Why Are Tasmanian Oceans so Special?

Cover photo: nudibranch sea slug, Nick Perkins

Deep Reef, Jun Zhang

"Tasmania has a spectacular coastline and diverse marine environments which form an integral part of the lifestyle of many Tasmanians. Our coastal waters also have extraordinary natural values that are of global conservation significance on the basis of high biodiversity, unusually large numbers of unique species found nowhere else, and rare ecosystems within pristine underwater wilderness areas that rival World Heritage listed lands. "[1] Dr Karen Parsons

Fast Facts

There are lots of reasons Tasmania is special. When asked to make a list scientists noted:

[1] N*owhere Else on Earth: Tasmania's Marine Natural Values 2 Prepared for Environment Tasmania by Dr Karen Parsons of Aquenal Pty Ltd. Report citation: Parsons, K. E. (2011) Nowhere Else on Earth: Tasmania's Marine Natural Values. Report for Environment Tasmania. Aquenal, Tasmania.*

- A long and highly complex coast including numerous estuaries and bays and more than 6,000 islands and smaller rocky islets, estuaries, wetlands, sheltered lagoons, rocky headlands and reefs, sandy beaches, mudflats, saltmarshes and seagrass beds;
- variation in wave exposure due to the complex shape of our coast;
- complex coastal landforms, underwater topography, and odd geology;
- lots of tidal variation between regions;
- It is at the meeting point of three major ocean currents;
- Tasmania is at the southern limit of a range of warm temperate species;
- Upwellings of cold, nutrient-rich subantarctic water near Tasmania, give it higher nutrient levels;
- Tasmania has been isolated from other temperate oceans for around 65 million years, leading to levels of marine diversity and 'endemism' (i.e. species unique to the region) that are amongst the highest in the world;
- It has unusual Gondwanan 'relic' species, including the world's rarest skates and a number of fish, invertebrates and algae limited to only one or two sites;
- Its wild. It has the most extensive undeveloped coastline in South Eastern Australia, an unusually high percentage of undisturbed estuaries, and a large number of remote, pristine islands;
- There is an exceptionally variety of estuary types, because of rainfall differences in each area.
- It has as a higher diversity and number of wetlands and internationally important bird sites *relative to its size than any other Australian state,*
- The highest densities of a number of resident and migratory bird species in Australia,
- Tasmania sits in a unique location at the outhern end of the East Asian Australasian Flyway for migratory shorebirds;
- It is a hotspot for seabird activity including the only nationally listed Critical Habitats for marine species such as albatross ;
- Tasmania has stronghold populations of Endangered seals and a very large number of Threatened species.

Little Penguins, Eric Woehler

Seal, Jun Zhang

Experience it!

Our world is increasingly crowded, where quiet areas of wilderness are shrinking rapidly, but the ocean is our last great wilderness.

To many people the ocean is a place that is inaccessible, literally out of sight, therefore out of mind.

It is a hard place to study and explore. Humans can't stay for long or travel very far underwater. It has been said that we know more about the surface of Mars than we do about many places in the ocean. We aren't even sure how many species of animal live there.

The curious among us notice the things that happen at the surface when we go to the sea, or what is exposed when the tide goes out. It can be a fascinating experience. For those who have tried snorkelling, or diving, there is even more to see. Drift over a section of rocky reef and the first thing that strikes you is just how many different plants and animals there are. In Europe and many parts of Asia, the waters are relatively dead and lifeless. In Tasmania, our shorelines are a mass of vegetation, with every sheltered crevice home to an array of strange and colourful life. Go and explore it if you can.

It is normal to sometimes worry about the danger that might lie beneath the surface. Contrary to what you may think, the ocean is not full of dangerous animals. You won't get attacked by a shark. In any given location there are less threats to life and limb than there are on land in the cities.

Sit there and spend some time just taking it in. The ocean is exploding with life. The fish are fun, but look closer and you will see an underwater city full of countless species going about their day. All these animals and plants live in complex relationships with thousands of other nearby species.

Look even closer. The greatest things out in the ocean are the tiny things. They swarm in vast numbers and are food for everything else, look for the little amphipods and other shrimp-like animals clinging to the weed.

Out in the open ocean depths there are huge swarms of tiny plankton. Every night they move silently into the shallows in the greatest animal migration on the planet. They provide food for many ocean animals and also supply 50% of our oxygen. The smallest shrimp-like krill feeds the Blue Whale, the largest animal on the planet.

The amount of seaweed along the reef is huge, but the fish you see mostly can't eat the seaweed. They rely on the tiny shrimp-like amphipods to unlock all that food. These little creatures are then food for all the other animals on the reef.

Urchins love seaweed too, and they breed so quickly they can completely eat out the reef and make it a desert-like barren. The amphipods rely on large crayfish to tackle the urchins and keep their numbers in balance and the seaweed garden healthy. Everything is linked, and we damage those relationships at our peril.

If you have a boat and a scuba tank, you can go even further and deeper. In deeper waters with a hard seabed there is an array of strange and ancient animal forms that have been around since the beginnings of life on the planet. To dive under the water there is a journey to an alien world, and a trip back in time too. These deep reef invertebrates, animals like sponges, soft coral, sea fans and sea lilies come in a riot of primary colours. They are stuck to the bottom and look more like plants.

For most Tasmanians, seeing or travelling on the ocean is a routine part of life. We don't spend our lives walking on concrete. Most of us live 30 minutes away from the shore. We walk on the beach, fish and take the boat out for a run. We take it so much for granted that it sometimes seems routine. What could possibly be so special about a little place on the edge of the world? If it was so special it should be on TV every night, or swarming with tourists?

In some places you can explore spectacular sunken caves and peaks and be the only person there. In Europe, places like this would be iconic tourism sites.

Rocky Cape, Jun Zhang

Because Tasmania is an unusually green and often undisturbed little place on the edge of the world, everything about it is unique, especially its oceans. The vast majority of people in the world don't get the opportunity to ignore seals sunning on the surface, or rafts of penguins fishing in the river near major cities. A big day out in Seoul, Berlin, Shanghai or Chicago is to visit a shopping mall. There are hours-long crowds to push through to get to any partly natural place, and in some places you wade through fields of plastic waste on the beach. People still fish, but it is a novelty to catch any fish, of any size, as the oceans are often lifeless.

Tasmania's oceans are above the world standard, and more noticeably because the world standard is slipping further every day.

Tasmanians take their riches for granted, its just everywhere and unchanging, but wild places are becoming globally rare, even along and under our coasts. Its time to do something about it.

Diving deeper into the detail

Tasmania has *"…an exceptionally wide variety of marine ecosystems that are amongst the most diverse and productive on earth". Dr Karen Parsons*

Complex Coast

One reason why Tasmania is special is because of its shape and complicated coastline. Most Australian States have a fairly straight coast just facing in one direction and they are usually very exposed to the wind and waves.

Tasmania has numerous little estuaries, reefs and bays and more than 6,000 islands and islets. Some areas have deep waters up to the coast and others are shallow and wave swept. Some coasts are bathed by clear blue currents from the north during summer, others by food rich tannin-stained rivers and Southern Ocean currents. There is also a lot of variety in the tides, especially in the North of the State. The little nooks and crannies with varying temperatures and nutrients allow lots of different species to thrive. It is not all sand either, about half of the Tasmania coastline is rocky.

The compact shape of Tasmanian means that a very long coastline fits around a small island. Tasmania has about 1% of Australia's land area but about 8% of its coast. Tasmania's coast is bigger than the coast of New South Wales. It also means that you probably don't live far away from this special ocean wilderness.

Special landforms and geology;

The Tasmanian coast has the oldest rocks in eastern Australia, it looks more like Antarctica in some places. The coasts have big sea caves, ancient tilted quartzite sea terraces, strange basalt columns, eroded archways and blowholes. Not all of this rich geoheritage is fully appreciated.

Areas with complex rock types tend to have a broader range of habitat for marine species. Rare rock types can lead to unusual marine communities. An example is Rocky Cape. In Tasmania, ancient Precambrian rock dominates on our South-West coast, but it outcrops again at a small number of North coast locations as quartzite schist. Rocky Cape has highly folded old metamorphic rocks that create submarine caves and crevices. This type of habitat is rare in the NW Coast and supports a greater diversity of marine life than more uniform rocky reefs on nearby sections of the coast.

Other complex rocky habitats include massive submarine cave systems, like the Ile des Phoques off the East coast, and Waterfall Bay on the Tasman Peninsula. These caves can reach over 10 m high and 100 m long. These caves contain unique species that are specialised for cave life.

