

MARINE *Life*

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Our Goal

To educate, inform, have fun and share our enjoyment of the marine world with like-minded people.

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Cover Photo: Weedy seadragon with eggs – John Smith

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Queensland News

Great Barrier Reef – is the end getting nearer?



A recent study shows that surface temperature measurements across most of the regions of the Great Barrier Reef are changing. "Across the whole reef we found water temperatures increasing by an average of 0.2 of a degree over a quarter of a century – but

the increase was significantly more in some areas." "For example, off Rockhampton the water has warmed by about half a degree over the last 25 years." "Risk of coral bleaching increases with higher water temperatures.

In some areas summer is coming earlier and lasting longer; in others, both summers and winters are warmer than in the past. This all affects the sea life." This affects where sanctuary zones might be needed."Some people think we ought to have the highest levels of protection for areas that are changing the least, so they remain as refugia to recharge the surrounding reef areas," Dr Ban says.

"Others argue the opposite – that the greatest protection should be afforded to the most vulnerable areas. "

The study came out just as another international study pointed to the loss of coral reef across the world. It concluded that not taking strong steps to mitigate carbon dioxide is certain to result in major coral loss

by mid to late century. A modelling study from German, Canadian and Australian scientists has concluded that increasing global temperatures to two degrees Celsius above pre-industrial global temperatures will be too hot for two thirds of the world's corals and hence coral reefs. Global warming and ocean acidification, both driven by human-caused CO2 emissions, pose a major threat to these important marine ecosystems.

"Our findings show that under current assumptions regarding thermal sensitivity, coral reefs will no longer be prominent coastal ecosystems if global mean temperatures reach 2°C above the pre-industrial temperatures"

"For a long while, we thought that coral reefs would be safe up to 2°C higher in average global temperature but our research shows that this is no longer true."

To project the cumulative heat stress at 2160 reef locations worldwide, they used an extensive set of 19 global climate models. "...About 70 per cent of corals are projected to suffer from long-term degradation by 2030 even under an ambitious mitigation scenario."

The authors have concluded on the basis of this information that the thermal threshold required to protect at least half of the coral reefs worldwide is estimated to lie at or below a 1.5°C mean increase in global average temperature.

Corals derive most of their energy from a close symbiotic relationship with tiny plant-like organisms known as zooxanthellae. Under environmental stresses such as sudden increases in sea temperature, this critically important symbiosis breaks down and the brown symbionts are lost from the tissues of the coral. This can cause large numbers of corals to take on a brilliant white colour over a few days; referred to as 'mass coral bleaching'. First reported in 1979, coral bleaching has become more frequent and intense across the planet, and

has often been followed by mass mortality events across tens of thousands of square kilometres of coral reef.

"In the warm year of 1998, 16 per cent of the world's corals disappeared from reefs all over the world. In some locations - such as the Western Indian Ocean and islands off North-West Australia - reefs lost as much as 50-80 per cent of their corals in this disastrous year-long event."

The paper also investigates what would happen if the susceptibility of corals to thermal stress increased as a result of other factors such as ocean acidification and pollution. Ocean acidification is a consequence of the increasing amount of carbon dioxide entering the world oceans.

"Recent studies have indicated that the sensitivity of corals to thermal stress increases when they are exposed to acidified conditions" Professor Hoegh-Guldberg said.

"This has serious implications, including the possibility that current assumptions about the thermal sensitivity might underestimate, not overestimate, the future impact of climate change on corals." This comprehensive analysis highlighted how close we are to a world without coral reefs.

"The window of opportunity to preserve the majority of coral reefs, part of the world's natural heritage, is small," said Malte Meinshausen, co-author at the Potsdam Institute for Climate Impact Research and the University of Melbourne. We close this window, if we follow another decade of ballooning global greenhouse-gas emissions."

The bad news kept coming with another report revealing that more than half of the Great Barrier Reef had disappeared in the last 27 years.

Scientists from the Australian Institute of Marine Science in Townsville say the world heritage area is under a triple attack from crown of thorns starfish, cyclones and coral bleaching.



The study links large numbers of the starfish to problems with water quality in the Great Barrier Reef, such as fertiliser run-off. The study says the rate of coral decline is faster than expected, and if current trends continue, the Great Barrier Reef's coral cover could halve again by 2022.



Structures may cause jellyfish blooms



Most scientists try to explain the increase in jellyfish blooms by a lack of predators or competitors due to overfishing, but the new study suggests it's a result of the proliferation of artificial structures, which allow jellyfish polyps to flourish. Human-made structures such as harbours, tourist facilities, oil rigs and aquaculture farms provide ideal sanctuaries for jellyfish polyps to flourish and may explain an apparent increase in jellyfish blooms in many coastal waters around the world.

That's the conclusion of a new WA study. Professor Duarte said most theories that seek to explain increased jellyfish blooms focus on jellyfish at their more mature swimming stage and factors such as a lack of predators or competitors due to overfishing. But the new study examined the tiny polyp phase of jellyfish and found they congregate in

millions on the underside of human-made structures. "We call this new proposition the 'Trojan Horse' hypothesis," Professor Duarte said.

"The proliferation of artificial structures such as harbours, shipping facilities and aquaculture structures provides a habitat for jellyfish polyps and may be an important driver in explaining the global increase in jellyfish blooms."

