

**SEAWEED RESOURCES
OF THE WORLD**

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Plate 5

Top: Harvesting of *Ascophyllum* on the coast of Norway. Middle-L: Experimental cultivation of *Laminaria* in Helgoland, Germany. Middle-R: Harvesting of *Laminaria* on the coast of Brest, France. Bottom L&R: *Durvillaea potatorum* being air dried on racks, King Island, Tasmania, Australia.

13 THE SEAWEED RESOURCES OF AUSTRALIA

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A general overview of the oceanography of the Australasian region is provided in Jeffrey *et al.* (1990). Australia has poleward-directed currents on both the east and west sides of the continent. These bring tropical ocean waters, with their entrained plants and animals, to southern Australian waters. On the east is the East Australian Current and on the west is the Leeuwin Current which, when it reaches the south-west corner of the continent (Cape Leeuwin), turns and runs to the east along its southern margin (Fig. 1).

MAIN ENVIRONMENTAL FACTORS

WATER CURRENTS

The East Australian Current (EAC) has its source in the Coral Sea where an inflow at a depth of about 200m splits, turns south and rises towards the surface to form the EAC. At about 33°S it turns eastward to the Tasman Sea. At this point its surface temperature is 20-24°C with salinity of 35.6-35.9 ppt. Eddies

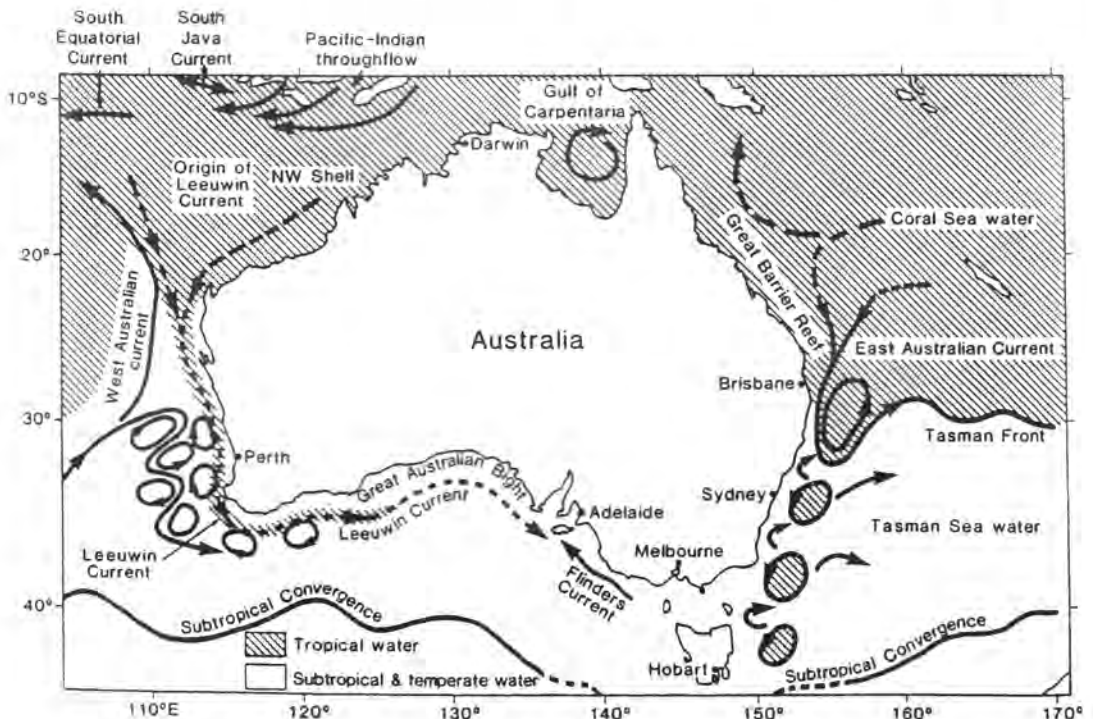


Figure 1. The major features of Australia's oceanic circulation. (From Jeffrey *et al.* 1990)

are sometimes pinched off its southern extremity and these can extend further south in summer, even as far as eastern Tasmania.

The Leeuwin Current is a surface flow of low-salinity, warm water that flows south from north-west Australia to Cape Leeuwin. It then turns east, spreads over the continental shelf and slowly crosses the Great Australian Bight out from the shelf. Sea-surface temperatures indicate that small extensions of this current may reach the west coast of Tasmania, especially in winter. The Leeuwin Current flows mainly in the autumn and winter, is relatively narrow (less than 100 km wide) and can reach a speed of 1.8 m sec^{-1} . In summer months, winds between the Leeuwin Current and the shore drive the water northwards, generating a slow northwards current close to the shore. As the Leeuwin Current flows south, it intrudes between the coast and a branch of the West Australian Current. The latter is a weak, broad, northward flow that is part of the anti-clockwise subtropical circulation of the Indian Ocean.

The Flinders Current is a summer coastal current that flows northwards past the west coast of Tasmania, across the western side of the Bass Strait, then north west along the Victorian and South Australian coasts.

In the Gulf of Carpentaria there is a slow clockwise circulation in winter and summer, and the flow through the shallow Torres Strait is very low thus the Gulf is best regarded as a bay of the Indian Ocean.

