WARMING TO THE ICE PLANTS

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INTRODUCING THE ICEPLANTS

The challenges of global warming are yet to be fully appreciated in relation to their potential impacts on our vulnerable indigenous vegetation communities and the habitat they support for our threatened flora and fauna. One predicted response to gradual global warming will be a relentless search for tolerant species, suitable for our future landscape and revegetation sites that will be able to adapt to the harsher environmental realities. Fortunately, members of the ice plant family have a series of rare attributes that will enable them to flourish in these predicted climatic extremes. This article seeks to explore these attributes further as well as highlight some of the fascinating cultural, historic and bush tucker values ascribed to its members.

Known botanically as the Aizoaceae (Latin for "evergreen" or "ever living", the name reflects the ability of members to maintain green coverage of fleshy foliage whilst existing in the harshest and driest environments. There are between 1800 and 2500 (depending on who's treatment of the family one follows) succulent, herbs and shrubs in the family from South Africa, Asia, North and South America, with only 50 indigenous Australian species (four Tasmanian species). Disturbingly, already over 26 naturalised South African invaders thrive in Australia's harsher locations suggesting climate change may exacerbate their invasive potential.

The family is composed of four subfamilies including the following two worthy of note that can be distinguished by the presence or absence of petal-like staminoides (large sterile stamens). The subfamily Ruschoideae has showy daisy-like flowers made of these brightly coloured staminoides typically seen in native pigface *Carpobrotus rossii* (Figure 1), whilst the other subfamily Aizooideae has small insignificant flowers that are brightly coloured on the inside as seen in bower spinach *Tetragonia implexicoma.*

Like many of the Australian species, the Tasmanian representatives act as key framework species in saline wetlands and dry coastal communities. Local examples of this type of habitat include the Pitt Water and Lauderdale saltmarshes as well as the remaining Tasmanian undisturbed, pristine sandy beaches exclusively vegetated by indigenous flora.

From an historic perspective immense significance can be directly attributed to two of the family's indigenous species *Tetragonia implexicoma* and *T. tetragoniodes* (many common names apply such as iceplant, New Zealand spinach, Botany Bay spinach, Warrigal greens and Cook's cabbage). It could be considered that these species had a significant influence in relation to the choice of establishing Australia instead of colonial African nations, as

the preferred penal colony. Undeniably many Tasmanians' ancestries would link to this decision.

Figure 1. *Carpobrotus rossii*, a widespread and common member of the Aizoaceae along Tasmanian coasts. Photo: H. & A. Wapstra.

ADAPTIVE RESPONSES TO THE GLOBAL WARMING CHALLENGE

Climate change's predicted warming, reduction of overland flows and reduced soil moisture will impose severe habitat limitations on our indigenous plants and animals. However certain plants within families such as the iceplants, native grasses (*Poaceae*) and the cactuses (*Cactaceae*) may be competitively advantaged and potentially increase their natural ranges. Consequently they will attract attention due to their tolerance and adaptability. An obvious example will be kangaroo grass (*Themeda triandra*), which benefits from a more efficient photosynthetic process (known as a C_4 pathway) enabling it to flourish in the dry summer periods when most other competitive grasses withdraw into dormancy. Interestingly, recent observations suggest an increased richness of native grasses on disturbed dark-soil grassy woodland due to their exotic competitor grasses, such as yorkshire fog (*Holcus lanatus)* and greater quaking-grass (*Briza maxima*) withering and dying under drought stress (Hovenden & Morris 2002).

Remarkably, iceplants have evolved a separate mechanism, technically Crassulacean acid metabolism (CAM) photosynthesis, giving rise to another of their names "night-time breathers", that will increase the plants' adaptive capacity to cope with climate change. By storing carbon in the form of organic acids produced during night time respiration, they do not need to absorb carbon dioxide by opening their stomatal pores. Hence CAM plants

stop moisture losses through their pores during the heat of the day. This endows them with added xerophytic abilities that enhance their succulency mechanism to accumulate moisture and halophytic characteristics to survive in highly saline areas.