Professor Duarte said jellyfish larvae typically settle on a hard surface and grow into polyps as part of a colony. The polyps are generally inconspicuous because they are very small - usually only a millimetre or so in length.

The study examined polyps growing on a variety of man-made structures around the world - including in Japan, Britain, Spain and Slovenia - and looked under docks, piers, pontoons and artificial reefs, and on the underside of oysters attached to piers. "Jellyfish polyps existed on the underside of such artificial structures at densities of more than 10,000 individuals per square metre, and sometimes up to 100,000 per square metre,"

Cable Beach awash with jellyfish

A natural event this September saw hundreds of thousands of jellyfish wash up and rot on Cable Beach in Broome.



Jellyfish are not an uncommon sight along Broome beaches and large aggregations can get blown ashore in onshore winds. This year the numbers were very high.

They are a relatively harmless type of brown jellyfish that can deliver a sting, but are not fatal. Despite this it put tourists off and the beaches have been deserted.

Little Penguin population monitored



University researchers hope a three-year study of little penguin (*Eudyptula minor*) colonies in the Rockingham region will help them gain a better understanding of the impacts of climate change and the Leeuwin Current.

Earlier this year Murdoch reported that at the end of 2011, 49 Little Penguins died in WA's South West and on Penguin Island, citing starvation—most likely caused by high sea temperatures, as the reason behind their deaths. High sea temperatures are linked to the strong La Nina conditions and Leeuwin Current, which force many fish the penguins rely on to cooler waters. There has been a noticeable absence of sandy sprat, the prey that comprises the greatest proportion of the penguins' diet when raising chicks.

Satellite and GPS tags will be used to assess the foraging habitats of the penguins during different stages of their breeding. Dr Cannell says she also hopes the research will, "improve our predictions for the likelihood of the little penguin colony to survive impacts associated with climate change and coastal use".

The study will promote community stewardship of the environment and locals will be asked to walk along the coast looking for dead penguins, which will then be autopsied.



NT News (& a bit WA)

Illegal fishing vessels caught



Two foreign fishing vessels suspected of illegally 'blast fishing' in Australian waters off Broome (WA) and the Tiwi Islands (NT) have been seized.

ACV *Roebuck Bay* apprehended a foreign fishing vessel and ten Indonesian fishers at Scott Reef off Broome. Explosives were found

on the boat including a length of detonator cord and 15 aluminium tubes (5-6cm long) packed with cotton wool and a dark powdery substance. Other suspected blasting devices were found in the water directly beneath the vessel. Over 320kg of fish was seized including sea cucumbers, shark flesh and fins, and sea snails (trochus).

As part of a joint border patrol with Indonesian authorities, the ACV *Botany Bay* apprehended a second foreign fishing vessel near Evans Shoal – north of the Tiwi Islands with ten Indonesian fishers yesterday. Explosive detonators and 200kg of fish, mainly Red Snapper, were seized. Cooperative efforts between Australian and Indonesia are yielding strong results in combating illegal fishing in the region. Apprehensions in Australia's waters have fallen from 367 vessels and 2,961 illegal foreign fishers in 2005–06 to just 12 vessels and 68 fishers in 2011–2012.

"Blast fishing is highly destructive to the marine environment and any suspected blast fishing will be dealt with seriously", Mr Venslovas said. The vessel apprehended at Scott Reef will now be escorted to Broome while the vessel apprehended near Tiwi Islands will be taken to Darwin. AFMA will further investigate the activities of these vessels.



SA News

Cats, rats and penguin colonies

per ABC News

Authorities say 25 feral cats have been trapped near little penguin colonies on Kangaroo Island SA. Trapping was done over two three-week periods.

Feral cat project officer Helen Achurch said rats were also trapped. "There's been a couple of studies done that suggest rats have had an impact on little penguin chicks," she said. "With that number of rats there, that number of cats there ... all these sort of factors are contributing to impacts to the birds in their nesting areas."



"We know that feral cats have significant impact on lots of native fauna around Kangaroo Island. From gut samples we've seen that they take lots of small birds, reptiles and also penguin feathers have been found so we know that they're likely to take some penguins, but we don't have a lot of information on how much impact they're having."

The Kangaroo Island Natural Resources Centre says more trapping will be done next month, after penguin chicks have hatched.



TASSIE News (that 'other' island)

Macquarie Harbour fish farms expand

The Federal Environment Minister, Tony Burke, has approved a massive expansion of fish farming at Macquarie Harbour in Tasmania's west. Salmon farmers Tassal, Huon Aquaculture and Petuna are expanding their marine leases in the harbour to nine square kilometres.

The companies won State Government approval for the expansion in May and say a Federal Government review has made almost no changes to the plan. State Resources Minister Bryan Green says the expansion will provide an economic boost to the region.

"[There will be] 100-odd people employed through construction ... and ensuring that \$88 million-odd is spent in this important industry for the state," he said.

Environment groups argued the project was unsustainable and could damage ecosystems in the nearby world heritage area. Alderman Gerrity believes the pollution concerns have been overstated. "But I think this will probably be the max it could take."

A conservation group is calling for strict environmental monitoring.



Humans have brains like sharks... (or vice versa)

New research shows that shark's brains share several common features with those of humans,

"The studies... suggest that people may have more in common with sharks than we thought," said Dr Kara Yopak.

