
RESEARCH PROJECT SUMMARIES

Solitary Islands Marine Park

This document provides a collation on non-technical summaries for research and monitoring projects conducted within Solitary Islands Marine Park with support from the NSW Marine Parks Authority. Further additional funding was provided for some projects by a number of State and Commonwealth agencies and universities.



The distribution of selected continental shelf habitats and biotic communities in the Solitary Islands Marine Park

Little is known of the continental shelf habitats found within the Solitary Islands Marine Park (SIMP). The aims of this study was to identify the distribution of continental shelf habitats and benthic communities present within the SIMP. The study consisted of two components: (1) targeting specific sites identified from fine scale bathymetry maps and previous surveys; and (2) the completion of four cross-shelf transects. Depth and substrate type along the transect were recorded from echo-sounder readings. Replicate video images of the substrate were obtained from target sites and areas of hard substrate encountered along transects. Video images were examined to obtain qualitative and quantitative data of the substrate type and composition of benthic communities at each site. Data from hard substrate sites were analysed in relation to environmental factors (i.e. depth, distance offshore and latitude). Groups of sites with similar taxonomic and substrate characteristics were identified from cluster and multivariate analysis. Data previously collected on continental shelf habitats within the SIMP by Mau (1977) was included in this analysis.

Significant areas of hard substrate with diverse benthic communities were found throughout the Marine Park. Major taxa encountered include encrusting and turfing algae, kelp, hard and soft corals, sponges and invertebrates. Cluster and multivariate analysis identified five major groups of sites: (1) nearshore reefs located along the length of the Marine Park with an overstory of kelp and mixed algal/invertebrate assemblages; (2) shallow midshelf shoals near North West Solitary Island and Sandon Shoals, which have a high cover of hard coral and taxonomically diverse algal and invertebrate communities; (3) rubble/sandy sites located near North West Rock and Arrawarra Headland with high cover of turfing and encrusting algae and isolated invertebrates; (4) deeper midshelf reefs and shoals located throughout the Marine Park with diverse sponge fauna and presence of encrusting corals; and (5) deeper offshore sites located along the eastern margin of the Marine Park, which have a high cover of bare substrate or sand and low cover of soft corals, invertebrates and sponges. Areas of high cover and diversity of benthic organisms include Sandon Shoals, reefs to the north of the North West Solitary Island, and reefs off Woolgoolga Headland.

The video drop camera technique used in this survey enabled cost-effective sampling of benthic habitats over a large area and depth range, and proved effective in identifying broadscale taxonomic differences in the structure of benthic communities within the SIMP.

Reference

Mau, R., Byrnes, T., Wilson, J. and Zann, L. (1998). The distribution of selected continental shelf habitats and biotic communities in the Solitary Islands Marine Park. Unpublished report from the Southern Cross University School of Resource Science and Management for the NSW Marine Parks Authority, 52pp.

Surveys of rocky shore habitats – Sandon Bluffs and Station Creek Headland – Solitary Islands Marine Park

Semi-quantitative studies of the biota associated with intertidal rocky shores at Sandon Bluffs and Station Creek Headland were conducted over a three-week period in July and August 1999. The objective of these studies was to provide data on the species richness and habitat diversity of each headland using methods which would allow direct comparison with data for other headlands within the Solitary Islands Marine Park (SIMP).

Sandon Bluffs support each of the major repetitive habitat types, which have been identified in past studies (shallow pool, deep pool, scree lagoon). Although there were a few extensive sections of sheltered rock platform associated with the headland complex, most of the area surveyed is exposed to moderate to high wave energy. As a result, biotic species richness was lower than would have been predicted based on the area of the headland that was surveyed. However, one embayment in the mid-section of the headland supports a range of taxa which, either because of their abundance, or because they are rare at other headlands within the SIMP, make this area of regional importance.