A FAMILY WITH MANY APPEALING COMMON NAMES

The family members are suitably bestowed with intriguing common names, most relating to their striking attributes that enable them to survive low moisture or high salinity conditions. The name of "iceplant" is linked with many family members mostly as a consequence of their leaves being surfaced with salt accumulating bladder-like cells that often sparkle like ice granules to reflect sunlight and reduce transpiration (Figure 2). This name is applied to the fleshy leaved South African iceplants (*Mesembryanthemum* species and *Lampranthus* species) as well as the previously mentioned *T. implexicoma*.

Figure 2. A close-up of *Mesembryanthemum crystallinum* showing the ice-like salt accumulating bladder-like cells on the leaf surface. This species is sparingly naturalised in Tasmania (islands of the Furneaux only). Photo: H. & A. Wapstra.

The aptly named "living stones" or "pebbles" (*Lithops* species) and living stone daisy (*Doroanthemum bellidiformis)* are robustly designed to mimic both the colour patterns and tough surface textures of surrounding stones and pebbles. This ensures survival during arid periods by imparting drought resistance and camouflage from foraging herbivores. During the rainy season when the desert is alive with edible vegetation they transform from their chameleon-like behaviour, into large perfumed, boldly coloured,

daisy–like flowers in an attempt to gain the pollination services of passing insects or butterflies.

The term "noonflower" is another popular descriptive name applied to family members such as the Australian coastal noonflower *Carpobrotus. glaucescens*, the Tasmanian saltmarsh roundleaf noonflower *Disphyma crassifolium* (Figure 3), as well as the many South African species such as wiry noonflower (*Psilocaulon tenue*), due to their habit of opening attractive blooms around noon and closing later in the afternoon.

Figure 3. A carpet of *Disphyma crassifolium*, common in saltmarshes and on rocky shores on much of the Tasmanian coastline. Photo: H. & A. Wapstra.

The resulting carpets of pinks and yellows are irresistible to their insect pollinators, which are at their busiest from noon to the mid afternoon.

The less than attractive common name "snot wort" (*Conicosa pugioniformis*) relates to this succulent's slimy roots, which surprisingly are valued as a South African bush tucker delicacy.

THE TASTY "GREENS" WERE HIGHLY VALUED BY EARLY EXPLORERS

As mentioned in the introduction, iceplants form an important historic connection with our Tasmanian convict ancestry. This arose as a consequence of the 1768 voyage of Captain Cook to observe the transit of Venus. He satisfied his scurvy-stricken crew's desperate need to savour fresh greens by harvesting the pot herb New Zealand spinach, *T. tetragonoides* from the New Zealand shoreline. Following discovery along the Australia coast by Cook and other explorers of large swards of both *T. tetragonoides* and Botany Bay greens *T. implexicoma*, they soon came to rely on these greens as dietary necessities to enhance their spartan rations. It is interesting to note that if the early explorers and colonists had shown a little appreciation for the Aboriginal way of life, they would soon have selected today's popular bush tucker treats but instead limited their choice to only those indigenous plants that reflected the image of English vegetables. Besides the

iceplants these included sea celery (*Apium prostratum*) and grey saltbush (*Atriplex cinerea*).

So impressed was Sir Joseph Banks with these iceplants, he sent their seeds to Kew Gardens from where they rapidly gained favour in high society cuisine as a summer spinach. In 1779 Bank's fondness for this plant's ability to provide reliable quantities of nutritious greens was portrayed exuberantly in the House of Common's inquiry delving into the relative suitability of Australia compared to West Africa as a convict-based colony (Low 1992). He obviously left a strong impression and the rest is now history.

WAS "PIGFACE" TASMANIA'S FIRST BUSH TUCKER?