"For instance, one of the papers shows that with great white sharks, the area of the brain that receives visual input is quite large, and suggests the relative importance of vision in these animals is quite high.

Although sharks were previously thought to have relatively simple brains, the researchers have shown that sharks and other cartilaginous fishes have a battery of highly developed sensory systems and relatively large brains.

"Another of the papers suggests that the cerebellum - which appeared first in early sharks - is an important evolutionary advancement that has paved the way for some aspects of higher neural function in vertebrates, including humans," Dr Yopak said.

So yes, the boss does think just like a shark.

Identifying rays by their DNA

STUDY by Charles Darwin University and UWA Oceans Institute provides the first application of DNA-barcoding to tropical rays.

Species barcoding is now a global campaign with a large number of research projects across a range of species.



"We need investment in barcoding elasmobranch biodiversity in developing countries, where species are under extreme pressure from over fishing. Such information is critical for limiting species boundaries, fisheries management and conservation of tropical rays."

The study sampled rays at Ningaloo Reef and found nine species with new barcode sequences from Australia, now added to the GenBank database. The study also produced new distributions for previously barcoded species.

The decline in taxonomic expertise globally presents problems for field studies. "There is a mistaken belief that molecular genetic data can replace traditional morphology-based taxonomy. While barcoding will facilitate accurate identifications, it still requires specimens to be formally described, or identified, by taxonomists. This is where the potential of barcoding will fall down."

Love Sea Cucumbers and they love you back

- by Mike Jacques

Last edition we asked you to love gross animals like sea cucumbers, even if they look like poo and worry less about iconic but common sea mammals. Apparently this love keeps you healthy and young.

Rescuing your looks



Sea cucumbers and sea urchins can fix your wrinkles (although if you are like me you won't have any). They are able to change the elasticity of collagen within their bodies, and that could hold the key to maintaining a youthful appearance.

U.K. researchers have found the genes for "messenger molecules" known as peptides, which tell cells in their bodies to cause rapid stiffening or softening of collagen in the body wall of sea cucumbers.

"Although sea urchins and sea cucumbers may not look much like us, we are actually quite closely related to them [some more than others]. As we get older, changes in collagen cause wrinkling of our skin, so if we can find out how peptides cause the body wall of a sea cucumber to quickly become stiff or soft then our research might lead to new ways to keeping skin looking young and healthy."

"We also found that sea urchins have a peptide that is very similar to calcitonin, a hormone that regulates our bones to make sure that they remain strong," Professor Elphick said.

Rescuing the poor

UK researchers also think sea cucumbers could be used as a natural, organic cleaner on fish farms around the world as well as a source of food. Used widely in Chinese medicine and cuisine, sea cucumbers are also a rich source of glucosamine and chondroitin which are used in a range of common food supplements.

As well as looking at the potential for farming sea cucumbers in the UK, the team is also leading a major aquaculture project in Tanzania where animals are being grown in lagoon-based cages in a hatchery built for producing juveniles to support a growing industry. This food export can provide a valuable income and a sustainable alternative for people living in the poverty. "Sea cucumbers are fairly simple to farm, they just require clean water and plenty of food in the form of nutrient-rich waste.

Rescuing Diabetics

Marine animals, like sea urchins and acorn worms, produce NG peptides - proteins that help the creatures release their eggs and sperm at the same time. NG peptides are made by a gene very similar to the mutant gene that causes diabetes insipidus in humans.

He says: "Genetic tests on patients with diabetes insipidus show their symptoms are caused by an inability to produce the hormone vasopressin, which tells the body how much urine to make. "By researching further into how animals like sea urchins produce NG peptides, we will understand better why the faulty human vasopressin gene can cause this form of diabetes in around 10,000 people in the UK."

Rescuing the Disabled

Sea cucumbers are the champions of organ regrowth because they direct their wound healing abilities towards restoring their organs and give us the opportunity to discover how to repair our own wounds and, perhaps eventually, how to regenerate body parts.

All animals possess some kind of tissue repair mechanism. The scientists found that over a four-week healing period sea cucumbers healed up rapidly after receiving a 3 to 5 millimetre cut along the body wall. The repair process involved special cells called morula cells moving to the injury site and full repair was achieved after just a couple of weeks. "Sea cucumbers will probably provide us with the key to deciphering how to regenerate our tissues, or at least find out what is needed to do this."



They can also throw up their intestines on an attacker – ikky but it works

Spearfishing records saving science



Competition records collected by fishing clubs over the past 50 years will be used by CSIRO scientists to detect changes to fish distributions along the south-east Australian coast.

CSIRO hope to understand how these changes will impact on the experience of recreational fishers and to better develop adaptation strategies for coastal communities.

Scientists will review historic records from New South Wales, Victorian and Tasmanian fishing clubs from as early as the 1960s.

Recreational users of coastal waters are often in the best position to see changes occurring locally. These records will provide insight into how fish populations have moved as the East Australian Current (EAC) pushes southwards.

Reports from the Melbourne-based Southern Freedivers spearfishing club shows changes in species are already being seen in Victoria.

In contrast, the Underwater Skindivers & Fishermen's Association said some New South Wales fishers have noticed 'less movement of northern species down the central area of the NSW coastline compared to the previous decade'.

Previous studies suggest the 1980s was a tipping point for change among marine species on the east coast of Australia. Early records from the 60s and 70s will provide a baseline against which we can measure change and compare distributions.

