and the introduction of binding standard protocols for user groups. Sound scientific research is the key to the success of such initiatives and this study has provided a sound basis for their development.

## **8.0 Benefits**

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The principal beneficiaries of this project are the stakeholders of the Abrolhos Islands including the western rock lobster industry, the scallop fishery, the wetline fishery, the aquaculture industry, the dive charter industry, conservation groups and the local community. The Fisheries Research Report on the status of existing knowledge (Appendix 3) and the workshop proceedings (Appendix 4) provides a valuable tool for the future research and management of this unique region. Volume 1 of the research report provides a clear understanding of the distinction between natural habitat perturbations and the impact of anthropogenic activities, while Volume 2 indicates the need and direction for enhancing our understanding of the Abrolhos marine ecosystem and monitoring human use. The results of this project will enhance both the community debate surrounding multiple use of the Abrolhos Islands, and the ecologically sustainable management of this unique and valuable region.

## **9.0 Further development**

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The discussion at the Workshop on 12 and 13 July 2001 identified a number of projects which attendees saw as a priority. Details of the proposed projects are listed in the workshop proceedings (Appendix 4). It is anticipated that the Abrolhos Islands Management Advisory Committee will assign priorities to these projects. The strategic plan, when so prioritised, will form the basis for research institutions seeking funding to undertake projects utilizing their various areas of expertise. This will enhance the collection of data important to community debate and management decision making.

## **10.0 Planned outcomes**

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The publication of the Department of Fisheries (WA) Fisheries Research Report No. 134, Vol. 1 Summary of existing information and current levels of human use and Vol. 2 Strategic research and development plan achieved the planned outcomes for this project. The planned outcomes were to provide this information to the Western Australian community, to provide an objective statement about current anthropogenic activity and the “health” of Abrolhos reef systems and to provide direction and priority for research. The research plan details the environmental issues of relevance and the research projects needed to ensure ecologically-sustainable multiple-use of the Abrolhos Islands marine habitats.

## 11.0 Conclusion

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All objectives of the original proposal were achieved. The Department of Fisheries (WA) Fisheries Research Report “Towards an assessment of natural and human use impacts on the marine environment of the Abrolhos Islands: Volume 1 Summary of existing information and current levels of human use” provides an up to date overview of existing research and other data available for the Abrolhos Islands. Furthermore, it provides a description of the existing human use activities at the Abrolhos and places these impacts in their correct perspective against natural impacts. A general status report of the condition of the Abrolhos Islands marine habitats is given based on the results of this project. A dedicated research/monitoring programme, which took into account issues raised by all stakeholders (Fisheries Research Report Volume 2 Strategic research and development plan) will serve as a valuable tool for directing priority research in a timely manner to support the future ecologically sustainable management of the Abrolhos region.

## 12.0 References

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## **13.0 Appendices**

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### **Appendix 1. Intellectual Property**

There is no intellectual property in this report.

### **Appendix 2. Staff**

Chris Chubb (Principal Investigator) BSc (Hons), PhD

Kim Nardi (Co-investigator) MSc

Chris Dibden BSc, Grad. Dip. Rem. Sens. & Land Data Mgmt

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### **Appendices 3 and 4 (contained on CD)**

#### **Appendix 3.**

Webster, F.J., Dibden, C.J., Weir, K.E. and Chubb, C.F. 2002, Towards an assessment of the natural and human use impacts on the marine environment of the Abrolhos Islands Volume 1. Summary of existing information and current levels of human use. Fisheries Research Report (WA) No. 134, 120pp.

#### **Appendix 4.**

Chubb, C.F., Webster, F.J., Dibden, C.J. and Weir, K.E. 2002, Towards an assessment of the natural and human use impacts on the marine environment of the Abrolhos Islands Volume 2. Strategic research and development plan. Fisheries Research Report (WA) No. 134, 31pp.

The Research Division of the Fisheries Department of Western Australia printed a limited quantity of the two volumes of Fisheries Research Report No. 134 which are available on request to the Research Division. Both documents are contained in full on the interactive CD which also is available from the same source.