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## The Marine Fauna and Flora of Moreton Bay, Queensland

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Editors: Peter J.F. Davie & Julie A. Phillips

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PO Box 3300, South Brisbane 4101, Australia  
Phone 06 7 3840 7555  
Fax 06 7 3846 1226  
Email [qmlib@qm.qld.gov.au](mailto:qmlib@qm.qld.gov.au)  
Website [www.qm.qld.gov.au](http://www.qm.qld.gov.au)

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# Proceedings of the Thirteenth International Marine Biological Workshop

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### Volume 1

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## INTRODUCTION

# The Marine Fauna and Flora of Moreton Bay Workshop: a focus on species

Peter J.F. Davie & Julie A. Phillips

Moreton Bay, in southeast Queensland, is one of Australia's most outstanding natural areas. It is a place of great beauty and variety on the edge of one of Australia's largest cities. However, the southeast Queensland region is one of the fastest growing large urban areas in the developed world, and this inevitably exerts enormous pressure on Moreton Bay. A healthy marine ecosystem is crucial for maintaining the important commercial fisheries, and also for the enormous numbers of recreational users that pour out of Brisbane and nearby centres to enjoy this unique environment.

Of great interest to scientists is the fact that Moreton Bay lies at the heart of a major biogeographic overlap zone. It is here that the southern and northern biotas meet, forming unusual communities of both temperate and tropical species. This is enhanced by the unique geography of Moreton Bay, that has allowed the development of a diversity of habitats all in close proximity, including mud and sand flats, seagrass, mangrove and macroalgal-dominated intertidal areas, extensive soft-bottom subtidal communities, rocky shores, reefs covered in coral, and pristine sandy ocean beaches. Furthermore, the sandy oceanic-influenced eastern bay differs markedly from the muddy estuarine western Bay, and this contributes to the diversity of habitats, and the development of a remarkably diverse fauna and flora. This may help explain why there appears to be a relatively large number of apparently indigenous species – prior to the 2005 workshop there were about 27 species known only from Moreton Bay (Davie & Hooper 1998). With the many new species described as a result of the Workshop, the number of indigenous species may prove to be considerably more.

While it remains a remarkably beautiful system, it is clear that quality care and management will be essential if it is to survive in a healthy state for future generations. The impor-

ance of Moreton Bay and the Brisbane River to the people of southeast Queensland is clearly illustrated by the establishment of the *Moreton Bay Marine Park* in 1993, with a revised and improved management zoning plan released this year. Another major initiative has been the commitment and financial support given to the Healthy Waterways program of the Moreton Bay Waterways and Catchments Partnership, a whole-of-government and community collaboration that has produced some very significant results, especially in understanding nutrient cycling and the impact of sewage on the western Bay. The 1999 book *Moreton Bay Study: A Scientific Basis for the Healthy Waterways Campaign* (Dennison & Abal 1999), for the first time laid down an important foundation for understanding the ecological dynamics of the Bay and the Brisbane River.

Nevertheless Moreton Bay's biodiversity remains relatively poorly known. Clearly much more effort to discover and document the species-level diversity of Moreton Bay is urgently required to answer many important questions. Are there more new species endemic to Moreton Bay, and do such species need special management considerations? Are there local marine species that may have bioactive compounds important for medical research? What specific organisms may be crucial to the feeding ecology of the endangered dugong and green turtle? What is the ecology of some common species of algae, and what causes some algal and cyanobacterial species to form dramatic seasonal blooms? Such questions were the impetus to convene the 2005 workshop, and never before has such a diverse group of specialists been convened at the same time and place to investigate them.

## A HISTORY OF STUDY

It was the emergence of marine biology and ecology as scientific disciplines during the 1950s



FIG. 1. Landsat image of Moreton Bay. © copyright Commonwealth of Australia (Geoscience Australia) [2008].

that ignited a growing emphasis on marine studies in Moreton Bay. Since then the Bay has received much scrutiny, and, especially since the 1970s, it has been the focus of a number of scientific symposia which have covered diverse topics ranging from geology to terrestrial and marine plant and animal communities, to environmental management. In particular these have included:

