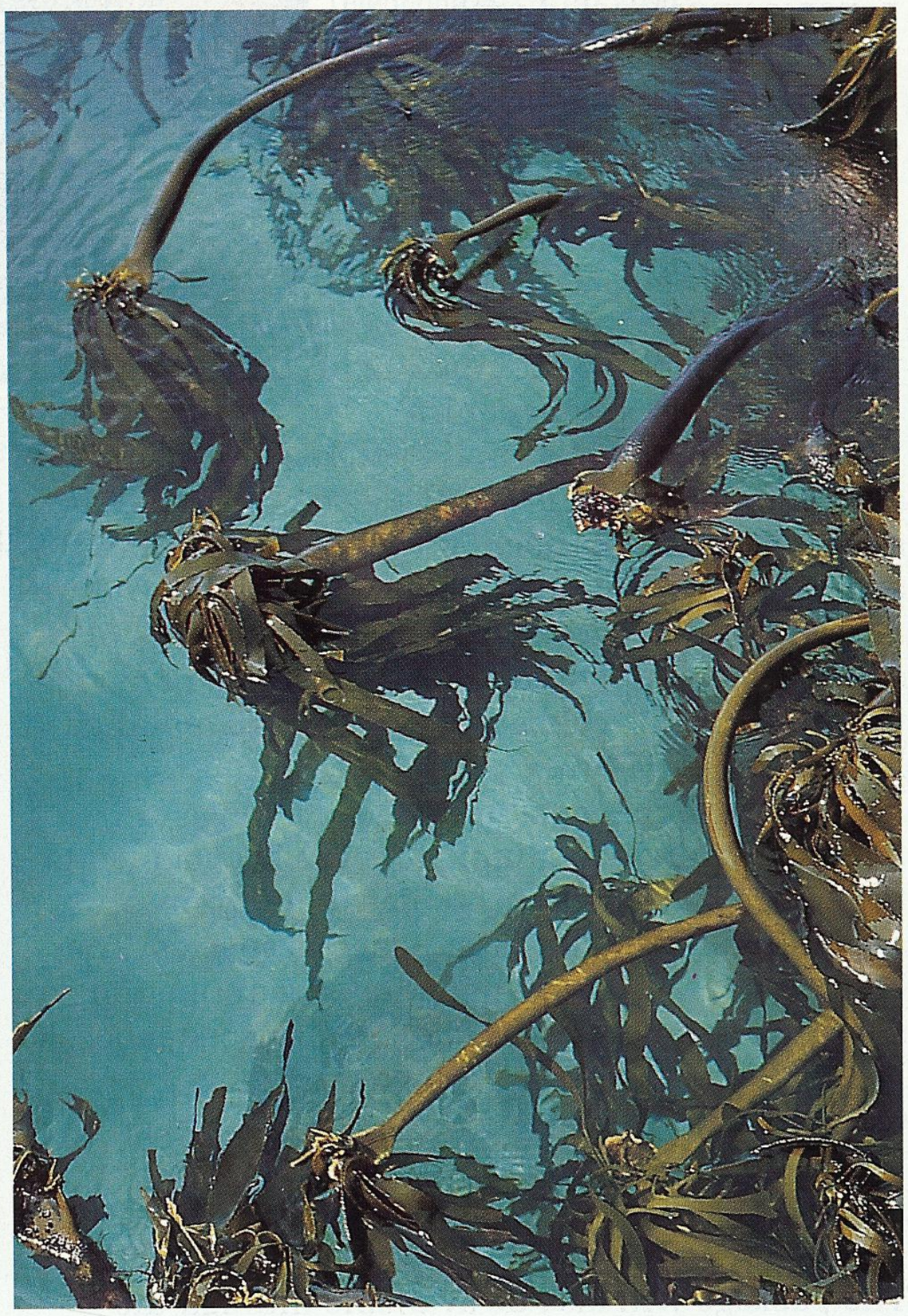
TWO OCEANS'

INFLUENCE ON ALGAE

The dramatic differences between the marine plants and animals found along the east and west coasts of southern Africa are due mainly to the influence of the cold Atlantic Ocean in the west and the warm Indian Ocean in the east.

by Margo Branch

South Africa's position between two major oceans with different temperatures and currents, has resulted in dissimilar flora and fauna along the east and west coasts. This is even evident when one examines the life found on either side of the Cape Peninsula. These differences are particularly obvious when one compares the seaweed from these two coasts. Along the west coast there are vast, underwater forests of kelp, whilst on the east coast the tide pools are filled with small colourful seaweeds and the gullies are fringed with masses of tough, wiry jelly-weeds and pink, jointed coralline algae.



