Brown Algae 3G

The brown algae include some of the largest and most complex seaweeds: the kelps, wracks and sargassums. Brown algae belong to the Phylum Phaeophyta and are particularly common in the temperate zones of the world, although many species of sargassum grow in warmer waters. One sargassum forms enormous floating rafts in the doldrums near the equator and has given its name to the Sargasso Sea. Kelps can reach a length of 12 m and form extensive forests along the west coast of South Africa, creating a unique ecosystem where animals and plants live and feed in the calm shelter of the kelp 'trees'. On the subtropical east coast of South Africa the brown seaweeds are generally small and some of them are vivid yellow or blue in colour. Most brown algae secrete chemicals that deter herbivores; these may be tannins, lime or even sulphuric acid, found in the acid weed, Desmarestia firma.

The importance of brown pigments

Brown algae are generally khaki-brown in colour, due to the possession of green pigments (chlorophyll a and c) and the brown fucoxanthin. The different pigments absorb different coloured light and this is very important for seaweeds that live in deeper water. Sunlight contains all the colours of the rainbow mixed to form 'white light'. Green objects reflect the green light but absorb the other colours particularly violet and red. As light passes through water it is filtered out so that it becomes darker the deeper one goes. But red and violet light disappear first and blue-green light penetrates furthest, giving deep water its characteristic blue hue. Unfortunately this means that green seaweeds with only green pigments are not able to absorb this blue-green light at depths. Brown pigments can absorb the blue-green light energy and pass it to the green chlorophyll for photosynthesis (a process whereby algae manufacture food from carbon dioxide and water using light energy). A unique starch, laminarin is produced in brown algae.

EXAMPLES OF BROWN SEAWEEDS

Kelps Three common species of kelp occur on the west coast, the sea bamboo, *Ecklonia maxima*, the split fan kelp, *Laminaria pallida*, and the bladder kelp, *Macrocystis angustifolia*. A smaller kelp, *Ecklonia biruncinata*, with spiny blades is found on the south coast. Most of the kelps have growth points in the middle of the plant, usually where the blades join the stipe. This is an advantage because the blade can continue to grow at its base while the tip is worn and grazed away. Kelps have the most complex tissues of all algae, the stipes (stems) have strengthening tissues and tubular cells to transport the food through the plant. The blades are many cells thick with a protective outer layer, pigmented photosynthetic cells and storage tissues containing starch and tannin, to deter herbivores. Spores are produced in specialised sporangia situated in raised patches (sori) on the blades. During its life cycle the kelp alternates between the huge spore producing plant (sporophyte) and microscopic male and female plants (gametophytes) that produce the gametes. The gametophytes contain half the number of chromosomes (n) that the sporophytes have (2n).

Dead man's fingers

Acid weed

Turban weed

Life-cycle of the Split fan kelp

During fertilisation the male and female game
grow into a new large kelp sporophyte.

Sargassum and Turbinaria The sargassu
seaweeds with stems and leaf-like blades. S
use bladders to hold them up to the light. Sp
ductive branches occur in the axils of the bla
Several different species occur in South Afric
gullies and intertidal pools. In tropical areas t
Turban weed, *Turbinaria ornata,* is found in w
compact bushes bear trumpet-shaped fertile

Wracks Carpets of hanging wracks, *Bifurca*
brassicaeformis, clothe wave pounded rocks
Saldanha Bay and Cape Agulhas. The tough
cylindrical axes hang from creeping holdfasts
Spear-shaped reproductive blades bear
gametes in cavities along their margins.
The tiny eggs hang from the branches on
mucous threads so that they are not
washed out of the surf zone where they
live. The wracks are related to the common
seaweed *Fucus*. *Splachnidium rugosum*, co
called deadman's fingers occurs on rocky sh
When underwater, the finger-like bladders of
mucous are swollen but as the tide drops, they
lose water from the bladders and become
wrinkled and withered, although their living
skin is not damaged.


Hanging wrack

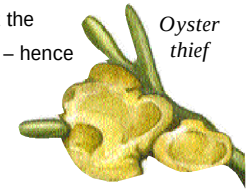

Dictyota

Dictyota group (Flat forking branches) There are many thin, flat brown seaweeds, *Dictyota* species, that grow from an apical cell that divides, forming regular forked (dichotomous) branching. *Dictyopteris* species are similar but the blades have a central midrib.


