Underwater Sydney

The most bio-diverse marine harbour on earth

Red morwong – *Cheilodactylus fuscus*.

Here, for the first time, is a book that looks deep beneath the captivating vistas of Sydney Harbour and discovers an undersea wonderland. Millennia before Sydney became one of the world's most spectacular harbour cities, it was a thriving source of sustainable food and natural habitat curated by the Gadigal people of the Eora Nation. Just under 250 years later, that harbour fed by hundreds of natural freshwater streams and bordered by grasslands, rocky cliffs, mangroves and white sandy beaches is now better known for its glass and concrete towers, the Sydney Opera House and the steely magnificence of John Bradfield's Harbour Bridge. The harbour itself must be decimated by the city surrounding it, surely? Author Inke Falkner and photographer John Turnbull prove that assumption very wrong in their book, *Underwater Sydney*. Not only do they show how the unique 'drowned river valley' environment of Sydney Harbour fosters extraordinary biodiversity, they also provide a visual feast of native marine wildlife. This is a book that will positively change the way you look at Sydney, forever.

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ONE GORGEOUS spring day, mild and clear, I remember travelling home on the ferry from Taronga Zoo to Circular Quay. On our way, the captain made an announcement that we had to stop. There was a communal sigh of impatience, followed by an 'ooh' after we were told that we had to give way to a humpback whale.

All of us instantly headed for the ferry's bow ready to take a look at the animal ahead. In anticipation, we stood waiting in front of a smooth swirling patch of water. We never saw the whale, but the fact that we crossed paths with one of these magnificent creatures in the middle of Sydney Harbour, this busy waterway in the heart of a major city, still astounds me.

Humpback whales are regular visitors inside the harbour on their biannual migration along the coast and they are always greeted with much enthusiasm, but what most of us don't know is that Sydney Harbour and the adjacent coast are teeming with wildlife.

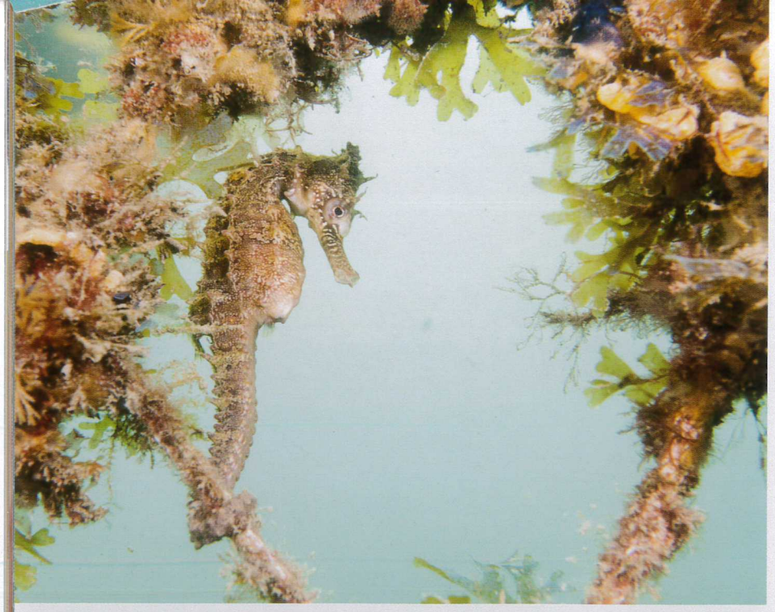
Sydney Harbour is instantly recognisable from above, but underwater, its beauty and diversity are perhaps even more breathtaking. Beaches interspersed by rocky reefs adorn the harbour foreshore and surrounding coastline, seagrass meadows grow in protected bays, pontoons and wharfs are densely overgrown with strangely shaped and beautifully coloured invertebrates, and mangroves grow further upstream.

Scientists from the Australian Museum analysed more than 20,000 museum records of fishes and invertebrates, to get an estimate of the harbour's extraordinary wealth in marine life and counted over 3000 species – and that's a conservative estimate. The Museum scientists concluded, "Considering that Australia's largest city surrounds the harbour, it's amazing that we have such a diverse fauna."

Drowned river valley estuaries such as Sydney Harbour are flanked by steep-sided banks and are well flushed by the tides, making conditions inside the estuary largely marine, especially since freshwater input from the Parramatta, Duck and Lane Cove rivers is small for most of the year. The harbour is connected to the open ocean through a 3km-wide entrance framed by North and South Heads. The southward flowing East Australian Current (EAC) brings warm, nutrient-poor water to Sydney's shores, while winds and other currents push cold, nutrient-rich bottom water to the surface. The regular renewal of harbour water contributes greatly to the overall health of the system and its natural resistance to environmental stress.

Above: I like to watch – Parma watching a pair of Tasmanian chromodorid (*Chromodoris tasmaniensis*).