- *Stradbroke Island Symposium*, Point Lookout, North Stradbroke I., 15–17 June, 1974, Royal Society of Queensland and ANZAAS – Qld Division (see Stevens & Monroe 1975)
- *Northern Moreton Bay Symposium*, 1978, Royal Society of Queensland (Bailey & Stevens 1979).
- *Focus on Stradbroke*, Point Lookout, North Stradbroke I., 11–12 Aug., 1984, Royal Society of Qld (see Coleman, Covacevich & Davie 1984).
- *The Brisbane River – its Future and Management*, 20 Aug., 1988, Australian Littoral Society (see Davie, Stock & Low Choy 1990).
- *Moreton Bay in the Balance*, Brisbane, 14 July, 1989, Australian Marine Science Consortium & Australian Littoral Society (see Crimp 1992).
- *Future Marine Science in Moreton Bay*, Feb., 1993, School of Marine Science, University of Qld (see Greenwood & Hall, 1993).
- *Moreton Bay and Catchment Conference*, Dec. 1996, School of Marine Science, University of Qld (see Tibbets, Hall & Dennison 1998).

These symposia and their subsequent publications have all been vital and timely tools to draw together the gradually evolving research data on Moreton Bay, and have been used extensively for devising strategies for environmental management and conservation planning in the region. The 2005 Moreton Bay Workshop differed from these earlier efforts by gathering a team of scientists together not to summarise existing data, but to actively generate new information in a short but intense period of study and research.

#### A REMARKABLE BIODIVERSITY

A major result of the Workshop was a significant contribution of new knowledge on the marine species of Moreton Bay. Over the last two decades much of the scientific focus has been related to water quality monitoring,

and while this has had important management implications in terms of trying to achieve an overall healthy ecosystem, such studies need to be underpinned by more comprehensive taxonomic inventories and data on species biology. Ecosystems are complex, and few, if any, resources are being currently directed towards biological monitoring of species presence and abundance. Such monitoring can give a much more accurate assessment of system health, than simply measuring a limited number of physico-chemical parameters during a narrow sampling window. Furthermore, if we are to identify invasions of marine pests, protect rare and threatened species, identify biodiversity hotspots, and predict the impacts of climate change, then we need to have strong baseline data on taxonomic biodiversity and individual species biology. Such information is also crucial for effective marine park zoning.

Taxonomy is the foundation for not only all biological scientific study, but also for environmental management and conservation initiatives. It is not possible to deal with a species that is not defined by a name because it cannot be placed in national or international contexts in terms of its 'uniqueness' or 'commonality', and it cannot even be individually discussed without that all important name-tag that allows it to exist in our language and consciousness. Similarly, science based on inaccurate species names (misidentifications) can be meaningless. Different but related species can have markedly different physiological, ecological and reproductive characteristics that must be individually taken into account.

The urgent need for taxonomic studies is clearly illustrated by the numerous taxonomic papers resulting from this Workshop. These studies report on the discovery of a remarkable total of 53 new species, six new genera, and even a new family. In addition, over 80 new distributional records are provided for previously described species, with many of these new to not only the Moreton Bay region, but also to Queensland and Australia. This increase in known biodiversity is even more extraordinary when you consider the narrow interval of sampling of little more than two weeks, and the relatively small sampling area mostly con-

finned to the central-eastern part of the Bay. A simple extrapolation of this result clearly indicates that there are potentially hundreds more new species to be discovered right here in the shallow waters so close to Brisbane — especially if a wider group of experts could be marshalled together, and a longer period for collections was available. It is well established in the scientific literature that species richness is inextricably correlated with sampling effort and the size of the area sampled, and that marine communities are dynamic entities that are both spatially and temporally variable.

The present volume of the Proceedings will be subsequently accompanied by publication of another two volumes, one being a complete taxonomic revision of the hard coral species living inside the Bay, their fossil record in the Bay, and their distributions in southeastern Australia. This work also reviews and updates records from the broader Moreton Bay region, and reviews the history of corals in Moreton Bay based on Queensland Museum collections from 1924 to the present. Such a work is, of course, not just the result of the 2005 Workshop, but the authors used the workshop as an opportunity to finish investigating and mapping many new areas. Of a total of 68 coral species now known to live in the inside waters of Moreton Bay, 22 species are reported for the first time. Such basic work as this, is crucial to fully understand the changing dynamics of coral communities, and to understand what might be the ecological response to global climate change, rising sea levels, and rising sea temperatures.

