Potential new invasive plants of coastal dunes: bad news from Australia

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Leonard Cockayne's survey of the early 1900s documented the extent and botanical distinctiveness of active coastal duneland in New Zealand. Since then they have declined in area by around 70% nationally[1], and up to 80% in some regions. Moreover, many of the remaining dunelands, particularly in central New Zealand, the west coast of both main islands and the south coast of the South Island, are now dominated by marram grass (*Ammophila arenaria*) and other exotic species. These dune systems have been stabilised and can no longer be considered "active dune systems". Compared with weed-free dunes, they contain little natural character, including little or no transgressive dune activity, and low native species and landscape/ habitat diversity. Tahakopa Bay, in the Otago region, for example, was ranked of national significance in the early 1990s[2], yet marram grass now occupies over 95% of the recently active dunes. Pingao (*Desmoschoenus spiralis*) and associated species will not survive at this site without intervention. The situation is somewhat better in the North Island, particularly the upper North Island, where it appears marram grass is less vigorous and less able to disperse. The outlook for active dunelands and their flora and fauna is also more positive in the far south of New Zealand in Fiordland and on Stewart Island (Rakiura), where the Southland Conservancy of the Department of Conservation is mounting a successful progamme of marram grass eradication. Elsewhere DOC, local authorities and conservation groups have been active in conserving smaller dune remnants, although on an ad hoc basis — New Zealand is yet to develop a national strategy for duneland conservation.

Duneland conservation management is likely to face new challenges in the near future. The Australian experience demonstrates we should be alert to the establishment of new exotic plant species in our coastal dunes, particularly plants from Europe and South Africa. A number of species from these regions have established in Australian since European colonisation. Three species are of particular concern, because of their capacity to rapidly invade open sandy habitat; their capacity to form dense, virtually monospecific stands; their capacity to stabilise dunes; (and so reduce the diversity of dune habitat); their ability to displace indigenous species; and, finally, their potential to invade New Zealand dunes. Pyp grass (*Ehrharta villosa*), is already in New Zealand. Sea spurge (*Euphorbia paralias*) and sea-wheat grass (*Thinopyrum junceiforme*) are widespread along the south coast of continental Australia. They also occur in Tasmania, on a diversity of coasts with climates comparable to those in New Zealand.

Sea spurge

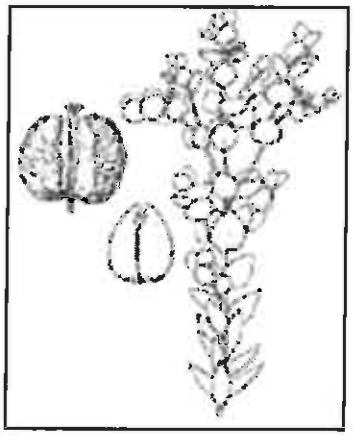
Euphorbia paralias should not to be confused with the endemic New Zealand shore spurge (*Euphorbia glauca*). The European shore spurge is a perennial herb of semi-vegetated coastal dunes, native to southern Europe and the Mediterranean Sea. Plants comprise multiple stems around 70cm high originating from a common base at ground level (compared with the single stem growth form of *E. glauca* where the plant is growing on accreting dunes); fleshy leaves are glabrous and glaucous, and grow to 3cm long. The sap is milky. It flowers from September to May in Australia and a vigorous plant can produce 60 flowers in a season, with 25 to 40 fruits per flower. Three round seeds, 3mm in

Potential dune invaders continued

Sea spurge*, Euphorbia paralias, *photographed in Tasmania.

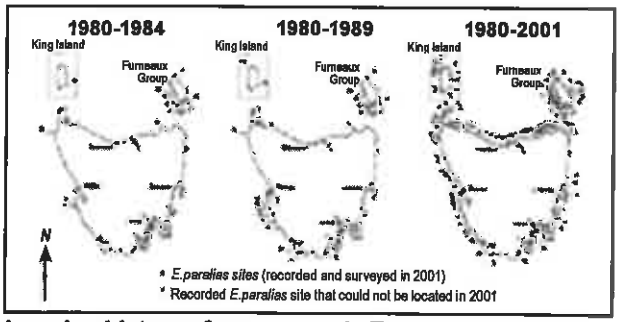
diameter are produced per fruit — annual production can be around 5000 seeds per plant. Seed is shed throughout the year. Stands in Australia may comprise many thousands of plants or more. The seeds are grey, spherical and 2.5-3.5mm in diameter.