Fossil Bluff, Wynyard, Jun Zhang

Special Ocean Conditions

Because Australia is a hot and dry place, many Australians think Tasmania's waters are cold. By world standards, they are temperate. Sitting between the tropics and the frozen Antarctic waters. Tasmania has an average sea surface temperature of 10-12 ˚C in winter and 18-20 ˚C in summer, although it varies a lot from place to place and year to year, with Southern Tasmanian waters generally colder.

Ocean currents dictate how warm our waters are, as well as how salty, how productive and how diverse they are. Tasmania is a meeting place for three of Australia's main ocean currents. The warmer, nutrient-poor East Australian Current starts in the tropics and flows south down the Australian East coast to Tasmania's East coast. It is strongest in summer.

The Zeehan Current is also a warm current that flows down the Tasmanian West Coast during the winter. It is generated by the Leeuwin Current that starts in Western Australia. It causes the waters around North Western Tasmania including King Island, to be warmer in winter than elsewhere in Tasmania.

An important current for marine life is the cool Antarctic Circumpolar Current. It originates in the Southern Ocean. It pushes nutrient rich water to the surface near the Tasmanian southern coast. Tasmanian waters are generally higher in nutrients and more productive than northern regions of Australia. Whole ecosystems, like giant kelp forests, depend on this current.

In the places where the currents join, these mixing zones are also an invisible barrier. They have further isolated Tasmanian species so that we have quite a few old and odd species unique to the region. Some unusual Gondwanan 'relic' species include the world's rarest

skates and a number of fish, invertebrates and algae limited to only one or two sites. Our waters have been isolated from other temperate systems for around 65 million years.

As the ocean warms with climate change, these mixing (or convergence zones) are moving. The most obvious example is the Tasmanian East Coast which is becoming increasingly dominated by species more at home in southern NSW. Some of these species are very destructive, like the long-spined urchins, which have created huge barren areas in Tasmania.

Tasmania in a way, is on the edge of everywhere else. It is the southern limit for a range of temperate water species. It is the most southerly point of the East Asian-Australasian Flyway for migratory shorebirds. It is the last land mass before reaching the Southern Ocean. Those vast, cold and deep ocean depths are another immense physical barrier that isolates Tasmania's marine species. Tasmania is the northern geographical limit for subantarctic species too, like albatross breeding colonies. The closeness of deep water means that the Tasmania coast also has deepwater species usually not found so close to the coast.

Wild Places

Tasmania has a lot of pristine coastline, particularly in the South West and the Furneaux Group. The beaches and headlands of the South West are the most extensive undeveloped coastline in south eastern Australia. These unique, undisturbed environments are rare globally.

Tasmania also has an unusually high percentage of undisturbed estuaries, and a large number of remote, pristine islands. It is now very hard to find places in the world so isolated from pollution from the land. These areas are sometimes protected, sometimes not.

Tasmania can be wet in the West and dry in the East. It also has big tides in the eastern and western approaches of Bass Strait, while the tides are less noticeable in the South. That means that it has all different kinds of estuaries and wetlands. For its size, Tasmania has a higher diversity and number of wetlands than any other Australian State.

Our wilderness is in good condition but always under threat, and it needs human help to stay healthy. Every year, groups of volunteers travel to these remote beaches to clean away the piles of rubbish that have washed up onto these remote beaches.

Seabirds and shorebirds

Tasmania has a higher diversity and number of internationally important bird sites relative to its size than any other Australian state, as well as the highest densities in Australia of a number of resident and migratory species. Tasmania, including Macquarie Island, provides breeding or foraging habitat for around 90 shorebird and seabird species, as well as at least 20 additional species that are very occasional visitors or 'vagrants'. Tasmania's seabirds include numerous protected migratory species, including albatrosses, petrels, shearwaters and terns.

Tasmania is visited by subantarctic species. Tasmania and Macquarie Island have over half of the world's albatross species. Albatross and petrel species have huge foraging routes around the temperate and subantarctic parts of the southern hemisphere. Tasmania has the only nationally listed Critical Habitats for albatross species.

Shearwaters and Caspian Terns circle the Pacific Ocean to travel between northern foraging and southern breeding sites. Every spring, 18 million short-tailed shearwaters, (mutton birds) arrive. They fly 15,000 kilometres each way in just six weeks to nest in Tasmania. Their arrival is one of nature's great wildlife spectacles.

Tasmania has a diverse shorebird fauna of 43 species, representing 64% of the shorebird species recorded nationally. During the summer migratory season, Tasmania has an estimated total population of 40,000 shorebirds. Tasmania has a large proportion of the world population of oystercatchers, hooded plovers, ruddy turnstones, double-banded plovers and the Endangered eastern curlew. The habitats that support Tasmania's remarkable aggregations of shorebirds have been recognised as internationally renowned 'Ramsar'[2] wetlands.

Many birds use a migration route called the East Asian-Australasian Flyway. It is 12,000 kms long and includes 23 countries. Tasmania has a unique location at the southern extremity of the East Asian Australasian Flyway. Up to 20 protected migratory species breed in northern China, Mongolia, Siberia and Alaska during our winter. In the southern summer, they set off for Tasmania to feed.

Tasmania is reported to be the Australian stronghold for the Endangered Little Penguin (Eudyptula minor). The world's smallest penguin is making a bit of a comeback, and is now being seen in many coastal towns. This amazing bird forages over huge distances and can climb to 100 m above sea level in search of suitable breeding sites. It will even nest near homes, roads, or in the dunes of popular beaches. Many Tasmanians have set up support groups to fence out habitat and keep them safe from roaming pets, cars and feral animals.

Not all of these species are doing well. Twenty-nine species consisting primarily of seabirds are listed as Threatened including 14 albatrosses, seven petrels, four terns, two cormorants and one prion. An additional albatross species and two subantarctic penguins not listed in Australia are Threatened at the global scale.

Several shorebird species are of conservation concern including the Eastern curlew, red knot, hooded plover, black-tailed godwit and Asian dowitcher.

Macquarie Island supports magnificent aggregations of seabirds including breeding populations of 13 Threatened species, seven of which are Endangered: the wandering, grey-headed, and black-browed albatrosses, Antarctic tern, southern fairy prion, and southern giant and soft-plumaged petrels. Breeding colonies around the Tasmania support a very high proportion of the Australian population of the Vulnerable fairy tern (12%).

[2] Rasmsar is the place where this international treaty was signed.

Several additional nationally protected marine species are restricted to southern Australia including Tasmania, such as the black-faced cormorant and Pacific gull.

Protecting their habitat is a very important part of keeping them safe. Groups like Birdlife Tasmania track the progress of these species with regular bird counts, creating one of the largest bird databases in the world. Governments have funded very successful programs to eradicate pests from Macquarie Island, and other Tasmanian offshore islands.

Humpback, Eric Woehler

Sea mammals

More than 40 species of marine mammals are found in the waters and on coastlines around Tasmania and Macquarie Island. They include seals, sea lions, whales and dolphins. Tasmania's location means we can also see Antarctic and subantarctic species more frequently than the Australian mainland.

Tasmania supports a very diverse range of seal species compared with other parts of Australia. Colonies of seals occur mainly on rocky, remote parts of our coast. They also form several breeding colonies, with some islands in Bass Strait and Macquarie Island being particularly important.

Fur seals are being more commonly seen. Seals can be regularly spotted sunning themselves on the surface, or relaxing on offshore rocks. Some well-established seal colonies now form the basis of tourism adventures. There have even been isolated instances of them moving around suburbs of Tasmanian cities and coastal towns. They are clever exploiters of human

food sources and can annoy fish farmers and game fishermen by damaging nets and stealing catches.

Despite the appearance that the Australian fur seal is now common, they are yet to completely recover from 19th century hunting. Some populations are still about one third of their estimated pre-sealing sizes.

Tasmania's whale and dolphin species consists of 34 known species that include a large number of Threatened and protected species.

Endangered blue whales are occasionally seen on wildlife encounter cruises on the East Coast. Vulnerable fin and sei whales are also a novelty. The sperm whale is an ocean roamer that is rarely seen. It is categorised as globally Threatened.

Tasmania's East coast is particularly important as a migration path for the Endangered southern right whale. While southern right whales are doing well in the Great Australian Bight, the populations in south-eastern Australia have never recovered from 19th century hunting. The East coast of Tasmania was historically the Australian centre for calving activity. They were called "right whales" because they were slow, easier to harpoon and yielded good oil. In the 1840s the population was almost completely wiped out. They will still try to rest and socialise in Tasmania's bays and estuaries. Courtship and mating come with displays of lunging, chasing, jaw clapping, head butting, spiralling and strong 'singing'. Now many bays are noisy with humans, they can be easily disturbed even by well-wishers, let alone shipping and industry.

