



State Herbarium
of South Australia



Native *Carpobrotus rossii*, male plant

Hybridisation in native pigface, *Carpobrotus rossii*

June 2016



Background

Introduced *Carpobrotus* are global weeds of concern

Carpobrotus (pigface) is a world-wide genus of succulent plants, with species native to South Africa, Australia, South America and California.

In South Australia there are four species of *Carpobrotus* and two species in a closely related genus *Sarcozona*. *Carpobrotus modestus* and *C. rossii* are native to South Australia as are the two *Sarcozona*, *S. bicarinata* and *S. praecox*.

The native species, *Carpobrotus rossii*, has a coastal form and an inland form, the latter currently referred to as *Carpobrotus* sp. Short calyx (*S.T. Blake 20451*). Ongoing research will clarify if these become two species.

There are two species of *Carpobrotus* that are introductions from South Africa, *C. edulis* and *C. acinaciformis*, (previously known as *C. chilensis*).

Worldwide, *Carpobrotus* species are recognised as serious invasive weeds. *Carpobrotus edulis*, is listed in the Global Invasive Species Database for 24 countries. They have been recorded as forming hybrids.

The Metropolitan Adelaide and Northern Coastal Action Plan (MANCAP) lists *Carpobrotus edulis* as a priority environmental weed for coastal Adelaide. Removal of this species is a problem when it is hard to confidently determine species identity.

The yellow flowered *C. edulis* is relatively easy to identify, however, a high degree of morphological variability has been observed among pink flowered *Carpobrotus*. We now know there are hybrids between the introduced *C. edulis* and the local native *C. rossii*. It appears that these hybrids have become widespread in many areas, in fact wherever the two species come into close proximity.



Introduced *Carpobrotus edulis* (yellow) and *C. rossii* (pink), from Torrens Island, Adelaide, showing plant habit and the two species growing together.

Pigface and the problem with hybrids

Hybrids can form when cross-pollination occurs between species and the offspring survive. Hybrid formation between an invasive species and a closely related species that is native to a region can be particularly problematic due to the potential for:

- genetic swamping of the local populations of the native species
- the generation of hybrids with 'hyper-vigour' or hybrids with very poor vigour
- changing the ecological function of *Carpobrotus* species in the landscape.

State Herbarium botanists, NRM staff and coastal managers have all observed highly variable morphology of *Carpobrotus rossii* in the field.

We have now investigated the basis of this morphological variability.

The native species has formed hybrids with introduced *C. edulis* or *C. acinaciformis* where they co-occur.

To determine the presence of hybrids we have undertaken detailed genetic analysis of the number and nature of potential hybrids between the native *C. rossii* and introduced species in natural populations.

Results of *Carpobrotus* hybrid genetic testing

Our analysis shows that hybridisation is common between *C. rossii* and *C. edulis* where they co-occur (table below).

Multiple generations of hybrids were detected in the sampled populations.

The genetic signature (genotype) of 'pure' original species is still observed (i.e. *C. rossii* without a hybrid signature).

The status of *C. acinaciformis* is unresolved, it may be itself a hybrid.

Yellow flowers remain the main character to identify *C. edulis* and some of its hybrids.

There are many hybrids that have pink/purple flowers so colour is not a unique feature to identify the native species.

References

Biffin, E., Toelken, H.R., Van Dijk, K., Kellermann J. & Waycott, M. (2016). An assessment of native and introduced *Carpobrotus* spp. in the AMLR region. Final report for Natural Resources Adelaide and Mt Lofty Ranges. (State Herbarium of South Australia, Adelaide).

Results of genetic analysis indicating the number of field collected samples of *Carpobrotus* in each category of parent or hybrid plants from the Adelaide region.

Site (from north to south)	Number of samples analysed	<i>C. rossii</i> (native)	Hybrids	<i>C. edulis</i> (introduced)
Webb Beach	5	3	2	-
Middle Beach	2	2	-	-
Torrens Island	42	10	22	10
Moana	33	14	19	(present)
Aldinga	7	1	6	-
South-East	15	15	-	-

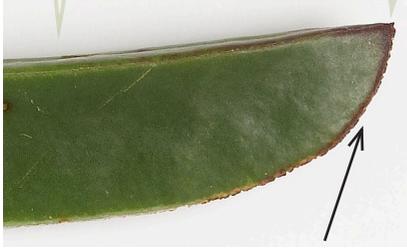


Simple key to the *Carpobrotus* of the Adelaide coastal region

1. Tip of **abaxial keel** of leaves and large **sepals** \pm split into unequal segments so the 'edge' of the **abaxial keel** is 'rough'; flowers single, more than 60 mm across, ovary and fruit with (10) 11 or 12 (–14) locules.
 2. Flowers with **yellow petals**, with long sepals 28–36 (–45) mm long, usually twice longer than other sepals; leaves usually broader than 10 mm, with **abaxial keel** coarsely split (sometimes wearing off on old leaves and turning dark brown); prostrate main branch usually longer than 1 m and with leaves \pm straight-erect, yellowish-green, rarely tinged red along the margins; fruit obovoid to obovoid-conical with \pm cuneate base, 21–30 mm in diameter ****C. edulis***
 2. Flowers with **purplish-pink petals**, with long sepals with broad eared base, usually one third longer than other sepals; leaves up to 9 mm broad, with **abaxial keel** shallowly split; main branches creeping up to 1 m long with leaves incurved-erect, dark greyish-green and \pm tinged purplish-red; fruit ellipsoidal abruptly constricted into pedicel (flower stalk), 15–24 mm in diameter (nb. taxonomic status requires revision) ****C. acinaciformis***
1. **Abaxial keel** of leaves and large sepals entire, rarely puckered when desiccated so the 'edge' of the **abaxial keel** is 'smooth'; flowers **pink/purple-pink**, (1) 2–3 in terminal inflorescence, rarely more than 60 mm across in case of male plants, ovary and fruit with (7) 8–10 locules; main branches creeping, incurved leaves 5.5–7 (–8.1) mm broad, greyish-green and \pm tinged reddish-brown; fruit obovoid-conical with cuneate base, 10–15 mm in diameter ***C. rossii***, coastal form
 3. Large sepals usually scarcely longer than other sepals, incurved before and recurved after flowering; flowers up to 60 mm across, with stigmas united into a central conical cone (that does not extend stigmas outward) ***C. rossii***, male plants
 3. Large sepals usually twice as long as other sepals, erect or incurved to touching another before and after flowering; flowers smaller than males, with recurved stigmas in centre ***C. rossii***, female plants

