Water facts 6

GOVERNMENT OF WESTERN AUSTRALIA

WATER AND RIVERS COMMISSION JULY 1998

Algal Blooms

Increasingly, algal blooms are a public health concern and an ecological problem in wetlands, waterways (rivers and estuaries) and oceans of south west Western Australia. This Water Facts leaflet describes the algae that live in our surface waters and the problems caused when they grow in excess forming algal blooms and 'red tides'. Examples are given of some blooms affecting wetlands and estuaries in the south west. The management of algal blooms in the Swan and Canning rivers is described as a case history of a river system under environmental pressure.

From ancient origins to environmental problem indicators

We would not be alive today if it wasn't for algae! When the earth was first formed, the atmosphere as we know it did not exist. There was no oxygen in the atmosphere and no protective ozone layer. Scientists believe that about 2000 million years ago, tiny organisms appeared. They lived in water and produced oxygen which entered the atmosphere. The oxygen produced by these primitive creatures was of such large quantities, and released over such long ages, that the atmosphere in which we live was created. These earliest life forms included the ancestors of algae that can be found in our wetlands, waterways and oceans today.

What are algae?

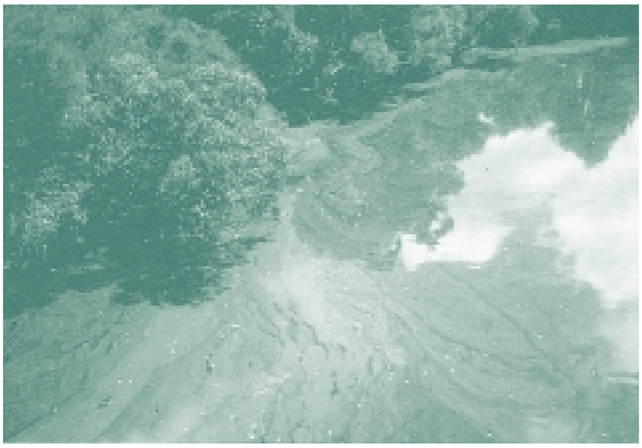
Algae are a diverse group of aquatic plants containing chlorophyll and other photosynthetic pigments. Many are microscopic (often being single cells) but some can be large, including the large seaweeds. They grow as single cells or aggregations of cells (colonies).

Thrombolites and stromatolites

Microbialites are rock-like structures built by microorganisms, principally blue greens (cyanobacteria). Stromatolites are one form of microbialite, and those at Hamelin Pool, Shark Bay are probably the best known. Fossil stromatolites represent the earliest record of life on earth. Thrombolites are a particular type of microbialite that have a clotted internal structure, unlike stromatolites which are layered in cross section. Lake Clifton, a lake 100 kilometres from Perth, supports a thrombolite reef over 6km long and up to 120m wide and has structures up to 1.3m high, possibly the largest living thrombolite reef in the southern hemisphere. The Lake Clifton thrombolites represent modern-day examples of thrombolites that were common some 600 million years ago, whose fossil counterparts are found today in the Amadeus Basin, Northern Territory where ancient shorelines once existed.

Stromatolite means layered rock.
Thrombolite is derived from the same root as thrombosis, which means clot.

Linda Moore, Water and Rivers Commission Principal Research Officer, at the Lake Clifton thrombolites.



Blue-green bloom in the Canning River

Algae are very diverse

Algae are amazingly diverse in size, shape and colour. They include a variety of aquatic plants ranging from single-celled plants that are invisible to the naked eye to giant kelps that can grow up to 45 metres and weigh as much as a small tree. Algae can be found on soil, beneath polar ice and in snow, but greatest numbers are found in the waters that cover 70 per cent of the earth's surface.

It is the chlorophyll and other photosynthetic pigments that give algae their characteristic colours. Most people have seen piles of green or brownish weed stranded along an estuary or ocean shoreline, or noticed lake waters turn a murky 'pea soup' green colour.

Photosynthesis is the conversion of carbon dioxide and water to carbohydrates using light energy. Oxygen is produced in the process.

The most familiar algae to many people are the large green, brown or red seaweeds, but there are several thousand species of algae and most of them are microscopically small.

Phytoplankton

Phytoplankton are the plant component of plankton. Phytoplankton are microscopic (up to 1-2mm in diameter) free-floating or weakly mobile aquatic plants e.g. diatoms, dinoflagellates, chlorophytes, cyanobacteria.

Microscopic algae, including diatoms and chlorophytes (microscopic green algae), are a major component of phytoplankton. However not all organisms in the phytoplankton are algae. Other organisms include dinoflagellates (Dinophyta), which cause 'red tides', and cyanobacteria (Cyanophyta or Myxophyceae), which cause blue-green blooms.

The Canning River is among the waterways that have suffered from blooms that turn the water a bright blue-green colour. In still conditions the scum on the surface can look like a vast spill of green paint!

Cyanobacteria are an ancient group of photosynthetic bacteria. Like true algae, they get their own energy requirements for growth from sunlight. Cyanobacterial blooms and red tides are not strictly speaking algal blooms (although they are commonly referred to as such). They are included in this Fact sheet because they are of significant concern in Western Australia.

Common types of phytoplankton in south-west Western Australia

The major types of phytoplankton found in the waterways and wetlands of south-west Western Australia include:

Dinoflagellates - red tides

Dinoflagellates are organisms in which the body form is a single cell or colony of cells with threadlike extensions of the cell called flagella which are used for locomotion.

Red tides are commonly caused by dinoflagellates which colour the water red/brown. Dinoflagellates form an important part of the diet of many shellfish, and are a key component of the phytoplankton. They occur naturally in many water bodies and in small numbers are harmless, but under certain conditions they can multiply rapidly and become so dense that they discolour the water.

Dinoflagellate red tides in the upper reaches of the Swan River have caused problems for swimmers because they cling to hair, skin and bathers.

Dinoflagellate bloom scum adhering to swimmers in the Swan River estuary. (Photograph reproduced with permission of Mr R. Irving, Community Newspapers).

