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Department of Fisheries

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Fish for the future

FISHERIES FACT SHEET

ALGAE

Photo: Michael Burgess

Are essential

Algae are an extremely diverse group of photosynthetic organisms that are the basis for almost all food chains in the world's oceans. They range from tiny, single-celled organisms called phytoplankton, visible only with the aid of a microscope, to the large kelps that can form massive undersea forests.

Distribution and origin

Algae support highly productive and varied ecosystems. These tough organisms can survive throughout the world on soils, beneath polar ice and in snow, but most are found in the waters that cover the Earth's surface such as wetlands, rivers and oceans.

When the Earth was first formed, the atmosphere we breathe did not exist. There was no oxygen and no protective ozone layer so UV radiation scorched the planet's surface. Scientists believe that about 3,500 million years ago tiny organisms appeared. Protected from the sun's rays by living in water, they produced oxygen which bubbled up into the atmosphere. The large quantity of oxygen, released over a long time, gradually produced the atmosphere we have today. It also created the huge deposits of iron ore we now mine as iron dissolved in the oceans reacted with the oxygen and rusted, settling as sediment on the ocean floors. These earliest life forms included the ancestors of algae that can be found on Earth today.

Plant … or not?

In the aquatic environment, the term 'plants' is sometimes used in a very flexible sense, and can refer to seagrasses, algae and photosynthetic bacteria. Although they all share similar habitats, seagrasses are the only true plants found in the marine environment.

Algae lack the features of true flowering plants such as roots, stems and vascular tissue. Instead of roots, they anchor themselves to rocks or other organisms using root-like attachments called 'holdfasts'.

They can reproduce sexually, with male and female structures, but they do not have prominent flowers. Algae contain chlorophyll and other photosynthetic pigments, which are used to create oxygen. They form the basis of the food chain in the marine environment, converting energy from sunlight into starches and sugars in a process called photosynthesis.

The term algae, encompasses several groups that are only distantly related to one another. Benthic marine algae (which live on the seabed or attached to reefs) are also known as seaweeds or macroalgae.

Microalgae

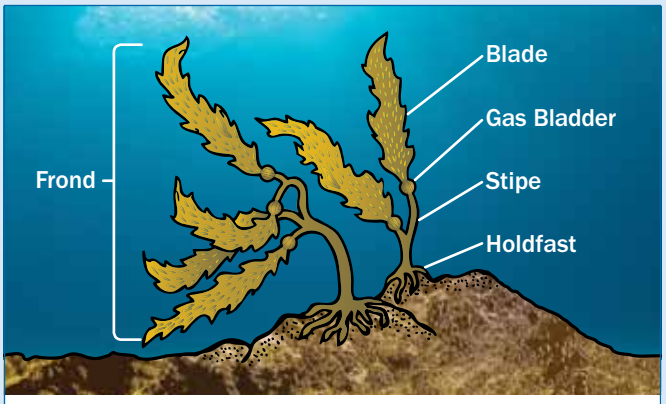
Microalgae can only be seen through a microscope, and are typically found in rivers, estuaries and oceans. They are single-celled species which can exist individually, or in chains or groups. Depending on the species, their sizes can range from a few micrometres to a few hundred micrometres.

Because they can photosynthesise, microalgae are very important for life on Earth. It is estimated they produce between 50 and 75 per cent of the Earth's oxygen and simultaneously absorb about 25 per cent of the greenhouse gas carbon dioxide to grow phototrophically.

Macroalgae

Macroalgae are algae that can be seen with the unaided human eye. They can vary from a few centimetres to many metres long. The piles of seaweed often washed up onto river banks and ocean shores are a mixture of macroalgae and seagrass and are referred to as 'seawracks'.

Seawracks are composed of macroalgae and seagrasses.



The anatomical make-up of macroalgae.