Humpback whale numbers are recovering quickly. They are fairly regularly seen now as they move between their summer subantarctic feeding grounds and winter birthing grounds along Australia's south east coast. They will come inshore sometimes to rest and socialise, with Rocky Cape and the quieter bays of Tasman Peninsula and Bruny Island being spots where they are frequently seen.

Tasmania's diverse coastline is a hotspot for marine life, but the complicated underwater terrain can be confusing for whales. Two thirds of Australian stranding events occur in Tasmania, with the West Coast's Ocean Beach being notorious for regular strandings of pilot whales. These strandings can also include rare species like Hector's beaked whale.

A walk along the foreshore in the early morning and evening are the best times to see dolphins, often the Common Dolphin and Bottlenose Dolphin. Large pods of dozens, or even hundreds of dolphins are regularly seen. Studies are expanding our knowledge. Sometimes dolphins aren't widely ocean roaming, but will stay in small groups close to a regular home territory.

The majestic orca, one of the top predators in the ocean is more frequently sighted in Tasmania than most other areas of Australia. It is very common at Macquarie Island.

A good way to see these animals is on one of the many wildlife encounter cruises on offer in Tasmania that are becoming very popular.

Strange species

Tasmania has been geographically and climatically isolated from other temperate systems of the world for around 65 million years. While the tropics have a lot of colourful variety in fish species, fish can travel widely over the Indo-Pacific area, so many of the fish you might see on the Great Barrier Reef are the same as in other tropical countries like Thailand.

About 85% of our more than 600 species fish species, 90% of echinoderm species (e.g. seastars, sea urchins) and 95% of mollusc species (e.g. sea snails, shells) are only found in the southern waters of Australia ("endemic"). Some species can only be found in Tasmania. Tasmania's mobile marine fauna includes more than 1,000 molluscs. Crustaceans are represented by numerous subgroups (e.g. lobsters, crabs, shrimps, sandhoppers) and include species totally unique to Tasmania. Of the >500 sponge species recorded from Tasmania and adjacent areas of southern Australia, 60% are endemic, while two thirds of the 200 recorded ascidian species and ~500 bryozoan species in the same region are also endemic to the region.

This high diversity has been attributed to the long period of geological isolation, coupled with southeast Australia containing the longest ice-free coastline in the world.

The things that tend to be really special in Tasmania are the ones noticed less on tourist brochures, the algae (seaweeds) and the smaller creatures. We have the high nutrient levels and cool water temperatures that seaweeds really like. Our algal diversity and rarity is amongst the highest in the world with 60% of species being unique. Half of Australia's temperate species are present in Tasmania, with an estimate of 635 species counted so far for Tasmania and its offshore islands, excluding Macquarie Island. There are at least five subantarctic macroalgae in Tasmania that have not been recorded elsewhere in Australia.

The red handfish is rarer than the giant panda, M. Jacques

Up to 35 species are recognised as rare in Tasmania, with seven of these endemic to our state. The majority of the unique (endemic) species are red algae, and include two species in the genus *Pterothamnion* that are only known from one site each in Southern Tasmania. The

three-node seaweed (Cystoseira trinodis) is limited to Blackman Bay in the south-east. Rare algae include Brown's cystophora (Cystophora brownii) is found on Tasmania's north coast.

It is more likely that a Tasmanian marine species will be isolated to small areas and be a very old design. Some of these species are 'relics', surviving from the time when the continents of the earth were joined together as part of the ancient Gondwanan landmass. Rare and unusual animals like Maugean skates, handfish and live-bearing seastars have found a refuge here. Their forms are likely millions of years old, handfish fossils have been found in Italy that are 50 million years old.

Of the 14 known handfish species, 11 are found only in Tasmania. Only three species are regularly seen in shallow coastal waters. Once seen over the whole eastern side of Tasmania, most are now sighted in the southeast, especially close to the Derwent River. The red and spotted handfish are the only species now seen regularly, the spotted handfish has a total estimated population of just 1,000 to 1,800 mature individuals occupying an area less than 3 km2 spread over several sites. The red handfish may have less than 500 surviving fish. One of its two surviving aggregations may only have 13 fish. The pink handfish *Brachiopsilus dianthus* was recently seen for only the second time in history, this time on a deep seamount off the Tasmanian South Coast. It has been seen previous in Waterfall Bay on the Tasman Peninsula. One other species was recently declared extinct, not having been seen since the 18th century. They are a very Tasmanian, very delicate and very special creature.

Red-necked stint, Eric Woehler

Another iconic Tasmanian species is the Endangered Maugean skate, the oldest lineage of skate in the world. It is the only skate worldwide that can live in brackish water and it is one

of the world's rarest. It was only discovered in 1988 and is confined to the low salinity (saltiness) upper reaches of Macquarie Harbour on Tasmania's west coast. Only a few years ago it was found in Bathurst Harbour too, but recent efforts to find any were unsuccessful. Unfortunately, a large expansion of the salmon aquaculture industry has been located near their habitat. This was probably because of poor survey work and the wrong emphasis on expansion at almost any cost. Errors in stocking levels have severely reduced oxygen levels in the harbour and put the Maugean skate at unnecessary risk. Its total population size has been estimated at less than 2,500, while its area of occupancy is not more than 100 km2.

Other rare and endemic fish species have recently been identified in Tasmania, with a new species of sand fish (Lesueurina sp.) confined to our South coast, and studies underway suggesting the presence of many additional endemic species including gobies and clingfishes. Because these animals have limited economic value we rarely look for them. It is likely that there are lots more rare and unusual Tasmanian creatures still to be found.

The Vulnerable Australian grayling is limited to south-eastern Australia, occurring in estuaries around much of the Tasmanian coast. The young spend the first six months of life in the ocean, and then they return to the rivers. The Tasmanian whitebait (or 'Derwent whitebait') is unique to Tasmania. It has a similar life cycle and only lives for a year. It has been heavily fished.

Tasmanian waters contain a diverse range of protected seahorse, sea dragons and pipefish (Syngnathidae), including the colourful and iconic Weedy Seadragon, listed as Near Threatened globally. It doesn't move very far and is not regularly seen except at Waubs Bay in Bicheno. New studies are indicating that the population has crashed in recent times, along with many other fish species.

Two of the aquatic grasses, the large-fruit seatassel (*Ruppia megacarpa*) and the tuberous seatassel (*Ruppia tuberosa*) are listed as Rare in Tasmania. Both species occur in the east and south-east of the state. The large-fruit seatassel prefers estuaries and lagoons and the tuberous seatassel occurs in channels and saltmarshes. The Ruppia species are the only aquatic grasses capable of surviving the highly variable salinities within the upper estuary.

Threatened species

We don't study marine animals in enough detail to know exactly how many species there are, let alone if they are threatened. We don't study them very often at all if they are small and economically unimportant species.

We do know that 55 marine species are listed as threatened in Tasmania (28 seabirds, six fish, five whales, four turtles, four seals/sea lions, three seastars, two estuarine grasses, one shorebird, one mollusc and one seaweed. An additional range of species found here are listed as globally Threatened, including fish, seabird and shorebird species. In fact, it is likely that a much larger number are threatened, especially smaller species.

Some areas occupied by Threatened species are also listed nationally as Critical Habitats. There are also threatened ecological communities like giant kelp.

Many marine populations have shown gradual declines in response to human activities[3].

The listed fish species at extreme risk include the spotted handfish, Maugean skate, great white shark, Australian grayling, red handfish and Ziebell's handfish. A lot of commercially fished species have been doing it tough too. There are conservation concerns about school shark, orange roughy, eastern gemfish and southern bluefin, and they have been classed as 'Conservation Dependent'. Catch statistics indicate that numbers of many major fisheries species have declined by >50% or even >80% over three generations.

Across the world, sharks are in trouble, with large population declines. Many of Tasmania's shark species are listed as globally Vulnerable (e.g. spotted dogfish, school shark, shortfin mako), while our coastal waters include key nursery sites for sharks, rays and skates that have been designated as protected Shark Refuge Areas.

Tasmania's marine environments support rich and colourful marine invertebrate communities. The Critically Endangered Derwent river seastar has probably been lost, and the Vulnerable live-bearing seastar now has a restricted range. Indications are that mollusc diversity has dropped dramatically over time. Inshore mollusc biodiversity has decreased by nearly 70% over the last 100 years, but almost no-one is monitoring it. The Gunn's screw shell is being swamped by a feral screw shell brought in accidentally from NZ.