About 30 species produce powerful neurotoxins (nerve poisons) that can affect humans. People who eat seafood contaminated by dinoflagellate toxins can suffer from severe gastrointestinal and neurological illnesses such as Paralytic Shellfish Poisoning (PSP). In extreme cases PSP can be fatal. The toxic marine/estuarine dinoflagellate *Alexandrium minutum* has been recorded in very low numbers in Western Australia. Other potentially harmful species *Gymnodinium breve*-like, *Gambierdiscus* and *Dinophysis acuminata* have also been recorded.

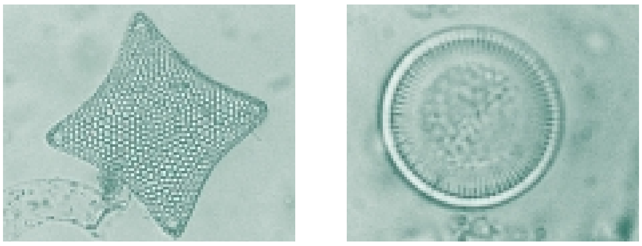
Bloom in the Murray River

Red tides are regularly observed in the Swan-Canning estuary, Serpentine and Murray River estuaries and the Collie River. In late summer, blooms of the non-toxic *Gymnodinium simplex* in the upper Swan River at Bassendean have led to warnings being issued to advise people to avoid the bloom, which is more of a nuisance than a health hazard. Blooms containing *Alexandrium pseudogonyaulax*, along with other species, in the Murray River and Yunderup Canals have been associated with production of a mucus that traps other phytoplankton and supports bacteria. Scumming on the surface during hot weather, and the associated high levels of bacteria, have necessitated warnings to the public to avoid affected areas.

Alexandrium (magnified)

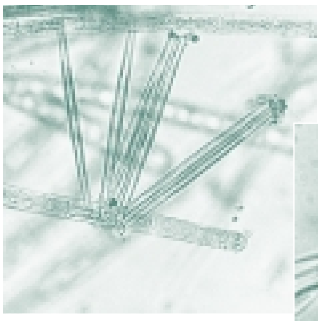
Diatoms

If you have a swimming pool filter or kitty litter, you may have been using diatom skeletons! Microscopic diatoms were among the first living organisms. Diatoms are found all around the world and are the dominant form of life in many aquatic environments. They are very diverse and more than 400 species have been recorded in the Swan River system. These tiny yellow or brown plants live within glass-like cell walls made from silica. They have amazing shapes - some look like jewels, others like spaceships. When the diatoms die, they sink to the bottom of the lake, river or ocean floor. Here, their empty cell walls accumulate and form deposits called diatomaceous earth. This can be mined as diatomite for use in a variety of ways including as a cutting agent in car polish, in pool filters and water treatment systems, and as a thickener in paint. Fossil diatom cell walls also hold clues to how the environment has changed in the past. Studies of Lake Monger in Perth have shown that it has marine diatom cells deep in the sediments - a reminder of the time when this land was under the ocean.



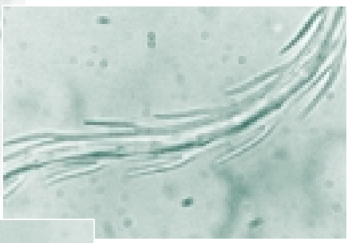
Diatom cell walls (highly magnified)

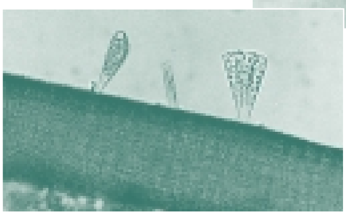
Many species of benthic (bottom-dwelling), epiphytic (living on the surface of other plants) and planktonic diatoms are found in Western Australia. Diatoms commonly bloom in south-west waterways, turning the water a murky yellow-brown colour. Harmless dense blooms have occurred in the Peel-Harvey estuary and lower Swan River estuary. In recent years several toxic diatoms (*Pseudonitzschia*) have been found in other parts of the world and have resulted in shellfish toxicity and the deaths of humans and brown pelicans. Some species of marine diatoms have barbs which can damage fish gills.



Epiphytic diatom (Synedra).

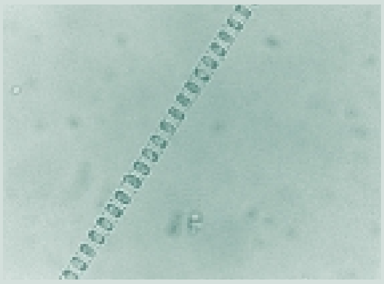
Chaetoceros barbs





Epiphytic diatom Licmophora

A common diatom that appears every year in the Swan River estuary is *Skeletonema costatum*. It usually appears in spring in Melville Water when the estuary becomes more saline after winter run off. *Skeletonema* can be found upstream past Maylands as the saline water moves upstream in summer. This harmless chain-forming diatom is an excellent food source for invertebrates such as copepods and mussels.

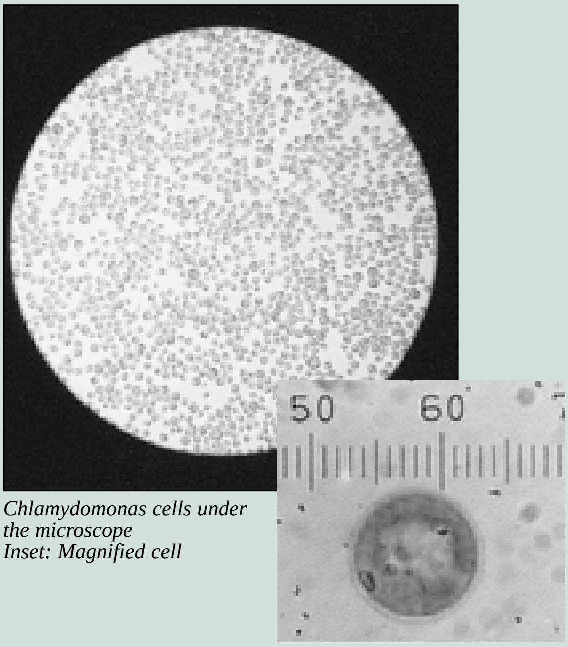


Skeletonema (magnified)

