
RESEARCH PROJECT SUMMARIES

Jervis Bay Marine Park

This document provides a collation on non-technical summaries for research and monitoring projects conducted within Jervis Bay 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.



Effectiveness of temperate Australian Marine Protected Areas as tools for biodiversity conservation and informing fisheries management

Surveys of subtidal rocky reefs were conducted in the Jervis Bay Marine Park (JBMP) as part of a broader study into the effectiveness of marine protected areas (MPAs) in Australian temperate waters. The study used the same standardised methodology used in baseline and long-term monitoring programs in Western Australia, South Australia, Tasmania and Victoria. Surveys assessed fish size, diversity and abundance, as well as macro invertebrate and algae abundance. Baseline surveys were conducted in 1996 (18 replicate sites), 2000 (24 replicates) and 2001 (25 replicates). Since establishment of the JBMP zoning plan in October 2002 three surveys in 2003, 2004 and 2005 have been completed at 27 sites. Sites were chosen to allow an approximately balanced design between treatments with 14 sites in sanctuary “no-take” zones and 13 reference sites where fishing is still permitted. Sites were also stratified by wave exposure between sheltered and exposed locations.

A diverse fish fauna totalling 216 species has been recorded. Site attached species such as wrasse, damselfishes, red morwong *Cheilodactylus fuscus* and rock cale *Crinodus lophodon*, provided the most temporally and spatially stable components of the fish assemblage. More mobile and schooling species such as the snapper *Acanthopagrus australis*, and the bream *Chrysophrys auratus* were highly variable between sites and between years. Newly-recruited juveniles of tropical species, which presumably die each winter, also added considerable variation between years.

The invertebrate fauna was dominated by the long-spined urchin *Centrostephanus rodgersii*, while other species such as *Turbo* snails and red-throated ascidians (*Herdmania momus*) were locally abundant. Commercially and recreationally important abalone and rock lobster species were extremely rare. Algal diversity was relatively low compared to other temperate Australian study locations, with the kelp *Ecklonia radiata* the most common species.

Results from surveys showed some divergence between “no take” sanctuary zones established in October 2002 and fished reference sites. Two exploited fish species, the red morwong and bream, and one threatened species, the grey nurse shark, exhibited trends for population increase in sanctuary zones; however, longer-term trends will be required before the significance of these observations can be reliably assessed. While numbers were low, the re-establishment of grey nurse sharks within a sanctuary zone in Jervis Bay was certainly an encouraging sign that general protection from fishing may help protect this threatened species. Other patterns observed over the monitoring period included divergence between fished and unfished zones for the abundance of invertebrate gastropod *Astralium tentoriformis* and the total cover of the common kelp *Ecklonia*

radiata. As for the fish results, more time is required to properly determine the biological significance of these trends.

As the JBMP has only been protected on paper for 2.5 years, and due to a one year advisory phrase strongly enforced for only 1.5 years, it is not surprising that few changes have been detected as yet. A more realistic and biologically meaningful timeframe to detect change will be 5-10 years, hence it is recommended that annual surveys continue over this period.

Due to the broad scale of the survey the current design should be able to detect changes at all levels of species interaction. Ideally surveys will continue to be repeated at the same time each year. This will produce a time-series of data documenting changes in the abundance and size distribution of species of interest, allowing clear trends through time in sanctuary zones to be differentiated from chance divergence and natural levels of inter-annual variability.

Reference

Barrett, N., Edgar, G., Polacheck, A., Lynch, T. and Clements, F. (2006). Ecosystem Monitoring of Subtidal Reefs in the Jervis Bay Marine Park (1996-2005). Tasmanian Aquaculture and Fisheries Institute Internal Report.

Temporal and spatial distribution of the White-bellied sea eagle (*Haliaeetus leucogaster*) in Jervis Bay

White-Bellied Sea Eagles (WBSE) are spectacular residents of the Jervis Bay Marine Park, yet we know little about their natural habits. Like other top order predators, WBSE's are useful indicators of the health of the environment. They also have the added bonus of being sensitive to both potential impacts on water resources and also disturbance on land. This paper presents results of a sea eagle monitoring project carried out between April 2001 and April 2003 in Jervis Bay, NSW. The sea eagles in Jervis Bay are seasonal birds with numbers of adults and non-adult birds peaking in autumn. It is at this time that juvenile birds become independent of their parents and adult territorial display becomes more important. During April, immature birds aged between 2-3 years arrived from outside the bay, often in rowdy bands of up to eight birds.