WATER TEMPERATURES

Most of the waters surrounding Australia are tropical ($25\text{-}31^\circ\text{C}$) or subtropical ($15\text{-}27^\circ\text{C}$). In the north, sea-surface temperatures range from $25\text{-}30^\circ\text{C}$ but a gradual cooling of the sea surface occurs with increasing distance from the Equator (Fig. 2). However temperatures close inshore do not always follow the general pattern shown in this figure. In southern Australian open ocean coastal waters, the monthly temperature means can range from about 14°C (winter) to 19°C (summer) but in sheltered bays temperature ranges can be much greater.

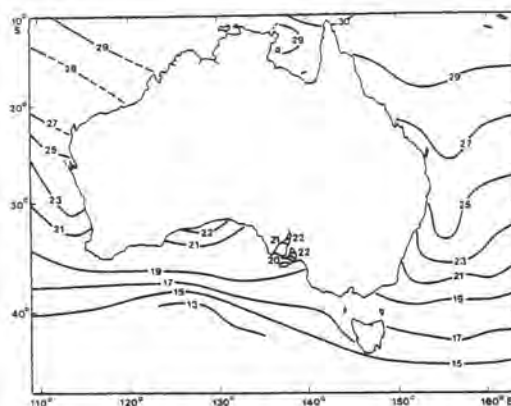


Figure 2. Mean (3-10 year) sea-surface temperatures ($^\circ\text{C}$) of Australian ocean waters in mid-summer (January). (From Jeffrey *et al.* 1990)

SALINITY

Salinity is 35-36 ppt on the open coasts of southern Australia but this can vary in specific localities, e.g. increases to 45 ppt at the head of Spencer Gulf in South Australia have been recorded. There is little seasonal variation in open waters, except near river mouths, in estuaries, on tidal flats and in isolated rock pools. Algae in these habitats are usually tolerant of varying salinity and if killed, show rapid regrowth from basal parts. In northern Australia, tropical water salinity generally falls within the range 34-36 ppt.

NUTRIENTS

Australian surface waters are generally low in nutrients, particularly nitrates and phosphates. Few nutrients are contributed from the land mass due to low run-off of water and soils that are themselves low in nutrients. The coastal waters are isolated from major oceanic sources of nutrient. There is little input from the rich sub-antarctic waters to the south, and the upwelling usually associated with boundary currents of other continents is absent. There are some local sources of enrichment from upwelling, cyclonic eddies and convective overturn but these only occur on a small proportion of the Australian coast.

MAIN SPECIES OF THE AUSTRALIAN MARINE FLORA

Australia has a rich and highly endemic marine algal flora, with that of the temperate coasts most noteworthy (Womersley 1990). Seaweeds of the tropical coasts are less well known taxonomically though it is clear that there are fewer species and a lower degree of endemism, and many of the species have wider distributions in tropical waters.

TRANSITIONAL WARM-COLD TEMPERATE COASTS

The algal flora of the southern Australian coast is well known through a series of papers and monographs: see especially publications on the Chlorophyta (Womersley 1984), Phaeophyta (Womersley 1987) and Rhodophyta (Womersley 1994, 1996). These studies can be used to identify the taxa in the region and have established the Australian marine flora as the noteworthy region of the world (within a limited range of seawater temperature) for its diversity of benthic algae (Womersley 1990). There is as yet no understanding of the factors promoting this algal biodiversity, but it is significant since it results in there being few species which occur in monospecific stands of sufficiently high biomass suitable for harvesting.

WARM TEMPERATE COASTS

The algal flora of the warm temperate coasts on both the eastern and western seaboard are less well known than those of the southern coasts. The existing data suggest a transition in species to the tropical and subtropical flora in northern Australia. For the New South Wales coastline recent catalogues exist for each of the major seaweed groups (Chlorophyta - Millar and Kraft 1994a; Phaeophyta - Millar and Kraft 1994b; Rhodophyta - Millar and Kraft 1993), while for Western Australia there is a detailed catalogue and supplement for Rottnest Island, near Perth (Huisman and Walker 1990; Huisman 1993).

TROPICAL AND SUBTROPICAL COASTS

The marine algal flora of northern Australia is poorly known except for specific regions such as the Great Barrier Reef (Price and Scott 1992). Checklists based on earlier published records are available for the Rhodophyta, Phaeophyta and Chlorophyta (Lewis 1984, 1985 and 1987).

ECONOMIC SEAWEEDS OF AUSTRALIA

Very few algae, whether microalgae or seaweeds, are exploited commercially in Australia. In addition to the seaweeds listed below, species of *Enteromorpha* (greenweed or baitweed) and *Gracilaria* (blackweed) are sometimes collected and sold to amateur anglers as bait. The only mass culture of microalgae is of *Dunaliella salina* undertaken in large open-air ponds such as those at the Hutt Lagoon in northern Western Australia (Borowitzka and Borowitzka 1990).

DURVILLAEA POTATORUM (LABILLARDIERE) ARESCHOUG (Figs 3A, B, C, D)

This species is endemic to south-eastern Australia, occurring from about Kingston in South Australia to Tathra in southern New South Wales, and around most of the coast of Tasmania. Beach cast *Durvillaea* is harvested in Tasmania. It grows mainly in the intertidal and shallow subtidal, often in regions where there is strong wave action. This precludes the direct harvesting of the species in nature. On King Island, located in the Bass Strait between Victoria and Tasmania, *Durvillaea* grows on offshore reefs along the west coast of the island. It becomes detached after storms or heavy swells and probably about 10% of this loose material is rolled onto coastal areas where the sea bottom has a gentle slope. The beach-cast kelp is collected and transported to a central drying area where it is air dried by hanging the thalli on 5 m high racks (Figs 4A, B, C, D). After about 10 days, depending on