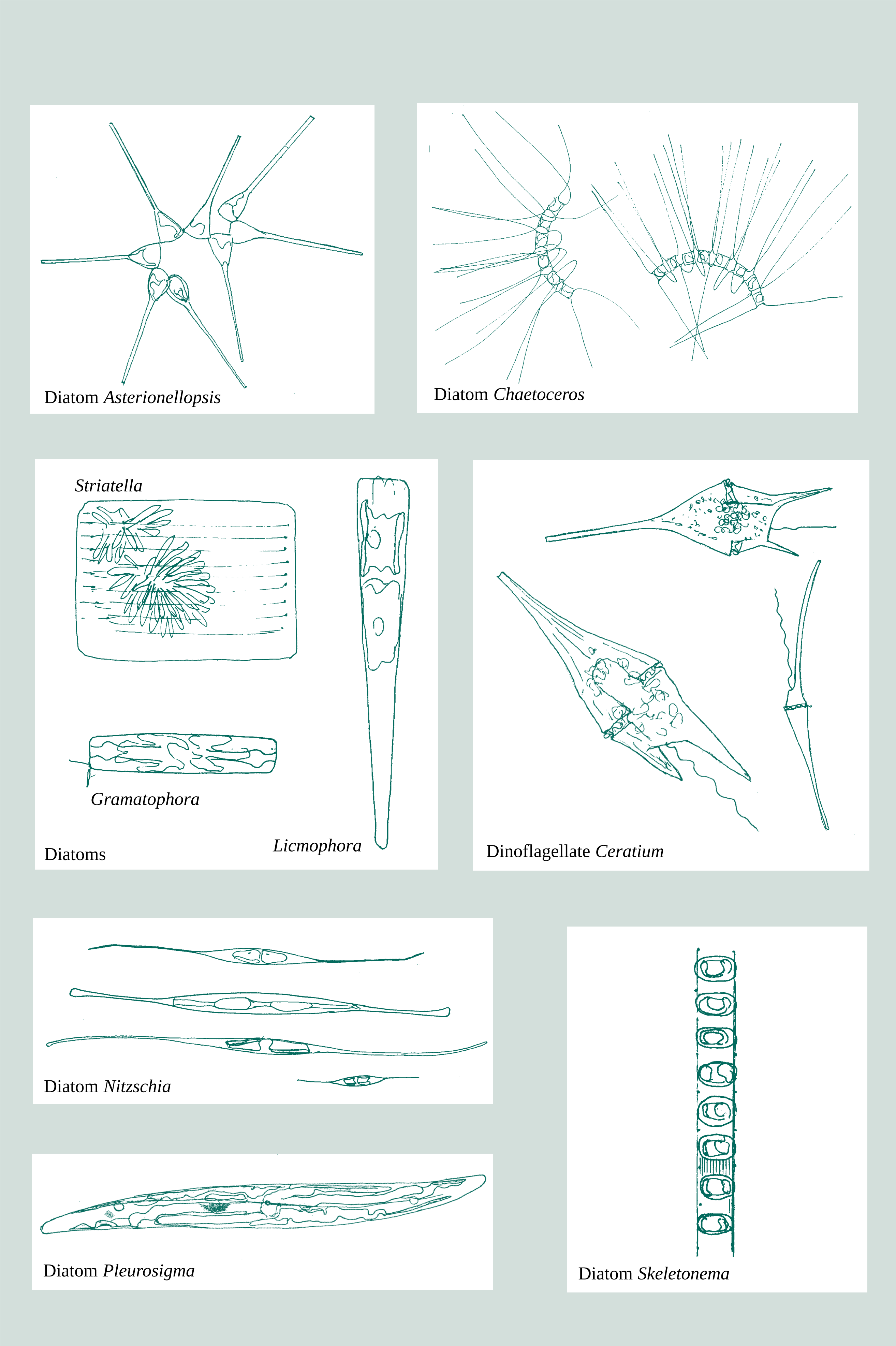
Microscopic green algae

Green microalgae *(Chlorophyta)* are often found in fresh water and frequently have flagella (tails) to help them swim. They are non-toxic but when blooms die and decompose rapidly they can use up all the oxygen in the water.

The microscopic green alga *Chlamydomonas* often colours the upper reaches of the Swan River a bright green in spring (October-November). It is a harmless freshwater species, and can occur as far downstream as Perth Water after very wet winters. Filamentous *Rhizoclonium* blooms annually in the Canning River estuary near Shelley Bridge.



Chlamydomonas cells under the microscope
Inset: Magnified cell



Examples of phytoplankton found in south-west estuaries.

Cyanobacteria: blue greens

Cyanobacteria, or blue greens, are primitive single-celled organisms that have no cell nucleus and are related to bacteria. The microscopic cells form colonies or threadlike chains (filaments). Like plants, they use light energy for photosynthesis.

Blue greens were among the first forms of life on earth. They dominated the earth for millions of years, producing carbohydrates from solar energy and releasing oxygen which made the evolution of higher life forms possible. Cyanobacteria were responsible for the blooms that have caused costly environmental problems in the eastern states in the Murray-Darling river system. Many of our local wetlands, rivers and estuaries have experienced cyanobacterial blooms.