West coast seaweeds

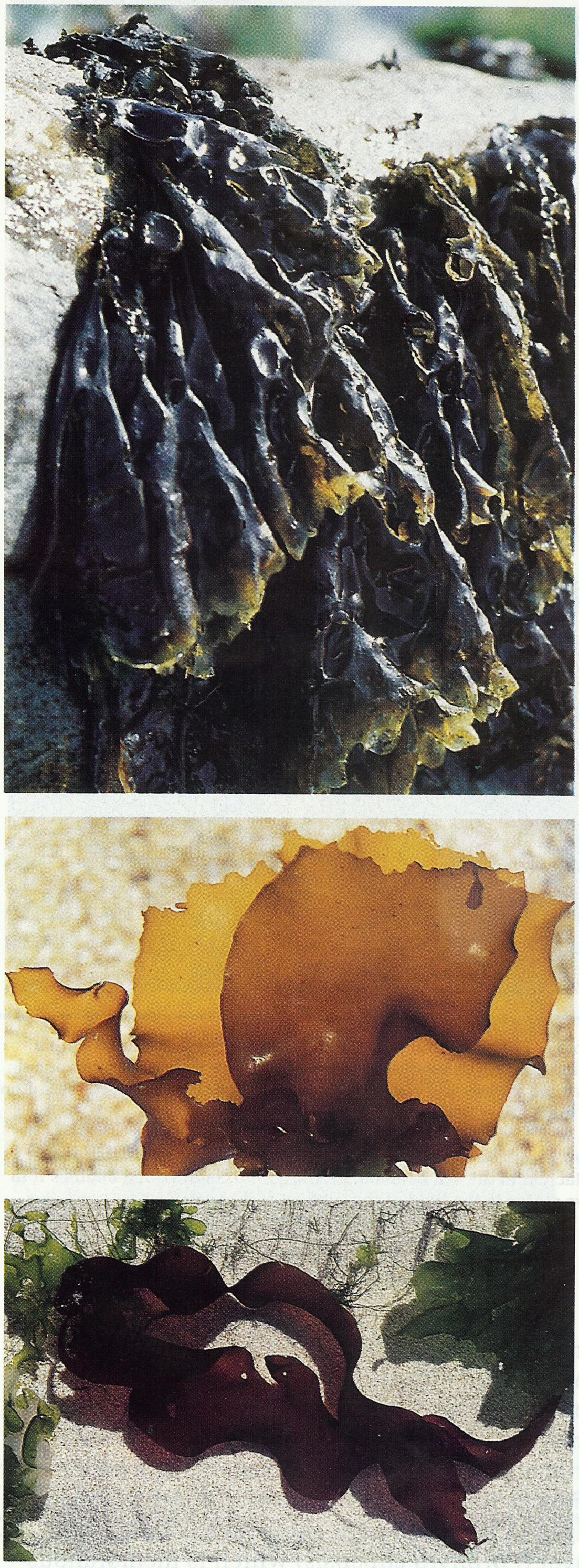
Sea temperatures along the west coast range between 6 and 21 °C, with an average of about 14 °C, and are influenced by the cold, north-flowing Benguela Current. South-easterly winds play a major rôle by moving the surface water offshore so that cold, deeper water wells up to the surface. Kelps, which are among the fastest-growing algae, flourish in this upwelled water because it is rich in nutrients. The sea bamboo *(Ecklonia maxima)* can grow 13 mm a day and reaches lengths of 12 m. It has a sturdy root-like holdfast and a hollow gas-filled stipe expanding at the top into a bulb that floats and holds the strap-shaped fronds at the surface of the water. Larger individuals extend offshore to depths of 10-15 m. The split fan kelp *(Laminaria pallida)* has a solid, stiff stipe, terminating in a large fan-shaped blade which is irregularly split into fronds. It grows under the canopy of *Ecklonia maxima* to 15 m but replaces the larger kelp in deeper water. The fan curves over and sweeps the ocean floor keeping grazing sea-urchins away from the base of the plants.

The kelp forests create a unique ecosystem. They break the force of the waves and provide a sheltered habitat. Many animals rely on the kelp for food, either grazing the plants or consuming the fine soup of particles that continually erode from the tips of the fronds. Important grazers are large molluscs and sea urchins. The abalone or perlemoen *(Haliotis middae)* and the china cap limpet *(Patella argenvillei)* lift their shells and clamp down on kelp fronds that sweep past in the waves, and the granite limpet *(Patella granatina)* traps drifting kelp in a similar fashion. The kelp limpet, *(Patella compressa)* has a compressed shell designed to fit the kelp stipe on which it lives and feeds. It even territorially defends its kelp from other limpets. Mussels, sea cucumbers and redbait *(Pyura stolonifera)* are important filter-feeders that live in kelp beds. The mussels, in turn, are eaten by rock lobsters.

