RED AND BROWN SEAWEEDS

DOMAIN	Eucarya
KINGDOMS	Rhodophyta Phaeophyta
SPECIES	ca 5,500 and ca 2,000

IN SHALLOW SEAS, RED AND BROWN seaweeds are highly successful primary producers, providing shelter and a vital food source for marine animals. Both are kinds of algae and are not true plants, but they have many plantlike features. Like plants, they obtain food by photosynthesis using solar energy, but unlike plants, they use pigments other than chlorophyll to trap the sunlight, hence their red and brown colors. The classification of seaweeds is not agreed. Red and brown seaweeds are treated here as two kingdoms, while green seaweeds are considered to belong to the plant kingdom. Some researchers regard red and brown seaweeds as protists and green seaweeds as plants, or all seaweeds as protists, or all seaweeds as plants.

ANATOMY

Red and brown seaweeds live in, and are supported by water, so they have no need for strong skeletal supports or moisture-retaining tissues. Some seaweeds, including the large brown kelps and seashore wracks, have stiff stalks (stipes) or gas-filled bladders (pneumatophores) that hold up their fronds toward the light, and away from grazing sea-bed animals. Unlike most plants, but like green seaweeds, red and brown seaweeds do not need roots to absorb water and nutrients, or complex vascular systems to transport them; they absorb these directly from the water and photosynthesize over their entire surface. In place of roots, seaweeds have a holdfast, which acts as an anchor. Red and brown seaweeds vary enormously in form from tiny single cells and delicate filaments to giant kelp, more than 330 ft (100 m) long. Depending on the species, red and brown seaweeds can reproduce asexually by fragmenting or division—where parts of the plant break off and grow into new individuals—and sexually by producing spores.

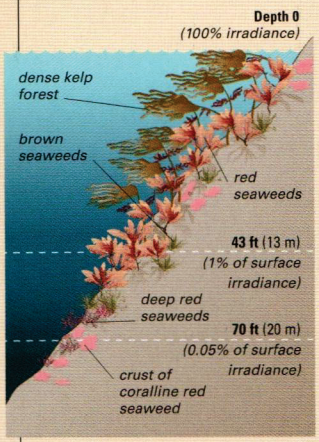
PERENNIAL SPECIES
This beautiful red seaweed is called sea beech. It grows new fronds each year from a perennial stipe, and reproduces from spores in winter.

HUMAN IMPACT

FARMING THE OCEANS

Seaweeds are harvested wild, but are also increasingly grown or enhanced artificially, especially in Asia. They are used for food, and seaweed extracts are used in a wide range of products—for example, in gels as a stabilizer, in cosmetics and pharmaceuticals, in beer-making, and as a fertilizer.

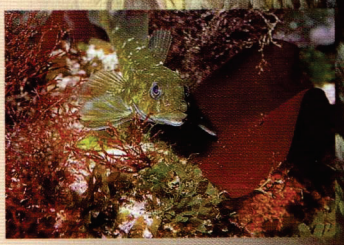
SEAWEED HARVEST IN ZANZIBAR
Many seaweeds grow readily on floating rafts, as seen here. They flourish in strong light, away from grazing invertebrates, and provide vital income for coastal communities.



LIGHT AND DEPTH
Light is absorbed rapidly by temperate coastal water rich in sediment and plankton. This diagram shows the depths at which kelps, smaller red and brown seaweeds, and encrusting red seaweeds grow in such water.

HABITATS AND DISTRIBUTION

Red and brown seaweeds thrive in fast-moving water on exposed coasts or on current-swept sea beds. In cooler climates, they often dominate rocky seashores. Great underwater forests of brown kelps grow in colder waters. Because of light limitations (see left), seaweeds do not usually grow below 100 ft (30 m) deep. However, in the clearest waters, such as in the Mediterranean, they can grow below 330 ft (100 m). Red seaweeds have pigments that enable them to grow in deeper water and shade than brown ones. Red and brown seaweeds are less abundant in tropical waters, an exception being the red coralline encrusting seaweeds, which have an important role in cementing coral reefs, and in building other carbonate reefs in warm, shallow water. Some seaweeds grow unattached, in sheltered lagoons, and a few grow in salt marshes, anchored in mud. The brown sargassum or gulfweed, *Sargassum natans*, is unusual in that it floats at the surface of the open ocean, forming the basis for a unique ecosystem (see p.444). Drifting seaweeds may have an important role in the long-distance transport of marine life to isolated islands.



