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A tale of two species: *Pringlea antiscorbutica* and *Azorella polaris*, sub-Antarctic scurvy remedies

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Research Article

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Abstract

Pringlea antiscorbutica (Brassicaceae) and *Azorella polaris* (syn. *Stilbocarpa polaris*, Apiaceae) are endemic sub-Antarctic flowering plants of significant ecological and historical importance. *Pringlea antiscorbutica* occurs on Îles Kerguelen and Crozet, Prince Edward, and the Heard and MacDonald Islands; *A. polaris* on Auckland, Campbell, and Macquarie Islands. We examine the use of these unrelated species of "wild cabbage," as scurvy remedies and sustenance for eighteenth–nineteenth-century sailors. We trace their European discovery, taxonomic treatment, morphological representation, and cultural association through the historical record. Scurvy killed more sailors during the sixteenth-nineteenth centuries than armed conflict and shipwrecks combined. Both plants were essential to the survival of sailors and formed a nutritious, carbohydrate-rich staple of their diets, however, attitudes to these plants were strongly influenced by cultural background. Use of *P. antiscorbutica* as a scurvy remedy was promoted by Cook and Anderson, leading to a greater historical legacy than *A. polaris*, and a unique contemporary research focus on the plant's nutritional value and cultivation potential. In contrast, contemporary studies of *A. polaris* have been directed primarily at the plant's protection. *Pringlea antiscorbutica* and *A. polaris* are intrinsically linked to human associations with the sub-Antarctic islands, which further increases their cultural and conservation value.

Introduction

This article explores the use of two endemic sub-Antarctic species, *Pringlea antiscorbutica* (Brassicaceae; Kerguelen cabbage) and Azorella polaris (syn. *Stilbocarpa polaris*, Apiaceae; Macquarie Island cabbage), as scurvy remedies and sustenance for eighteenth–nineteenth-century sailors and castaways in the sub-Antarctic. Both species are megaherbs, large perennial herbaceous flowering plants found on many of the subantarctic islands. They are regionally endemic and do not overlap in range: *P. antiscorbutica* occurs on Îles Kerguelen and Crozet, Prince Edward, and the Heard and McDonald Islands; and *A. polaris* on Auckland, Campbell, and Macquarie Islands. The sub-Antarctic islands lie between 45° and 60°S latitude, with a strongly oceanic climate and typically treeless flora characterised by grasslands, such as tall coastal tussock grasses, herbfields, including megaherbs, and open fellfield communities, low-growing vegetation on exposed slopes subject to high wind and frost (Convey, 2013). Biological delineation of this region varies by author (Greene, & Greene, 1963; Holdgate, 1977; Selkirk, 2007; Skottsberg, 1960; Wace, 1960), but conventionally includes those islands north of, or close to, the Antarctic Convergence or Antarctic Polar Frontal Zone, the oceanic boundary where cold Antarctic waters sink beneath the warmer subantarctic waters to the north. It is bounded by the south temperate zone to the north, and the maritime Antarctic and Antarctic zones to the south. A "core" set of sub-Antarctic islands: Crozet, Kerguelen, Heard and MacDonald, Macquarie, Marion and Prince Edward, and South Georgia, are often defined by their lack of woody plants and the paucity of terrestrial vertebrates, apart from a few species of bird, but are strongly associated with marine vertebrates (Convey, 2020). The term "peri-Antarctic" islands is also used within a wider definition of sub-Antarctic and includes Amsterdam and Gough Islands, the Aotearoa New Zealand sub-Antarctic islands, the "core" set of sub-Antarctic islands, and islands further south, such as Bouvetøya, Balleny, Scott, Peter I, Shag Rocks, South Sandwich, and South Shetland Islands (Headland, 2009). Selkirk (2007) introduces the islands included in different definitions of the sub-Antarctic. In this article, the term "sub-Antarctic" refers to (with claimant country): Îles Crozet and Îles Kerguelen (France), Prince Edward Islands (South Africa), South Georgia (UK), Heard and MacDonald Islands and Macquarie Island (Australia), and Auckland Island and Campbell Island (Aotearoa New Zealand). Aotearoa New Zealand's outlying islands are sometimes referred to as "oceanic cold temperate" islands (Convey, 2013), but are included as sub-Antarctic in this paper, as they share flora (Godley, 1989), including the focus species

A. polaris, which is found amongst these islands. We recognise Ngāi Tahu iwi (Aotearoa New Zealand Māori tribe) as the tāngata whenua (original claimants) and kaitiaki (guardians) of the Aotearoa New Zealand sub-Antarctic islands, and refer to these islands by their Te Reo Māori (Māori language) names of Motu Maha/Auckland Islands and Motu Ihupuku/Campbell Island, in the text.

Scurvy was prevalent on long sea voyages during the sixteenth–eighteenth centuries, so its prevention and cure were of considerable interest. In this article, we trace the history of European discovery, taxonomical description, and morphological representation of *P. antiscorbutica* and *A. polaris,* using written and visual sources such as diaries, published books, paintings, illustrations, photographs, and scientific reports. We explore how the diverse cultural backgrounds, as well as botanical knowledge, amongst sailors, contributed to differing perceptions of plant use and significance and influenced modern botanical understanding for both species (see Hartley, 2023). Furthermore, we aim to demonstrate the vital importance of *P. antiscorbutica* and *A. polaris* to the culture of the sub-Antarctic islands.

