Surprises in the sand

When we think of marine biodiversity, coral reefs or perhaps seagrass areas spring to mind. But what about bare sand habitats? The sand patches in shallow areas between the offshore reefs and the shoreline—such as at Jurien Bay Marine Park on the Turquoise Coast—appear devoid of life. Or are they?

by Sue Morrison

Jurien Bay Marine Park has some extensive patches of bare sand or soft bottom habitats covering about 130 square kilometres, or 10 per cent of the region. Some of this habitat has a sparse cover of short-lived seagrasses such as paddleweed (*Halophila*) and eelgrass (*Heterozostera tasmanica*) species, plus a small quantity of algae during the warmer months.

Cryptic creatures

While bare sand may appear to be largely devoid of life, some fascinating marine plants and animals have adapted to this relatively inhospitable environment. Although the species tend to be less diverse than in habitats with greater physical complexity, such as seagrass meadows and rocky reefs, numbers of individuals can be large. Many organisms are cryptic or only active at night, and many are microscopic.

In the Jurien Bay Marine Park, sand consists mainly of calcium carbonate from the shells of marine animals and smaller quantities of quartz particles from eroded rock. Sands range from less than 0.5 to two millimetres in diameter. Smaller grains are classified as mud and silt, and any larger are considered to be gravel. The size of sediment particles has a major influence on fauna in sand habitats. The smallest organisms live under the surface, on and between the sand grains. Some of the smallest, such as protozoans, bacteria and microalgae, are associated with the surfaces of particles. Others, such as nematodes, flatworms and crustaceans, live in the spaces between sand grains. Animals big enough to burrow through the sediment include worms, crustaceans, bivalves and echinoderms. Those living on the sediment surface tend to be much larger and include fish, echinoderms, molluscs and crustaceans.

It is difficult for seagrasses and algae to establish in sandy habitats, particularly where turbulence is strong and sediment transport is high. A few may grow in more sheltered areas, but usually wash away in winter storms. Because of the lack of marine plants, plant matter needed for the food web must largely come from outside the sandy habitat. In protected areas, however, a small amount of

single-celled algae survive near the sediment surface and provide some plant material from within the habitat. A few herbivores are found in sandy regions, often adjacent to seagrass or algal beds. One is the bubble shell (*Bulla quoyii*), which retreats under the sediment during the day and emerges at night to graze on algae.

Most plant matter that enters the food web in sandy habitats, however, is dead material (detritus) that has washed in from seagrass meadows and rocky algal reefs. A surprising number of detritivores live in soft-bottom habitats. Plant and animal plankton are another important source of food in such habitats and are consumed by filter or suspension feeders.

Some animals, such as worms and echinoderms, alternate between deposit feeding and suspension feeding. Many of the worms are small and hide beneath the sand. One more visible species is the purple feather duster worm (*Sabellastarte* species). Its delicate feathery plumes act as gills and also trap small food particles. Smaller particles are eaten and larger ones are used to build up the tube it inhabits.

Sea cucumbers, heart urchins and sand dollars consume large quantities of detritus. Ludwig's sea cucumber (*Stichopus ludwigi*) and the ubiquitous soft sea cucumber (*Stichopus mollis*) occur in sandy areas, often close to seagrass beds. They slowly amble over the sand at night, ingesting great quantities of sediment, picked up with leaf-shaped tentacles around the mouth. Their convoluted gut absorbs the small amount of organic matter in the sediment. They must consume huge quantities to obtain sufficient nutrients. A sea cucumber that feeds during the day, *Neothyonidium* species, buries itself in the sand with only its fine, branched tentacles protruding. It traps plankton and can pick up particles from the sand with its tentacles. It is possible to see it insert its tentacles into the mouth one at a time, and suck off the attached food.