The dispersal of sea spurge in Australia has been singularly rapid, following its accidental introduction to Western Australia and South Australia early last century, probably in ship's ballast. It



Sea spurge*, Euphorbia paralias, *showing the flowers, fruit and seeds, from Walsh, NG and Entwisle, T.J., 1999,* Flora of Victoria, *Inkata Press, Melbourne.

subsequently spread across the southern coast of the continent; reaching Kangaroo Island, South Australia, in 1958, Wilson's Promontory, Victoria in 1974; Flinders Island, Bass Strait, in 1982; the northeast coast of



Invasion history of sea spurge in Tasmania with the small black triangles showing the increasing number recorded occurrences over time.

Tasmania in 1980; and the west coast of Tasmania in 1984. Recent fieldwork by the author indicates that the species is now widespread along the north coast of Tasmania and spreading down the west coast of the state. Sea spurge is still rare on the east coast of Tasmania.

Sea spurge is adapted to marine dispersal and is probably able to drift to New Zealand from eastern Australia. The seeds possess a layer of spongy tissue containing air–spaces between the kernel and the hard testa. Dr Petrus Heyligers, formerly of CSIRO, established that the seeds have an initial dormancy period and may float in sea water and remain viable for several years (at least in the laboratory). Seed may also arrive in New Zealand aboard ships, including sand dredges that frequently work along Australian beaches infested with sea spurge.

Once ashore, sea spurge exhibits specific adaptations to substrate instability, sand accretion and drought. The seeds contain relatively large food reserves that are primarily utilized in root production. The tap root can grow to 5-6cm 3 days after germination, reaching 10-15cm within 7-14 days. Therefore, seedlings are more likely to attain a depth where the moisture content is higher and subject to less fluctuation before the onset of summer drought. This adaptation also allows the plant to minimize exposure to erosion. Sea spurge is also capable of surviving moderate rates of sand accretion.

In Tasmania, sea spurge occupies a wide range of dune environments — strandline, the face and crest of the foredune and most backdune situations, including certain shrub and grassland communities. It tolerates and is adapted to moderate rates of sand accretion. The ecological impact of sea spurge in Tasmania is

Potential dune invaders continued

the subject of ongoing research at the University of Otago. It forms dense, continuous stands, along the north coast of Tasmania, sometimes in conjunction with marram grass. It appears to have displaced *Spinifex sericeus* and associated species from the primary foredune and backdunes in northeast Tasmania. Over the medium to long-term this species is likely to inhibit or prevent sand movement and so reduce the area of habitat for indigenous species. Sea spurge may also be an agricultural weed — several hectares of sea spurge have recently established in pasture bordering dunes on the Yorke Peninsula in South Australia.

Sea-wheat grass fore dune, Coorong, South Australia, showing separation from the spatial separation from older* Spinifex*-covered dune.

Sea-wheat grass

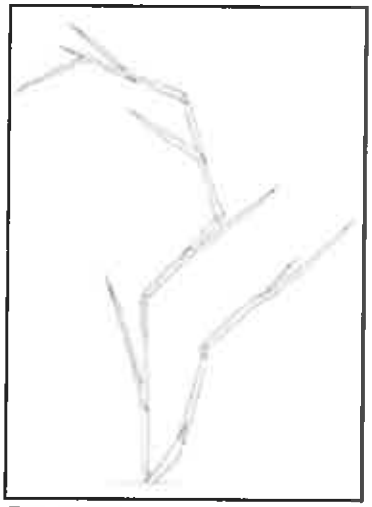
Sea-wheat grass has transformed the foredunes of South Australia, establishing a new foredune landscape and botany. It is a perennial, rhizomatous grass, of coastal foredunes of Western Europe and the Mediterranean. This coastal grass was introduced to Australia accidentally, probably in ballast water, prior to 1933, when it was first collected in Port Philip Bay. It was subsequently cultivated and distributed as a dune stabilisation species and dispersed naturally. It is salt-tolerant and in its home range is a pioneer of beaches and sand plains around and above the strandline. In Britain and in Australia it grows closer to the sea than any other dune grass. It grows best when soil water is brackish, which is usually seaward of the crest of the pre-existing foredunes. In comparison, *Spinifex* and pingao require relatively fresh soil water, so the two species are usually spatially separated as in the picture above. It spreads rapidly by long slender wiry rhizomes. Sea-wheat grass foredunes are typically low, broad and continuous alongshore on prograding coasts. Dispersal may occur by either seed or rhizome.