Scurvy: the "plague of the sea"

Scurvy is estimated to have been responsible for the death of more than two million sailors (primarily on vessels from Europe and North America) during the European colonial expansion period often referred to as the "Age of Sail" (1571–1862). This is greater than the number of deaths of naval personnel by shipwreck, combat, and all other diseases combined (Brown, 2003, p. 9; Carpenter, 2012). The disease is caused by a lack of vitamin C (ascorbic acid). The human body cannot synthesise its own vitamin C (unlike most animals and plants), it can only be stored in the body for ten to twenty days (Naidu, 2003), and so needs to be consumed regularly. A lack of fresh vegetables during lengthy sea voyages by European and North American vessels in the sixteenth–nineteenth century made scurvy especially prevalent. Other seafaring cultures, such as China, recorded few instances of scurvy, likely due to shorter sailing times, and the presence of vitamin C in their diet through pickled cabbage, green tea, and soybean, sprouted on board (Torck, 2009, pp. 133–134, 239–240). Polynesian sailors consumed dried breadfruit, kelp, fern root cakes, banana, sugar cane, yams, taro, and sweet potato on long voyages, all sources of vitamin C, and took cuttings, tubers, and seeds to plant for food when voyaging to previously uninhabited islands (Holmes, 1993, p. 12; Roullier et al., 2013; Torck, 2009, pp. 48–40).

Scurvy destroys the connective tissues in the body by preventing collagen, carnitine, and neurotransmitter biosynthesis. Symptoms include lethargy, swollen gums, and opening of old wounds. In the late eighteenth century, the confluence of greater naval technology, geographical exploration, and international conflict meant a cure was considered a "vital factor in determining the destiny of nations," particularly for Britain, France, the Netherlands, Portugal, Spain, and America, during long voyages and periods of conflict (Brown, 2003, p. 12). Given the remoteness of the sub-Antarctic region, the existence of a native edible antiscorbutic (preventing or curing scurvy) would prove vital to the health of eighteenth and nineteenth-century sailors stopping at those shores.

Cook was determined to prevent scurvy from impacting his voyages, and *P. antiscorbutica* was to prove vital to this cause. His second voyage, aboard *Resolution* and *Adventure*, (1772–1775) included the first known European observations of South Georgia and South Sandwich Islands, and his third voyage, aboard *Resolution* and *Discovery* (1776–1780), saw the naming of Prince Edward Islands, and landings on Îles Kerguelen, which Cook called The Desolation Islands. Cook actively followed the Admiralty's advice on scurvy prevention on board his ships, including enforcing a regime of fresh air, personal and general hygiene, and antiscorbutic acid in the diet for the crew (Brown, 2003, pp. 165–198). Cook stocked a range of antiscorbutics on board ship, including sauerkraut, wort of malt (a mixture of water and mashed malted barley from beer making), carrot marmalade, and "rob" or boiled-down syrup of orange and lemon juices. However, confusion and speculation remained as to the cause of scurvy and the relative effectiveness of these remedies.

Unknown to Cook, the ascorbic acid content in citrus juice deteriorated with certain preservation methods, such as boiling to reduce its volume, or storage in copper vessels, producing a less effective antiscorbutic. Wort of malt was instead promoted by Cook and the British Admiralty as an inexpensive treatment for scurvy. Sauerkraut, from cabbage and other fresh vegetables, was served at most meals during Cook's voyages, despite its initial unpopularity among sailors. James Lind discovered citrus fruits and lemon juice to be the most effective cure for scurvy in 1747, through controlled systematic clinical trials on board *HMS Salisbury*. However, these would not be endorsed as effective antiscorbutics by the British Royal Navy until nearly half a century later. Fresh leafy green vegetables remained a vital part of the fight against scurvy during Cook's voyages. He aimed to supplement the crew's diet with native plants from lands visited during the voyages and insisted on fresh vegetables being collected "at every port or landing place" along the expedition (Kodicek, & Young, 1969, p. 49), including the sub-Antarctic islands.

Kerguelen cabbage – *Pringlea antiscorbutica* (Brassicaceae)

Discovery and establishment as an antiscorbutic

From 1734, when Dutch physician Johannes Bachstrom coined the term "antiscorbutic," until 1795, when the British Admiralty made the issue of lemon juice compulsory on ships, leafy vegetables in Brassicaceae, including cress, mustard, cabbage, and turnip, were commonly employed as remedies for scurvy during long voyages. The edible Kerguelen cabbage *Pringlea antiscorbutica*, a member of this family, was first described by Europeans in 1776 from Christmas Harbour on Kerguelen Island during Cook's third voyage (1776–1780). William Anderson (1750–1778), naturalist and surgeon on this voyage, provided the first description of Kerguelen cabbage, recognising it as an edible member of Brassicaceae, and detailed its use as food, and as an antiscorbutic. He placed the plant in the monotypic genus *Pringlea,* in recognition of the plant's distinctiveness (Hooker, 1847, p. 238). Native southern hemisphere Brassicaceae had proved popular as antiscorbutics throughout Cook's voyages because they resembled the familiar edible common cabbage (*Brassica oleracea*), cress (*Lepidium*), and horseradish (*Armoracia rusticana*) from Europe (De Lange & Norton, 1996). Cook encouraged the crew's consumption of *Pringlea*, "gathered with much labour among the cliffs of the rocks," (Cook, 1785, p. 38). His regime was successful, and he did not lose a single sailor to scurvy during his third voyage.