Station Creek Headland supports each of the main habitat types with the exception of lagoons. Biotic diversity is relatively low in the shallow pool habitats but the deep pools, which are scattered throughout the rock platform, support a rich biota which includes six species of zooxanthellate corals and a number of species which are either rare, or have not been recorded from other headlands in similar studies.

Comparisons with other headlands within the region suggest that biotic richness at Sandon Bluffs, as a whole, is low and that Station Creek Headland supports a relatively diverse biota but with low abundance for many of these species.

Reference

Smith, S.D.A. and James, K.A. (1999). Surveys of Rocky Shore Habitats – Sandon Bluffs and Station Creek Headland – Solitary Islands Marine Park. Unpublished report from the University of New England School of Biological Sciences for the NSW Marine Parks Authority, 35pp.

Recreational fishing competition survey of the Solitary Islands Marine Park

Recreational fishing competition data have been collected in the Solitary Islands Marine Park (SIMP) since 1993, with the data-set last analysed and reported in 1997. This report focuses on the period 1999 to 2003, but provides comparisons with the 1997 report.

During 1999 to 2003, thirteen recreational fishing clubs held permitted fishing competitions within the SIMP. This includes ten of the sixteen clubs that held competitions in the marine park between 1993 and 1997. Each club, as a condition of their competition permit, was required to submit data on the species caught during competitions, the number and weight of individuals, the grid location where fish were caught, as well as additional anecdotal information. The data were separated into line fishing and spearfishing, with Coffs Harbour Blue Water Free Divers being the only club undertaking spearfishing competitions. These data were analysed separately in this report due to the different method of capture used, but were not separated in the 1997 report.

The annual harvest values (number and weight of fish taken) and harvest rates (number and weight per angler day) were analysed over the five-year period. Overall harvest values and rates remained similar from 2000 to 2003 but this was not consistent by species. Harvest values were lower in 1999 while harvest rates were markedly higher than subsequent years. The grid locations within the marine park where the most fish were harvested were identified and compared between the two fishing methods. Spearfishing competitors concentrate at different areas of the marine park to anglers.

More than 100 species of fish were recorded by line anglers, with snapper, venus tuskfish, trevally, flathead and teraglin being the most abundant. More than 50 species were taken by spearfishing, with kingfish, fusilier, trevally, black-spot goatfish and mulloway being the most prominent. Overall more than 108 species were captured by angling and spearfishing methods combined. This compares with more than 77 species recorded in 1993 to 1997. The actual number of species captured is unknown due to problems with common names, species identified to family only, and potential misidentification.

A comparison of harvest values and harvest rates for the periods 1993 to 1996 and 1999 to 2003 indicated that the number of anglers, competitions, angler days, and the resultant harvest values were higher in the first period, but that overall rates were higher in the later period.

Several problems with the current data-reporting scheme were identified. Species were commonly assigned incorrect names, the number and weight of fish were often omitted and grid locations were often not filled in. Several potential solutions to improve data return are suggested within this report.

The data collated through fishing competition returns have provided information on species fished in the SIMP, as well as information on fishing competition activity within the marine park. Recreational fishing clubs can be a valuable source of information on fishing activities and harvest within the marine park, which can be used as stand-alone data or to aid interpretation of

concurrent research projects. It is worthwhile rectifying any problems with data recording and ensuring that competition data continue to be collected for future analysis and comparison.

Reference

Malcolm, H., Butcher, P., Irving, L. (2005). Recreational Fishing Competition Survey of the Solitary Islands Marine Park. Unpublished Report to the Solitary Islands Marine Park Steering Committee, Solitary Islands Marine Park Advisory Committee and the various Fishing Clubs that undertake recreational fishing competitions within the Solitary Islands Marine Park.

The impacts of four-wheel vehicles on beach macrofauna

Exposed sandy beaches are important and widespread coastal habitat which are focal areas for recreational activities. Indeed, recreational activities are the most common anthropogenic disturbance on sandy beaches and these pressures have been increasing in recent years. The effects of 4WD vehicles on sandy beach macrofauna were investigated by conducting a community level manipulative experiment on an exposed sandy beach in NSW.