Estuary News

The estuary trawls amongst you will be excited to hear about this news just in from the Fisheries Research and Development Corporation. Funding has recently been secured to conduct an Australia-wide Business Case on repairing estuaries. The call has officially been put out Australia-wide for nominations of potential estuaries that could do with a helping hand.



Works include constructing road or railway line culverts to improve tidal flows, removing bunds, levees, drains and ponded pastures to re-establish tidal wetlands and manipulating flood gates to re-connect fresh and brackish wetlands to estuaries.

The Fisheries Research and Development Corporation (FRDC) is co-ordinating a business case for these works across Australia and needs you to name key wetlands and estuaries where works can be easily achieved to repair fisheries values.

More than 300 estuaries in Australia are listed as "substantially modified". Most of these are typified by big floodplains, and this is also where investment has the potential to have multiple community benefits - commercial fishing, recreational fishing, water quality, landscape amenity, carbon sequestration flood management and more.


So if *you* have a favourite estuary that you'd like to nominate for protection, get in touch with FRDC via frdc.programs@frdc.com.au

Turning the tide on past mistakes

Re-introducing tidal flow and re-connecting wetlands ensures there will always be fish and prawns

Nominate an estuary or wetland where repair works can be undertaken

Email: frdc.programs@frdc.com.au



Re-creating Australia's fishery productivity

TRAVEL FEATURE (at last!)

A magazine that also caters for divers soon gets requests to publish boring international travel stories. It will have to be special before we'll cover it. We need a complete seaside wilderness with an absolute guarantee of peace and quiet, a bit like the Montebellos.

Gruinard Is, West Scotland



Travel Tip: Check your travel insurance cover

were taken to the island and hit with a cloud of anthrax spores. The sheep became infected and began to die within days of exposure. It's a credit to the British people, that even when facing the realistic prospect of Gestapo and gas chambers, they never actually used this tactic. Efforts to decontaminate the island afterwards failed due to the high durability of anthrax spores. Visits to the island were prohibited. Starting in 1986 a determined effort was made to decontaminate the island with 280 tonnes of formaldehyde and the worst-contaminated topsoil was removed. A flock of sheep was then placed on the island and remained healthy. On 24 April 1990, after 48 years of quarantine, warning signs were removed. It's all safe, trust us.

In 1942, during the Second World War there was an investigation by the British government into the feasibility of an attack using anthrax, known as operation "Dark Harvest". It was recognised that tests would cause widespread and long-lasting contamination and a remote uninhabited island was required. Gruinard was deemed suitable. Eighty sheep

Rebirth Island



Located in the central Aral Sea, Vozrozhdeniya Island was one of the main laboratories and testing sites for the Soviet Microbiological Warfare Group. The Soviets called it Rebirth Island, as you would with an island of death [*handy, as it's easier for Club Med tourists to say too*]. It has every conceivable kind of disease, what's tularemia by the way? It was once home to 1,500 people who happily lived next to canisters of bubonic plague without any (reported) problems.

It was probably a sensible precaution to put it on an island, except that they also created a disastrous cotton irrigation scheme and the Aral Sea began to dry up and disappear. The laboratory staff members abandoned the small island in 1992 and it ceased to be an island in 2001. Many of the containers holding the spores were not properly stored or destroyed. In 2002, American and Uzbekistani authorities decontaminated the site, so now you can travel there, no problem. How about a tourism-led rebirth? It even has its own 'house' wreck, and what a breeze for novice divers.



Critter Files

Latchet, *Pterygotrigla papilio*

These beautiful fish are also known as sea robins.

In Australia the Latchet or Spiny Gurnard is recorded from temperate waters of eastern Victoria, around to about Perth, Western Australia. I have also seen an even more colourful red species called the Latchet Gurnard, or Sharpbeak Gurnard (*P. polyommata*) with a similar range.

Adults are found on the continental shelf while juveniles enter bays and estuaries. Sources vary about how deep it lives with some saying less than 60M, others 400+M.

I've only ever seen one example of each of these species in my life and both in the D' Entrecasteux Channel in 15 Metres or less. When alarmed they spread their brightly coloured 'wings' probably to confuse an attacker and also to alert them to their many sharp spines.

Considered a dry table fish it is rarely targeted by fishermen, but is caught in small quantities in the by-catch of the trawl fishery.



The lowdown on Australian Salmon (*Arripis trutta*)

They have become part of the fishing culture of SE Australia and their migration is one of Australia's great natural spectacles. Tasmania is a breeding ground and sanctuary for Salmon.



Australian salmon were first recorded by Captain Cook in 1769 in waters near New Zealand. To him, they looked like European salmon. In fact, Australian Salmon are not true salmon but belong to the Perch family. Australian salmon is also known by a number of other names, the most popular locally being Black-backed salmon, or Cocky salmon. Eastern Australian salmon are found in waters from mid-NSW to central Victoria including Tasmania.

Australian salmon are a relatively quick-growing species, sexually mature at about 4 years of age when they are around 40cm long. They can grow to 90cm in length. On reaching this size, they are around 10 years old. Eastern Australian Salmon can live for up to 26 years and reach 7kg in weight.

When they get to a mature size they are ready to spawn, but they need energy for that. Huge schools migrate for breeding to coincide with the summer migration of schools of pilchards, whitebait and krill. The fish migrate from Tasmania and central Victoria to waters off southern NSW and north-eastern Victoria.