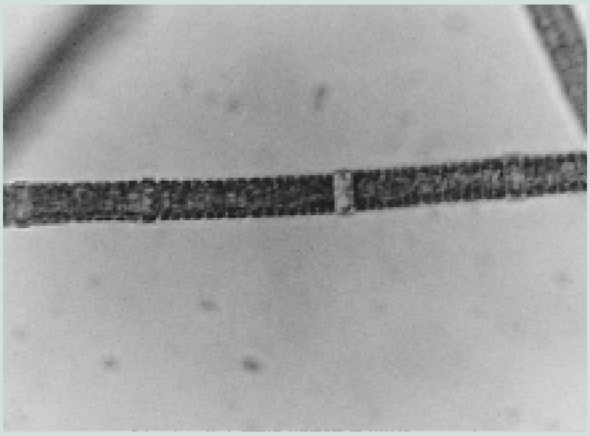
Blue greens are widely distributed wherever there is water. They grow naturally in Australia in fresh and saline waters. Still and confined waters, with warm surface water, tend to promote conditions where blooms of cyanobacteria develop, particularly if the water has plenty of nutrients in it. When they bloom they discolour the water blue-green, khaki, or green. During calm weather, a scum may form on the surface that looks like green or bright blue paint and sometimes like jelly. Affected waterbodies include urban wetlands, poorly flushed nutrient-enriched south-west estuaries, river pools, farm dams, coastal marine areas, and even hot springs.

Several species produce potent toxins. These toxins are only dangerous to humans under certain conditions, and this is not fully understood. Potentially toxic blue-green blooms of *Anabaena, Microcystis* and *Nodularia* have been a regular occurrence in some Western Australian wetlands for many years. Long chains of *Anabaena* are usually found in rivers and lakes; the spherical colonies of *Microcystis* are most common in lakes and reservoirs; the filaments of *Nodularia* are found in fresh and brackish lakes, rivers and estuaries, but rarely in saline waters.

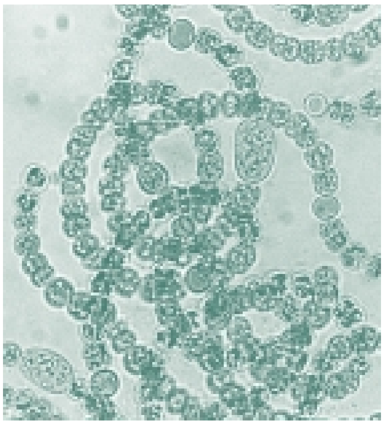
Some blue greens have the potential to cause asthma-like symptoms in people if inhaled as a fine mist, for example when contaminated waterbodies are used as a source for sprinkler irrigation. Children swimming in such waters may also be at risk, and there are maximum permissable guidelines for recreational contact with blooms and scums. Toxic species are also a risk to livestock and domestic animals that may drink or swim in contaminated waters. Blue-green blooms can kill native birds and upset the ecological balance of a wetland. They can pose a threat to human health by direct skin contact and through consumption of filter-feeding shellfish such as mussels.

In recent years, dense cyanobacterial blooms have affected many south-west waterways and contaminated areas have been closed to recreational use, domestic use and stock watering after dogs were reported to have become ill after drinking from the Blackwood River.

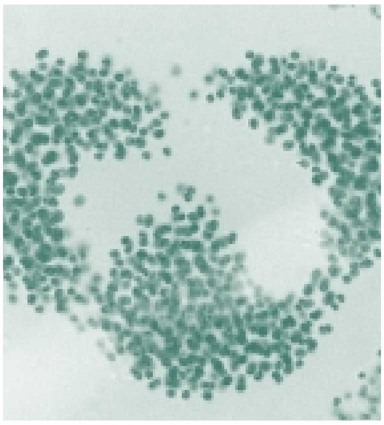
The potentially toxic blue green *Nodularia* has been found in the Peel-Harvey estuary, Serpentine, Vasse-Wonnerup, Swan-Avon and Blackwood rivers. It can cause skin irritation. It was a serious problem in the Harvey Estuary until construction of the Dawesville Channel made conditions in the estuary more marine and less favourable for *Nodularia*.



Nodularia (magnification of chain of cells)`



Anabaena (magnified)



Microcystis (magnified)

Macroalgae in south-west Western Australia

Macroalgae are algae that can be seen by the unaided human eye, in contrast to microscopic algae which must be studied under the microscope.

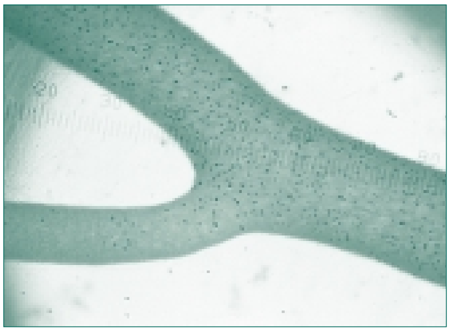
Macro means large. The piles of weed often washed up onto river beaches and foreshores are macroalgae, and sometimes also include seagrass. Macroalgae can be a few centimetres to many metres long, and are often referred to as seaweed or weed.

They can be free-floating or fixed to a substrate (solid surface) such as rocks, shells, other algae or jetty pylons. They may be green, brown or red, and grow in a variety of forms including large leafy types like sea lettuce, filaments, clumps and balls. Some grow in different ways in different environments. For example *Cladophora* appeared in the Peel-Harvey estuary as small dark green cottonwool-like balls forming a carpet on the bottom. In the Swan River estuary it appears in small clumps on jetty pylons and boat ramps.

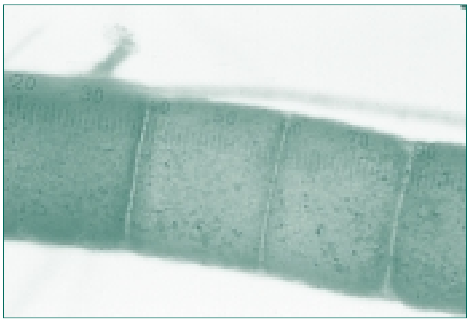
Common types of macroalgae in the waterways of the south west are *Gracilaria*, *Ceramium*, *Polysiphonia* (reds), *Cladophora* (goat weed), *Chaetomorpha* (ropeweed), *Rhizoclonium*, *Enteromorpha*, *Ulva* (sea lettuce), *Caulerpa* (greens), and *Giffordia/Hinksia* (browns).