This study comprised pre- and post-impact sampling of four replicated treatments. These included a control and three impact treatments that were each subjected to a different intensity of 4WD vehicle traffic (ten, twenty and forty vehicle passes per day over a five day period). Five biotic variables were monitored, including the total number of individuals, species richness and species abundance of the three most common species: the cirrolanid isopod *Pseudolana cocinna*; the ghost crab *Ocypode cordimana*; and the blood worm *Lobochesis longiseta*. Sediment granulometry and beach gradient were also measured each sample.

Of the fifteen analyses that were conducted on the biotic variables, fourteen revealed no impact. An impact was detected at the medium treatment level for species richness, though this may have been a chance event. It was concluded that 4WD traffic at the treatment levels used had no significant impact on the macrofauna and that variation due to natural disturbance was more important in generating the patterns observed over the four month duration of the study.

Reference

Hastie, B. (2000). The impacts of 4WD vehicles on beach macrofauna. Unpublished Honours Thesis, University of New England.

The impact of four-wheel drive vehicles on, and the natural variation of sandy beach meiofauna

Sandy beach meiofaunal communities were examined at two locations within the Solitary Islands Marine Park (SIMP), on the mid-north coast of NSW, Australia. The impact of fourwheel drive (4WD) vehicles on the meiofaunal community, and the natural (spatial and temporal) variation within the meiofaunal community was examined.

The 4WD experiment incorporated a Beyond BACI (Before/After, Control/Impact) design with replicated control and impact treatments (low, medium and high). Each impact treatment corresponded to a specific number of vehicles passes per day; 10, 20 and 40 respectively. 4WD impacting occurred each day for one week, with samples collected directly before and after impact in all treatments. A detectable effect was only apparent for copepods; however, this may be due to the high level of natural spatial and temporal variation masking any 4WD effects.

The temporal experiment incorporated a two-factor design (Time and Plot) and involved sampling eight times over a period of 128 days. Temporal variation was detected for all univariate, multivariate and sediment analyses. Meiofaunal community structure changed almost entirely after a period of 6 days, with very few species being consistently responsible for these differences. At the community level, only a slight correlation was found with the sediment characteristics. In contrast, a strong relationship was observed between some univariate variables and sediment characteristics.

The spatial experiment incorporated a four-factor (Beach, Location, Site and Plot) fully nested design across a number of spatial scales (kilometres, 100's metres, 10's metres and 10's centimetres). Spatial variation within the meiofaunal community was detected across all scales examined. Sediment characteristics (particularly grain size) were the major factor in structuring the meiofaunal community over most spatial scales examined, with strong correlations at the community and taxon level.

Overall, it appears that meiofaunal communities vary over a wide range of temporal and spatial scales. It is also apparent that detecting physical disturbances to meiofaunal communities relies on prior knowledge of patterns of natural spatial and temporal variation.

Reference

Bell, T. (2005). The impact of four-wheel drive vehicles on, and the natural variation of, sandy beach meiofauna. Unpublished M.Sc. Thesis, University of New England.

Critical habitats for the mudcrab *Scylla serrata*: identification, significance and management

The Solitary Islands Marine Park (SIMP) in New South Wales, Australia, was formed in 1998 to manage human activities and to ensure the sustainability of the marine environment. Mud crab (*Scylla serrata*) populations are exploited in the Wooli, Sandon and Corindi estuaries, which form part of the SIMP. When the park was declared, different zones were implemented, restricting fishing in some areas while allowing unrestricted activities in others. The 'no fishing' zones aimed to maintain the area in its natural state. In so doing, it was hoped that commercial and recreational use could continue while ensuring a sustainable future for mud crabs.