Tasman's voyage of 1642 was not only historically significant as the arrival of the first explorers to Tasmania, but also for the collection of 'greens' (recorded as a *Mesembryanthemum*) by his crew from the banks of Boomer Creek flowing into Marion Bay. This collection heralded the start of the current bush tucker bonanza. The collection of what is considered to be *Disphyma crassifolium* was reported to be "*...not unlike a certain plant growing at Cabo de Bona Esperance* [Cape of Good Hope]...".

Many diaries of early explorers and settlers not only record positive entries on the edibility of these "greens" but also draw attention to the unique strawberry-fig like flavour of the native pigface's fruits. During the late 18th century a number of explorers referred to the harvesting of iceplants for pot herbage or edible fruits. These included Bligh's 1788 voyage on the *Bounty* and D'Entrecasteaux's 1793 voyage on the *L'Esperance*. During this latter voyage, D'Entrecasteaux noted that "*the fruit proved a delicacy with the New Hollanders (Aborigines) and resembled the Hottentot's Fig of South Africa (Mesembryanthemum edule = Carpobrotus edulis) except that the flowers were not yellow but reddish purple"*. Settlers at Collin's first settlement at Risdon Cove collected iceplants for nutritious "greens" (Potts *et al.* 2006), whilst inland explorer Edward John Eyre partook of pigface fruits freely noting the ripe fruit was rich, sweet and refreshing in hot weather.

ROBUST LANDSCAPE PLANTS WITH WEED POTENTIAL

Australia has approximately 25 exotic species recognised as environmental weeds, a number of which derived from naturalising around old settlements, especially near the coast.

The Tasmanian weed representatives including noon flower (*Lampranthus glaucus*), heart leafed ice plant (*Aptenia cordifolia*), common ice plant (*Mesembryanthemum crystallinum*) and the South African hottentot fig or sour fig (*Carpobrotus edulis*) and the Chilean pig face (*C. aequilaterus*). Of these, the later two present major concerns as they are either out-competing native species or are being inadvertently planted by unaware, enthusiastic bush regenerators. Their ability to release 100s of seeds when triggered by rainy spells from the fleshy fruit or establishes from fresh or even significantly dehydrated

cuttings ensures they will remain a persistent threat. Given the recent enthusiasm for planting indigenous pig faces, it is important to positively identify them before planting. Remember, if it has a yellow flower err on the side of caution and check it is not a weedy sour fig!

VALUABLE "PEOPLE'S PLANTS" SUPPLYING FOOD AND MEDICINE

It was apparent that explorers and colonists developed a strong desire for the tasty and nutritious green foliage of *Tetragonia* species. This attraction continued to gain momentum over the next two centuries with these pot herbs being cultivated in European gardens. They have now become an heirloom vegetable, worthy of any menu especially being suited to stir fries, spinach dishes and quiches. Of course, they also prove just as attractive to wildlife; hence protection from browsing is required, during their establishment. Once growing vigorously the wildlife grazing can be used to advantage by acting as marsupial pruning shears, limiting their rampant growth!

It is important for the digestion system to be aware that, like rhubarb and silver beet, it is best not too over indulge in them due to the low levels of oxalates and saponins existing in the succulent leaves and stems. (Pengelly 1997).

In relation to the luscious fruits of *Carpobrotus rossii*, local Aboriginals eagerly awaited their summertime ripening. Aboriginal family bands would often establish camp next to broad expanses of fruiting pigface in order to supplement their fish and seafood diets with otherwise distinctly difficult to find harvestable offerings of summer ripening bush tucker. They not only enjoyed the fruits but also cooked leaves of this native pig face or at times the roundleaf noonflower *Disphyma crassifolium* to accompany their fire pit-roasted possum, kangaroo or echidna.