Excessive growth of green macroalgae created a costly problem in the Peel-Harvey estuary. Abundant weed growth in the 1960s was the first sign that the estuary environment was deteriorating. Rotting weed caused a terrible smell of hydrogen sulphide and smothered fringing vegetation. The Peel Inlet Management Authority has harvested the algae in shallow water to keep beaches clean for recreational use and lessen the impact on nearby residents. Weed harvesting and the Dawesville Channel, built to improve water quality in the estuary, cost more than sixty million dollars. The Leschenault Estuary at Bunbury has about the same level of weed growth as the Peel Inlet, but it does not usually cause a problem because the weed rarely blows up onto beaches near residential areas.

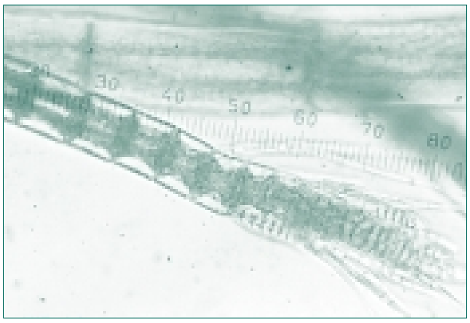
Harvester on Peel Inlet



Gracilaria x 100



Chaetomorpha x 100



Polysiphonia x 500

Cladophora x 115

Health Warning

In waters that are used for recreation, even non-toxic cyanobacterial blooms can cause allergic skin reactions or contact dermatitis in sensitive people. Accidentally swallowing small volumes of water contaminated by toxic Cyanobacteria can cause headaches, stomach cramps, nausea and diarrhoea.

Most cyanobacterial poisoning of animals involves hepatotoxins (liver poisons) and leads to death within a few hours to a few days. Some strains of toxic cyanobacteria produce neurotoxins (nerve poisons) which can cause death within minutes to a few hours. Some are suspected to promote tumours.

Toxins are not removed by boiling or by using household disinfectant.

Pay attention to any signs warning people of blooms

If you withdraw water from lakes or rivers:

- Inspect the intake pipe regularly for scum.
- Have any suspicious scums or colourations tested and identified.
- Avoid showering or bathing in contaminated water.

If you see warning signs or evidence of contaminated water in dams, rivers or lakes:

- Ensure your animals do not drink or go in the water. (If your dog does go in the water, hose it down before it licks its coat).
- Provide alternative water supplies for farm animals.
- Avoid contact (e.g. swimming, water-skiing).
- Do not touch any scum around the bank.
- Do not drink the water.
- If contact does occur, rinse it off.

If symptoms develop, seek medical advice

***If you are concerned about the safety of private water supplies, contact the Health Department on* (08) 9222 4222.**

TO REPORT ALGAL BLOOMS IN WETLANDS AND RIVERS, PHONE THE WATER AND RIVERS COMMISSION ON **(08) 9278 0300.**

Alien invaders

While many species of algae are native to our local waterways, others have been introduced. Toxic microalgae have been spread worldwide in the ballast water of ships from contaminated ports. These cargo ships take in seawater (often containing various plants and animals) in one port and dump the water and its exotic cargo thousands of kilometres away in another port. Pest creatures and plants such as toxic algae have established themselves in ports around the world. Often these introduced plants and animals find themselves in ideal conditions free from the competitors and predators that kept them in check in their natural environments.

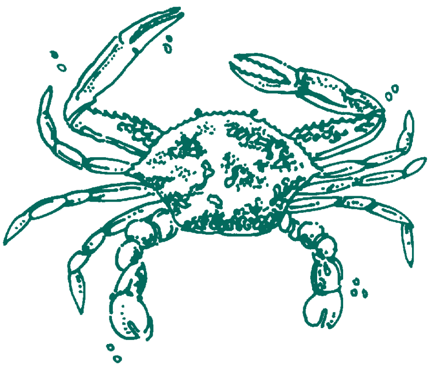
About 155 million tonnes of ballast water are discharged into Australian ports each year. Some potentially harmful microalgal species are found in Western Australia, but their history is not known. This can pose a serious threat because some introduced species can survive for many years in the sediments around ports. Large industries have been threatened by introduced algae in other parts of Australia. For example the shellfish industry in Tasmania was damaged by blooms of the toxic chain-forming dinoflagellate *Gymnodinium catenatum*.

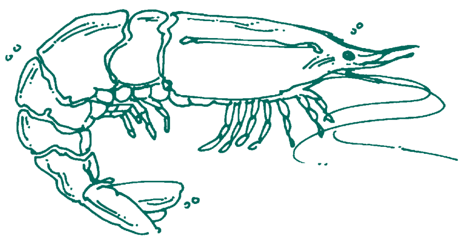
The role of algae in waterways

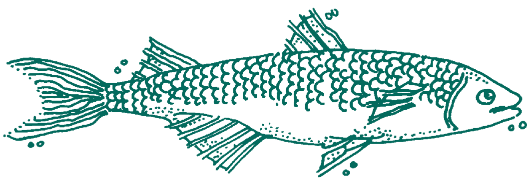
Without algae our waterways would be deprived of oxygen and food and would become underwater deserts supporting few life forms. Without phytoplankton, there would be no Australian fishing industry.

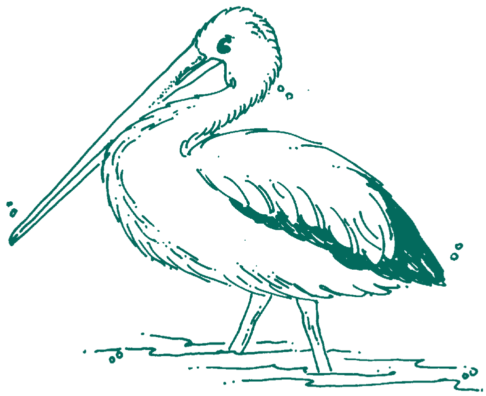
Algae play an extremely important role in the ecology of rivers and estuaries. Microscopic algae are a major component of plankton - the population of small organisms that float, swim weakly or drift in the water and form the basis of aquatic food chains. Microscopic algae, especially diatoms, can also be important components of the flora attached to submerged surfaces such as sediments and other plants. Both microscopic algae and macroalgae are important oxygen producers and are the major primary producers of organic carbon compounds in the world's water bodies. Microalgae provide the basic food source for many filter feeders including oysters and mussels, for zooplankton including crustaceans, and for grazers, which form the diet of many fish and birds.