To assess the effectiveness of this zoning for protecting mud crabs, replicate fished and unfished zones were sampled each month from December 1998 (Wooli) and July 2000 (Sandon and Corindi) until August 2003 using commercial wire traps. The sampling program coincided with changes to the zoning schemes implemented by the NSW Marine Park Authority in August 2002 as part of a zoning review, which had otherwise been unchanged since 1991. This enabled the collection of pre- and post-zoning data and the assessment of mud crab population responses to areas which were reopened (Wooli and Corindi) or closed (Sandon) to fishing.

Methods of tagging success were validated for mud crabs. Anchor t-tags inserted into the posterior margin of the crab did not hinder crab movements or become detached during moulting. These tags were effective for long-term tagging studies to describe movement patterns, and were used throughout the study. Crab behaviour around traps was assessed in special tanks. Video analysis revealed that male crabs were initially dominant around baited traps and entered first. However, all crabs of each sex entered the trap in a short period of time and did not escape.

The sampling program provided evidence that no-take zones were protecting mud crabs from exploitation in the SIMP, as these areas contained greater numbers of crabs in all size classes. Higher proportions of males were captured in the Sanctuary Zone sites, presumably because males dominated around traps and females travelled to the downstream, fished zone when migrating offshore to spawn. These Sanctuary zones provided spill-over of crabs to adjacent fished areas. The success of this spill-over apparently depends on flooding events during which low salinity pushes crabs further downstream. However, between floods, crabs were primarily caught at the zone border where the recreational fishing pressure was greatest.

Abundances of legal-sized crabs declined within two months of opening in areas that were previously closed to fishing in the Wooli and Corindi estuaries. These results suggest scope for refinement of reopening strategies for future zone openings. Reopening of sites also distributed fishing effort away from the Sanctuary Zone borders, enabling crabs to move further into the fished area. In a reciprocal manipulation, some areas within the Sandon Estuary were excluded from all fishing while others allowed the resumption of recreational fishing after previously being targeted by commercial fishers only. Results suggest that closures are an immediate and effective management tool for the recovery of fished mud crab stocks when populations become overfished. At the protected site, crab numbers and the average size of crabs increased within

months of closing while there was no change in the number of crabs caught each month in the area where recreational fishing effort resumed.

Telemetry studies in the Corindi Estuary showed that the average daily distance moved, and the average distance moved by crabs from the release point, was greater in deep channel areas than in shallow *Zostera*-dominated channels. Therefore, there is a greater probability of spill-over if Sanctuary zones are implemented where deep channels form the border between fished and no-take areas. There would also be a greater chance that shallow areas could become locally depleted because areas would be slower to recover after exploitation.

Natural barriers such as rock bars were found to enhance the effectiveness of the zoning schemes as they generate social and environmental benefits. These areas are left open to fishing, meeting with public approval, while physically, fisher access is restricted upstream of the bar. Existence of a natural barrier at Wooli resulted in crab populations upstream of the rock bar being similar in abundance and size class distribution to those in Sanctuary Zones. Meanwhile, crabs declined in the site downstream of the bar by the first sampling period, three months after the zoning change. The area above the rock bar also provided a recruitment source of crabs to the heavily fished area downstream after flooding.

The results illustrate the effectiveness of estuarine protected areas in the SIMP for sustaining recreationally and commercially targeted species such as mud crabs. It provides information that can be used to justify the effectiveness of these areas to managing authorities and the public. The project provides evidence that a management plan that incorporates the biology of the species being protected (the mud crab), the behaviour of the fishers targeting that species, and the tools available (e.g. zones, gear restrictions, and natural barriers) can be integrated to design effective zoning schemes in Marine Parks.

An ongoing monitoring program has continued since 2003 in each of the three estuaries. Monthly samples have been collected during December and April and will continue until the 2007 zoning review. The general catch trends (relative abundance and size classes) during these two periods was similar too those found during the previous years. This included high mud crab abundances in the Sanctuary Zone during December and April. The same annual trend occurred in the fished area with high abundances of all sizes of crabs in December before they were fished down over the Christmas period. These crabs were then replaced by small undersized individuals that were now big enough to enter the fishery during the April sampling period. These crabs would then become the following year's legal sized crabs. The cycle then started again.