Macroalgae grow in a wonderful variety of forms including large leafy types like sea lettuce, filaments, clumps and balls. They are divided into three colour groups - green, brown and red. They are not always true to their colour, as sometimes different pigments can dominate and mask their actual colour, making identification difficult. While these groups have a greater structural affinity with each other than with higher plants, each group is more closely related to another organism (for example, green algae are closer to flowering plants) than to each other.

Green algae *(Phylum: Chlorophyta)*

***Ulva*, or sea lettuce is an abundant species on shallow, moderately exposed shores.**

Green algae are probably the most wide-ranging algae, found in moist terrestrial environments and fresh water as well as the marine environment. They may be either attached or free-floating planktonic algae.

Marine-attached green algae are commonly found on shallow rocky shorelines where the sunlight penetrates the water easily so they can photosynthesise.

Green algae come in a variety of shapes including flat sheets, cylinders, strings of beads and spheres of hair-like filaments.

Brown algae *(Class: Phaeophyceae)*

A number of species of the genus *Sargassum* are found in southern Australia.

Brown algae are found living mainly on rocks, seagrasses or other seaweeds. They are the heaviest and largest of seaweeds and are frequently seen on shorelines and in shallow water. Almost entirely restricted to the marine environment, they are generally shades of brown, though some (of the order *Dictyotales*) can appear blue underwater.

Brown algae can form tall kelp forests by attaching themselves to solid structures such as rock. Known as the 'true forests' of the sea they provide habitats and shelter for a wealth of animals.

Red algae *(Phylum: Rhodophyta)*

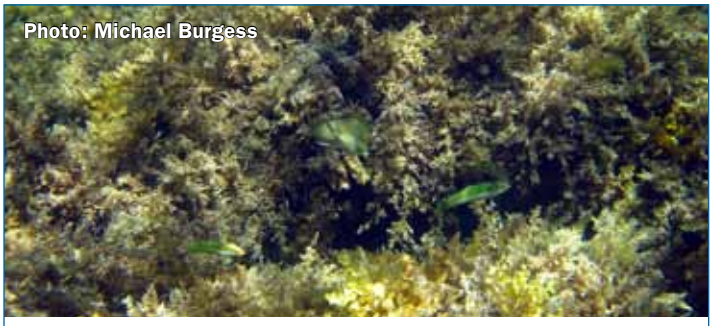
Red algae are the most numerous of the three seaweed groups with around 5,000 – 5,500 species worldwide and about 1,300 of these occur in Australian waters. They are predominantly benthic and live in all of the world's oceans. Red algae are generally the most abundant algae in deep water (to more than 200 metres) as they can photosynthesise in lower light conditions. The red algae are relatively small in size, never form extensive beds and rarely dominate reef communities.

Naming red algae is often more difficult than the other seaweed groups as it relies on the characteristics of the reproductive structures rather than overall appearance. They come in a variety of forms and their texture may vary from fine and delicate to hard and crusty.

It should be noted that 'red tides' (brownish-red discolouration of marine waters) are caused by a type of phytoplankton, not red algae.

Weeds of the ocean?

Larger algae are often called ‘seaweeds’, but this is really a misnomer as normally they are a natural component of the marine ecosystem and not weeds at all.



Naturally occurring seaweed beds in Yallingup Lagoon, WA.

Algal blooms

WA is renowned for its long, hot summers. Shallow and slow-moving water expanses, bright, sunny days and high nutrient levels can provide ideal conditions for an ‘algal bloom’. An algal bloom (or marine or water bloom) is caused by a rapid increase in the population of algae in an aquatic system.

Some blooms are caused by high levels of nutrients (particularly phosphorus and nitrogen) in waters. These nutrients enter the waterways mainly as a result of activities on nearby land, including the use of fertiliser in gardens and parks, from animal wastes, sewage and septic tank waste and industrial waste. As concentrations of these nutrients in water increase, they may accelerate the growth of algae and green plants.

Some algae blooms can cause water to discolour, and turn it from clear to green, yellowish-brown or even red. Too much algal growth can have dire consequences for the water’s inhabitants - killing large numbers of fish, either by the toxic effects of the algae itself or de-oxygenation of the water.