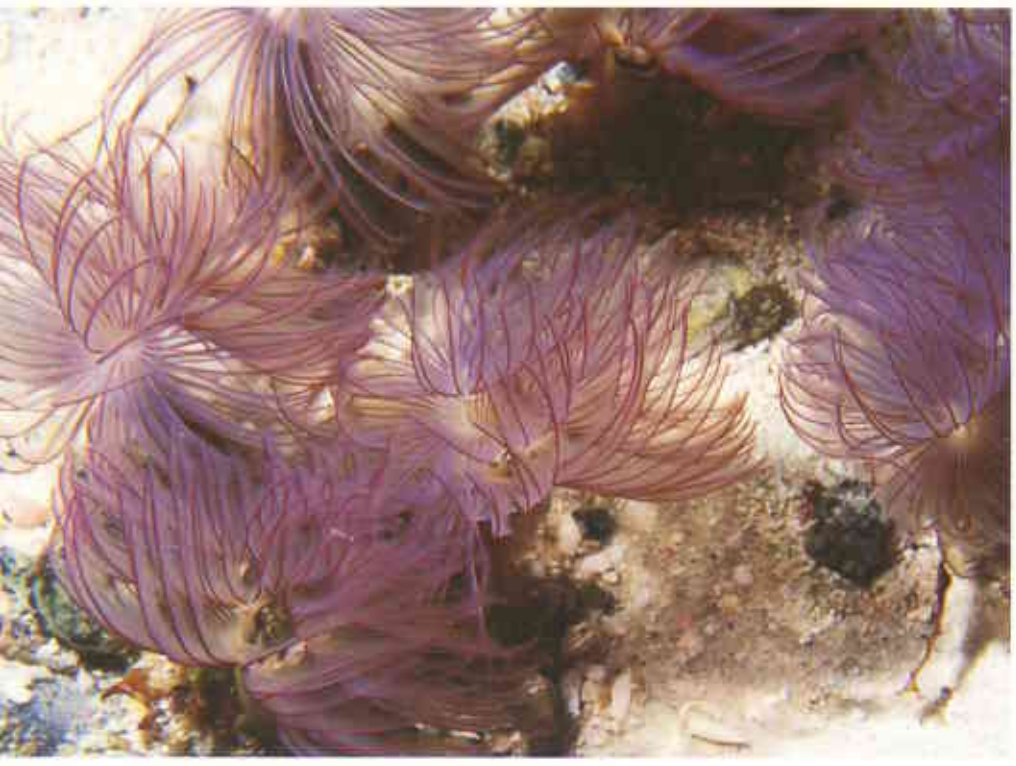
Heart urchins, such as *Brissus agassizii* and the smaller *Echinocardium cordatum*, hide under the sand during the day. They have short, fine spines and a few longer, flattened spines for burrowing. Equally well hidden are Lesueur's sand dollar (*Peronella lesueuri*) and the sand dollar *Ammotrophus arachnoides*, which only extends from Cockburn Sound to Jurien Bay. These flattened, disc-shaped urchins have very short, fine spines and lie just beneath the surface. You can sometimes see their outline in the sand. Heart urchins and sand dollars sieve small organic particles from the sand. The sea star *Stellaster inspinosus* also ingests large quantities of sediment, from which it extracts organic matter.

Several species of tiny crustaceans, known as gammarid amphipods, live in soft sediments and feed on detritus. Ghost and mud shrimps sometimes occur in huge numbers in soft sediment areas. They are rarely seen, however, because they build extensive burrows under the sediment. They fan water along their burrows and trap organic particles that float through.

Bivalve burrowers

Soft sediments, including those of Jurien Bay Marine Park, are a haven for filter-feeding bivalve molluscs. Normally, they are only noticed once they have died and their empty shells wash onto the beach. For most of their lives they remain hidden under the sediment, using various adaptations to filter organic particles from the water.

Bivalves inhabit different depths in the sediment, depending on their body



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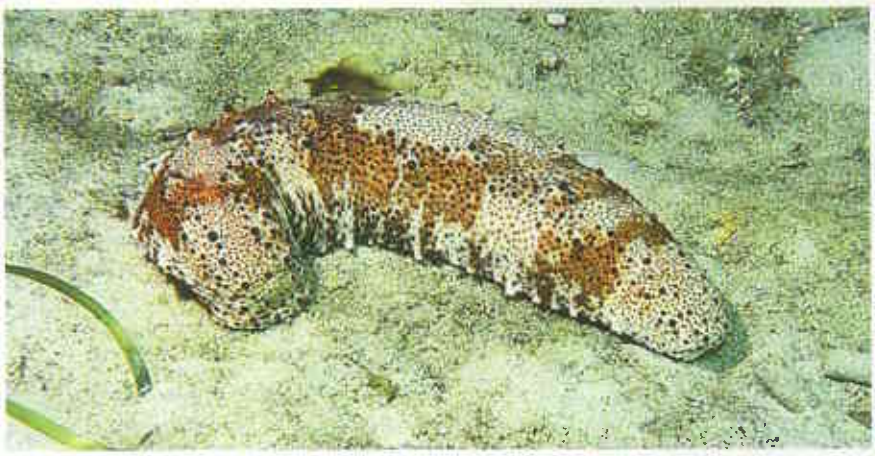
Main Lesueur's sand dollar mostly remains hidden but you can sometimes see its outline in the sand.
Inset The little scorpionfish is a carnivore that feeds on smaller fish.

