Durvillaea kelp: harvesting and biology

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In the north of New Zealand, eg at places like Piha and Bethells, the only species of *Durvillaea*, is *D. antarctica*. Knowledge of a distinctive southern *Durvillaea* species was slow to reach the north, and because of the huge size of the plants, nobody was able to press an entire mature plant onto a herbarium sheet.

In the south, however, Mrs Eileen Willa, life-time resident of Stewart Island, was busily collecting and pressing seaweeds onto herbarium cards which were kept at Rakiura Museum in Oban. Her favourite collecting place was Ringaringa beach where large quantities of drift seaweed washed ashore after easterly storms. Over the years Mrs Willa communicated with several of the world's most famous marine botanists including Prof F Papenfuss at the University of California and many of her specimens are now scattered throughout plant herbarium collections worldwide. Mrs Willa always knew that there were two types of *Durvillaea* in the south. In letters and with drawings and specimens she communicated this information to Victor Lindauer (son of the famous portrait painter of Maori, Gottfried or Bohumir Lindauer) at the University of Auckland who described the new species in 1949, naming it after Mrs Willa.

This discovery of such a large, undescribed kelp seaweed in 1949 may seem inconsequential. For many folk, seaweeds are pretty much all the same — an infernal nuisance when they get around the propeller! But for marine botanists, the late discovery of such a distinctive and ecologically dominant kelp, widely distributed on mainland southern New Zealand, was as if terrestrial botanists had suddenly stumbled on an undescribed dominant tree like rimu of kahikatea.

While *D. willana* is an important habitat for commercially lucrative species such as paua, kina, morari (greenbone or butterfish) and moki, the plant itself is currently of no immediate commercial importance in New Zealand. It has, however, been harvested on a small scale in relatively recent times.

Alginates

Up to one half of the dry weight of *D. willana* is a substance called alginic acid. It cements the cell walls together much like cellulose in land plants. Alginic acid (which is insoluble) can be chemically converted to other alginate salts, eg by soaking chopped kelp in washing soda to produce soluble sodium alginate, which is the main ingredient of non-dairy ice creams in America. These sticky, viscous alginates have a thousand-and-one uses in food preparation as a stabilising and suspension agent. Alginates are also added to car polishes, certain paints; they are used as moulds for metal castings and they stick the flux to the outside of electric welding rods. They are also used medicinally partly because of their ability to absorb radioactive substances.

In 1971 a major Japanese Chemical company exported a trial shipment of 10 tonnes of *D.antarctica* from the northern Kaikoura coast to Japan for alginate extraction. Their scientists, who travelled the length of the South Island east coast taking samples and asking local fishermen to harvest the kelp, received a mixed reception. On the Kaikoura

coast the (then) New Zealand Railways predicted that harvesting bull kelp would remove an important buffer to wave action on a coast where sections of the main trunk line were constantly undermined by wave action. Local Kaikoura fishermen were also concerned about possible detrimental effects such harvesting would have on various fish and shellfish species such as moki, morari and paua.

Raising little enthusiasm for their venture on the Kaikoura coast, the Japanese business men and scientists came south to Otago where eventually they engaged a local business man from Palmerston to harvest *Durvillaea* in the Shag Point area. The Ministry of Agriculture and Fisheries issued an experimental license for him to harvest two stretches of coast of 16 and 19 km. Commercial harvesting by snorkellers began in 1971. Severed *Durvillaea* plants, at first mainly the buoyant *D. antarctica*, in bundles of about 150 kg, were winched ashore where attempts were made to dry and mill the plants at a factory at Shag Point into a coarse "meal" for export.

The business operated erratically for about 3-4 years, and finally closed in 1976. There were, with persistently bad weather for harvesting and especially for drying the kelp, poor price, high labour costs for harvesting and processing difficulties. The harvesters also found that they quickly exploited the *Durvillaea* on the most accessible parts of the shore. The total export was probably 75-100 tonnes (dry), which amounted to about 450-600 tonnes of wet kelp.

At King Island in western Bass Strait, Tasmania, *Durvillaea potatorum* has been collected as a source of alginate since the early 1970s. Only storm cast plants are harvested and over a ten-year period from 1976-86 approximately 25,000 tonnes of dried, milled kelp was exported from King Island to the UK for alginate manufacture.