Birds are having to deal with overfishing, plastics and loss of habitat especially. Declines of up to 65% have been recorded amongst Tasmanian shorebird species since the 1950s.

As we warm up the planet and thus change the chemistry of the oceans, this decline will speed up. There are signs that this is already happening. Giant kelp forests communities have all but disappeared down the Tasmanian north and east coasts. The whole native flat oyster reef habitat is down to one remaining natural bed in Georges Bay. Seagrass beds have declined by an estimated 25%. Recently, two new artificial oyster reefs have been built in SE Tasmania.

All is not lost and things can be done. A handfish recovery team has been working with success on creating artificial breeding habitat for handfish, and a captive breeding program. Their natural breeding areas have been devastated by an introduced seastar. Volunteers have been removing Pacific seastars from the Derwent River.

You can reduce the population of marine animals with all kinds of things, but nothing drives them to the edge of extinction like degrading their habitat. It has been shown that if the habitat is kept in good condition, marine animal and plant communities have greater resistance ("resilience") to natural or human disturbances, such as introduced marine pests.

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Georges Bay angasi oyster reef and black urchins, Photo: Simon Brooks

Knowledge gaps

Do we understand everything we need to know about Tasmania's oceans? No, and we have a shortage of information about what it should look like normally, called "baseline" information. We tend to assume that it is in good shape and ignore grandad's stories about how big the fish used to be, or how huge the flocks of birds were in the 'good old days'. Because we only live for a short time, this leads to each generation accepting a more and more damaged marine environment as the 'normal' way it has always been. This is called "sliding/shifting baselines syndrome", or "generational amnesia". This means that species can approach extinction, and habitats approach collapse, without us really even noticing.

Tasmania is lucky to have the Antarctic Division, IMAS and the CSIRO based in Hobart. There is a strong core of researchers able to examine problems in Tasmanian waters and raise awareness about local issues. Doing underwater research is costly and people can only go underwater for a short time and in limited depths. A lot of research is now being done by underwater robots. Because of the expense, we rarely study ecosystems. We often study one or two species of fish that we commercially fish, because these fish are worth money and funding organisations expect a 'return' on their research investment. People who care about the ocean need to support broad research funding. It is vitally important.

Despite these difficulties, we do have some basic ideas about how the ocean works and we are constantly improving our knowledge.

How Tasmania's Oceans Work

Cover

TASMANIANS FOR MARINE PARKS

Photo anemones Jun Zhang

What makes the ocean tick?

The basic things marine species need aren't much different from the things land plants and animals need. As well as food, they also need a secure place to shelter, breed and feed. The things they are specialised to eat need to be plentiful in that place. The numbers of predators and prey need to be balanced. Plants need sunlight and nutrients in the amounts they are adapted to grow in. They don't like it too hot or cold compared to what they are use to. The 'atmosphere' they live in (in this case sea water) needs to be stable and free of harmful pollutants.

Most plants and animals are evolved to cater for just one set of ocean conditions, the right amount of light, nutrients, temperature, acidity or salinity. They also might need certain types of seabed to provide places to hide from predators or shelter from storms. Different physical conditions like the structure of the seabed, the temperature, depth, light levels and wave exposure, also affect the mix of different animals and plants that can handle living in that place. They develop interrelationships. These interconnected creatures and the places they live are called ecosystems.

slicks of planktonic tunicates in Fortescue Bay

Everything in the ocean is linked together. A “food chain” describes who is eating who in a community of living things. It is a one way of explaining how living things are connected.

The basic building blocks for the whole ecosystem are the simpler animals like plants and bacteria. Humans would starve without plants as we either eat plants, or plant-eating animals. It is not much different in the ocean, except that the plants are often simple and free-floating in the surface layers of the ocean. Plankton are often microscopic animals (zooplankton) and plants (phytoplankton) that drift with the currents and tides. They are getting sunlight and absorbing nutrients just like you garden plants, except that the seawater is their ‘soil’. There is a vast amount of life in the ocean, so much that it creates half of our planet’s oxygen. There are so many of them that they also play a key role in slowing down climate change and getting rid of excess nutrients in the water.

Many things eat plankton, from tiny fish right up to whales. Even big fish that might later eat other things, tend to start out life eating plankton. One example is juvenile Southern Rock Lobster (crayfish). Crayfish start out life as plankton themselves, floating on the currents out at sea, until they drift in and settle on rocky reefs.

Little creatures floating around in the oceans are eaten by larger ones, then even larger ones, right up to the apex predators in the ocean. That use to be sharks and killer whales, but these days its humans.

Changing the chemistry of the ocean can upset the whole system as plankton are sensitive to these changes. When the plankton struggles, everything else struggles, because most creatures can trace their food supply back to these tiny little plants and animals. We can badly damage whale populations with hunting, but we can kill off entire species by altering their food supply, or the habitat of their food supply. If we make the oceans too acidic, or melt all the sea ice in Antarctica, krill will die. Without krill no species of baleen whales, like humpback whales, can thrive. There is a point where they will simply become extinct.

We can already see that the plankton communities in Tasmania are changing as the oceans warm. Some of these newly arrived species can be toxic. Now we regularly have to close fisheries when blooms of toxic dinoflagellates occur. This wasn’t happening in the 1980s.

Some changes appear to be harmless. We also now see *Noctilucca scintillens* off our beaches, the bioluminescent plankton. As the waves frighten the plankton they let off a burst of light that they normally use to confuse predators. Sometimes during the summer we can literally see the sea sparkle.

The numbers of animals don’t normally explode out of control in healthy systems. If urchins start increasing in numbers, their predators increase in numbers too until the population balances. Without this the urchins would eat off all the seaweed and hundreds of animal species would have nothing to eat. Removing large numbers of a prey species, or a predator, can upset this balance.

Only a few species can tolerate sudden and dramatic changes to these basic living conditions. An additional concern with sea water is that when humans raise sea temperatures and add carbon dioxide by burning fossil fuels, we also make the oceans more acidic. Acidic oceans do

things like start eroding away sea shells (molluscs). Many marine animals are also affected by changes to rainfall and salinity in places like estuaries. Evolving to deal with warmer ocean temperature might take thousands of years, but the problem is that our oceans are warming up every year because of human caused changes. It is important that these conditions remain stable.

Variety of marine ecosystems and habitats

Open Ocean Habitat

When we interact with the ocean its usually only the thin and relatively shallow strip of land along the coast called the continental shelf. In some places like south eastern Tasman Peninsula this shelf is quite narrow, and it drops off suddenly into very deep water. These deeper regions are very cold, dark and subject to extreme pressure.

This generally flat and muddy deep seabed is known as the abyssal plain. Life tends to be very spread out, but there are also spectacular ridges and seamounts too in some places. The largest mountains and deepest canyons on earth are in the ocean. Offshore seamounts tend to be areas rich in nutrients and are hotbeds of life. They attract deep water fish and shark species that are specialised and not often found in shallow water. These seamounts tend to be far offshore in areas managed by the Commonwealth government.

In some places, such as to the West of King Island, there are current eddies called upwellings. They push nutrients up to the surface from deep water as the currents brush against the continental shelf. This causes an explosion of life with blooming plankton attracting fish, seabirds, whales and dolphins.

The microscopic phytoplankton need sunlight and stay in the shallows. As soon as there is enough warmth and nutrients they start breeding rapidly. Phytoplankton communities in the southern Australia region include over 500 species. Tasmanian plankton communities are a unique mix of species due to temperate communities mixing with tropical and subantarctic plankton.

Zooplankton are the tiny animals that feed on this phytoplankton. Zooplankton can include the larval (juvenile) phases of many animal species, such as fish, lobsters and sea urchins. Coastal Krill (*Nyctiphanes australis*) is a major food item for fish and birds.

Blooming plankton attracts vast swarms of school fish, who are in turn chased by tuna, dolphins and seals. Their hunting forces the fish upwards towards the surface where they can be accessed by diving birds. Tasmania is a hotspot in Australia for seabirds, and supports around 60 species that only hunt in the open ocean.

Tasmania's open ocean provides an important migration path for whales who feed on coastal krill and other zooplankton during their migration. Threatened whale species including the southern right whale and Humpback whale. 'Beaked whales', such as the sperm whale, killer whale, and dolphins, as well as a variety of seals, feed primarily on fish and squid. These whales also come inshore and are often seen resting and socialising in inshore areas like near

Rocky Cape National Park and the Tasman Peninsula and Schouten Passage. In many areas wildlife encounters support small and large tourism businesses.