Whilst at the bay they probably spend their time learning the skills of courtship and hunting from the bays established pairs during the fresh southerly winds of autumn. When WBSE use of the bay was analysed it appeared that sea eagles, and non-adults in particular avoided the more developed parts of the foreshore. Even adult birds seen near suburban areas avoided areas of housing, preferring to perch in small patches of forest that remained between suburbs. Surprisingly, analysis showed that the Australian Defence Force (ADF) bombing range on Beecroft peninsula may provide an ideal site for WBSE. Like their well studied American cousin; the bald eagle, boat-based surveys provided an excellent method for determining where and when WBSE's used the bay. After analysing our results it was decided that of the numerous months surveyed, April was the best time to detect changes in the Jervis Bay sea eagle population.

Reference

Spencer, J.A. and Lynch, T.P. (2005). Boat surveys for White-bellied sea eagles (*Haliaeetus leucogaster*) in Jervis Bay, New South Wales. *Emu* 105: 211-216.

Recreational fishing monitoring project

Theoretical models of marine protected areas (MPAs) that explore benefits to fisheries or biodiversity conservation often assume a fishers are evenly spread over the sea. I tested this with a case study of the multiple-use Jervis Bay Marine Park. Prior to zoning of the park I conducted 166 surveys of the park's recreational fisheries, plotting the location of 16,009 anglers. I converted these plots into diagrams of fishing effort and then compared the location of fishing with habitat and the effect of two reserve designs – the draft and final zoning plans of the park – on the 15 fisheries observed. Fisheries were strongly associated with particular habitats and were disproportionately concentrated into small areas. In the draft zoning plan, sanctuary zone (no-take) area and potential impact on fishing effort were similar. In the final plan, which was altered in response to public comment, the area of sanctuary zone increased, and the impact on fishing effort decreased. In only one case was a fishery's most intensely targeted location closed to fishing. Due to the discriminating manner with which fishers target habitats, if simple percentage targets are used for planning, sanctuary location can be adjusted to avoid existing fishing effort. According to theory the implication of this may be diminished reserve effectiveness. To address this, reserve area should be implicitly linked to removed fishing effort when designing MPAs.

Reference

- Lynch, T.P. (2006). Incorporation of recreational fishing effort into design of marine protected areas. *Conservation Biology*. *Conservation Biology* 20(5): 1466-1476.
- Macready, A.M. (2000). Assessment of recreational fishing in Jervis Bay Marine Park and comparison of angler effort and success over an eleven year period. Unpublished Honours thesis, University of Wollongong.

Recreational SCUBA diving in the Jervis Bay Marine Park

The New South Wales State Government (Australia) gazetted the Jervis Bay Marine Park (JBMP) in 1998. During the preparation of the Draft Zoning Plan in 2000 societal data on two conflicting park user groups; recreational scuba divers and fishers (anglers) was collected. While conflict resolution was a plan priority, other factors, such as cumulative environmental impacts of users and protection for the critically endangered grey nurse shark (*Carcharias taurus*), further complicated planning. Both scuba diving and angling are primary summer activities and are disproportionately concentrated around the headlands of the bay. Furthermore, shore based game-fishing was concentrated on the northern headland, where the conflict was centred. However, when the exact locations of divers and anglers were determined, there was a partial partitioning of the available space, with only a small contested overlap. To resolve conflict and maximise positive environmental outcomes a Sanctuary Zone and No Anchoring Zone option in the Draft Zoning Plan was sought to formalise this partition.

The human dimension data proved valuable in guiding environmental management in this politically volatile situation. A baseline study conducted 11 years previous was also used to gain a limited perspective on change in user numbers. Comparison between study periods indicated dive numbers had remained similar, while the number of dive charter trips was significantly less. The numbers of anglers, for the four months compared, had doubled and tripled. The actual data used to inform management is presented and the limitations of this “best available data” approach are discussed.

Reference

Lynch, T.P., Melling, L., Hamilton, R., Macready, A., Wilkinson, E. and Feary, S. (2004). Conflict and impacts of divers and anglers in a Marine Park. *Environmental Management* 33(2): 196-211.