Macroalgae are also important in the ecology of estuaries because they provide habitat 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.









Algae provide the basis for aquatic food chains and habitat for fish, crabs and prawns

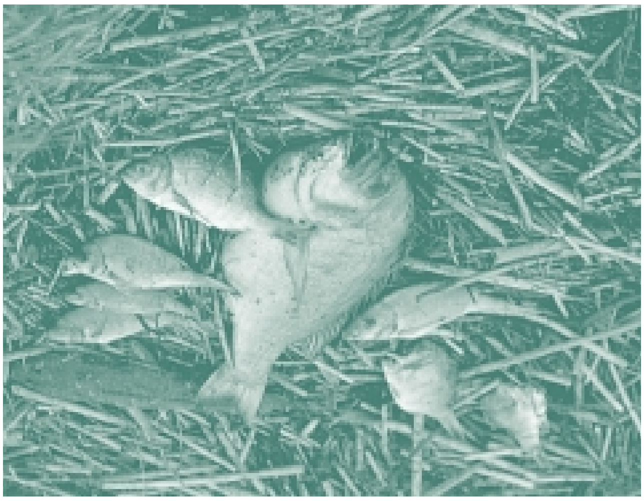
Algal blooms

Algal bloom: the rapid excessive growth of algae, generally caused by high nutrient levels and favourable conditions. Blooms can result in deoxygenation of the water mass when large masses of algae die and decompose, leading to the death of aquatic plants and animals.

Algal blooms are not a new phenomenon - Captain Cook recorded an algal bloom during his voyage in 1770!

Algae are a natural component of aquatic environments, and even when they are abundant, it is not necessarily a problem. Often a proliferation of microscopic algae can have beneficial effects on fisheries and aquaculture industries such as oyster or mussel farms by increasing the amount of food available. Macroalgae provide sheltered habitat for juvenile fish. In fact, the local fishery production in the Peel-Harvey estuary almost doubled in the 1970s when weed (macroalgae) growth in the estuary was at its peak, without a similar increase in fishing effort.

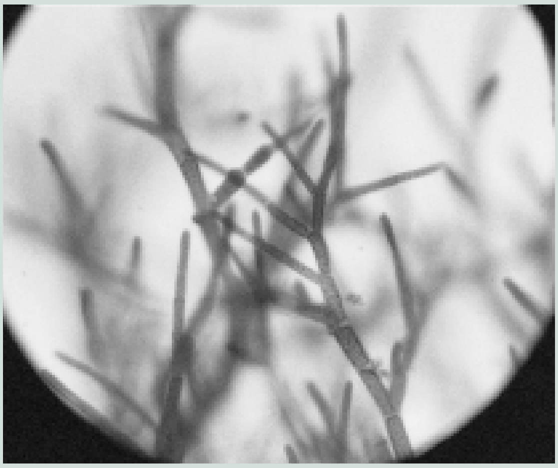
However, when algal blooms increase in intensity and frequency, the results can cause community concern, health problems, and in some cases can be catastrophic to the environment. The impacts are ecological, social and economic.



Fish kills can result when decaying algae use up all the oxygen in the water.

Algal blooms upset the delicate natural balance of plant and animal ecosystems in a waterway or wetland. They can degrade recreation, conservation and scenic values, and interfere with economic uses such as fisheries and tourism. Weed that washes ashore and forms rotting piles on beaches can cause offensive smells and become a health problem for nearby residents as well as a nuisance to beach users and fishers. An over-abundance of algae can choke a body of water such as a river, clog irrigation pipes, and block out the light other plants, such as seagrasses, need to produce food. Excessive weed growth can eventually kill seagrass beds. When an algal bloom dies the process of decay can use up all the available oxygen in the water, effectively suffocating other aquatic life. This can kill fish, crabs and other animals, especially those that are attached or sedentary (do not move around). Some species of algae produce toxins.

Princess Royal Harbour at Albany has lost most of its valuable *Posidonia* seagrass beds because of nutrient pollution. A survey in 1988-89 showed that up to 90 per cent of the seagrass meadows had been lost since the 1960s, when they were considered to be in pristine condition. Excessive growth of large algae *(Cladophora)* had smothered and shaded out the seagrass.



Cladophora

Midges and algal blooms

Local government authorities spend hundreds of thousands of dollars each year trying to control midge outbreaks around urban wetlands. These insects are small flies that do not bite, but their densities cause severe nuisance to people living around wetlands. Midge larvae live at the bottom of lakes and are a natural and important component of wetland ecosystems. When a wetland become eutrophic and large algal blooms occur, the dead and dying algal material accumulates on the bottom of the lake. This provides a ready food resource for midge larvae and some populations multiply to very high densities. When these larvae mature, they emerge from the wetland as adult flies and swarm in their thousands around lights, causing a nuisance to nearby human populations.

When is a growth of algae a bloom?

Microscopic algae

Algal blooms can represent very large numbers of algal cells. Some algal blooms have been recorded in excess of 800,000 cells per millilitre (mL) of water. An excessive growth of microscopic algae is defined as a bloom when it reaches high densities of cells in an 'integrated sample' - a water sample obtained by combining samples (or a core of water) taken from a range of depths.

Macroalgae

When macroalgae grow in excess, the growth can be measured in tonnes. For example, in the 1980s when weed growth was at a peak in the Peel-Harvey estuary, the Peel Inlet Management Authority harvested up to 20,000 tonnes per year in an attempt to keep foreshore beaches clean.

How many algal cells make a bloom?

If moderate to large algal cells (greater than 15 to 20 microns in diameter) exceed 15,000 cells per mL of water, it is referred to as a bloom. Small microscopic cells (less than 1-5 microns) discolour the water at much higher densities, around 100,000 cells per mL, to be considered a bloom. The concentration of algal cells on the surface can vary during the day, and can be 20-50 times the 'integrated' density in calm conditions. However, impacts can result from lower densities - a bloom of a toxic species in a shellfish harvesting area could pose a threat at densities as low as 5 cells per mL.