Reference

Butcher, P. (2005). Mud crabs (*Scylla serrata*) and marine park management in estuaries of the Solitary Islands Marine Park, NSW. Unpublished PhD thesis, National Marine Science Centre, University of New England.

Mud crab (*Scylla serrata*) monitoring program in ICOLL's of the Solitary Islands Marine Park

Eleven mud crab surveys have been undertaken over the past 4 years (March 2002 to March 2006) in four Intermittently Open and Closed lagoons (ICOLL's) within the Solitary Islands Marine Park. These were Hearn's Lake, Woolgoolga Lake, Arrawarra Creek and Station Creek. Each survey consisted of one overnight set of nine traps in each ICOLL. Overall, 339 mudcrabs were caught, measured, sexed, tagged and released during the 396 overnight trap sets.

In total, 153 crabs were caught in Arrawarra Creek, 79 crabs in Station Creek, 62 crabs in Woolgoolga Lake and 45 crabs in Hearn's Lake. Considerably more crabs were caught in Station Creek and Arrawarra Creek (crab trap closure) during the first survey (March 2002) in comparison to Hearn's Lake and Woolgoolga Lake (Mean of 2.4 and 3.3 crabs per trap versus 0.4 and 0.6 crabs per trap, respectively). However, since the first survey mud crab catches have dropped substantially within Station Creek.

These results suggest there was a big pulse of effort in Station Creek in months prior to the Sanctuary Zone coming into force in August 2002. This was possibly related to the Zoning Plan being released in April 2002, providing four months of 'last opportunity' to legally fish in Station Creek.

There has been a continued decline (with zero crabs caught in March 2003 and March 2004). This could be due to various reasons including low recruitment or environmental conditions, although basic water quality measurements in March 2004 were similar in both Arrawarra Creek and Station Creek. There could also be illegal fishing occurring in Station Creek and bush camping activity has been observed on the bank of the Sanctuary Zone at a position with a very difficult access track. Approval was gained from the NPWS in August 2002 to close the track into this campsite and this is currently being scheduled as part of an overall access-track management plan for this part of Yuraygir National Park. There is also a possibility that mud crab numbers in Arrawarra could increase as the main access track through private land was fenced off in 2005. While it does not remove all access it may reduce the number of anglers using the area.

Very few tag returns have been received (6 tags), so movement patterns of mudcrabs in ICOLL's cannot be examined. One crab that was tagged in the Station Creek Sanctuary Zone was caught in the Habitat Protection Zone approximately 1.2 km downstream.

Solitary Islands Marine Park reef fish assessment program

This program has two main components: 1) evaluating the influence of sanctuary zones on reef fish densities and relative abundance, and 2) describing spatial patterns of reef fish diversity.

Annual monitoring surveys have now been conducted for the past five years (2002 to 2006) using a combination of diver and baited video methods to assess the influence of sanctuary zones. This monitoring program commenced at the time the current zoning scheme was declared.

Red morwong have continued to show a strong response to sanctuary zones using diver surveys and there are early indications that larger sanctuary zones may respond more strongly than smaller sanctuary zones. Various other taxa, including bream and tropical snappers / sweetlips /emperors, appear to be showing a positive sanctuary zone response although it is still early days for any definite patterns or trends to emerge.

Both bream and red morwong show strong site influences. Not all sites have responded in the same way. This suggests another benefit of larger sanctuary zones, in that larger sanctuary zones will contain more sites. This increases the probability that a sanctuary zone will include sites that respond well for a particular species.

Snapper showed a strong response in 2005 in both sanctuary zones and non-sanctuary zones using baited remote video, with greater relative abundances recorded in the sanctuary zones. In 2006 there was a decrease in both sanctuary zones and non-sanctuary zones but this decrease was markedly stronger in non-sanctuary zones. In sanctuary zones, relative abundance of snapper in 2006 was still three times greater than in 2004, but in non-sanctuary zones they had returned to similar levels to those recorded in 2004. Surveys planned for 2007 should enable more robust conclusions to be made.