Lots of ocean-roaming creatures still have strong connections with the land. Albatross and other seabirds have to breed onshore and favour certain islands. Seals also aggregate around traditional haul out sites and breeding islands. On a wildlife encounter cruise, especially off Tasman Peninsula or in Bass Strait, you might be followed by albatross. In earlier times albatross were such a common sight that seafarers hardly paid them any attention. In most places, encounters with this huge seabird are now uncommon.

These deeper open ocean areas are usually outside the 3 nautical mile limit of Tasmanian waters and have to be managed and protected by the Commonwealth Government. While the process of declaring new marine parks in Tasmania has been stalled for the last 15 years, fortunately the Commonwealth is currently progressing with new offshore marine parks. Hopefully, they will be placed in the right areas that reflect the patchiness and mobility of life out in the open ocean.

Between the Tides

A trip to the beach will eventually result in a walk over to the foreshore rocks to some marine life. It is the way many Australians learn about the ocean. Tasmania's intertidal communities are unique, with a mix of cool temperate species of algae, seastars, crabs and molluscs not found on mainland Australian shores.

On the gently sloping sea terraces you will notice bands of different kinds of life along the shore. Some species need it to be cooler and wetter than others. On the driest rocks ancient lichens can survive. They add a splash of orange to the rocks, which is a distinctive feature of Tasmania's granite coastlines.

Up on the drier parts of the sea terrace near the high tide line, the animals and plants need to be very hardy and are evolved to survive hot days and long periods without sea water. Crabs often hide under the rocks or in burrows in the sand. In the splash zone there are barnacles, worms, anemones, limpets, chitons and other small shelled animals. Some shells will close their trapdoor to keep in moisture and they wedge themselves into cracks to avoid being swept away by the waves. This is a real challenge on the West Coast which is hit by some of the world's largest waves. There is a distinct intertidal community on the West Coast not found on mainland Australian shores.

In the wet tidal pools you will see anemones, crabs, small fish, transparent glass shrimps and some seaweed species. Rock pools are a favourite with kids, small threefin blennies dart for cover as rocks are turned over. There is more diversity closer to the sea where colourful sponges, seaweeds, crabs and shrimps, sea urchins, flatworms, sea stars and sea squirts and anemones take refuge in rock pools or under the shade of boulders.

In the deeper pools with good light penetration seaweeds can start to dominate. In the dangerous surf zone, only the toughest species of algae like Bull Kelp can thrive. On the exposed West Coast it grows so large and dense that it is commercially viable to recover it for food additives and stock feed.

Bull kelp, attacked by nibbling little amphipod shrimps, Photo: M.Jacques

Because the Tasmanian coast is so complex, there are lots of nooks and crannies for different kinds of animals. Northern coasts offer particularly large sea terraces at low tide due to the higher tidal range. Subantarctic Macquarie Island also has unique intertidal communities.

Tasmanian intertidal reefs have the most southerly populations of a number of intertidal species. The south-east also has three endemic seastar species found nowhere else in the world, including one of the world's smallest species. It bears live young, something very odd that only a few seastars species can do.

They are nursery habitats for fish and foraging shorebirds. They support internationally significant numbers of sooty oystercatchers, a shorebird that relies primarily on intertidal reefs and rocky headlands for foraging and breeding habitat. Half of its total population is found in Tasmania.

Beneath the Tide – Rocky Subtidal Reef

Foreshore rock pools allow us to see a tiny fragment of the huge variety of life that can be found in deeper water. Subtidal rocky reefs occupy large areas of the Tasmanian coastline and are diverse and productive habitats. According to Dr Parsons, They are a *".. globally significant hotspot for both diversity and endemism".*

Beyond the surf zone the waves are losing their power and more delicate forms of life can thrive.

Tasmania's coast is a rocky place. About 50% of the Tasmanian coastline is backed by rocks, and reefs extend out into the sea to varying degrees. Depths of 5- 15 metres close to the shore are not uncommon. In some places rocky reef can be found to 100 metres depth even in coastal waters.

Rocky reef habitat isn't all the same. Some of it is flat and exposed to the waves. Other reefs have gutters filled with sand or cobblestones. In a few areas there are large underwater caves, and in other places fields of house-sized boulders. Where the reef drops suddenly over into the depths, especially if there is a current, these 'drop-off' walls are jam packed with colour as rich as anything on a tropical reef.

Putting on a mask and swimming over reef quickly makes it clear that the well-lit reef shallows are all about seaweed (algae). Tasmanian reefs are more highly vegetated by macroalgae than any other reefs in Australian waters. These areas may produce up to 10-20 kg of plant material per square metre, making them equal to the most productive habitats in the world.

Seaweeds provide different layers of shelter for fish and other animals. Encrusting pink coralline algae tends to cover the rocks underneath the denser beds of large seaweed. It is hard like coral and resists the sweeping action of the kelp as it moves with the swell.

At the surface floating kelp fronds (e.g. giant kelp) soften the light. Where they are dense enough they can even dampen the swell. Tasmanian was once renowned for its huge forests of giant kelp, growing up to half a metre a day, and growing so thick that boats sailing into it

could easily become stranded. We took it for granted, or even thought that it was a menace to boaters. It was a key fishing ground for the crayfish and abalone industry. Due to global warming giant kelp forests (*Macrocystis pyrifera*) have virtually disappeared from the north and east coasts. Its few remnant populations, mainly in the South-West, are threatened ecological communities. What is left is an important potentially 'seed source' for possible future recovery programs.

Tasmanian macroalgae (big seaweed) communities are amongst the most diverse in the world and include a range of coldwater subantarctic species that are rare north of Tasmania, such as the strapweed (*Lessonia corrugata*), and the brown algae (*Xiphophora gladiata*). A recent study has identified 35 macroalgal species in Tasmania that are rare, including seven species never recorded outside Tasmania. These are mostly unusual red algal species with highly restricted ranges. Other cold temperate algae in Tasmania are also amongst the largest Australian species, including bull kelp, strap kelp (*Lessonia corrugata*), common kelp (*Ecklonia radiata*) and other large brown algae such as crayweed (*Phyllospora comosa*).

Lessonia corrugata

Below the algal canopy, animals take shelter, such as abalone, crustaceans, echinoderms (urchins, seastars) and fish. The foundation of animal life in the weedy reef is not fish, but the small animals that they feed upon, small crustaceans like *Tethygeneia* amphipods. Amphipods can reach numbers of 50,000 per square metre, with over 50 species occurring on a single tufted plant. Almost everything in the reef depends on them for food as seaweed is hard for most fish to digest directly.

Our subtidal reefs have particularly high conservation value because a large proportion of their fish, echinoderms and molluscs are totally unique or 'endemic' to the southern temperate region. Fauna groups containing ascidians (sea squirts), amphipods and bryozoans

(sea moss) are also more diverse than any other location of a similar size in the world. The south east coast has three of the rarest and most unusual seastar species in the world. It is likely that the Derwent seastar is already extinct, genetically swamped by invasive species. We also have a threatened species of live-bearing seastar, one of only a handful of global seastar species that bear live young.

Patrolling over the weed are fish wrasse, sweeps and leatherjackets. Half of the larger fish likely to be seen gliding over the reef are purple wrasse or blue-throated wrasse. Down in the weeds are smaller and well-camouflaged oddities like weedfishes, warty prowfish, seadragons and even handfish. Tasmania is a stronghold for handfishes, with many species only found in a few places and now rarely seen. After surviving for 50 million years, they look like they are in decline. Red Handfish were once found in Bass Strait and down the eastern half of Tasmania, now they are known from two locations. One is only 70 metres wide.

In a place rich with seaweed there are plenty of grazers, including abalone and sea urchins. Native urchins (*Heliocidaris ethryogramma*) can sometimes get out of control and eat off patches of reef. Their populations tend to quickly get back in balance. The hollow-spined (or black) urchin (*Centrostephanus rodgersii*) has recently travelled on the Eastern Australian Current from the mainland coast. As our waters warm with climate change, this new urchin can now breed here successfully. It eats relentlessly and explodes in numbers, leading to the overgrazing of reefs of the Tasmanian east coast. In some areas they have completely eaten down the reef to large areas of barren rock, such as the St. Helens area.

Reefs are important ecologically and for fisheries harvesting blacklip and greenlip Abalone, wrasses, morwongs trumpeter, and Southern Rock Lobster. Rock lobster spend between 9 months to 2 years out in the open ocean. When the conditions are right juveniles home in on the smells and sounds of healthy reef. The tiny larvae settle and begin to grow. In fished areas they hide in crevices during the day, but in unfished areas large crayfish will roam at will over the reef day or night. Overfishing of the older and larger crayfish has altered the makeup of our reefs and contributed to overgrazing by urchins[4].