Nuisance algal blooms have occurred in Perth’s Swan River estuary and potentially toxic blue-green blooms have happened in the Canning River.

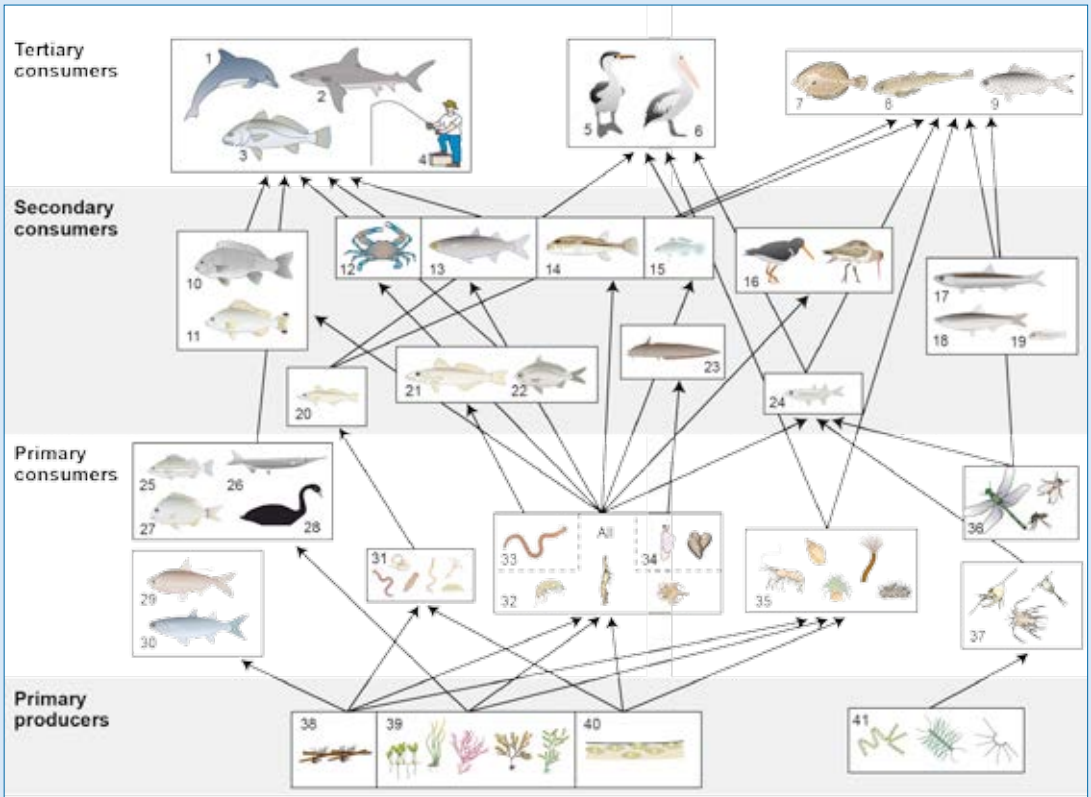
Algal blooms are not a recent phenomena – Captain Cook recorded an algal bloom during his voyage in 1770.

Tiny but mighty

Without algae, our waterways would be deprived of oxygen and food. They would become underwater deserts barren of all but a few life forms. Without phytoplankton, there would be no fishing industry.

Microscopic algae is a major component of plankton – those minute organisms that float, swim weakly or drift in the water and are the first link of aquatic food chains. They provide the main food source for many species, including filter feeders such as oysters and mussels, and zooplankton including crustaceans.

Macroalgae are habitats for small animals such as molluscs and shrimps and nursery areas for juvenile fish, crabs and prawns. They also shelter fish and crustaceans from predators such as larger fish or birds and can help to reduce erosion along the shoreline.