Cyanobacteria

Cyanobacterial densities in excess of 15,000 cells per mL make the water unsafe for people to drink, and even densities of 500 to 2,000 cells per mL require action by water managers.

Eutrophication

Eutrophication is a natural process of accumulation of nutrients leading to increased aquatic plant growth in lakes, rivers, harbours and estuaries. Human activities contributing fertilisers and other high-nutrient wastes can speed up the process, leading to excessive algal blooms and deterioration of water quality.

Eutrophic is a Greek word that means 'well fed'. Algal blooms have become a worldwide problem because wetlands and waterways are becoming too well fed, or oversupplied with nutrients, due to human activities in their catchments.

A catchment is the area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.

Like people, algae need just enough nutrients in the right balance to grow. When excessive amounts of nutrients, especially nitrogen and phosphorus, are added to an aquatic system it can become nutrient-enriched or eutrophic. Algal blooms are a symptom of eutrophication.

Excess nutrients enter the waterbody from the urban and rural catchment, either dissolved in water or attached to sediment or soil particles. Organic matter, such as leaf material and animal wastes, is also a source of nutrients. Nutrients come from a variety of land use activities. Farming, horticulture and intensive animal industries like piggeries contribute fertiliser, animal wastes, and sediment; urban development can be a source of park and garden fertiliser, sewage and septic tank waste, watercraft discharges, leachate from rubbish tips and industrial wastes. Nutrients are carried in ever-increasing amounts into our waters in stormwater drains, agricultural drains, surface runoff and groundwater.

Western Australia 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.

Like other living things, most algae need food (nutrients and minerals), warmth and light to grow. Several conditions are required before algae are able to form blooms. The requirements vary from species to species but can include nutrient levels, water temperature, salinity levels, light, pH, and the extent to which a water body is flushed. When conditions are right, the algae multiply rapidly until all the available nutrients are used.

The bloom then collapses, decays and recycles its nutrients to the water or sediments. Nutrients stored in the sediment build up over decades. These nutrients can be released into the water under certain conditions, and recycled to fuel another bloom, often of a different species. Different species of algae may predominate at different times of year, so that you might observe an annual cycle and succession of algal growth.

Wilson Inlet, on the State's south coast, is showing signs of eutrophication. Nutrients from fertilisers and other sources in the catchment have led to large growths of seagrass and algae. This has resulted in accumulations of rotting plant material on the shoreline. Algae that grow on the surface of other plants (epiphytes) are growing on the seagrass, giving the leaves a furry appearance, reducing light penetration to the seagrass itself, and threatening the valuable seagrass beds. These signs of eutrophication mean that careful management is needed to prevent further environmental damage.

Managing algal blooms

Algal blooms may appear suddenly. However, often water quality declines over many years before symptoms such as algal blooms appear. There is no quick fix for the causes of blooms. The key is to reduce nutrient inputs and this may take many years to show an effect in better water quality, especially when sediments have built up large nutrient stores. Understanding how algae respond to changes in nutrient levels, river flows, wind and tides, the role of the sediments, and where and how much nutrient is entering the water system, is the basis for developing management strategies to control algal blooms.

Managing algal blooms can include actions to:

- reduce nutrient losses from the catchment
- change conditions in the water body so that algae are less likely to bloom (e.g. oxygenation, treating the sediments)
- harvest macroalgae in shallow water or on beaches to keep the shoreline clean
- increase flushing so that more nutrients are lost from the water body

In the long term, reducing nutrient inputs is the best preventive measure. Catchment management to reduce soil loss and cut down the input of fertilisers and other pollutants is the key to reducing the incidence of algal blooms.

Integrated Catchment Management

Integrated Catchment Management (ICM) is the coordinated planning, use and management of water, land, vegetation and other natural resources on a river or groundwater catchment basis.

A coordinated approach across a catchment, involving the whole community, is needed to protect and improve water quality in our waterways and wetlands. Integrated Catchment Management is gaining momentum across the south west of the State. All levels of government are working together with industry, landholders and the community to improve land management and waste disposal practices and restore degraded waterways. The amount of waste that was once pumped directly into rivers and streams has been cut dramatically through legislation, licensing and better environmental ethics. In agricultural regions, farmers and local communities are improving fertiliser management, planting trees, managing farmland to prevent soil and nutrient loss, and fencing and replanting vegetation along streamlines. City people are being encouraged to take an interest in their local environment and to reduce their individual impact on wetlands and rivers, for example by reducing the amount of fertilisers used in gardens, being waterwise, and by joining in with ‘friends of’ or catchment groups. Much more still needs to be done to protect our rivers and wetlands from excessive nutrient loads if we are to control algal blooms.

Rhizoclonium. Scum on the water or piles of rotting weed on the shoreline are the visible symptoms of eutrophication.

The role of the Water and Rivers Commission

In Western Australia, the Water and Rivers Commission is working to clean up the State's rivers, estuaries and wetlands to protect their environmental, recreational, scenic and heritage values and to restore areas which are showing signs of environmental degradation. Waterways Management Authorities pull together all the key stakeholders to manage the estuaries and rivers that are under most pressure, including the Peel-Harvey estuary, Leschenault Estuary, Wilson Inlet, Albany waterways and the Avon River. The Swan River Trust protects and manages the Swan-Canning river system.

The Commission will continue working to reduce the incidence and severity of algal blooms by working with other government agencies, local government, universities, industry and the community to:

- provide information and advice on the causes and prevention of algal blooms, and best practices to reduce nutrients entering our water systems;
- ensure that planning policies and decisions minimise the impacts of development on water quality;
- encourage improvements in infrastructure such as sewerage and stormwater management systems;
- foster conservation projects and Integrated Catchment Management to minimise erosion and land degradation that contribute to the buildup of nutrients that fuel algal blooms;
- ensure adequate licensing and control of point sources of water pollution;
- fund research into the prevention, detection and control of algal blooms;
- develop methods to modify river conditions to reduce the occurrence of algal blooms;
- monitor stream and estuary water quality;
- monitor types and levels of algae and cyanobacteria in Western Australia's wetlands and rivers;
- ensure the public is notified when algae or blue green levels are likely to affect recreational enjoyment of the lakes or waterways, or to have public health impacts.