The unique rock formations and high biodiversity of Tasmanian rocky reefs combine to provide some of the most spectacular underwater scenery offered in Australia, including complex cave systems, dense kelp forests, and gardens of sponges, anemones, gorgonians and sea whips, the colour and diversity of which rival any tropical coral reef.

Deep Reef

Needing light, the big brown algae are limited to shallower waters and quickly get replaced at greater depth by smaller, delicate red algae. As light becomes even dimmer, there is little seaweed. In depths usually over 30 metres (or 15 metres in high current areas) reef communities transform into deep ‘sponge gardens’.

4

The rock faces are dominated by ancient forms of simpler animals that don't need light. They attach themselves to the bottom and filter food out of the water column. Most are invertebrate animals (animals without a spine) such as bryozoans, ascidians, sponges, hydrozoans, gorgonians, anemones, tube worms, and soft corals. These types of animals can be found in fossils hundreds of millions of years old. These underwater gardens of animals are delicate, long-lived and often slow-growing.

These animals can daily filter tens to hundreds of litres of water for every square metre of reef. These colourful reef animals are especially thick where there is a strong current flow, like around headlands in areas such as Rocky Cape and the Bass Strait islands. They can even be found in shallower water in dark and narrow estuaries like Bathurst Channel. For some reason these animals usually come in bright colours such as red, purple, orange, green, white and yellow. These deep reefs may include huge pink clouds of plankton-feeding butterfly perch. The deep reef has the colours to match even the tropical corals of the Great Barrier Reef. Governor Island MPA off Bicheno, and the Tasman Peninsula east coast have some of the nation's most spectacular deep reefs.

Seagrass beds

Another very different type of habitat is seagrass, it is actually a type of grass not a seaweed, but it supports a lot more life than your front lawn.

Seagrasses can form dense 'meadows' that are important refuges, breeding habitat and feeding grounds for fish, invertebrates and seaweeds. The beds can be so dense they shelter foreshore beaches and housing from erosion. They also process quite a lot of unwanted nutrients that we put into the water.

Tasmania possesses a unique mixture of warm and cool temperate seagrass species. Out of 60 seagrass species worldwide, one third of these occur in Southern Australia, and at least 14 species occur nowhere else. Tasmania has seven species of seagrass, as well as three Ruppia species that create a similar habitat in estuaries and lagoons. Tasmanian seagrass species can be found mixed together in the same bed.

Recent mapping has revealed 190 km2 of seagrass beds around mainland Tasmania. This excludes the biggest seagrass beds, that are found in the Furneaux Group and Boullanger Bay in the north. They may add 400-500 km2 of seagrass, but they haven't been fully mapped. Seagrass beds still aren't that common, less than 3% of Tasmania's coastal waters are seagrass.

The northern areas of Tasmania form the majority of the habitat for the Tasmanian eelgrass. The cool-water loving Tasmanian Eelgrass is unique to Tasmania and Victoria. Eelgrasses 'come and go' and die-back when their growing season is over.

Strapweeds and sea nymph are persistent, long lived species that are extremely slow to recover from environmental disturbances. These long-lived species, particularly the southern strapweed, form large, dense seagrass meadows on Tasmania's north coast and in the

Furneaux Group, while sea nymph is also important on parts of the east coast. The fibrous strapweed *Posidonia angustifolia* appears to be confined to the north-west and Furneaux Islands. This species is unusual as the nearest other population is 600 km to the west in South Australia.

Because of clear waters in places like Flinders Island, seagrass tend to survive in deeper water than in mainland locations. Other relatively deep seagrass beds have also been recorded at Waterhouse Point.

Seagrass beds are very productive, providing important habitat for many protected species, such as pipefishes and seahorses. Big clouds of juvenile leatherjackets are common. In the intertidal zone, beds of Mueller's eelgrass provide feeding grounds for shorebirds as well as small fish. Seagrass beds are important nursery areas for southern calamary (or 'squid', *Sepioteuthis australis*) which lays its eggs almost exclusively on beds of sea nymph. The seagrass beds of Great Oyster Bay have been identified as being particularly important. Surveys found that between 55% and 84% of calamary in south-eastern Tasmania were born in Great Oyster Bay. The rainbow kelp shell (or 'green maireener', *Phasianotrochus irisodontes*) is found in seagrass and is used for necklace making by Tasmanian Aboriginal people.

Whilst not being listed as Threatened, the marine seagrasses have high conservation values and provide key nursery and foraging habitats for marine animals, including protected and commercially significant species.

coastal beach and inlet NE Tas, Photo M.Jacques

Beaches

Most Australians at some time will interact with the ocean. An exercise walk on the beach is one of Australia's most popular leisure activities. People often look out for birds and mammals, but less often notice the animals living in and around the barren-looking sand.

The upper shore is home to a range of insects and air-breathing crustaceans including crabs, sandhoppers and isopods (slaters). This upper 'strandline' zone is biologically unique in Tasmania.

The lower shore is dominated by many species of burrowing worms, molluscs, and small crustaceans. On beaches without too many humans you may see occasional swarms of soldier crabs, marching apparently aimlessly over the muddier sections of sheltered beaches. Pick up a strand of washed up seaweed and huge numbers of amphipods will hop around madly looking for cover. Most of the species of sand hopper in Tasmania are undescribed animals and are only found here. They are a major source of food for fish waiting offshore, such as flathead, flounder, whiting and sandfishes.

You will also see small air holes from shells that have burrowed down into the cool and wet sand. The sand keeps them safe but it is also low in oxygen, so they often have little siphons and make air holes to help with breathing. Shellfish species vary depending on the wave exposure. The elongate surf clam *(Paphies elongata)* is common at surf beaches, the fine tawera (*Tawera lagopus*) prefers more sheltered ocean beaches.

There is often plenty of bird life. Oystercatchers will sort through the sand to force open shellfish with their chisel-like beak. Hooded plovers (*Thinornis rubricollis*) will scurry along the dry sand trying to draw you away from the nest. Their nest is only a shallow scrape on the dry sand or dunes. Species like the hooded plover and pied oystercatcher have a favourite spot they come back to every year. They will noisily drive out other birds trespassing onto their feeding patch, but they are easily disturbed by dogs and humans, even unintentionally. Tasmanian beaches support internationally significant numbers (1% or higher of total global population) of the hooded plover, but they are few in number and breed far better in wild places. Many species like the fairy tern, little tern, and the pied oystercatcher are struggling.

Vegetated dunes are an important natural sea defence in low-lying areas, protecting estuaries and wetlands from storm surge flooding and erosion. Where beaches have nearby undisturbed coastal grasslands and herbfields they are often rookeries for seabirds like penguins and muttonbirds. Individual muttonbird rookeries can be as large as 6 million birds. Muttonbird flocks form huge clouds at dawn and dusk and are one of the world's great natural spectacles. Little Penguin will waddle ashore at beaches looking for nesting sites but they are put off by lights, noise and feral animals. They can still be found even close to urban areas, if the area is fenced to keep out dogs and cats.

The high energy south and west coast beaches are some of the last truly wild beaches in the world. They have a particularly high diversity and density of organisms and largely undisturbed shorebird and coastal plant habitat.

Soft Seabeds

Rocky reef is usually only a narrow fringe around the coastline, in many areas not extending out deeper than 15 metres depth. Areas of sand and mud, often mixed with pebbles and shells, can make up 75% of the seabed in nearshore areas.

Soft sediments are common in estuaries and bays. A lot of the richest sediment areas are where nearby rivers are washing nutrients out to sea. At first glance, these areas look barren. There isn't a lot of structure to provide cover, so a lot of the marine species like brittle stars, shells and worms, burrow out of sight during the day. Camouflage is important for animals like flathead, flounder and dumpling squid. They are waiting for the chance to ambush small invertebrates. These little crustaceans live on microscopic algae, bacteria and small food particles that are common in these habitats. Fishermen love these sediments, as one of the most sought after species for recreation fishers is the flathead.

These soft seabeds support lots of shelled animals. Most of the seashells out on the mud are little, smaller than a match head. There are also larger rare volute species that are very old species, relics of Gondwanaland, when the world's continents looked very different from today. The only marine mollusc species that is listed as threatened in Tasmania, the Gunn's screw shell (*Gazameda gunnii*), is only found on these sandy sediments.

Where there is debris on the bottom, like shells and pebbles, and there is a bit of water flow, larger animals can get a foothold. In channels like D'Entrecasteaux Channel, Bathurst Channel and the entrance to Pittwater, fields of unusual sponges, seawhips, anemones, tube worms, bryozoans and hydroids get established.