They move about in age groups, and are opportunistic feeders. Stomach contents from fish caught in Western Port, Victoria, showed they ate anchovy (*Engraulis australis*), pilchard (*Sardinops neopilchardus*) and sandy sprat (*Hyperlophus vittatus*). Adult anchovy were the dominant food item in Spring and early summer. In Autumn they chased juvenile anchovy and pilchard.

Australian Salmon are nearly always found in large schools. In experimental feeding, juvenile Australian salmon had higher rates of successful attacks when foraging in bigger groups. Schooling fish are better at reducing the confusion effect of seeing a mass of swarming prey. The spectacle of this huge migration also excites Australian Salmon predators.

Conflict between the commercial and recreational sectors is a big thing in Victoria. Commercial netting often occurs in daylight hours close to the shoreline. Anglers can see commercial fishing remove entire salmon schools. But that is just a small slice of the real picture. Here is one fishery where there is no point trying to say that recreational fishermen really aren't having much of an impact. It's estimated that Victorian surf anglers alone could account for more than 80% of the total catch. After spawning, the surviving fish move back south into Bass Strait and also into NSW waters.

Spawning has released eggs in the open ocean in batches over a period of time. Once fertilized the 1mm sized eggs hatch within 40 hours and then drift with the zooplankton in the current. Once hatched the first year fish drift and migrate south and east away from the spawning grounds to waters in Victoria and Tasmania. They are assisted by the south flowing East Australian Current. Juvenile fish up to 6cm will start

to appear in Tasmania waters between January and September where they will frequent bays, estuaries and other sheltered coastal waters. One fisherman, Shane Flude, has recorded the spectacle of a large school of Australian Salmon, you don't have to read for long to 'feel the love' and sense the wonder,

"In Tasmania waters on calm days you may sometimes see large schools of feeding salmon sipping food items from the surface. Disturbing the feeding salmon can be as simple as a low flying bird which then sends one thousand fish straight to the bottom. They are often identified from some distance by a large number of actively feeding and diving sea birds as the salmon drive their food source to the surface. A relationship such as this is known as a commensal relationship, one that benefits the birds greatly but neither harms nor helps the salmon. It has been suggested that overfishing of salmon could have serious effects on the breeding success of the birds, such is the importance of this relationship."

For another recreational fisherman it was 'shock and awe' at the spectacle, *"Diving for a feed of Abalone at Primrose Sands once and was swimming along minding my own business when I was bum rushed by a couple of thousand Blackback Salmon who was being bum rushed by about 20 Dolphins. The Salmon were in that thick a ball and that panicked they were smashing into me left right and centre and believe me they hit pretty hard. Wondered what in the hell happened for a minute it all happened that fast. The Salmon cleared and then the Dolphins went charging past at a hundred mile an hour as well. Frightened the hell out of me for a minute. Took a good fifteen minutes for all the scales to settle out of the water, they were shimmering like snow flakes."* The trick is to turn the love and wonder into concern for the long-term sustainability of the fishery.

Most Australian salmon caught in Tasmanian waters are juveniles. Fishing out juveniles isn't generally a good idea and Australian salmon stocks were decimated by intensive commercial netting during the second half of the 20th century. Most ended up in cans intended for lunch meat, or as pet food. They were also used for bait in crayfish pots. Commercial catches have declined and the species is slowly staging a modest recovery.

FEATURE - WA

Microalgae Biofuel and the Coast

Primary Source: Borowitzka et al GIS study



The algae pilot plant of Aurora Algae in Karratha, Western Australia

The ever increasing global demand for energy has led to substantial interest in the development of biofuels. Modern commercial liquid biofuels such as bioethanol and biodiesel are made from crops, or waste fat.

According to the OECD (2009) the global annual production of bioethanol is projected to increase from 93 to 115 GL between 2010 and 2019, and biodiesel production from 21 to 41 GL. However, the fuels face competition with food crop production. Therefore, there is an urgent need for alternative sources of raw material for biofuel.

Biofuels from algae are seen as an important component of the future biofuels mix. Algae are plant-like small organisms. They are extremely diverse and can be found in most habitats of the world including fresh and sea water, salt lakes, soil, snow and on surfaces such as rocks.

Because of their fast growth rate and high lipid (fat) content, microalgae appear to be especially well suited for renewable biodiesel production. Algae production does not necessarily compete for limiting resources such as fresh water. Algae photosynthesis rates are higher on an area basis compared with land plants, thus requiring less land.

An important advantage of microalgae over any other oil containing crops are their capability to grow on saline and hypersaline water, and also the possibility of growing them on land not suitable for agriculture. This means that microalgae can be cultivated in coastal regions and even on the surface of the ocean. However, the process of growing algae as a source of raw material for biodiesel production is not yet commercially viable. Although commercial production of microalgae for biofuels does not yet occur, commercial production of microalgae for high value products such as pharmaceuticals, nutraceuticals and health food has been carried out for over 60 years.

There are more than 25 companies worldwide trying to establish an economical process for growing microalgae. Australia has the two largest commercial algae production plants in the world at Hutt Lagoon Western Australia, and Whyalla, South Australia. Open ponds are the most widely used systems for commercial large-scale outdoor microalgae cultivation.