The diver field-component of the reef-fish diversity program has now been completed with 71 sites at 47 locations having been surveyed. There are strong patterns in reef-fish assemblages, especially going from inshore to offshore. Detailed analysis and reporting of this data is currently in progress. The use of baited video to explore spatial patterns on reefs below diver depths is planned for 2007. An assessment of representation (of reef fish assemblages) in sanctuary zones under the current zoning scheme is planned for early 2008.

References

- Malcolm, H. (2004). Solitary Islands Marine Park reef-fish monitoring program. Status Report 1. Unpublished report to the NSW Marine Parks Authority
- Malcolm, H. (2005). Solitary Islands Marine Park reef-fish monitoring program. Status Report 2. Unpublished report to the NSW Marine Parks Authority

Assessment of reef habitat condition in Solitary Islands Marine Park

Widespread coral bleaching (the loss of colour in coral polyp tissue due to the expulsion of internal symbiotic algae) was observed within the Solitary Islands Marine Park (SIMP) in 1998 during a global, but variable, bleaching event. The extent and effect of this event was not measured or described in the Solitary Islands. This was the impetus for this project.

During 2000 to 2003, the Solitary Islands Underwater Research Group (SURG) and NSW Marine Parks Authority (MPA) monitored coral bleaching and coral recovery / mortality at three locations (island reefs) within SIMP. This was undertaken using a combination of tagged corals (123 colonies in total), belt transects (proportion of colonies bleached), and temperature loggers (30 minute recording intervals).

The results from this study indicated there was not a widespread bleaching event during 2000 to 2003 in the SIMP due to elevated sea-temperature. This includes the summer of 2002 when a severe bleaching event occurred in the Great Barrier Reef (GBR). The 2002 event was described as the most severe bleaching event on the GBR to date (Great Barrier Reef Marine Park Authority 2002). Warmer sea temperatures were recorded in the SIMP during the summer of 2002 when compared with 2001, with the highest recorded temperature being 27.4° C.

Low levels of bleaching have occurred throughout the 2.5 years monitored under this study in the Solitary Islands Marine Park, with occasional minor elevation of bleaching in some species at some sites. A minor elevation in levels occurred during the winter of both years, but not at all sites. These results indicate there is a low 'background' level of bleaching that generally occurs in this area.

The exception was *Goniopora* spp., which strongly bleached in 2001. This followed a major rain event that caused extensive flooding in the Clarence River. A number of white-bleached *Goniopora* colonies were tagged and these had recovered their colour within three months. This bleaching was not related to elevated sea temperature.

A disease (that causes rapidly spreading mortality through a colony) was detected through the tagging study. At least 18% of tagged colonies (11 of the original 60) were affected by this spreading disease and 10% (6 of 60) had died from this disease. This disease caused extensive mortality in tabulate *Acroporas* and *Turbinarians*, especially at SW Solitary Island. Overall this disease affected 32% of tagged *Acropora* colonies and 35% of tagged *Tubinaria* colonies, with total mortality being 16% and 21% of these colonies, respectively.

Reference

Edgar, J.E., Malcolm, H., and Dalton, S. (2003). Coral bleaching in the Solitary Islands Marine Park, NSW. Technical data report to Coastcare.

Assessing the frequency, distribution and virulence of coral disease within Solitary Islands Marine Park

Scleractinian corals dominate benthic community structure at locations within the Solitary Islands Marine Park (SIMP). Hard corals present are subjected to stress from both biotic (competition and predation) and abiotic (variable seawater temperature, wave exposure, turbidity and freshwater inundation) factors. Recently, coral stress and mortality have been associated with elevated seawater temperature and recent reports of a spreading disease.