These inshore areas are great nurseries for juvenile fish species, including yelloweye mullet, Eastern Australian salmon and greenback flounder. Non-commercial species like gurnards, cowfish, globefish, skates and rays love it too. Gummy sharks also use shallow areas of soft sediment for pupping. Two species of sand fish are only known from shallow sandy habitats on the south coast of Tasmania.

Estuaries

Estuaries lie at the mixing zone between fresh and saltwater. Estuaries produce more organic matter per year than equivalent areas of forest, grassland or agricultural land.

In larger Tasmanian waterways they are usually major ports, cities and towns. 84% of Tasmanians live within estuarine catchments. Our coasts have very many different types of estuaries in varying degrees of naturalness. Some are remote and fed by huge West Coast rainfalls. Others are dry or even closed up. Southport Lagoon has large sand banks that are constantly changing, often blocking it from the sea. A total of 113 estuaries covering an area of approximately 111,000 ha occur around Tasmania. Unusually, Tasmania has every type of estuary other than fjords.

The Derwent and Tamar are important large estuaries. Despite being heavily modified in some places, the Tamar estuary at Low Head still has exceptionally high biodiversity. Another global rarity is that Tasmania still has untouched wild estuaries, 37 of our estuarine catchments have been identified as pristine.

Tasmanian larger estuaries contain a mixture of beaches, rocky foreshores, marshes and other wetlands, mudflats, seagrass meadows, kelp forests and rocky reefs.

There are five basic types, large drowned river valleys (e.g. Tamar, Derwent), fast flowing river estuaries, barrier or bar estuaries, saline coastal lakes and lagoons, and enclosed coastal inlets. Estuaries in northern Tasmania are all open to the sea and possess the highest tidal ranges, while many estuaries in eastern Tasmania and the Bass Strait islands are intermittently closed by sand barriers.

West coast estuaries are wild, dark and wet with poor nutrient levels. The nearby vast buttongrass plains and peaty heathlands result in brown tannins leaching into estuaries. These conditions do not occur in any other part of Australia. It allows animals from darker deep waters to move into accessible shallow waters. Low light adapted rare and delicate species of red algae be found in 5 metres of water. Filter feeding marine invertebrates such as gorgonians, sponges, lace bryozoans, anemones, sea whips, seapens, soft and hard corals, and tubeworms, normally found below 60 m depth are in shallow water in Bathurst Channel in the South West. This system is recognised as having global significance.

The diversity of estuaries means that they are often dominated by hardy species specially adapted to live in both fully marine or freshwater systems. Up to 150 fish species and 350 invertebrates have been identified in some individual estuaries.

Tasmanian estuarine environments contain Endangered species known nowhere else in the world, such as the spotted handfish, Maugean skate, and Derwent seastar. The range of the spotted handfish has shrunk back to just the Derwent estuary, it was the first fish to be listed as Endangered in Australia. The Endangered Maugean skate (Zearaja maugeana) was limited to two estuaries in south-west Tasmania. It is now only seen in Macquarie Harbour.

Estuarine habitats play an important role in nutrient cycling and pollutant filtration. Nearly 80% of estuarine habitat in Tasmania is listed as having very high conservation value. Many ecologically, recreationally and commercially valuable fish species depend on Tasmanian estuaries during some point in their life cycles. Estuaries are often called the ‘nurseries of the sea’, providing food, spawning habitat and shelter for juveniles to develop.

Intertidal mudflats, saltmarshes and other coastal wetlands

Most people think of mudflats as smelly and lifeless, and that is the case in badly polluted areas. Lots of mudlflats get filled in, to make way for ‘nicer’ seaside areas. But its normal for large banks of mud to form in the sheltered shallow of estuaries and bays. In more stable areas, seagrass will get a foothold, like Mueller’s Eelgrass, *Zostera capricorni*.

Mudflats tend to collect lots of nutrients running off the land which makes them prime real estate for some types of animals. Most of these are really small, too hard to see with the naked eye. They are mostly microalgae and small invertebrates, 55 species of diatoms and dinoflagellates have been recorded on just one Tasmanian mudflat. When the tide comes in these are easy things for juvenile fish to snap up and eat. Flounder, blennies, gobies, hardy heads and Australian salmon forage over the mudflats.

In the top 10 cm of sediment there are lots of burrowing little invertebrate species, crustaceans, molluscs and worms. 11,000 animals per m2 have been recorded in some locations. That added up to 135 species and 17 billion animals on one Tasmanian mudflat. That is a bonanza of food for any animal with the means to collect it.

In the summer months, up to a thousand shorebirds may land on one mudflat. These huge flocks of wading shorebirds chisel away at the shellfish they have extracted from the mud, with specially adapted beaks. Birdwatchers can see 25 resident or regularly visiting species and an additional 15 irregular visitors or 'vagrants'. Pied Oystercatchers and red-capped plovers are locals. The migrating Bar-tailed Godwit, Great Knot, Red Knot and Endangered eastern curlew, land to refuel after long migrations. Their specialised beaks mean that they cannot forage in any other habitat.

Mudflats perform a number of important ecosystem processes that help to protect the health of estuaries and sheltered bays. The activities of all these mudflat plants and animals help to remove potentially harmful nutrients from the water column.

Tasmania has proportionately more wetlands for its size than any other Australian state. Of the 40 recognised wetland types, 19 are found in Tasmania. Tasmania's wetlands also contain a large number of endemic and Threatened species, a disproportionately large percentage of all of the State's vascular plant species, and relic Gondwanan species. There are 44 marine and coastal wetlands in Tasmania on the Directory of Important Wetlands of Australia. Eight of these are also listed as internationally important 'Ramsar' wetlands, including Pitt Water-

Orielton Lagoon, Moulting Lagoon, Lavinia Lagoon on King Island, and Logan Lagoon on Flinders Island.

Right at the edge of the tides, in areas sheltered from wave action, a number of delicate specialised plants can colonise the brackish sand and mud. The soil is so salty, other plants couldn't live here. Tasmania has a very high diversity of saltmarsh plants, approximately 60 compared to 10 in northern Australia. In total, 336 saltmarshes, covering a total area of 57 km2 , have been mapped in Tasmania. Nearly 50% of this area identified as having high or very high conservation value.

Saltmarshes are most extensive and diverse along the south-east coast and in the far west of the north coast. In the wetter sections, saltmarshes are dominated by succulent herbs and shrubs. Their invertebrate communities include crabs, amphipods, worms and molluscs. Tussock species and non-succulent herbs are more common at brackish sites. Spiders and various insects enjoy the drier habitats. The saltmarshes on King Island provide critical habitat and food sources for the Endangered Orange-bellied Parrot.

Climate change and other human impacts mean that saltmarshes are now considered to be amongst the most threatened ecosystems in the world.

Red velvetfish, They aren't fished but numbers are believed to be falling dramatically in recent decades, Photo: M.Jacques

Coastal islands

There are around 600 named islands, 374 islands greater than 1 hectare in size and 6,163 islets smaller than 1 hectare as well as numerous small rocky islets and reefs around the

Tasmanian coast. These islands and islets have a total coastline length equivalent to 72% of the length of the Tasmanian mainland coast. These little remote specks of rock are refuges, often inaccessible to humans and feral animals. For breeding animals in particular, they are a safe oasis in a fast-changing world.

Tasmania's islands are home to some highly restricted endemic seabirds. Of the internationally significant Important Bird Areas (IBAs), nearly one third of them are located on islands around Tasmania.

The Australian fur seal (*Arctocephalus pusillus*) seems common enough, but it is one of the rarest seals in the world, and only occurs in Tasmania and parts of south eastern Australia. It breeds primarily in Bass Strait on a small number of rocky islands, but pups have been recorded as far south as the Ile De Phoques off eastern Tasmania, and The Friars off southern Bruny Island. As the ocean warms, more of these kinds of mobile species will try to relocate south to cooler waters, making Tasmania more important for their survival.

The most important seal site in Tasmania is Judgement Rocks, north-west of the Flinders Group. Nearly 2,500 seal pups have been seen here in one breeding season. Reid Rocks and Moriarty Rocks in Bass Strait are also important sites, with smaller numbers of pups recorded at eight additional breeding colonies.

Maatsuyker Island and several other small islands off Tasmania's south coast provide the only breeding habitat in Tasmania for the Rare New Zealand fur seal. Maatsukyer is also a haul-out site and occasional breeding site for the Endangered southern elephant seal.