The kelp canopy reduces the light in the kelp forest and this influences the growth of understory algae, which are predominantly large, flat, sheet-like red algae. These have a large surface area to absorb light and nutrients and have special accessory blue and red pigments to increase the uptake of light energy for photosynthesis. They are flexible and often have a rippled surface to allow the easy flow of water over them.

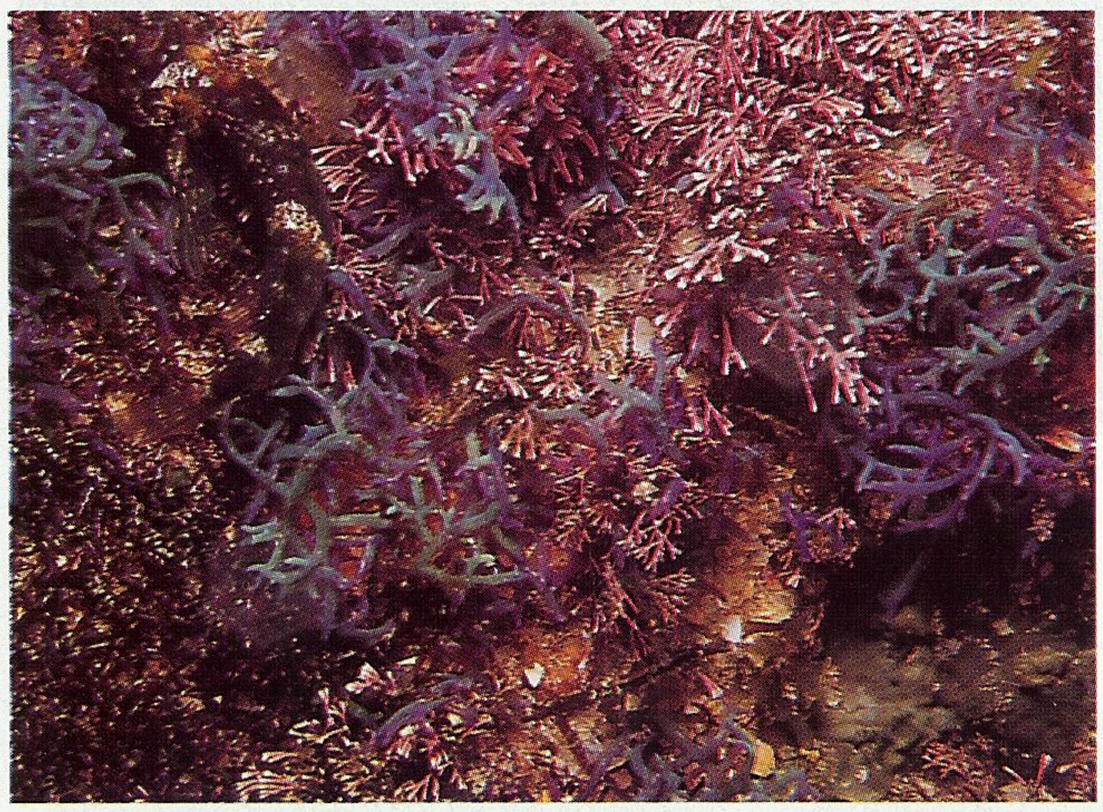
Epiphytic algae grow like ferns on the kelps which hold them up to the light. Three important epiphytes on kelp are *Carpoblepharis flaccida*, *Suhria vittata* and *Polysiphonia virgata*.

Another notable feature of the algae on the west coast is that even those occurring in the intertidal zone are predominantly foliose (flat and leaf-like) although they may be interspersed by tough, fleshy



Foliose (flat and leaf-like) red algae are common along the west coast. The purple laver, *Porphyra capensis* (top) **occurs high on the shore where it is able to withstand severe desiccation. The slippery orbit, *Aeodes orbitosa*** (centre) **is a tough, slippery midshore alga, while the ripple ribbon-weed, *Grateloupia doryphora*** (bottom) **occurs in deeper water.**

Opposite page. **The fan kelp, *Laminaria pallida*** (left) **and the sea bamboo, *Ecklonia maxima*** (right) **create extensive kelp forests along the west coast of southern Africa. Photos: G.M. Branch.**