Key to Adelaide region *Carpobrotus*

C. edulis leaf character, common in hybrids



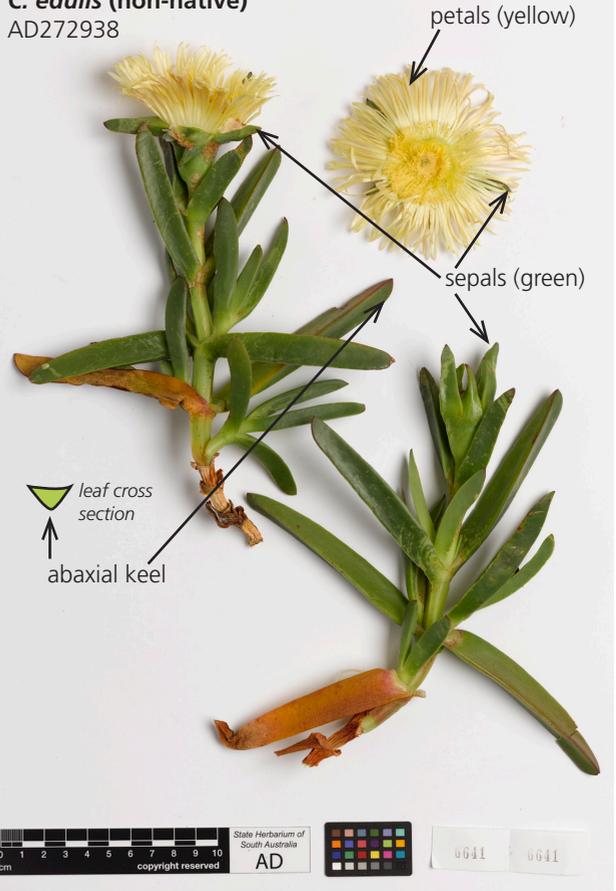
'edge' of the abaxial keel 'rough'

C. rossii leaf character



'edge' of the abaxial keel 'smooth'

***C. edulis* (non-native)**
AD272938



'male' flower of *C. rossii*, **stamens** releasing pollen and stigmas reduced or fused as a **column** in centre



'female' flower of *C. rossii*, **stigmas** open and expanding in mature flower, anthers reduced or do not shed pollen



Carpobrotus rossii parental genotype



Carpobrotus edulis parental genotype



What can we do?

The ongoing work by coastal NRM staff and specialist community volunteer groups is critical to reducing the impact of invasive *C. edulis* on the native species *C. rossii* and the environment.

The primary way to identify the introduced species is by flower colour (i.e. *C. edulis* has yellow flowers). It is important that we identify natural habitat locations that are infested with yellow flowered *Carpobrotus*.

We also expect to find hybrids in populations that contain, or have contained, yellow flowered *Carpobrotus*.

Managers will be developing a strategy to improve local genetic stocks of the native species—most likely by replanting 'pure' parental stock plants of *C. rossii*. This will include understanding where such populations exist, appropriate plant movement distances and the total capacity of donor source populations.

Contact options

Regions

Contact your local NRM office if you have observations or questions,
web: naturalresources.sa.gov.au

To contact staff in AMLR see
web: naturalresources.sa.gov.au/adelaidentoftyranges/find-us

Search for 'pest plant' on the NRM web site for your region for information on weeds.

Botanical advice

State Herbarium of South Australia,
email: stateherbsa@sa.gov.au

Carpobrotus updates

The State Herbarium has a website for information updates on *Carpobrotus* in South Australia. We plan to include a sightings update register,
web: carpobrotus.ourplants.org

Carpobrotus rossii × *edulis* F1 hybrids

'F1 hybrids' are those that arise from the first cross between 'pure' parental types.

'F1 hybrid' offspring of *Carpobrotus rossii* and *C. edulis* are uncommon among the samples we have analysed genetically.



Carpobrotus acinaciformis form (genetic data suggests 'F1 hybrid' as above)



Carpobrotus rossii × *edulis* backcross hybrids

'Backcross hybrids' are those that occur when any hybrid crosses with one of the original 'pure' parental types.

'Backcross hybrids' between *Carpobrotus rossii* and *C. edulis* were common in our genetic analysis.

Backcross rossii



Backcross edulis



The State Herbarium of South Australia

South Australia's key centre for the preservation and generation of knowledge of native and naturalised plants, algae, lichens and fungi.

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Associated report: Biffin, E., Toelken, H.R., Van Dijk, K., Kellermann J. & Waycott, M. (2016). An assessment of native and introduced *Carpobrotus* spp. in the AMLR region. Final report for Natural Resources Adelaide and Mt Lofty Ranges. 21 pp. (State Herbarium of South Australia; Department of Environment, Water and Natural Resources: Adelaide).

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