The shy albatross is the only albatross species totally unique to Australia. Shy albatross (*Thalassarche cauta*) are less ocean-roaming than other albatross. They are often seen by boaters in Bass Strait, and tend to remain relatively close to their breeding sites at Albatross Island off Tasmania's north west, and the Mewstone and Pedra Branca off the Tasmanian south coast. While they don't roam as much as other albatross they will still forage as far as South Africa. The wandering albatross (*Diomedea exulans*) and grey-headed albatross (*Thalassarche chrysostoma*) breed on Macquarie Island and are sometimes seen in Tasmania. These island habitats, and their adjacent marine feeding grounds, are recognised as critical to the survival of these species.

Tasmania's offshore islands support massive aggregations of other seabirds too, short-tailed shearwater, little penguin, sooty oystercatchers, black-faced cormorant, fairy prion, Australasian Gannet, Sooty Shearwater, White-fronted Tern, White-faced Storm-Petrel, Fairy Tern and Australian pelican. Macquarie Island has outstanding ecological significance for its enormous concentration of 3.5 million breeding seabirds, including subantarctic penguins and many other seabird species not found further north in Australian waters.

Threats

Of particular significance to low lying or soft coastlines like estuaries and beaches are: [5]

- increased siltation resulting from land clearance and urban and rural runoff,
- increased nutrient loads resulting from marine farms, sewerage and agricultural use of fertilisers,
- foreshore development, dredging, habitats clearing and reclamation
- modification to water flow through dams and weirs,
- acidification of rivers and heavy metal pollution from mines,
- the spread of introduced pest species, and
- sea level rise and coastal erosion.
- Wildlife displacement, disruption of social and feeding behaviour e.g. Beach crowding, Pet impacts[6].
- Microplastics and litter (particularly damaging to seabirds).

On Harder coastlines like reef, or in the open sea,[7]

- climate change effects, ocean acidification, changes food supply, damage/changes to food availability e.g. plankton communities change, changing diseases, range extension, weather changes, extreme events,
- overfishing ,
- invasive (feral) species.
- Microplastics and litter (particularly damaging to seabirds).
- Wildlife interactions – eg. Boat strike on sea mammals.
- Disruption of behaviour e.g. seismic testing.
- pollutants., Excessive nutrients e.g. salmon farms, sewerage, stormwater.
- Silt from erosion,
- Habitat damage- dredging and bottom trawling

The complexity of this list, and other published diagrams shows that there are many threats to ecosystems at any one time. We are often asked, 'who is causing that impact', and while there are sometimes clear dominant threats, often there are multiple threats operating in tandem.

It may be more useful in some cases to think of resilience", how well-protected and healthy is the ecosystem we are talking about. Is it healthy enough to resist these threats?

We need many responses to many threats, but protecting the habitat has to be a key way to manage those threats. It also seems to be the response we are least likely to take.

[5] Based upon, A Classification of Tasmanian Estuaries and Assessment of their Conservation Significance using Ecological and Physical Attributes, Population and Land UseG.J. Edgar1, N.S. Barrett2 and D.J. Graddon3, Ocean Rescue 2000

[6] Dr Eric Woehler, pers comms

[7] Based on media monitoring by Marine Life Magazine 2010 - 2020

What is the problem to fix? Related-issues and impacts	Barriers to action/challenges	Possible Actions
Major Focus Area - Greenhouse Pollutants		
-ocean acidification. -range extension. -invasive pests. -extreme events. -sea level rise and coastal erosion. -loss of snow, glaciers and Antarctic shelf ice. -extinction of sensitive species. -loss of fisheries/agricultural productivity. -damage/changes to habitat and food availability e.g. plankton. -changing disease impacts e.g. POMS - Fire frequency -Weather changes - Iconic places impacts e.g. GBR bleaching events.	- Lack of knowledge, science funding and education. - Weak institutional frameworks. - Indifference and avoidance. -Tribal identification with the issues, lack of political consensus. - Importance of damaging industries and internal focus on these impacts alone. - Barriers to education. - Information overload. - Negative prejudgements. -Passive public 'Resistance is futile'. -Competition with other issues and crisis fatigue. - Needs for simultaneous international action. - Too singular a concern for 'impacts on iconic 'cute' animals' Less concern for predators and potentially dangerous animals, microscopic and ugly animals. -Seen as too far away, -Scepticism about scale of impacts. -Abatement measures seen as a threat to jobs or cost of living. - Mixed understanding of the urgency, even in green minded people.	- National and international programs. - Education and advocacy. - Update national political policy. - Education of politicians and bureaucracy. - CO2 pricing or abatement measures. - International treaty initiatives. - Understanding your CO2 footprint. - Positive measures in the home. - Also need to see positive developments in the economy, new jobs and opportunities.

Major Focus Area - Biodiversity decline		
- Predator culls, e.g. Shark netting, croc culls. - Plastics. - Boat strike on sea mammals. - Wildlife displacement, disruption of social and feeding behaviour e.g. Beach crowding. - General habitat degradation (see below). - Spread of pathogen, e.g. root rot disease in NPs. - Hunting e.g. overfishing, hunt sea mammals under the mask of scientific research. - Feral animals and invasive species. - Pet impacts.	- Low interest in species that are not iconic. - Lack of recovery and action plans and funding to implement them. - Knowledge gaps. - Feral animal removal resistance. - Sheer numbers of threatened species and a lack of resources for all. - Threatened species are now so common they can compete with many socially useful developments. - Crisis fatigue. - Scepticism that the threatened species impact is confected. -Low advocacy priority at times. E.g. 'Plastics' can have a bigger profile than its impact (threatened seabirds).	- National and international programs. - Education and advocacy- - National policy. - Political and bureaucratic education. - International treaty initiatives. - Plastics policy to deal with the disproportionate impact on seabirds. - Habitat protection, e.g. MPAs - Federal resources. - Research - Local programs, 'backyard' restoration initiatives. - Large scale habitat restoration projects. - Feral culls. - Intensive management of sensitive habitat. - Strengthen local relevant institutions
Major Focus Area - Decline of Habitat Condition and Habitat Protection		
- Litter. - Poor development practices. - Noise. - Chemical contamination. - Destructive extractive practices, e.g. bottom trawling. (Many of the other listed threats and impacts feed into this result.) - Trampling and overdevelopment at popular sites	- Stalled efforts to enhance protections in many areas e.g. MPA sanctuary zones. - Pushbacks from extractive industries. - Knowledge gaps. - Measures are undermined by broadscale impacts like climate change that don't respect park boundaries on a map.	- National policy. - Education and advocacy. - International treaty initiatives. - Local protective and restorative programs,

Major Focus Area - Industrial and Domestic pollutants		
- Adverse elements from industry processes and waste– e.g. CSG chemical use, airborne particulants. - Medicines and treatment chemicals in sewerage. - Greenhouse gas (see above). – Excessive nutrients e.g. salmon farms, sewerage, stormwater. - Silt from erosion, e.g. clearing, construction sites. - Microplastics and litter. -Waterway and other legacy contaminants e.g PFAS, heavy metals, PCBs. - Oil spills and other contaminants, e.g. waste water from mines in heavy rains.	Sometimes limited to visible local issues e.g. slime in waterways. -status quo defended by industry lobby groups -Can be expensive to remediate or find substitutes for common processes/substances	- National and international programs. -Education and advocacy. - Local programs. - Restorative wetlands. - Litter traps. - Silt management. - Changed product use and factory processes.

Major Focus Area - Damage from Extractive and other Industry		
- Fishing - Overfishing, by-catch, trawl damage. - Wildlife interactions – eg. seals at salmon farms. - Competition for water supply with mines. - Disruption of breeding behaviour e.g. seismic testing. - Land degradation e.g. Mining. CSG chemical use, land management impacts e.g. on traditional owner land management. - Forestry clearing - Impacts on key habitats e.g. mangrove clearing for resorts, loss of koala habitat - Destruction of geoheritage sites and other special places -Seabed and estuary dredging.	Multiple issues but single issue responses. Local industry e.g. when it is in the news. NIMBI response to mine or new tip. Directed at threats to personal interest.	- National policy. - Political media and bureaucracy education. - International treaty initiatives and objectives. - Local programs , primarily education and advocacy.
Major Focus Area - Agriculture		
- Pesticides and herbicide use. - Nutrient runoff. - Grazing damage. -Erosion e.g. GBR sediments and crown of thorns. - Competition for water. - Land clearing.	- Values, asking for preservation/absolute protection can put a brake on all development. - Perception that that is the ENGO's intent is to damage economic benefits.	- National policy. - Education and reminders. - Local programs , primarily education and advocacy. - Policies and regulation. - Support local issues.

What we can do:

Facebook: At the "Tasmanians for Marine Parks" site.
Instagram: tasmanians_for_marine_parks
Website info: http://marinelife.org.au and www.moreparineparks.org
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