Turkeytail

Zonaria group (Fan-shaped) Fan-shaped brown seaweeds grow from a meristem along the rim of the fan. They are especially common on the east coast, where delicate light brown Turkeytails, *Padina boryana*, cluster in shallow mid-tide pools, and the large, more flexible *Zonaria* and *Stypopodium* species occur low on the shore.

aped *Colpomenia sinuosa* usually grows
n other algae. Its yellowish, hollow balls often
en and float and can become a nuisance in
s because they lift the
l float them away – hence
ster thief'.


Oyster thief

eaweeds have been used over the centuries
zers. Apart from their nutrient value they are
al fungicides and retain water, forming an
xcellent mulch. Brown seaweeds are rich in
iodine and at one time were burnt to
extract potash. This activity had disas-
results in Ireland, as the seaweeds were no
er used to mulch the potato crops and a
tating potato blight destroyed the harvest
famine. Kelp tablets are used to treat goitre
complaints. In South Africa kelps are com-
ly important. They are harvested fresh and
sed under pressure to be used as a growth
to dramatically increase the yield of crops
wheat and tomatoes. Washed-up kelps are collected and dried for the extraction of alginic acid, a gel widely used as stabilisers and emulsifiers in ice-cream, toothpaste, cosmetics and thousands of other products. Alginic acid fixes radioactive strontium allowing it to be removed from the body. Insoluble alginate salts are used to waterproof tiles and seal fine paper. A sludge of kelp, containing seeds can be sprayed on soil embankments to prevent erosion. Dried kelp is exported and not processed in South Africa.

Author: Margo Branch September 2000

Classification:	
KINGDOM:	Protoctista
PHYLUM:	Phaeophyta: Brown Algae

FURTHER INFORMATION: • Botany Department, University of the Western Cape, Cape Town. Tel. (021) 959 3201.
• Branch, G. M. & Branch M. L. 1981. *The Living Shores of Southern Africa*. Struik, Cape Town.
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• Seaweed Research Unit, University of Cape Town, Rondebosch, Cape. Tel.(021) 650 3717.

RELATED FACTSHEETS: • Kelp Forests • Seaweeds and their Uses • Plankton • Green Algae • Red Algae • Classification of Marine Species

For more information, please contact: The Coastal Management Office, Marine and Coastal Management, Department of Environmental Affairs and Tourism, Private Bag X2, Roggebaai 8012, Cape Town, South Africa. Tel: +27 (0)21 402-3208 Fax: +27 (0)21 418-2582 e-mail: czm@mcm.wcape.gov.za Website: http://sacoast.wcape.gov.za

Red Algae 3G

There are hundreds of species of red algae along the coast of South Africa. Some are large flat, blood-red sheets, others are delicately branched, but the majority are succulent, red-brown plants that populate the fringe of the ocean.

The red algae are seaweeds belonging to the Phylum Rhodophyta that are distinguished from other seaweeds by the presence of unique red and blue pigments, phycocyanin and phycoerythrin, in addition to green chlorophyll a. The red and blue pigments are a great advantage to these seaweeds as they can absorb blue-green light in deep water, passing the energy to chlorophyll for food production by photosynthesis. Red algae can live both high on the shore and at great depths. Deep-water plants have more red pigments, while those in the intertidal may be reddish brown, yellowish or almost black. As a result many red algae are confused with brown algae (Phylum Phaeophyta) that are yellow-brown in colour. One species of intertidal red alga, *Hypnea spicifera*, is often taken to be a green alga as it appears bright green and only the lower parts of the plant are pink. It has potential commercial importance for the extraction of carrageenan.

Hypnea spicifera

Generally, the red algae are very palatable and provide the staple diet for many of the marine herbivores, such as molluscs, crustaceans and fish. The food reserve is floridean starch, which is different from the starch stored in higher plants and other seaweeds. Red algae are also a source of agar, a gelling substance, of economic importance in confectionery and as a growth medium for bacteriological studies. A few such as the pink coralline algae are impregnated with lime and deter herbivores.

There are many different species of red algae with a diverse range of plant forms and a variety of complex life cycles. They are more common on the west and south coasts as they thrive in the rich waters where upwelling brings nutrients to the surface to be mixed by the turbulent water.