***1** dolphin, **2** bull shark, **3** mulloway, **4** human, **5** cormorant, **6** pelican, **7** flounder, **8** flathead, **9** Australian herring, **10** black bream, **11** yellowtail grunter, **12** crabs, **13** yelloweye mullet, **14** blowfish,**15** gobies, **16** wading birds, **17** Australian anchovy, **18** sandy sprat, **19** fishlarvae, **20** small whiting, **21** large whiting, **22** common silverbiddy, **23** estuary cobbler, **24** hardyheads, **25** eastern striped grunter, **26** river garfish, **27** tarwhine, **28** black swan, **29** Perth herring, **30** sea mullet, **31** meiofauna, **32** benthic macroinvertebrates, **33** polychaetes, **34** molluscs, **35** epibenthic macroinvertebrates, **36** insects, **37** zooplankton, **38** detritus, **39** benthic macrophytes, **40** microphytobenthos, **41** phytoplankton*

A generalised food web for the Swan-Canning Estuary. Source: Department of Water, River Science 28.

Invasive species

***Codium*: marine pest algae.**

Marine species which are introduced into environments where they do not live naturally can become deadly pests and represent one of the greatest threats to the world's oceans and biodiversity. In Western Australian waters, a subspecies of the green macroalgae, *Codium*, is now a marine pest.

This unwanted seaweed, formally known as *Codium fragile ssp. fragile*, is a large dark green macroalgae, also known as 'dead man's fingers'. It is thought to be native to Japan and was first detected in WA at Princess Royal Harbour in Albany in 2008.

Marine pests have the potential to have a significant impact on our local marine ecosystems due to their invasiveness; they may be toxic and out-compete local species for food and habitat. For more information about introduced algaes, refer to the *Fisheries Fact Sheet – Introduced Marine Species* which can be found at **www.fish.wa.gov.au**.

Humans and algae

It is clear that seaweeds are essential for the wellbeing of the coastal ecosystem, but they are also of huge value to people. Some 400 different species of seaweeds around the world are used by people for food, stock feed, medicines, cosmetics and fertilisers. They are also raw materials for food processing (such as agar as a vegetarian thickening agent) and industrial processes (for example, seaweeds are high in trace elements and their ash is used in ceramic glazes, and they are harvested for beta-carotene). More recently algae has been used to produce algal biodiesel. This product has the potential to be a sustainable, environmentally friendly alternative to diesel. More research is being undertaken with the aim of creating a viable industry with widespread uptake.

New species of algae are still being discovered today, with researchers from the Department of Environment and Conservation and the WA Herbarium, recently finding a species of green algae previously unknown to science during a survey of the Walpole and Nornalup inlet in 2011.

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Glossary

Algae
Aquatic plant-like organisms.

Algal bloom
Rapid and excessive growth of algae, generally caused by high nutrient levels and favourable conditions.

Benthic
Found in or near the ocean floor.

Carrageenan
Any of a group of closely related colloids derived from Irish moss and several other red algae, widely used as a thickening, stabilizing, emulsifying, or suspending agent in industrial, pharmaceutical, and food products.

Chlorophyll
A green pigment found in photosynthetic organisms that is able to capture the sun's energy.

Filter feeder
An animal that strains food such as plankton from water using a sieve-like structure in its mouth.

Macroalgae
Large aquatic photosynthetic organisms that can be seen without the aid of a microscope.

Microalgae
Small microscopic aquatic photosynthetic organisms that require the aid of a microscope to be seen.

Microscopic
Organisms that cannot be seen with the naked eye.

Phototrophically
Capable of using sunlight as the energy source in the synthesis of food from inorganic matter into organic materials.

Photosynthesis
Process by which green plants convert carbon dioxide to carbohydrates and oxygen using sunlight for energy.

Photosynthetic
Relating to or using or formed by photosynthesis.

Phytoplankton
Microscopic photosynthetic organisms that drift in open water.

Plankton
Tiny, free-floating aquatic plants and other photosynthetic organisms.

Terrestrial
Living or growing on land; not aquatic.

Zooplankton
Small free-floating or weak-swimming animals.

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FURTHER INFORMATION

Visit the Department's website at **www.fish.wa.gov.au** or contact:

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