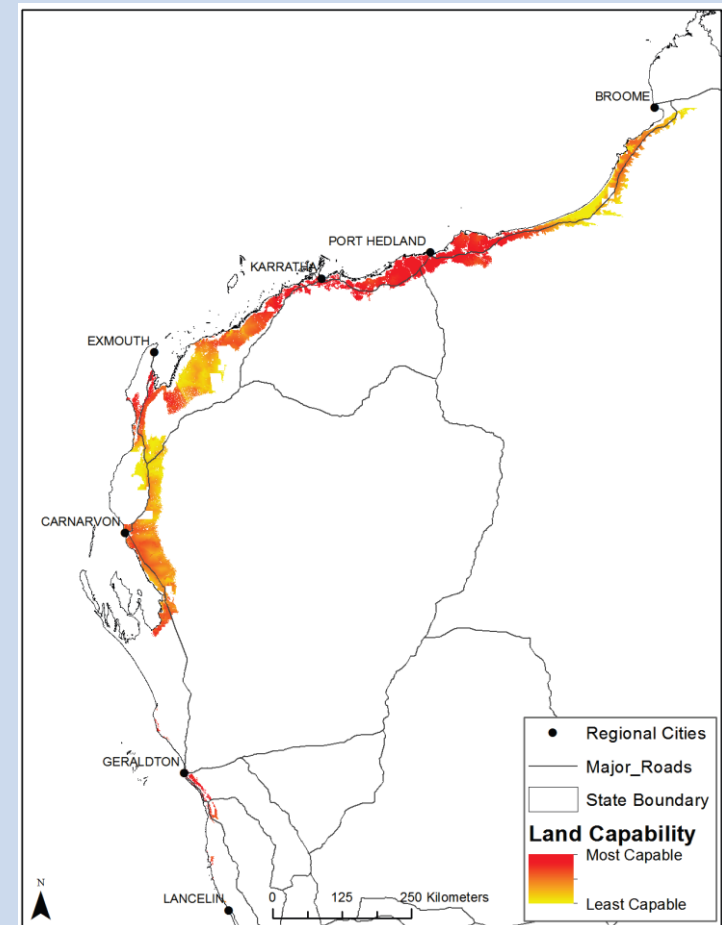
Considering that no more than 40% of microalgae biomass can be oil, the cheapest microalgae oil produced to date costs more than \$ 12 a litre. Extensive R&D is required to make biofuels from algae economically viable. One of the most important aspects for progress to commercialisation is to find suitable sites for economic large scale production.



Hutt Lagoon, WA

The largest areas identified as capable for algal biofuel production exist along the coast from the southwest of Karratha to the northeast of Port Hedland. This region provides ideal climatic conditions and suitable land in terms of limited topographic relief and competing land use. Potential limiting factors include low workability of coastal soils and the high frequency of cyclone development during the summer months.

The current study didn't go into the environmental consequences of remodeling coastal areas, especially sensitive coastal lagoons, as with tidal power we have to wait and see whether it's a boon or a bane, when there is a bit more detail.



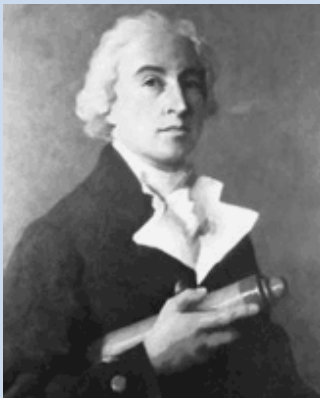
Explorers and their early Marine Life Observations

BASS and FLINDERS – 1797-98

Bass and Flinders are appropriately nearly always mentioned in the same sentence. In life they were an 18th century's version of the "Hardy Boys", knocking around together, having "simply smashing" adventures, and getting into dangerous spots where they have to work it out with only 'British pluck' and a bent bobby pin.

There isn't much adverse commentary written about them, and they seem like genuinely likeable, nerdy guys who loved maps and sailing. Someone you might want leading your local Sea Scouts group.

Matthew Flinders had wanted to become an explorer since first reading the book "Robinson Crusoe". He signed on as a Lieutenant's servant aboard the "*HMS Alert*". He also sailed with Bligh, as a midshipman on "*HMS Providence*". By 1795 he was Second Lieutenant aboard the "*HMS Reliance*", on her way to Australia. George Bass, was the ship's surgeon. Bass and Flinders quickly became firm friends. At Sydney they often went off together to survey the local area. First they explored Botany Bay and George's River, and then, after a brief visit to Norfolk Island, going farther south to Lake Illawarra.



In December, George Bass left the settlement at Sydney Cove to chart the mostly unknown land southward of the new colony. He had to provide his own whale boat, and was only given six weeks provisions, and a crew of six seamen.

He explored the waterway later to be known as Bass Strait and landed to make contact with a group of natives seen on an offshore island. He was surprised to find they were convicts who had run away with a boat from Port Jackson, to plunder the wreck of the "Sydney Cove". Not being able to find the wreck, there was a falling out and these convicts were marooned by their companions.

Bass caught a quantity of petrels [mutton birds], and spent a week salting them for the voyage. Unable to help the convicts he put five ashore on the mainland, and gave them implements and directions to Port Jackson. He then examined Wilson's Promontory and the northern half of the Strait.