Above The sea star *Stellaster inspinosus* ingests large quantities of sediment, from which it extracts organic matter.

Left Purple feather duster worm (*Sabellastarte* species).
Photos – Sue Morrison



Above Wavy grubfish hiding under a sand anemone.

Left Ludwig's sea cucumber consumes large quantities of detritus from the sea floor.
Photos – Sue Morrison

structure. Those that bury deep—to about 20 centimetres—include the trough shell (*Lutraria rhynchaena*) and *Psammotellina biradiata*. These molluscs have long siphons that reach up to the sediment surface, enabling them to breathe and filter feed, or deposit feed while hidden from predators. The lucinid (*Divalucina* species) lives at similar depths but, as it lacks long siphons, builds a mucous-lined burrow, which it irrigates instead. At mid-level, just a few centimetres down, are species such as tellins (*Tellina perna*) and sunset shells (*Soletellina biradiata*). Just below the surface, particularly at the shallow, low tide level, are pipis (*Donax* species). In slightly deeper water (three to 15 metres) there are numerous species of Venus shells (such as *Paphia crassisulca* and *Dosinia incisa*), dog cockles (*Glycymeris striatularis*) and carditas (such as *Cardita incrassata*). Those with short siphons burrow just below the surface, while species without siphons are at the surface with their back end exposed. Since most of these bivalves are largely sedentary, they need to live in areas with good water movement that will supply sufficient oxygen and food particles suspended in the water.

Scallops, such as the commercially caught saucer scallop (*Amusium balloti*) and the king scallop (*Pecten fumatus*), live at the surface of the sediment, sometimes disguised by a thin layer of sand. They are more visible than their buried relatives, but can escape predatory sea stars and fish by rapidly flapping their valves together and swimming off.

Omnipresent omnivores

Omnivores and scavenging species are less numerous than the detritivores and filter feeders in soft-bottom habitats. The popular edible king prawn (*Metapenaeus latisulcatus*) and western school prawn (*Metapenaeus dalli*) walk over the sand in search of food on dark, moonless nights. They are scavengers, and also take in some detritus. During daylight hours they remain under the soft sediment, hidden from the watchful eyes of predators such as fish.

The oddly shaped rounded pebble crabs are well adapted to living in soft sediments. Their triangular mouth cavity narrows at the front, allowing them to breathe when buried under the sand. They are thought to be general scavengers that also ingest some detritus.

A few species of omnivorous fish live in the sandy areas of the Jurien Bay Marine Park. The snakeskin wrasse and wavy grubfish prefer sandy areas adjacent to rocky reef and weed habitats. The inquisitive wavy grubfish often perches on its pectoral fins, surveying the

Left Tube anemones (*Pachycerianthus* species) use microscopic stinging cells on their tentacles to trap tiny organisms.
Photo – Ann Storrie

Below The bivalve *Cardita incrassata* usually sits just under the surface of the sand.
Photo – Sue Morrison

surroundings with its bright, mobile eyes. The snakeskin wrasse has the curious habits of sometimes swimming vertically and also of lying on its side on the sand.

Some gobies, such as the barred goby, are omnivorous and can be quite numerous, though often overlooked because of their small size. Stinkfish, including the painted stinkfish and fingered dragonet, have stunning colour patterns. These fish appear to 'walk' over the seabed at night using their pectoral fins, in search of small prey and organic matter. Goodlad's stinkfish often lies half-buried in the sediment, waiting for passing prey. The banded toadfish is familiar to anyone who has fished from a jetty. This widespread species feeds on anything it can scavenge or capture with its strong beak-like teeth. At night it can be found half buried in sand.

