

# Introduction

The southern coast of Australia has been rightly dubbed 'The unique South'. It has a long coastline of more than 5500 km, with a vast array of habitats, from exposed coasts to sheltered bays, and, in contrast to the tropics, the great majority of its species are endemic – occurring in no other country. This alone renders an understanding of their natural history and ecology all the more significant.

Four major systems can be recognised along southern Australian coasts – estuaries, two benthic systems (reefs and soft bottoms) and the pelagic system. Estuaries, characterised by fresh or brackish waters, are scattered along the southern coast, except in the arid central regions. Soft sediments dominate the benthos on Australia's continental shelf. Reef systems occur intermittently from the intertidal zone to the shelf edge, and the pelagic ecosystem, containing all the life forms that inhabit the water column, extends from coastal to oceanic waters.

The four systems are not independent, and interactions between them can be very important. Yet, they are very different – almost with different ecologies – and ecologists have tended to focus on habitats or organisms living in one or the other of the systems. In this book, our focus is on reef systems, mainly in the more easily accessible photic zone and adjoining deeper water, and the animals and plants associated with them. Reefs are a prominent habitat type along much of the coast, and provide substrate for the most highly productive ecosystems in the region. Because the links with soft sediments and the pelagic systems can be quite strong, such as via import and export of nutrients, pelagic larval stages of benthic species and so on, we consider in some detail these connections, where relevant.

Marine life has been observed and described since ancient times. In the 5th century BCE, Herodotus, Aristotle and others began to describe various forms of marine life. For Australia, much of the early work in marine science during the 19th and 20th centuries was devoted to taxonomic descriptions of the rich flora and fauna, and we can now safely assert that

most of the prominent benthic reef organisms have been described, thanks to the monographic works of Womersley, Kott, Poore, Gomon and others – although serious gaps still remain in some phyla. On the other hand, the meiofauna (animals < 0.5 mm) and microbial life are virtually unknown.

Ecology is the study of the natural history of organisms, and the relations between them and their environment. It has two approaches – a reductionist one, in which individual species or habitats are examined one at a time – or a holistic one, in which the whole system is examined, and its properties revealed, at that higher level. Reductionism is essentially a watchmaker's view of the system, which, like a watch, can be taken apart and each part looked at in isolation from other parts, whereas a holistic approach tries to reveal the working of the ecosystem as a whole. The often-stated aphorism that 'the whole is greater than the sum of its parts' is a simple way of putting the principle that when the parts are put together the whole may behave quite differently than its parts. We clearly need both approaches: the former to understand the role and importance of all the components in the system, and the latter to understand feedback mechanisms and to manage the many and increasing pressures that are imposed on our seas – including overfishing, pollution, and climate change.

Reductionist ecology uses observation, measurement and experiments to help understand the parts, and depends on a good understanding of the natural history of the species. As Paul Dayton (2003) stated: 'creative ecology is based on a deep sensitivity to natural patterns and processes'. A holistic approach, dependent on information from the parts, tries to reveal the system's properties underlying the complexities. This can only be done by using models, and has given rise to a new discipline, called systems ecology. In this book we emphasise the parts because they are best known, and touch on holism in the few cases where it has been unravelled.

The ecology of reef systems and their flora and fauna have been much studied over the past 50 years,