You can help to prevent algal blooms

- Use fertilisers with care - remember that water that runs off your garden can end up in your local stream or lake.
- Use water wisely in your home and garden.
- Plant local native plants in your garden and road verge to save water and fertiliser.
- Use low phosphate detergents.
- Protect and plant vegetation along streams, drains and foreshores - plants filter nutrients.
- Join community water monitoring, tree planting, catchment management, or wetland and foreshore rehabilitation projects.

Preventing algal blooms is one way to protect rivers and estuaries for the future.

The Swan-Canning River System - a case history

The problem

The battle is on to tackle the problem of nuisance algal blooms in the Swan River estuary and potentially toxic blue-green blooms in the Canning River.

The Swan-Canning river system is the scenic heart of Perth. It is a treasured community asset that has landscape, conservation, recreation, tourism, commercial and heritage values.

Although macroalgal blooms were recorded in the early part of the century, generally water quality has been good for a river flowing through a capital city. In the early 1990s, however, microscopic algal blooms in the upper Swan River caused fish deaths. Potentially toxic blue-green blooms, which prevented recreational use of the Canning River for several months in 1994 and 1998, focused community concern on the deteriorating health of the river system. The level of algal blooms was unacceptable to the public.

Action was urgently needed to treat the environmental problems in the upper Canning River, prevent further deterioration in the Swan River estuary, and make sure that future generations can continue to swim, sail, windsurf, fish, picnic and catch prawns, and take pride in the sparkling waters of the Swan.

The cause

Algal blooms in the Swan-Canning system are caused by excessive levels of nutrients in waters and accumulated in estuarine sediments. The nutrients come:

- dissolved in streamflow and groundwater
- bound to clay and silt particles washed from the catchment
- as organic matter, for example animal wastes and leaf litter

Nutrients stored in the estuarine sediments are also released under some conditions to help fuel algal blooms.

The Swan-Canning Cleanup Program

In 1994 the Western Australian Government commissioned the Swan River Trust to undertake a five-year, $6.3 million program to investigate and prepare an Action Plan to reduce algal blooms. The Swan Canning Cleanup Program has increased understanding of water quality and ecological processes in the rivers through research and modelling. Reviews of river management in other parts of the world have led to trials of likely river intervention techniques to reduce algal blooms. A special focus has been on supporting community-based catchment management to expand in the Swan and Canning catchments, especially in the environmental trouble spots which contribute most nutrients, and increasing public awareness.

The combined expertise of government, academia and the community has been drawn together to produce an Action Plan to reduce algal blooms. The Action Plan includes some short-term actions with a limited timespan, for example a public awareness campaign to encourage individual care and responsibility. However most actions will involve long-term changes in the way use of land and rivers are planned and managed. The draft Action Plan was released for community consultation in July 1998.

The draft four point Action Plan

1. Support Integrated Catchment Management to reduce nutrient inputs.
2. Improve planning and land-use management to reduce nutrient inputs.
3. Modify river conditions to reduce algal blooms.
4. Monitor river health, fill critical gaps in knowledge and report progress to the community.

SWAN RIVER TRUST

Find out more from the Swan River Trust
Telephone: (08) 9278 0400
Facsimile: (08) 9278 0401
Web Site: http://www.wrc.wa.gov.au/srt

Further reading

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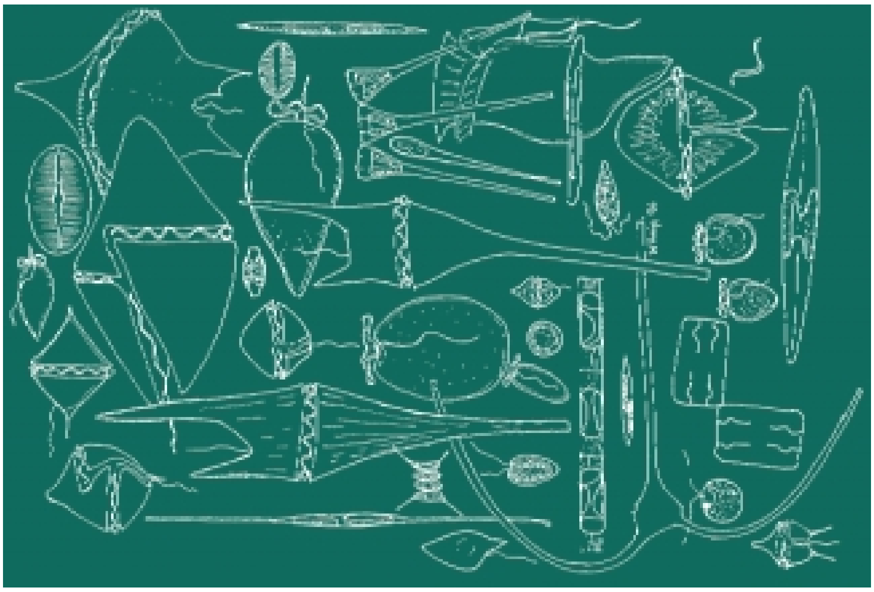

Some of the microalgae that occur in the Swan and Canning rivers. Illustration by Wasele Hosja.

For more information contact

WATER AND RIVERS
COMMISSION

Level 2, Hyatt Centre
3 Plain Street
East Perth Western Australia 6004
Telephone: (08) 9278 0300
Facsimile: (08) 9278 0301
or your regional office
Website: http://www.wrc.wa.gov.au

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This Water facts sheet is one in a series providing information on water issues of interest to the community.
Illustrations and most photographs by Wasele Hosja, Phytoplankton Ecology Unit, Water and Rivers Commission.

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