Beyond their bush tucker attributes, the finger-like leaves and stems when squeezed ooze a gel-like sap that acts as a soothing lotion in much the same way as *Aloe vera* does. As an aside, these bulky sappy leaves have proven problematical for all those plant collectors and students who have attempted to use plant presses to dry and press specimens. They are a botanist's nightmare!

When exploring the worldwide range of extraordinary plant uses attributed to iceplants, it would be remiss not to mention the captivating mind and mood altering qualities of the South African species known locally as "kanna" *Sceletium tortuosum* (van Wyk & Gericke 2003).

This mood-altering plant (attributed to the alkaloid "mesembrine") has been used by hunter-gathers and pastoralists from prehistoric times to elevate mood and decrease anxiety, stress and tension. Amazingly, larger doses have no severe adverse affects, as it induces a euphoric state enabling pastoralists to decrease thirst and hunger or for its application as a local anaesthetic and analgesic for tooth extraction. Traditionally prepared by crushing the succulent plant before sun drying prior to chewing, smoking, inhaling as

snuff or brewing as a tea, it is an important children's sedative and has been effectively used by indigenous healers to withdraw alcoholics from their addiction. Even now the plant may be called *onse droe drank* - "our dry liquor" (van Wyk & Gericke 2003). Although once widely traded in the South African Cape Province and stocked in trading stores, inventories of wild plants have dwindled due to over harvesting and habitat destruction. This has sadly resulted in its replacement by alcohol, tobacco and cannabis. It is pleasing to note that, using only cultivated rather than wild harvested materials, currently phyto-pharmaceuticals from *Sceletium* are being extracted for clinical trials in readiness for the international market.

Finally it is worth reflecting on another South African pigface look alike known as "khadi root" *Khadia acutipetala.* Its fleshy rootstock provides an alternative yeast source to act as the key fermentation agent in brewing a distinctively flavoured, yet extremely prized beer known as Khadi.

CONCLUSION

As alluded to earlier, the iceplant family primarily consists of hardy and environmentally resilient plants. Their tolerance is a consequence of their efficient methods of seed dispersal, ease of propagation from cuttings or off sets, their succulence, pest and disease resistance, fire resistance, xerophytic and halophytic abilities all supported by their CAM metabolism. In light of the potential global warming impacts, it is predicted that their recent popularity as landscape, erosion control, bush tucker and revegetation species will increase.

Disappointingly these competitive advantages will probably also result in the prevalence of many more exotic members menacing indigenous vegetation communities as invasive weeds.

To offset this dilemma, many exotics and native members add a rare three dimensional element to landscapes. This is a consequence of their thick, succulent leaves symbolising shapes of limbs and fingers. They can provide an inspiring contrast with the two-dimensional, flat leaves of the most other plants in the landscape (Low 1992).

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REFERENCES

Hovenden, M.J. & Morris, D.I. (2002). Occurrence and distribution of native and introduced C_4 grasses in Tasmania. *Australian Journal of Botany* 50: 667-675.

Low, T. (1992). *Bush Tucker: Australia's Wild Food Harvest.* Angus & Robertson, Sydney.

Pengelly A. (1997). *The Constituents of Medicinal Plants: An Introduction to the Chemistry & Therapeutics of Herbal Medicines*. Sunflower Herbals Fast Books, Glebe NSW.

Potts, B., Kantvilas, G. & Jarman, J. (editors) (2006). *Janet Somerville's Botanical History of Tasmania*. University of Tasmania and Tasmanian Museum and Art Gallery, Hobart, Tasmania.

Royal Tasmanian Botanical Gardens (RTBG) (2001). *Information Sheet: The Century Plant*.

van Wyk, B. & Gericke, N. (2003). *People's Plants: A Guide to Useful Plants of Southern Africa.* Briza Publications, Pretoria, South Africa

EDITORS NOTE: A slightly different version of this article has appeared on the internet: http://www.apstas.com/iceplants.html.

Note. All images shown as grey scale tones are also shown as full colour in the central pages of this volume.