Changes in species distributions as temperate species retreat and more tropical species expand their ranges, is one of the most accurate and sensitive indicators of the impact of climate change. We are fortunate to now have such reliable data for scleractinian corals, but for most other groups such knowledge is still critically lacking. Because of the lack of detailed baseline data, it is not possible to be sure whether the recent record of the seagrass *Halophila minor* in Moreton Bay (Phillips *et al.*, this volume) represents a latitudinal shift in the distribution of this formerly strictly tropical species, or is due to it having been previously confused with

the highly variable *Halophila ovalis*, and simply overlooked. Moreton Bay, being placed as it is on the cusp between the temperate and tropical bioregions of eastern Australia, makes it the ideal place for biological monitoring of climate change, but this hinges very much on good baseline data.

The workshop also served as a springboard to compile the first-ever regional lists of some major faunal groups such as jellyfish, hydroids, corals, molluscs, shrimps, parasitic isopods, tunicates and fish. These species lists will be necessary and invaluable aids for all researchers, students, environmental managers, and conservation planners, in identifying species and assessing biodiversity levels around the Bay, both now and into the future. As an indication of the scale of biodiversity that is now being documented, the broader Moreton Bay Marine Park area now has 1154 species of fish, 944 gastropod molluscs, 351 bivalve molluscs and 95 species of the Ascidiacea. However many groups still lack this basic level of documentation, and the compilation and provision of more such lists should be seen as a priority.

Although taxonomy was an important part of the workshop, there were many other research projects undertaken. These were wide ranging in scope, and included work on animal behaviour, algal and animal physiology, biotic surveys, ecology, and environmental impacts.

Environmental management, conservation strategies, and marine park planning, must all be underpinned by science and informed by ongoing research. We need to know the current status of species and communities in order to effectively manage and protect marine habitats now and into the future. Also the effectiveness of our conservation management efforts must be measurable, and have ongoing assessment through monitoring and feedback systems.

#### THE FUTURE

The Healthy Waterways work reported in Dennison & Abal (1999) was a well-funded thorough study of water quality, nutrient levels, and physical processes, however it did not in itself answer many of the other important questions regarding the maintenance of diverse,

healthy, and sustainable ecological communities. Indeed it was freely admitted that there is a diverse biota 'of economic and ecological importance' that was beyond the scope of that study. Moreton Bay urgently needs further major Bay-wide studies by diverse groups of scientists to systematically map this biota and describe the ecological inter-relationships.

Moreton Bay is still a poor cousin when compared to the study and resources that have been poured into gaining an ecological understanding of Port Phillip Bay, adjacent to Melbourne. From 1947 to 1952 CSIRO conducted a monthly sampling of Port Phillip Bay waters at six stations from Hobsons Bay to Bass Strait. This was followed by a six-year survey (1957–1963) by the National Museum of Victoria and the Victorian Fisheries and Wildlife Department, that involved comprehensive collections made by SCUBA diving and epibenthic sledges in each of 70 grid squares across the entire bay, disclosing for the first time the great richness and diversity of the Bay ecosystem. From 1968–1975 there were a number of quantitative biological surveys undertaken to provide a baseline with which to assess long term effects of urbanisation on the Bay. This included work on macrobenthic species composition and abundance data (Poore & Rainer 1974; Poore *et al.* 1975), and biomass data collected from three stations during 1973–1975 (Poore & Rainer, 1979; Poore 1993). Finally from 1992 to 1996 there was the intensive multi-disciplinary \$12 million Port Phillip Bay Environmental Study (Harris *et al.* 1996). Those studies are international benchmarks to which Queensland should also aspire for its own important Bay.

Biomass is a critical determinant of nutrient-cycling variables, yet reliable estimates of benthic faunal biomass are completely lacking for Moreton Bay. Wilson *et al.* (1993) estimated that, in Port Phillip Bay, suspension feeders (mostly bivalve molluscs) comprise half of the benthic macroinvertebrate biomass, and process a volume of water equivalent to the entire Bay in 16–17 days. Suspension feeders are estimated to be responsible for 15% of all organic matter ingested by benthic macroinvertebrates, but may account for over 40% of total assimilation

of organic material. Deposit feeders (mostly crustaceans, echinoids and polychaete worms) make up about 35% of total macrobenthic biomass, and in a single year, are estimated to process a volume of sediment equivalent to the top 13 mm of Port Phillip Bay sediments. Estimates of net annual secondary production from Port Phillip Bay by both benthic deposit- and suspension-feeding macroinvertebrates is about 62,700 tonnes C. By comparison, the productivity of benthic organisms has so far been virtually ignored in Moreton Bay, and yet, given the unique geography and rich subtropical sediments, their contribution to net productivity may well exceed the figures estimated for Port Phillip Bay. Direct measurements of secondary production by benthic invertebrates are needed to firmly establish the important role of these organisms in the ecology of Moreton Bay.