Above. **The intertidal pools along the east coast are lined with a colourful turf of small branching algae. The wiry iridescing purple *Hypnea viridis* and chalky-pink, jointed coralline algae are common in mid-tide pools in Natal.** Photo: G. M. Branch

Top. **Red ribbons, *Suhria vittata*, a common epiphyte that lives attached to the sea bamboo, *Ecklonia maxima*, which enables it to live closer to the light at the surface of the water.** Photo: G.M. Branch.

branching forms. Perhaps this is because the kelp reduces the force of the waves breaking on the intertidal rocks and the flat algae are not battered and torn. The cold, upwelled water influences the climate, causing frequent coastal fogs which reduces the stress of desiccation for the intertidal algae. A common high-shore alga is the purple laver *(Porphyra capensis)* which is membranous and slippery when wet, but resembles crumpled black plastic when dry. It is able to withstand severe drying because the water is lost from a mucilaginous layer between the cells and not the cells themselves. Purple laver is seasonal and tends to die back in summer. In winter and spring it grows extremely fast but is eliminated from low on the shore by grazers.

Anyone venturing over the west coast rocks soon learns about slippery orbits *(Aeodes orbitosa)*. This tough olive-brown alga has a thick mucilage that resists water loss and is apparently unpalatable to grazers. By contrast, the red ripple ribbon-weed *(Grateloupia doryphora)* is flaccid and membranous and ripples in the runnels where it never dries out. Its purplish-red pigments help it to photosynthesize in deeper water where there is less light penetration.

The kelp forests support several commercially important species, which include the rock lobsters (crayfish), perlemoen, mussels, limpets and the kelps themselves. Kelps are harvested fresh, for use as a growth stimulant and fertilizer in agriculture, or dried and used for the extraction of alginic acid. This extract has an amazing array of uses from stabilizing toothpaste, paint, ink and explosives to waterproofing cement, sealing fine paper and creating lacy fabric. Daily doses of algae are taken by workers in nuclear power stations in the United States because the alginic acid is able to fix radioactive strontium and enable it to be passed out of the body.

East coast seaweeds

Visits to the east coast are free from the smelly, washed up kelp and one is enchanted by iridescent small algae in the tidal pools. Brilliant blue and yellow forking *Dictyota* species (see cover), delicately branched purple *Hypnea* species and the fascinating curling turkey-tail fans *(Padina boryana)* catch the eye. But as one ventures into the more exposed, wave-washed areas and gullies, one is struck by the dense mats of wiry, finely branched jelly weeds *(Gelidium* species*)* and the beautifully jointed coralline algae.

The temperature of the sea under the influence of the south-flowing Agulhas Current makes the water much warmer on the east coast than it is on the west coast, averaging 17-24 °C. But it is low in nutrients. The productivity of seaweeds is much lower than on the west coast, and there are no kelp forests to break the force of the waves. The algae must be flexible, tough and firmly attached to avoid damage by the waves that crash unhindered onto the rocks. Of particular note are the jelly weeds which are harvested commercially for their agar which is used as a gelling agent in confectionery and as a growth medium for microbiological studies. (See *Veld & Flora* **77**(3), 76-77). There is also a variety of jointed upright coralline algae which have the dual advantage of being tough and unpalatable to grazers because their tissues are laden with lime.

The removal of carbon-dioxide during photosynthesis enhances the deposition of lime by influencing the chemical reaction which changes soluble calcium bicarbonate into carbonic acid

and insoluble calcium carbonate or lime. The deposition of lime is increased at high temperatures which may account for the great number of coralline algae along the east coast. Several other algae have lime-impregnated skins and these include the pink *Galaxauras*, the green jointed wedge weed *(Halimeda cuneata)* and the green fan *(Udotea orientalis)*. Even the turkey tail *(Padina boryana)* has concentric rings of lime.

Another interesting feature of the east coast is the vast, slippery sheets of colonial anemone-like zoanthids that cover the rocks. These are usually green because of the presence of unicellular algae or zoozanthellae in their tissues. These algae live symbiotically within the zoanthids, gaining protection and the use of the carbon dioxide and nitro-genous waste products of the zoanthids in order to synthesize organic compounds. In turn, the zoanthids benefit by gaining the products of photosynthesis such as glycerol and glucose. This is taken one step further in tropical waters where the zoozanthellae live within the coral polyps and assist, not only with their nutrition, but also with the deposition of the coral skeletons which collectively form vast coral reefs.

As primary producers in the marine ecosystem, algae have far-reaching influences on the health and welfare of marine life and on industries and human activities associated with the coast.