The utility of Marine Protected Areas in estuarine intertidal soft-sediment assemblages

Planners of Marine Protected Area (MPA) commonly use habitat as a surrogate for biological diversity when choosing areas for conservation. Most habitats when mapped are considered to be that same throughout their extent, however this assumption is rarely tested. We tested this assumption of sameness at three tidal flats on the south east coast of New South Wales, Australia. Our design was at three scales, plots (20m), sites (100s m) and estuaries (<30km), to determine which scale contributed most to differences in the types of the small animals that live in the tidal flats. Of the total variation in abundance and diversity of animals, the scales of sites and estuaries contributed 30-35%. However, all estuaries shared the same dominant types of animals and species turnover between estuaries was low. In contrast, 39% of the observed variation in species turnover occurred at the scale of sites. Our findings have two important implications for efficient planning of MPAs. First, the abundance and number of species in tidal flats can differ at the scale of 30km. Second, big changes in the types of animals observed occur at small scales (100s m). This implies that conservation of the whole habitat, rather than fragments, is required if all of the types of animals are to be included in the reserve.

Reference

Winberg, P.C., Lynch, T.P., Murray, A., Jones, A.R. and Davis, A.R. (2006). The importance of spatial scales for the conservation of tidal flat macrobenthos: an example from New South Wales, Australia. *Biological Conservation*.

Free-ranging Bottlenose Dolphins (*Tursiops aduncus*) in Southeastern Australia: acoustic behaviour and the effects of anthropogenic noise

Powerboats are a major source of disturbance to coastal cetaceans. Information is scarce, however, on the nature of interactions between powerboats and dolphins. The surface behaviour and acoustic response of travelling dolphins to approaches by a powerboat were assessed between November 2001 and November 2003 in Jervis Bay, New South Wales, Australia. Dolphin behaviour was monitored continuously from a research boat before, during and after a powerboat approached. Between these approaches observations of the dolphins were made as controls. Dolphins altered their surface behaviour when exposed to the powerboat approach and also changed their direction of travel. These changes occurred when the power boat was greater than 100 meters from the dolphins. This was well outside of the minimum approach distance of 30 metres for recreational and commercial vessels, as proposed by the New South Wales National Parks and Wildlife Service.

In contrast, there were no changes in dolphin whistle rates or the duration of echolocation click bouts when approached by the powerboat. This was understandable, however, as travelling dolphins in Jervis Bay generally do not produce many vocalisations. These findings suggest that powerboats do affect the surface behaviour and direction of travelling bottlenose dolphins in Jervis Bay; however it appears that this impact is not reflected in their acoustic behaviour.

Reference

Lemon, M., Lynch, T.P., Harcourt, R.G., and Cato, D.H. (2005). Response of travelling inshore bottlenose dolphins (*Tursiops aduncus*) to experimental approaches by a powerboat in Jervis Bay, New South Wales, Australia. *Biological Conservation* 127: 363-372.

Monitoring the Steamers Head seal colony

We provide an initial status report for the newly established, and most northerly, fur seal colony at Steamers Head, NSW. Seasonal trends in haul-out numbers, environmental effects and disturbances to the colony were investigated to establish a baseline. The haul-out site was occupied by Australian, *Arctocephalus pusillus doriferus*, and New Zealand, *A. forsteri*, fur seals, with *A. pusillus doriferus* the more abundant species. For both species, adult males, sub-adults and juveniles were present; the sub-adult seals were the most numerous age groups. The seasonal pattern of site occupation in 1999 suggests that the colony is a non-breeding haul-out site. Numbers of seals hauled out increased from occasional solitary individuals in May, peaked in September, and declined in October. Daily haul-out numbers varied considerably.

Two large declines in numbers coincided with a landslide at the site and naval bombardment of the Beecroft Weapons Range. No diurnal or tidal effects on haul-out behaviour were observed, though more *A. pusillus doriferus* hauled in strong winds and warm air temperatures. At the site, which is sheltered, shaded, steep and has a southerly aspect, environmental effects have different influences on the fur seals' haul-out behaviour compared to their behaviour at more exposed sites. Thus generalisation regarding haul-out behaviour of seal species in response to environmental conditions may need to be viewed with caution.

References

- Burleigh, A., Lynch T. and Rogers, T. (2006). A status report on the most northern East Coast Australian fur seal colony (Steamers Head, NSW) and the influence of environmental factors and disturbance on haul-out behaviour.
- Burleigh, A. (1999). Monitoring the Fur Seal Colony at Jervis Bay. Unpublished Honours thesis, Sydney University.