Carnivores of the bare sand

Carnivorous cnidarians, particularly anemones and sea pens, are abundant in soft sediments. They catch plankton and tiny invertebrates with stinging cells on their tentacles. Tube anemones, such as *Pachycerianthus* species, have long, fine tentacles that sway in the current. They live in a sand-encrusted mucous tube, into which they retract if threatened. Sea pens usually retract under the sediment during the day. At night, they pump their bodies full of water to reveal their beautiful forms. They have fine polyps either attached directly to the central stem, as in *Cavernularia* species, or on feather-like branches, as in *Sarcoptilus* species.

Carnivorous worms can be numerous, but are rarely seen because many species of nematodes and flatworms are microscopic. Occasionally, the large predatory nereid worms, such as *Perinereis* species, can be seen running across the sediment at night in search of tiny invertebrate prey.

Mantis shrimps, including *Squilla laevis*, are well-equipped predators. Huge spined claws on the second thoracic appendage are used to grasp and hold small fish and crustaceans. They live in burrows. Often, all that is visible is their large, reflective eyes that can move independently, peering from the hole.

Even carnivorous nudibranchs are found on soft sediments, including *Armina cygnae*, which feeds only on sea pens. Attractive olive shells (*Oliva* species) are also predatory. They often plough through the sand with just the tip of their siphon showing. They capture and hold invertebrate prey with their large foot.

Sea stars are slow moving but persistent predators. Some species that burrow in soft sediments have modified tube feet that are pointed at the tip and lack suckers. They include *Luidia australiae*, which is large enough to engulf whole heart urchins and bivalves, and an *Astropecten* species that feeds on small bivalves.

Some carnivorous fish leave a distinct trail where they have been feeding. Rays furiously flap their 'wings' to waft the sediment away from shelled

Above Snakeskin wrasse.

Right Western king prawn.
Photos – Ann Storrie

Far right Sea pens are carnivores that trap fine particles and plankton in their tentacles.
Photo – Sue Morrison

molluscs and other small invertebrates hidden under the sediment. This leaves round depressions in the seabed. Rays, such as southern fiddler rays and western shovelnose rays, feed mainly at night and grind up their prey with modified flat plates of teeth.

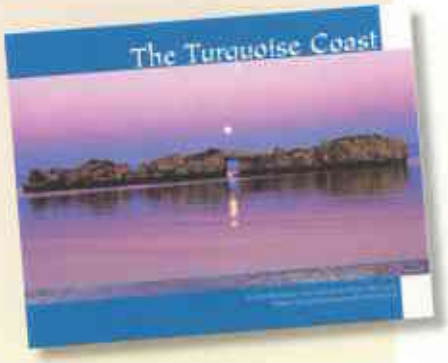
Fish such as spiny gurnard, trumpeter whiting and yellow-finned whiting feed on the abundant small worms, crustaceans and molluscs just beneath the sediment surface. The bar-tailed goatfish locates crustaceans and worms by probing the sediment with the two long barbels under its chin. The tiny slender seamoth has a very small mouth and feeds only on tiny crustaceans and worms. The silverbiddy or roach uses its small protrusible mouth to catch small crustaceans. The little scorpionfish lies in wait for small fish to prey on, and the southern blue-spotted flathead ambushes fish, crabs, shrimp and squid.

Flatfish are also active predators, beautifully adapted to living on flat, soft sediments. The many species of flatfish along the Turquoise Coast include the small-toothed flounder, elongate flounder and southern tongue sole. These peculiar fish have extremely compressed bodies and swim on their sides, maintaining a low profile. During their early development, one eye migrates to the top side of the body, so both eyes are eventually located on the upper surface. They are well camouflaged and can lighten or darken their skin to blend in perfectly with the underwater surface on which they are resting.

While the larger marine animals, such as whales, sea lions and fish, easily capture our attention when it comes to marine conservation, the smaller and even microscopic creatures are equally deserving of protection.

Sue Morrison works at the WA Museum as Collection Manager in the Fish Section of Aquatic Zoology. Museum field work has taken her all around the State, studying marine fish and, occasionally, marine invertebrates.

This article is based on a chapter from *The Turquoise Coast*, a full-colour, exquisitely photographed book on the area between Lancelin and Leeman, which is available from DEC and most bookshops for $29.95. Sue and co-author Ann Storrie took most of the photographs in the book.



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