Top: Spectacular seascape off Clovelly pool – a beautiful seaweed garden – *Ecklonia radiata*.



Broad marine biodiversity

Almost 700 species of fish alone have been recorded over the years in Sydney Harbour. Some of these fishes are visitors and not local residents, but such a diversity in an estuary roughly 50sqkm in area is astonishing and even more impressive when compared to other parts of the world. The entire Mediterranean Sea, for example, and, similarly, the coasts of both the United Kingdom and New Zealand, are home to fewer species of fish than Sydney Harbour!

With scientists studying the harbour's marine life for more than a century, one might think that the fish fauna is well described. But as recently as 2001, a group of recreational divers discovered a new species in 14m depth at Chowder Bay – the Sydney scorpionfish (*Scorpaenopsis insperatus*)! It has so far not been found anywhere else in the world and therefore seems to be unique to the harbour.

Sydney's rocky reefs and kelp forests are home to some of the most striking inhabitants. Old wives, yellowtail scads, eastern pomfrets and silver batfish are common sights, and so are leatherjackets, pufferfishes and wrasses. Among the kelp live golden weedfish (*Cristiceps aurantiacus*), which mimic perfectly the appearance and movement of kelp. Bullseyes and pineapple fish hang out underneath the rock ledges.

One of the most famous and admired fishes inhabiting Sydney's waters is the weedy seadragon. However, weedy seadragons are rarely seen in the harbour and are sadly declining in numbers in wider Sydney. But their relatives, the seahorses, pipehorses and pipefishes, are somewhat easier to find – that is if you can spot these well-camouflaged and, in the case of the Sydney pygmy pipehorse (*Idiotropiscis lumnitzeri*), also extremely tiny creatures.

Invertebrates rule

Invertebrates well outnumber fishes both in species richness and actual numbers. Molluscs are the most diverse group of invertebrates with well over 1000 recorded species.

The charismatic octopuses, squids and cuttlefishes are masters of disguise and agile predators. The reaper cuttlefish (*Sepia mestus*), for example, can change body colour and texture rapidly and blend in superbly with its environment. When undisturbed, it is easily recognised by its red body and two dark blotches on the back.

Most molluscs, however, live on the sea floor. Snails, sea slugs and chitons are particularly diverse on Sydney's rocky reefs and they come

‹ **Left:** A female weedy sea dragon, unencumbered by eggs (they are carried by the male), watches the photographer, John Turnbull, closely at Kurnell.

Centre: Not far from the seahorses, for the anglerfish every day is a bad hair day (Striate anglerfish – *Antennarius striatus*).

Top: A seahorse (*Hippocampus whitei*) peers out from the net at Clifton Gardens 2.

in all sizes, shapes and colours, while extensive mussel and oyster beds cover the rocky foreshore.

In addition, there are at least as many different types of crustaceans living in the harbour as there are fishes. The echinoderms and bristle worms are somewhat less diverse with just over 100 and 300 species respectively, but they include some of the most ecologically important animals found in Sydney.

Growing on sandstone boulders and reefs among the seaweeds and in greater depths are sea squirts, sponges and other invertebrates that have the appearance of plants, but are in fact animals. These communities form living habitats for other organisms and, being attached to rock, they are unable to escape predators.

So many of these creatures produce chemicals and sometimes bony elements in their tissues that make them unpalatable. Other animals, like sea slugs, take advantage of this and have evolved to eat sponges and borrow their defences. Spotting 'nudies', these delightful critters (the nudibranch, *Chromodoris tasmaniensis*), frivolously covered in polka dots, frills and stripes, is a highlight for any diver or snorkeller.

Corals in the harbour

Although corals are mostly thought of in the context of tropical reefs, Sydney is home to several species of hard corals. The coral *Plesiastrea versipora*, for example, grows in shallow depths where plenty of sunlight can reach it, so the algae inside the coral body can photosynthesise. Some colonies can be of an extraordinary green colour.

The bright orange coral, *Culicia tenella*, on the other hand, does not have photosynthesising algae in its tissue and it is common on rocky surfaces with little light, such as the walls of caves and overhangs.

Nowadays, more than half of the harbour's natural foreshore has been replaced by seawalls and other marine infrastructure. The remaining, isolated small pockets of natural habitat are less biodiverse compared to unfragmented natural shores. The foreshore is dotted with countless wharfs, pontoons and jetties, and these structures provide new habitat for marine life.

Some of the timber pylons that have been in place for many years are densely overgrown with the most colourful organisms, in turn attracting fish and crabs.

Artificial structures do have their problems, though. Many of the organisms that flourish on these structures are not naturally at home here. ▶

› **Right:** Golden weedfish (*Cristiceps aurantiacus*). Yes, it's actually a fish, not a weed.