The main aims of this study were to evaluate the factors that have increased coral mortality and to determine the effect coral disease is having on the coral community at sites adjacent to South West Solitary Island. Three survey methods (photographic images, radial arc belt transects and videotape transects) were employed to determine: the rate of disease progression in hard corals; the prevalence of coral disease in affected coral populations; and the difference in coral disease prevalence over seasonal and annual spatial scales. Finally, benthic community structure was compared between data collected in 2002 and 2003 in order to determine if any changes may be attributed to coral disease.

Results from the photographic assessment indicated that bleaching, coral disease, sediment abrasion and predation contribute to coral tissue stress. Coral disease was apparent spreading through common hard coral species from the genera *Turbinaria*, *Acropora*, *Goniastrea*, *Pocillopora* and *Stylophora*. Results from two-way repeated measure analysis of variance (ANOVA) indicated that the rate of spread of coral disease was significantly different between affected species and between the autumn and winter survey periods, suggesting that coral disease spreads more rapidly during periods of warmer seawater temperature.

Mean percentage coral disease at the northern side of the island varied between survey dates, increasing from 8.6% during March to 13.6% in June and decreasing to 7.8% in September. Coral disease prevalence was significantly different between affected species and between survey dates, suggesting that coral disease prevalence was higher during warmer months, and declines as seawater temperature decreases. In contrast, results from videotape transect data showed that coral disease frequency was not significantly different between 2002 and 2003. Benthic community structure varied between 2002 and 2003 survey periods; with hard coral cover decreasing, and other invertebrates and non-living habitats increasing in percentage cover. Results from the analysis of similarity (ANOSIM) indicated that benthic community structure was significantly different for all sites between survey dates. Changes in benthic cover may be due to coral disease, which has contributed to a loss of common coral species cover, particularly species from the genus *Turbinaria*, providing an increased area of substratum for colonisation by other benthic organisms. However, additional research is required to determine changes in coral cover due to other factors such as storm events.

Reference

- Dalton, S. (2003). Assessing the frequency, distribution and virulence of coral disease within SIMP. Unpublished Honours Thesis, Southern Cross University.

Assessing patterns of human activity and use in Solitary Islands Marine Park

Visitors Survey

The Solitary Islands Marine Park (SIMP) incorporates a range of estuaries, sandy beaches, rocky shores, islands and reefs, which support an array of marine plants and animals. The Marine Park is not only ecologically valuable, but also important to the region socially, culturally and economically. Tourism is a key industry in the region with visitors enjoying a range of activities in the Marine Park such as swimming, surfing, fishing, canoeing and sight seeing.

To better understand Marine Park use and visitor satisfaction, a visitor monitoring survey was initiated in 2002. The survey aimed to identify visitor demographics, activities undertaken, locations visited, the importance of experiences and advisory material as well as general visitor satisfaction.

Data was collected using several techniques: face to face interviews, provision of survey forms directly to visitors in the field to be completed at a later date and forms left in popular tourist locations. The surveys have been conducted in December and January 2003, 2004 and 2005. Survey teams targeted the majority of areas adjacent to the Marine Park, including Sandon Village, Minnie Water, Diggers Camp, Wooli, Red Rock, Arrawarra, Mullaway, Woolgoolga, Emerald Beach, Moonee, Sapphire and Coffs Harbour.

Results indicate that visitors are primarily aged between 25 – 55 years and 80% come from New South Wales (just under half live within two hours drive of the Marine Park). Of those travelling from locations over two hours drive from the Marine Park, approximately threequarters use commercial accommodation, primarily caravan parks and holiday homes/units. The most popular activity is usage of beach, in particular Woolgoolga, Wooli, Minnie Water and Moonee. Swimming and surfing account for about 70% of all physical activities mentioned. About 10% of respondents mentioned fishing. Of those that mentioned fishing, estuarine fishing is most popular (40%), followed by beach fishing (25%).