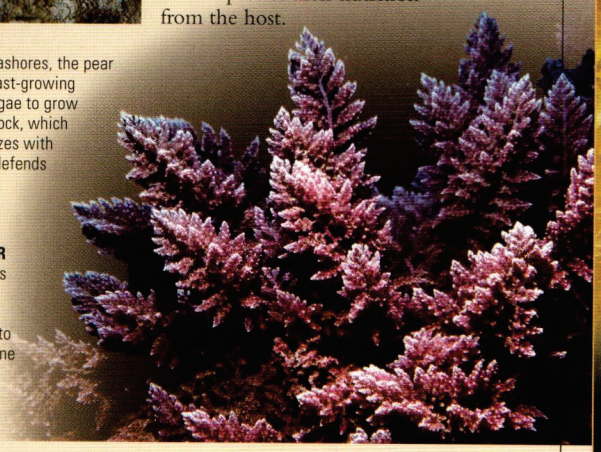
EVOLVING IN ISOLATION
Many of the seaweeds of Tristan da Cunha, in the south Atlantic, are found nowhere else, having evolved in isolation on an extremely remote, geologically young island group. The klipfish seen here is also endemic.

LIFE STRATEGIES

Red and brown seaweeds must cope with a disturbed environment. Seashore and rock pool species in particular experience daily and seasonal extremes of salinity or moisture and temperature, and the attentions of animal grazers. Because of regular exposure to air when the tide is out, the most dessication-resistant brown seaweeds usually live at the top of the shore. Although they may dry out at low tide, they can rapidly absorb seawater and resume photosynthesis as soon as the tide returns. Many seashore brown seaweeds produce mucus, both to keep from drying out and to deter grazers and colonizing animals. Some seaweeds are annuals, so they grow, reproduce, and die within a year. Others are perennial, or have parts from which new fronds grow each year. Many red seaweeds that colonize disturbed habitats have a two-phase life history, with conspicuous, erect filaments or fronds, present only during the calm season, and a perennial crust or creeping filament that helps it withstand abrasion during storms. These phases look so different that they were first described as separate species. The distinctive red seaweeds called coralline algae have a heavily calcified, pink frond, too hard for most grazers to eat. In some species, the frond is jointed, while others form crusts on rock. An unattached version, maerl, forms hard, free-living nodules on the sea bed. Some seaweeds are parasites of other seaweeds, obtaining at least part of their nutrition from the host.

NEW KELP GROWS FROM OLD
A new, yellow frond is growing from the top of this kelp stipe. The old frond, which will drop off, is covered in white animals called bryozoans, which block vital photosynthesis.

LIMPET GARDENS
On South African seashores, the pear limpet encourages fast-growing and nutritious red algae to grow on the surrounding rock, which it then grazes, fertilizes with its own waste, and defends from other limpets.



BARBED COLONIZER
This red seaweed has specialized barbed branches, enabling detached fragments to hook onto other marine growth and travel to new areas, carried either by currents or on ships' hulls.

SEAWEED CLASSIFICATION

Red and brown seaweeds have been classed as divisions, phyla, or classes of plants or protists, but here they are treated as independent kingdoms. Their defining features are their photosynthetic pigments.

BROWN SEAWEEDS

Kingdom Phaeophyta

About 1,500–2,000 species

Of the 14 or so orders of brown seaweeds, the most conspicuous marine orders are the kelps and wracks. Their brown color is due to the pigment fucoxanthin; other yellow pigments (xanthophylls) may also be present. They also have beta carotene, and chlorophylls a, c1, and c2.

RED SEAWEEDS

Kingdom Rhodophyta

About 5,000–5,500 species

There are two classes and 18 orders of red seaweeds. The majority are in the order Gigartinales, which contains a variety of frond-bearing (frondose) and crust-forming (crustose) species. The red color comes from the pigment phycoerythrin. Rhodophyta also have blue pigments, carotenoids, and chlorophyll a.

THRIVING IN SURF
To absorb nutrients, red and brown seaweeds rely on moving water. Many appear green, and they flourish on these wave-washed rocks in the Canary Islands.