At the same time, Captain Hamilton was setting sail for Preservation Island on the schooner *Francis*, for the wreck of his ship the "Sydney Cove", to bring up what remained of the cargo and the few remaining people. A young naval officer, Matthew Flinders, talked his way onboard so he could chart some more undiscovered lands.

Off Wilson's Promontory he saw small cluster of steep islands, and two or three rocks; one of which he named *Judgment Rock*, "from its resemblance to an elevated seat". He then found the Kent Group, "in honour of my friend captain William Kent, then commander of the "Supply"". He also passed by and charted many of the smaller islands off the Furneaux Group around what was later to be called Flinder's Island.



They anchored at the wreck site in Hamilton's Road, at the east end of Preservation Island. The hull of the ship "Sydney Cove" was still lying there broken up, and scattered beams, timbers, and parts of the cargo, were strewn all around the area.

By the end of his short but well-recorded voyage he had pretty much decided Bass Strait separated Tasmania from the mainland, but he could not prove it.

Back at Sydney Cove, young Bass and Flinders met up to compare charts. They excitedly prepared for another great joint exploration. This time they would attempt to sail the full length of the suspected Strait. Their skill and enthusiasm (as well as the valuable seal skin trade they had just helped discover) impressed Governor Hunter and despite being short of ships he gave them the tiny sloop *Norfolk*. They were also tasked to escort a small sealing vessel to the islands.

FLINDERS and BASS - 1798

On their next adventure they sheltered in the Kent Group, but it didn't seem enticing *"we could occasionally perceive a brown-looking vegetation of brush wood, and here and there a few starved gum trees; but there was neither bird nor quadruped to enliven the dreary scene"*.

They set sail and anchored at the east end of Preservation Island near the old wreck site. *"Mr Hamilton had left his house standing, with some fowls and pigeons in it, when we had quitted the island nine months before. The house remained in nearly the same state but its tenants were not to be found, having probably fallen a prey to the hawks"*.

Leaving the sealing vessel behind they sailed and later anchored in a small sandy bay, at the south-east end of the largest Swan Isle, *"which, on examination, they appeared very little to deserve, for we did not see a single bird of that species, or any of their nests; but there were several of the bernacle [Cape Barren] geese, and two of them were shot by Mr Bass"*.

Sailing West they passed over Fosters Reef well known to modern divers due to its large shipwrecks and big seas. They had a scare when they were *"carried by the tide over a ledge where there was scarcely 2*

fathoms; and was then driven westward on a curved line of rippling water, which extended northward from the islets as far as the eye could reach".

They then found the Tamar, *"Ducks and teal went by flocks in Port Dalrymple; but they were shy, and we took no trouble after them. The white-bellied shag, and the black and pied red bills were common in the lower parts of the port, and some pelicans were seen upon the shoals. The large black shag, usually found in rivers, was seen in different parts of the Tamar; and upon another occasion, we found these birds to be tolerable food."*

Neither our wants nor leisure were sufficient to induce any attempt to catch fish. Muscles were abundant upon those rocks which are overflowed by the tide; and the natives appeared to get oysters by diving, the shells having been found near their fire places. "

They then set sail and charted the north-west coast. Off Circular Head, *"A large flock of gannets was observed at daylight, to issue out of the great bight to the southward; and they were followed by such a number of the sooty petrels [mutton birds] as we had never seen equalled. There was a stream of from fifty to eighty yards in depth, and of three hundred yards, or more, in breadth; the birds were not scattered, but*



flying as compactly as a free movement of their wings seemed to allow; and during a full hour and a half, this stream of petrels continued to pass without interruption, at a rate little inferior to the swiftness of the pigeon. On the lowest computation, I think the number could not have been less than a hundred millions; and we were thence led to believe, that there must be, in the large bight, one or more uninhabited islands of considerable size."

This was obviously an awe inspiring spectacle and expecting no-one to believe him he scribbled down his method of calculation,

"Taking the stream to have been fifty yards deep by three hundred in width, and that it moved at the rate of thirty miles an hour, and allowing nine cubic yards of space to each bird, the number would amount to 151,500,000. The burrows required to lodge this quantity of birds would be 75,750,000; and allowing a square yard to each burrow, they would cover something more than 181 geographic square miles of ground."

They sailed past Three Hummock Island in the western extent of the now 'proven' Bass Strait.

At Albatross Island, Governor Collins later recounted the story as *"The birds they found were albatrosses innumerable. The spread of their wings was from seven to nine feet. Their colour was more white than black, and the appearance of their visitors did not occasion much disturbance among them, even when they approached close to them. This was the*



season of their breeding. The females sat upon nests not more than a foot and a half apart, built of muddy earth, bound with coarse grass, raised about four inches from the ground, and formed into a concavity of nearly that depth, with a diameter of five or six inches. One young bird only was in each nest: it was of the size of a small pullet, but at that time covered with a beautifully white down. The shapeless lump at some distance resembled a ball of cotton. Some nests held an addled egg of a dingy white colour, and equal in size to that of a goose. The nests were so near each other, and the birds so conscious of the great strength of their sharp s, that in going through them the voyagers were obliged to make use of their seal clubs, to procure themselves a passage. Even the young ones spouted plentiful mouthfuls of a not inodorous oil upon them. "

"The island, which obtained the name of Albatross Island, was a mere mass of stone, without any other vegetation than a few tufts of coarse grass. Besides albatrosses, it afforded shelter to a few scores of hair seals, and the large gull."