Sea-wheat grass is a comparatively recent arrival in southeast Australia and its dispersal has been singularly rapid. For example, over the last 20 years or so it has established along the Coorong coast in South Australia so that it now forms a new, near continuous foredune over a distance of around 195km. Along most of the Sir Richard Peninsula it has colonised the stoss face of the former foredune and established a new incipient foredune, 2-4m high, 5-10m wide, continuous alongshore. In places it appears to have formed a foredune where none existed before. Sea-wheat grass foredunes occur seaward of the former *Spinifex* foredune in South Australia which appears to decline in cover and vigour following the arrival of sea wheat grass. *Spinifex* is occasionally present across the crest of such dunes but seldom contributes more than 20% of the plant cover. The development of a new foredune, across the lower slopes of the former foredune and closer to the sea, appears to have impacted the hooded plover. The width of the beach along the Coorong has probably narrowed since sea-wheat grass established a new shore morphology, with the result that the plovers are more frequently threatened by offroad vehicles. Dispersal appears to be predominantly by sea-rafting of rhizome. It is not know how long the rhizomes survive in sea water or whether the species has the potential to drift to New Zealand or survive in ballast water.

Pyp Grass

Pyp grass is a rhizomatous perennial grass of coastal sand dunes, of cool-temperate latitudes, native to South Africa (S. Lat. 32-35°). It is a successful coloniser of open sandy ground in southern Australia, where it was introduced to stabilise active dunes. Pyp grass was introduced to New Zealand for the same reason and relatively small areas occur in the Manawatu (Turakina Beach) and in Hawkes Bay (Taikura Station, Blackhead). It has a distinctive "kinky" morphology.

Pyp grass has a significant impact on the flora of sand dunes — initial results of a joint University of Adelaide-University of Otago study indicate that pyp grass on the Sir Richard Peninsula, South Australia, forms dense almost mono-specific colonies, to the detriment of the abundance and diversity of indigenous plant



Pyp grass

Potential dune invaders continued

species. It creates a mass of interwoven rhizomes and roots below the soil surface, at least 0.5m deep, which may deprive existing plants of essential nutrients. The plant is highly invasive — Lyn Hodder's study of pyp grass in the Manawatu established that rhizomes extend away from the edge of the population at rates of 7-9m/y. In South Africa, pyp grass grows more as an open herb, allowing other dune plants to grow through it. In New Zealand and Australia pyp grass grows as a dense sward and has the capacity to climb over, cover and displace coastal shrubs of 2-3m height, including *Acacia sophorae* sp.

Pyp grass is invasive in New Zealand — it was planted at Taikura Station in 1956 over an area of 10x10m — and now covers approximately 4ha. Seed is wind dispersed, however, pyp grass probably does not rely on seed production for reproduction and seed dispersal is not critical to plant survival and spread. The seed is large and sharp pointed and tends to enter the fabric of socks and boot laces. It is, perhaps, more likely to thrive in the warmer northern regions of New Zealand. The species is able to regenerate from rhizomes after being detached from the parent plant. In South Australia pyp grass rapidly invades sandy ground in a range of dune habitats, from foredune to backdune.

Conclusions

The three species introduced here are highly invasive and destructive in Australian dune systems, including those of Tasmania in the case of sea-wheat grass and shore spurge. These species are ubiquitous along much of the south coast of Australia and in Tasmania, with serious ecological consequences. Sea spurge and sea-wheat grass have the potential to float long distances or survive in ballast water. The likelihood of them floating to New Zealand is probably increasing as they move north in southeast Australia towards New South Wales and release propagules in coastal waters at higher latitudes. Our best defence is to increase awareness of these species, in the hope that the first report of an arrival occurs early in the invasion sequence. Pyp grass is recognised as a problem species and known populations should soon be eradicated.

Notes:

[1] Hilton, M., Macauley, U. & Henderson, R. 2000: Inventory of New Zealand's Active Dunelands, *Science for Conservation 157*, Department of Conservation, Wellington.

[2] Johnson, P.N. & Partridge, T. 1992: *The Sand Dune and Beach Vegetation Inventory of New Zealand. I. North Island. II. South Island and Stewart Island.* DSIR Land Resources, Christchurch.