Purple laver

Slippery orbits

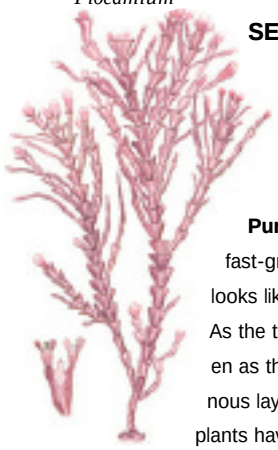
Hedgehog weed

Adapted to the conditions

The seaweeds are adapted to cope with the physical stresses they encounter where they live. Those living high on the shore are able to withstand severe desiccation during low tide and are often large and flat to be able to absorb the maximum nutrients and sunlight for photosynthesis during the short period that they are submerged. Mid- and low-shore species have to contend with wave action as well as desiccation. Many of them are branched or covered with papillae to increase their surface area without providing too much resistance to the waves. The agar in their bodies, enables them to retain water and reduce drying out. In deep water where there is a shortage of light and reduced wave action, the seaweeds tend to be large, flat and red. Many red seaweeds grow epiphytically on other algae especially kelps and, like the ferns and creepers in a forest, are held up to the sunlight. They are delicately branched so they flow with the water as the kelps sway in the waves.

Twisted gigartina

Plocamium



Jointed coralline

EXAMPLES OF COMMON RED SEAWEEDS

High shore, intertidal, flat red seaweeds on the west coast

Purple laver, *Porphyra capensis*, is a fast-growing, membranous seaweed that looks like crumpled black plastic when dried. As the tide rises the fronds expand and soften as they absorb water into the mucilaginous layer between the cells. The female plants have pink edges and the males yellow edges, from which the gametes are released.

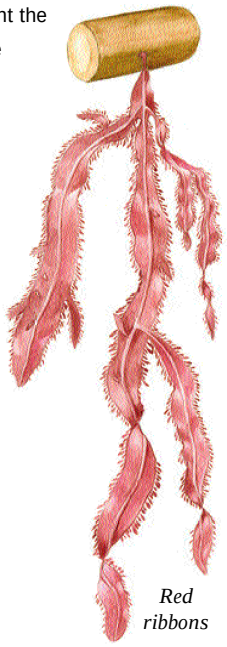
Porphyra is confined to the very high shore grazers eliminate it lower on the shore. *Porp* species are eaten by humans in the Far Eas and made into laver bread with oatmeal in Wales. They are tasty when added to soups, or savory biscuits.

Slippery orbits, *Aeodes orbitosa*, forms extremely slippery, yellowish-brown, tough sh to mid-shore rocks by a thickened disc. It is by grazers.

Broad wine-weed

Spotted iridea, *Iridea capensis*, forms brown strap-shaped blades with dark spots when fertile. Unlike *Aeodes* it has a rough texture and is not slippery.

Hedgehog seaweed, *Notogenia stiriata*, is very dark blackish-brown and occurs on sheltered rocks. It is papery when dry and the two phases of the life cycle differ. The gametophyte phase is covered with small, branched outgrowths while the tetrasporophyte is usually fairly smooth with a few papillae along the margin. If held to the light the dark spots can be seen indicating the pockets of four spores (tetraspores).



Red ribbons

Classification:	
KINGDOM:	Protoctista
PHYLUM:	Rhodophyta: Red Algae

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Green Algae 3G

The green algae are common inhabitants of both salt and fresh water. Green algae belong to the Phylum Chlorophyta and are thought to be the ancestors of land plants. Like land plants they are green in colour due to the presence of the pig - ments chlorophyll a and b. Both algae and land plants can manufacture their own food by a process called photosynthesis. This involves using the chlorophyll to absorb the light energy from the sun and converting carbon dioxide and water into simple sugars and oxygen. By this process the light energy is converted to chemical energy and stored as calories in food. The sugars can be combined with nitrogen and other mineral salts to make proteins and other organic compounds. All animals are either directly or indirectly dependent on algae and plants for food and their energy for life. Seaweeds are the algae found on the shallow fringes of the ocean where the sunlight can penetrate.

Seaweeds have a simple structure

The seaweeds are simpler than land plants. Being emersed in water, they can simply absorb nutrients, water, dissolved gasses and sunlight through the entire surface of the plant. They have no need for roots, leaves and a complex network to transport food and water around the plant, as land plants do. Some seaweeds such as the caulerpas have root-like holdfasts, but these serve only to anchor the seaweeds on the rocks or in the sand. The green seaweeds are particularly simple in structure and have three basic body plans. Some like the sea lettuce form thin sheets only one or two cells thick. In others such as the hairweeds the cells are placed end to end in a single row. A third group (the Siphonales) which includes the caulerpas and the codiums are made up of a network of fine tubes.