Benthic habitat mapping across Moreton Bay still needs a significant amount of attention. The work of Stevens & Connolly (2005) marked a quantum leap forward in mapping and classifying macrobenthic habitat types by using a compact video array at 78 sites spaced 5 km apart. In this way they were able to gather data for 2400 km<sup>2</sup> from estuarine shallow subtidal waters to offshore areas to the 50-m isobath. They recognised nine habitats, with only one being on hard substrate. These included previously unreported deep-water algal and soft coral reefs, and new areas of seagrasses. Nevertheless such a visual method is limited to some extent by water clarity, especially in the western part of the Bay; and at sites spaced 5 km apart, it is still a relatively coarse survey. Many of these zones would benefit by finer scale surveying and by ground-truthing using a variety of collecting techniques, as Stevens & Connolly themselves acknowledge.

Indeed, not all habitat types that appear similar have the same species composition. As Davie & Hooper (1998) reported, the sponge species composition at various hard bottom reefal sites both inside and outside the Bay can vary quite dramatically (Fig. 2). In general, there is less than a 20% overlap in species composition between adjacent communities; and this drops to no more than 6% when more

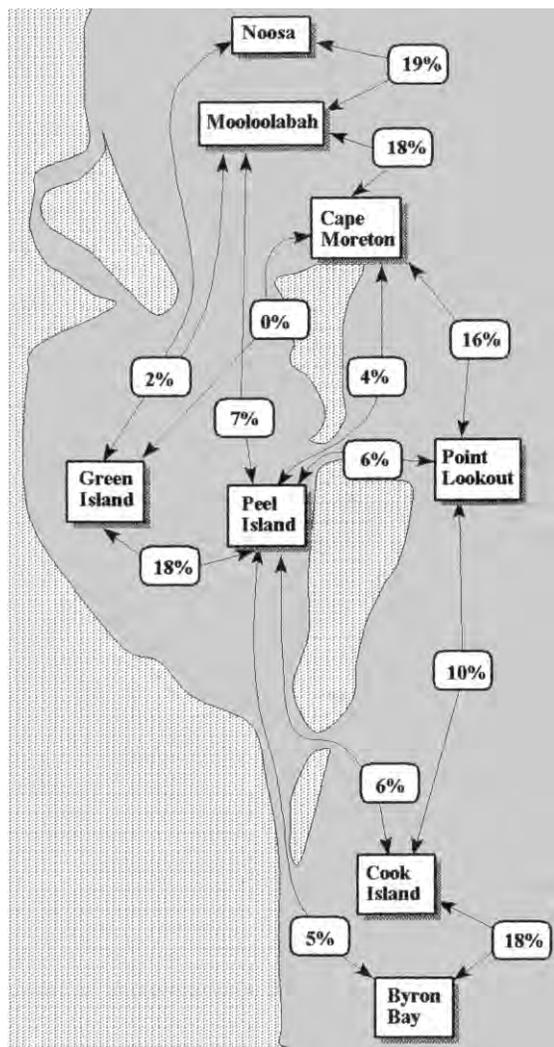


FIG. 2. A schematic representation showing percentage of sponge species shared between study sites within Moreton Bay, and those outside the Bay. After Davie & Hooper (1998).

distant sites inside and outside the Bay are compared. To reinforce this point, there is only 16% overlap in sponge species between Point Lookout and Cape Moreton which otherwise appear to be identical subtidal rocky reef habitats. This spatial heterogeneity has considerable implications for marine park planning which seeks to protect a representative sample of the biota. Similar-looking communities may be dramatically different in species composition

and thus needing separate conservation strategies.

The new Moreton Bay Marine Park Zoning Plan of 2008 has seen an increase in Green Zones to 16% of the marine Park area. This is to be applauded, as is the decision to undertake monitoring studies to assess, for the first time, the effectiveness of the new zones in protecting biodiversity. However, the zoning process has also starkly highlighted the lack of effective baseline data available on species level diversity, community structure, and the dynamics of communities in space and time.

Significant gaps continue to exist in our knowledge base of the marine biota of Moreton Bay. There are undoubtedly many new species yet to be discovered by science, and many species remain poorly known. Until we are able to begin to gather and interpret some long term datasets, as has been done for Port Phillip Bay, then we will continue to struggle in our attempts to ensure the health and productivity of Moreton Bay into the future.

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