The “usefulness” of marine park advisory material (signs, recreational user guide, brochures, boundary markers etc) were consistently rated useful (about five on a scale of seven), as was the importance of these products. The “importance” of seeing marine life proved to be very important with respondents scoring about six out of seven. The importance of catching a fish was generally rated about four out of seven. The overall satisfaction of visitors to the Marine Park was between approximately 5.3 and 6.5 out of a possible seven.

Other feedback from visitors that will assist with the future management of the marine park included comments on the most common sources of satisfaction: relaxing environment, beaches, the beauty, lack of crowds, clean water, surf, good weather, swimming, good for children, fishing and seeing marine life to name a few. Many suggestions were also provided that related to the provision of additional facilities and information, as well as suggestions to either increase or decrease access to some areas.

Recommendations highlight the need for sufficiently large samples and that future surveys are constructed to enable an assessment of “importance” against “satisfaction”.

Reference

Ryan, C. (2005). Visitors to Solitary Island Marine Park their behaviours, attitudes and perceptions. An analysis of surveys: 2002 to 2005. Unpublished report from University of Waikato Management School to the NSW Marine Parks Authority.

Small Business Survey

The purpose of this study was to assess the extent to which changes in the management of the Solitary Islands Marine Park since 2002 had impacted upon local businesses. In September and October 2005 a project officer approached 248 businesses operating within the vicinity of the Marine Park. Face to face interviews were undertaken. However, the majority of respondents sought to spend time (days / weeks) completing the questionnaire and forward the completed survey by mail. A total of 51 businesses within the estimated economic zone of the Solitary Islands Marine Park completed the questionnaire. They covered many types of business and the largest single segment was drawn from the commercial accommodation sector. No bait and tackle stores returned the questionnaire. Given that they are an important business type in the vicinity of the Marine Park they were contacted a second time by phone, sent the questionnaire again and encouraged to return it by the end of December. Again no questionnaires were received from bait and tackle stores. Upon analysis of the data of the businesses that provided information about the year in which they commenced operations, 50% started before 1990, and the remainder after that year.

The mean number of full time employees per business was approximately 3.1 throughout the period since 2001, with initially about the same number of part-time staff being recruited. However over the period since 2001, the number of peak season part-time staff increased to approximately 5. Over this same period estimated annual turnover for the sample increased by about 20%. Based on a smaller sub-sample, the best estimate of sample turnover indicates that that turnover increased from about AUS\$13 million to AUS\$15.7 million during the period 2001 to 2005.

The businesses specified that most of this growth has come from increased visitation. Only a handful of businesses indicated any significant amendment of their operations by extending product range or introducing new products. The largest source of increased business seems to have been generated by out of region visitors, notably those who are described as general beach users, followed by beach users who are resident in the region. Surfers then follow with recreational fishermen being next. There was little evidence that management changes in the Marine Park had adversely affected the turnover of the businesses surveyed. Only two respondents perceived building or development delays caused by new management regimes, and in the one case where these delays were costed, it was assessed that the delays cost the business AUS\$10,000. A list of 33 respondents provided a list of 96 reasons in the general external environment that had impacted upon their business; and together it was estimated that, with a

score of 6.7 on an 11 point scale, these reasons in total had a moderately positive impact upon the business community. In summary, there is little evidence to suggest that changes in Marine Park management have had a negative impact on the turnover and employment patterns of the local business community given that: other surveys have indicated high levels of satisfaction resulting from Marine Park visitation, and there is evidence of growing visitor numbers to the region and the Marine Park.

It can be concluded that the Marine Park continues to benefit local business by generating more potential customers and that the changes in management plans have neither adversely affected visitor flows nor overall levels of business activity in the local economy. These findings are premised on an assumption that respondents to the questionnaire are representative of the businesses in the region.

Reference

Ryan, C. (2006). The Impact of Revised Zoning and Management of the Solitary Islands Marine Park on Local Businesses. Unpublished report from University of Waikato Management School to the NSW Marine Parks Authority.