They then decided to go all the way and circumnavigate the island. They wisely stayed well offshore on the Western and southern coast before exploring Storm and Norfolk Bays. In the Pittwater, the lagoon was found to be frequented by ducks, black shags, pelicans, and gannets.

In the evening of the 21st they entered the mouth of the Derwent. *"In passing between two islands, the heads of the seaweed, which, from its size, is named the Gigantic, were showing themselves above the surface in six or eight fathoms water: a diminutive plant when compared with those of the kind seen in higher latitudes, but of vast magnitude in comparison with the generality of seaweeds."*

At Herdsmen's Cove, *"a great deal of long, aquatic grass growing upon these mud flats, seemed to have attracted the black swans, for the number collected there was not estimated at less than five hundred"*. They sailed out of the river on the return journey to Sydney Cove.

They stopped at Babel Island in the Furneaux Group for provisions. Bass returned with a boat load of seals and gannets. *"Besides these, the islet is inhabited by geese, shags, penguins, gulls, and sooty petrels; each occupying its separate district, and using its own language. It was the confusion of noises amongst these various animals which induced me to give the name of Babel Isles to this small cluster"*.



This was their last Tasmanian landfall. Back at Sydney Cove, Flinders showed that he was no egomaniac, *"to the strait which had been the great object of research, and whose discovery was now completed, Governor Hunter gave, at my recommendation, the name of BASS' STRAIT. This was no more than a just tribute to my worthy friend and companion, for the extreme dangers and fatigues he had undergone in first entering it in the whale boat..."*

Flinders then examined parts of the Queensland coast, but although he entered Glass House Bay, he did not discover the Brisbane River.

More Observations of the Furneaux Group

1798 – Seals, Penguins and Mutton



When Flinders visited Cape-Barren had sooty petrels [mutton birds], and large fur seals, *"some of them (the old males) were of an enormous size, and of extraordinary power. I levelled my gun at one, which was sitting on the top of a rock with his nose extended up towards the sun, and struck him*

with three musket balls. He rolled over, and plunged into the water; but in less than half an hour had taken his former station and attitude. On firing again, a stream of blood spouted forth from his breast to some yards distance, and he fell back, senseless. On examination, the six balls were found lodged in his breast; and one, which occasioned his death, had pierced the heart: his weight was equal to that of a common ox".

On Cone Point, *"the number of seals exceeded everything we had, any of us, before witnessed; and they were smaller, and of a different species from those which frequented Armstrong's Channel [NZ fur seals?]....The young cubs huddled together in the holes of the rocks, and moaned piteously; those more advanced scampered and rolled down to the water, with their mothers; whilst some of the old males stood up in defence of their families, until the terror of the sailors bludgeons became too strong to be resisted. ...The sailors killed as many of these harmless, and not unamiable creatures, as they were able to skin during the time necessary for me to take the requisite angles; and we then left the poor affrighted multitude to recover from the effect of our inauspicious visit"*.

On Cape Barren Island there were seals of two kinds, sooty petrels, and penguins. *"The hair seal [sea lion?] appears to frequent the sheltered beaches, points, and rocks; whilst the rocks and rocky points exposed to the buffetings of the waves are preferred by the handsomer and superior species, which never condescends to the effeminacy of a beach."*

"The sooty petrel, better known at sea under the name of sheerwater, frequents the tufted, grassy parts of all the islands in astonishing numbers. It is known that these birds make burrows in the ground, like rabbits; that they lay one or two enormous eggs in these holes, and bring up their young there. In the evening, they come in from sea, having their stomachs filled with a gelatinous substance gathered from the waves; and this they eject into the throats of their offspring, or retain for their own nourishment, according to circumstances. A little after sunset, the air at Preservation Island used to be darkened with their numbers; and it was generally an hour before their squabbings ceased, and every one had found its own retreat."

"The penguin of these islands is of the kind denominated little; the back and upper parts are of a lead-coloured blue; the fore and under parts, white. They were generally found sitting on the rocks, in the day time, or in caverns near the water side. They burrow in the same manner as the sooty petrel; but, except in the time of rearing their young, do not seem, like it, to return to their holes every night. The places preferred for breeding are those at the back of the shore, where the sand is overspread with salt plants; and they were never found intermixed with the petrels, nor far from the salt water. Their flesh is so strong and fishy, that had not the skins served to make caps, rather handsome, and impenetrable to rain, the penguins would have escaped molestation".

"Of the birds which frequent Furneaux's Islands, the most valuable are the goose and black swan; but this last is rarely seen here, even in the freshwater pools, and except to breed, seems never to go on shore. The

goose approaches nearest to the description of the species called bernacle; it feeds upon grass, and seldom takes to the water. I found this bird in considerable numbers on the smaller isles, but principally upon Preservation Island; its usual weight was from seven to ten pounds, and it formed our best repasts, but had become shy. Gannets, shags, gulls, and red-bills were occasionally seen; as also crows, hawks, paroquets, and a few smaller birds. Fish were not plentiful, but some were taken with hook and line from the rocks".

Back Issues

We have been gathering together a lot of information and stories since November 2009, so if you are new and interested, please log on our back issues page which has been generously hosted by the Tasmanian University Dive Club, <http://www.tudc.org.au/news/marinelife.php>