Life cycles of green algae

Most seaweeds have at least two different generations that alternate during the life cycle. An asexual spore-producing generation (the sporophyte) produces many spores, which settle and grow into male and female gametophytes. The gametophytes produce gametes. During fertilization the male and female gametes fuse and the resulting zygote develops into a new sporophyte generation. The gametophyte generations have half the number of chromosomes (genetic material) found in the sporophyte generation. The gametophyte is said to be haploid (n) while the sporophyte is termed diploid (2n). During the cell division leading to the production of spores (meiosis) these paired chromosomes are parted with half going to one spore and the other half to another. In the sea lettuce, *Ulva*, the sporophytes and the gametophytes look alike but in many seaweeds the two generations are different.

EXAMPLES OF GREEN SEAWEEDS

A) Flat sheets one or two cells thick (Order Ulotricales) Sea lettuces (*Ulva* and *Monostroma* species) and Intestine weeds (*Enteromorpha* species) are common in intertidal pools and estuaries. They are quick to colonise any bare areas on

Sea lettuce

Hair weed

Codium

rocks. They are able to tolerate a wide range salinities that may be caused when rain or rivers dilute the sea or, alternately, when heat causes evaporation and an increase in salinity. The spores are formed along the edges of the fronds and are released on the rising tide, when cool water enters pools. The spores are dispersed by the waves to colonise new areas. Sea lettuces are widely eaten in the Far East. They are cultivated on rafts off the coast of East and West Africa and are a potential future source of food and income for South Africa.

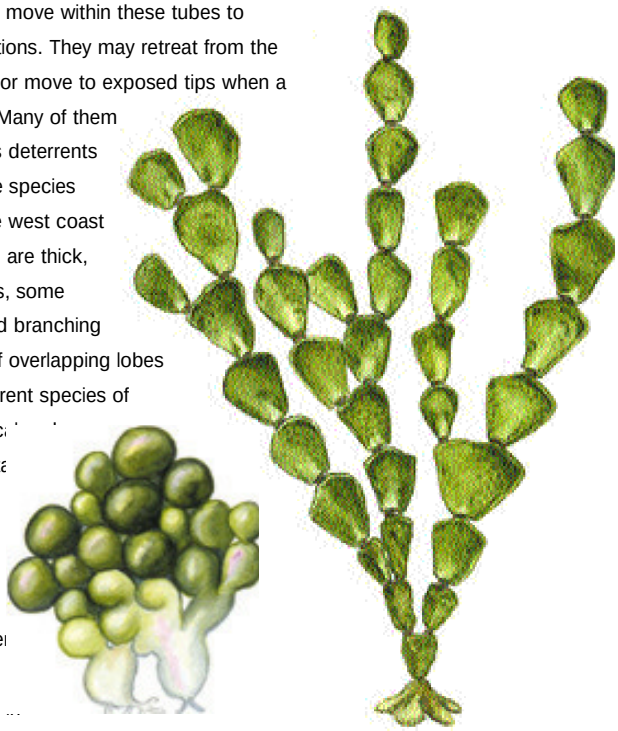
B) Filaments of cells end to end (Order Cladophorales)
The simple unbranched hair weeds (*Chaetomorpha* species) and the branched *Cladophora* species grow like tufts of grass on the side of pools or attached to larger seaweeds. Like hair, they flow with the movement of the waves and are not easily broken. Their spores are released from the tips of the hairs.

C) Complex green seaweeds (Order Siphonales)
The more complex green seaweeds are made up of fine branching tubes with numerous nuclei and few or no cross-walls. The green chloroplasts move within these tubes to make the most of light conditions. They may retreat from the surface to avoid excess light or move to exposed tips when a plant is smothered by sand. Many of them contain chemicals that act as deterrents to herbivores. There are more species along the east coast than the west coast of South Africa. The codiums are thick, spongy dark-green seaweeds, some of the species are upright and branching while others form cushions of overlapping lobes or balls. There are many different species of *Caulerpa*, particularly in tropic
subtropical waters, in which ta
gled root-like rhizomes give rise to upright blades. These may be strap-like, feathery or covered with bunches of gree
'berries'. The strap caulerpa forms dense stands
sandy gullies where they can survive being partially smothered by sand.

Three other easily identified, green seaweeds are found on the east coast; the wedge weed, *Halemeda cuneata,* with its series of flattened calcified green discs, green fans, *Udotea orientalis* and the black-green bubbles of *Valonia macrophysa*.

There are many green algae living in rivers and fresh-water ponds. *Author: Margo Branch September 2000*

Classification:	
KINGDOM:	Protoctista
PHYLUM:	Chlorophyta: Green Algae



Green balloons

Wedge weed

Strap caulerpa

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