In New Zealand in the 1970s we knew little about the biology or ecology of either *Durvillaea* species. By dint of a research grant from MAF, funds from the Golden Kiwi Lottery and from the McKenzie Trust, the Zoology Department of the University of Canterbury began a study. Much of the fieldwork was done on the Kaikoura coast and at Tautuku Peninsula in the Catlins.

Biology

Both species have separate male and female plants in approximately equal proportions. In winter the females release millions of very small eggs (about 1/30 mm in diameter) from pin-prick sized cavities in the blade (conceptacles). When ripe female plants are allowed to dry slightly, the exuded eggs rub off as a greenish-brown deposit. The eggs probably sink quite quickly, and once fertilized by sperm from the neighbouring male plants, quickly adhere to the rock. Within a few weeks a small leafy plant with a simple blade, stipe and holdfast appears. These grow quite quickly attaining lengths of about 0.5-1 metre in a year. However, fully grown plants are commonly at least 4-5 years old. There is little significant regeneration from cut stalks: typically the severed stalk and the holdfast rot away.

Areas harvested in spring and summer, when the seas are often calmest, are not quickly recolonised by *Durvillaea* because the female plants are not releasing eggs. Instead the

summer-cleared areas are often carpeted with other seaweeds especially coralline turf, which covers much of the space where the kelps had previously been attached. Such areas are only slowly recolonised by the kelp. Areas harvested in winter, however, when there are plenty of eggs about, are rapidly recolonised, especially if harvesters take the time and trouble to chip away the holdfasts. Unfortunately seas were roughest in winter and the holdfast-chipping process can be tedious. Which means that if most harvesting is in summer then the ecological nature of the coast might be changed from a *Durvillaea* dominant coast to one dominated by a low algal turf.

Although only a small quantity of dried bull kelp was exported from Otago, there is still a worldwide trade in dried milled seaweed for alginate. Much comes from beds of *Macrocystis* kelp in North America, Chile, and the Falkland Islands and from beds of *Laminaria* and *Ascophyllum* in Europe. A small amount comes from beach-cast *Durvillaea potatorum* on King Island in Bass Strait.

As these natural resources diminish, or because of resistance to harvesting for other reasons, and if the algin price rises, there is always a possibility that other international chemical companies will propose harvesting *Durvillaea* from New Zealand's southern shores. The ecological effects of this could be considerable, especially if an alginate extraction factory was established in New Zealand. Such factories require a continuous supply of raw material to be commercially productive.

The effects of harvesting *Durvillaea* on the myriad of animals and plants that live within the kelp forest still are not known. Many of these species such as the brown seaweed *Marginariella boryana*, various large chitons and limpets, sea squirts, species of paua and so on are also New Zealand endemics. The effect of large-scale harvesting of *D. willana* on our already depleted paua resource, and on declining stocks of kelp-dwelling fish such as trumpeter, moki and morari are not known. Without the kelp cover they would presumably be much more vulnerable to predators such as seals which have increased in number in recent years.

What is certain is that large-scale harvesting would dramatically increase wave action in the intertidal and shallow subtidal zone. This would probably be detrimental to many of these kelp-dwelling species. Large scale harvesting of *D.antarctica* also destroys the communities of chitons, top shells, worms and crustaceans that live within the burrowed holdfasts. Also certain is that large-scale harvesting of the kelp would aesthetically change the entire appearance of our southern shores.

Currently there are 17 marine reserves on the mainland New Zealand coast. Several are in estuaries and just seven are south of Cook Strait. Collectively they amount to far less than 1% of the length of the mainland coast and none in South Island includes any significant area of exposed *Durvillaea* coasts. It is therefore important that we protect a very good example of the type of shoreline on which endemic *D.willana* is the ecologically dominant species. On land we have reserves for red tussock, for rimus and even ranunculuses. Several sites along the Otago and Southland coasts and on Stewart Island would be ideal candidates for protecting this endemic and dominant kelp and the flora and fauna that live within forests of Mrs Willa's *Durvillaea* kelp.