Centre: Bad hair day – Sydney pygmy pipehorse (*Idiotropiscis lumnitzeri*). Bare Island, Botany Bay.

Top: A pair of nudibranchs (*Chromodoris tasmaniensis*) exchange sperm at Kurnell – as hermaphrodites, each will use the genetic material to fertilise their own eggs.

Having hitched a ride on ships entering the harbour, non-natives can thrive on the artificial structures at the expense of the local plant and animal life. So it's important to recognise that we are creating artificial habitats that do not resemble natural environments.

Problems with introduced species

All harbours – and Sydney is no exception – have a problem with introduced pests because they are globally connected through shipping. Other non-natives found on our shores, such as the Pacific oyster (*Crassostrea gigas*), have escaped aquaculture farms or, like the green algae *Caulerpa taxifolia*, have spread with the aquarium trade.

Caulerpa taxifolia originates from Queensland and was first discovered in Sydney Harbour in 2002. It is highly invasive and the smallest dislodged pieces can grow and multiply. Being toxic to many marine animals, it is known to create an environment that supports a completely different fish and invertebrate community to that of neighbouring native habitats.

Interestingly, its close relative, *Caulerpa filiformis*, which is native to the Sydney region, has also spread and is now considered a 'native pest'. At low tide you may have seen beds of this bright-green alga growing in the shallows of the harbour, for example at the Botanic Gardens next to the Opera House.

Caulerpa filiformis seems to grow easily at newly disturbed sites, where competition is low, and it copes better with murkier, nutrient-rich water compared to other native algae. These are exactly the conditions we find in many parts of the harbour and along the coast, where foreshore developments have changed local conditions.

Water quality on the improve

While water quality in the harbour has improved tremendously due to the closure of sewage discharge points and many polluting harbourside industries, some of the harbour's seafloor sediments remain highly toxic. Many pollutants, including metals such as copper, zinc and lead, a variety of organic chemicals, nutrients and sediments, continue to enter the harbour today via drains and stormwater canals.

Scientists have identified pollution as one of the main environmental threats to a healthy harbour and coastline, together with the impacts of fishing activities, non-native species, habitat modification and climate change. In a comprehensive review of all scientific knowledge available for Sydney Harbour, the scientists conclude:

"Sydney Harbour is a paradox; stunningly beautiful, astonishingly diverse but subject to serious threats … This iconic estuary has been subject to dramatic change and is facing enormous new challenges. The scientific community will be integral to providing independent, rigorous and credible data and analyses to manage the natural resources of Sydney Harbour into the future."

Despite the challenges, Sydney Harbour and the surrounding coast are incredibly diverse and a great national treasure. Scientists and non-scientists, locals and visitors alike love its natural beauty and cherish any encounters with the harbour's wildlife.

The underwater world of Sydney is full of life, drama and interaction, and there are struggles too. To see some of this theatre unfold before your eyes is a wonderful experience. ■

‹ **Left:** Puppies of the sea, blue groper, can still make your eyes widen.

Centre: *Caulerpa filiformis* at Shelly Beach, Manly.

Top: An endangered grey nurse shark, *Carcharias taurus*, cruises within touching distance of photographer John Turnbull at Magic Point (Maroubra).

› **Opposite page, top right:** Red cuttlefish like to perch on colourful sponges where they blend right in – until under the strobe light at Bare Island.

Bottom right: Pinkie – Red cuttle (*Sepia mestus*), at Shark Point. Smaller and smoother than the giant cuttle; found in sponge gardens rather than kelp or caves, yellow eyeline is diagnostic.

INKE FALKNER is a marine ecologist who focuses on creative science and environmental education and, having left Sydney, now lives on the NSW Southern Tablelands where she works as the program coordinator at the Australian National University's Coastal Campus. A lot of information for *Underwater Sydney* came from her previous 'day job' as the community outreach coordinator at the Sydney Institute of Marine Science, where Inke developed and established an extensive marine science program for primary and high school students focusing on Sydney Harbour. She also curated the content for the institute's Discovery Centre and ran educational harbour cruises and foreshore walks featuring the amazing underwater world of Sydney Harbour.

JOHN TURNBULL is a marine ecologist, social scientist and passionate underwater photographer. John has dived extensively in Sydney Harbour and coastline and knows their inhabitants extremely well – up close and face-to-mask. A few years ago John Turnbull traded a life in the business sector to pursue his passion for marine conservation, and is currently researching the relationship between humans, nature and stewardship of the marine environment at the University of NSW. Many of John's startling images can be found at www.marineexplorer.org and www.flickr.com/photos/johnturnbull.

Underwater Sydney by Inke Falkner and John Turnbull is published by CSIRO Publishing, Locked Bag 10, Clayton South, Victoria, Australia. www.publish.csiro.au