Further reading

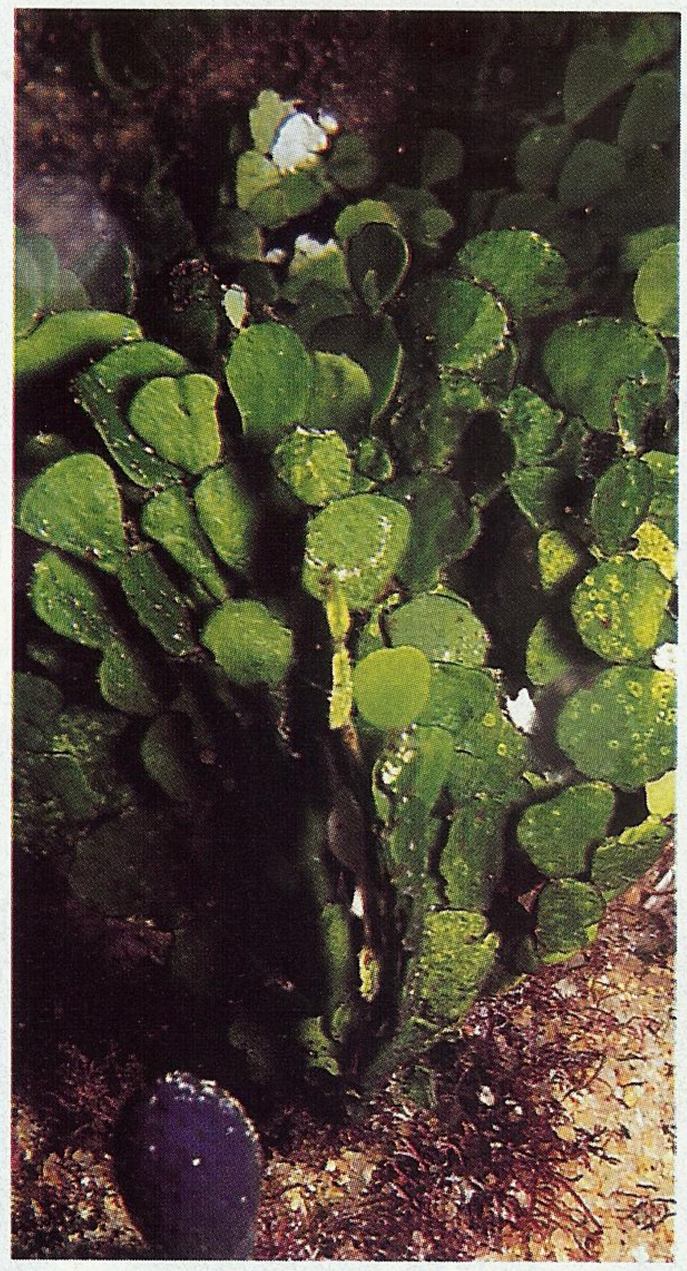
Branch, G.M. & Branch, M.L. (1991). *The living shores of southern Africa*. Struik, Cape Town.

Branch, G.M., Griffiths, C.L., Branch, M.L. & Beckley L.A. (1994). *Two oceans: A guide to marine life in southern Africa*. David Philip, Cape Town.

About the author

Margo Branch is a biologist, author and illustrator, committed to making scientific discoveries accessible to the general public. She is co-author of the recently published book: *Two oceans: A guide to the marine life of southern Africa* with G.M. Branch, C.L. Griffiths and L.A. Beckley, from which the photographs used in this article were taken. Other books to her credit include her own *Explore the seashore* and *Explore the Cape fauna and flora*, as well as *The living shores of southern Africa* and *A field guide to mushrooms of South Africa* to which she was a co-author.

The beautifully illustrated, and incredibly detailed (over 1 400 species identified) book, *Two oceans: A guide to the marine life of southern Africa* is available at the Botanical Society's Garden Shop, with a 10% discount to members of the Botanical Society of South Africa.



Top. **The wedge weed, *Halimeda cuneata,* is impregnated with lime which makes it tough and unpalatable to grazing fish and molluscs.**
Photo: G. M. Branch.

Centre. **The jelly-weeds *(Gelidium)* are tough, wiry and branched to withstand the pounding waves in the gullies on the east coast. They are harvested for the extraction of agar.**
Photo: G.M. Branch.

Bottom. **About 40 cm high, the turkey-tail, *Padina boryana* is common in high shore pools on the east coast. The growing edge of the fan is curled under for protection.**
Photo: C.L. Griffiths.