Pringlea antiscorbutica R. Br. Ex Hook. F. 1845 (Brassicaceae) is a long-lived perennial plant endemic to four sub-Antarctic islands and island groups lying between 37° and 73°E in the Indian Ocean.

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Figure 1. *Pringlea antiscorbutica* R. Br. ex Hook. f., Kerguelen cabbage, resembles common cabbage (*Brassica oleracea*), with a succulent, edible rosette of green leaves up to 45 cm in diameter, surrounding a heart of younger leaves. Older plants possess a woody stem that is also edible. Lithograph by W.H. Fitch (Hooker, 1847).

The plant resembles common cabbage, with a succulent, edible rosette of green leaves up to forty-five centimetres in diameter, surrounding a heart of younger leaves, all of which contain a pungent essential oil (Fig. 1). Older plants have a semi-prostrate woody stem up to one metre long, with rhizomes (often called the "root" in historical text), and flower spikes can remain on the plant for years. William Anderson stated in 1776, "It has not only the appearance, but the watery acrid taste of the antiscorbutic plants, and yet differs materially from the whole tribe; so that we looked upon it as a production entirely peculiar to the place." (Cook, 1785, pp. 84–85). Frequently eaten raw, Anderson explains, it tasted almost like the "New Zealand scurvy-grass," *Lepidium oleraceum* G.Forst. ex Sparrm. (1780) (De Lange, & Norton, 1996), called nau, heketara, and ngau in Te Reo Māori, also in Brassicaceae, and used by Māori for swollen gums, possibly predating European contact (NZPCN, 2023).

The importance of Kerguelen cabbage persisted for decades. Sealers and whalers resident on Îles Kerguelen and Crozet used the cabbage as one of the mainstays of their diet, along with elephant seal. John Bartlett visited Kerguelen from November 1792 to January 1793 as a sailor on the American fur trader *Ino*, and described their diet as being chiefly penguins, their eggs, and "a sort of wild cabbage that we picked up on the shore [Christmas Harbour]. It had a kind of peppery taste and was the only vegetable that grew on that barren land" (Bartlett, in Snow et al., 1925, p. 329). Bartlett referenced Cook's 1785 narratives of the island,

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with Anderson and Cook's accounts guiding the crew's awareness and appreciation of the Kerguelen cabbage as an edible antiscorbutic. The benefits of *Pringlea antiscorbutica* were highlighted by physician Nathaniel William Taylor (1823–1875), who aboard American whaler *Julius Caesar*, voyaged to Kerguelen from 1851–1853. Members of the crew with swollen gums and limbs (symptoms of scurvy) spent their days on the island gathering the "wild cabbage," and once included in the diet, the afflicted sailors showed "much improvement" and were able to return to their duties within a few days. Taylor describes the plant as "certainly the greatest boon of nature to man on this island" (Taylor, 1929, p. 72). To the crew, it remained "a most invaluable and constant accompaniment to our meals, whether cut up in its raw state and eaten with vinegar, or cooked by itself, fried in fat, or boiled with beef and pork." (Taylor, 1929, p. 82). It was the "principle food" for the cattle brought to Kerguelen: grazing on this plant allowed the animals to survive the austral winter.

As Cook and Anderson's work established the cabbage as an antiscorbutic, botanist Joseph Dalton Hooker (1814–1911) formally enshrined this fact in its scientific name, *Pringlea antiscorbutica*. The genus name *Pringlea* had been given to Kerguelen cabbage by Anderson in honour of Sir John Pringle (1701–1782), a Scottish physician to the British Army and author of a major work on scurvy (*Observations on Diseases of the Army*, Pringle, 1752) and President of the Royal Society from 1772 until 1778. However, Anderson's original manuscript *Nova Genera Plantarum* was never published, as he died from tuberculosis on board the *Resolution* in 1778; his descriptions of Kerguelen cabbage were instead published within Cook's accounts of the voyage (Cook, 1785). Most of the plant specimens collected on Cook's voyages, including Kerguelen cabbage, became the property of Sir Joseph Banks in Soho, London (Stearn, 1978, pp. 158–159). It fell to Hooker to formally classify the species in 1845, following his trip to the sub-Antarctic in 1840 as naturalist to Captain James Clarke Ross' Antarctic Expedition. Hooker was the first to formally publish Kerguelen cabbage within *Pringlea* W. Anderson ex Hook.f. (Hooker, 1847, p. 238). The crew had used the plant daily, with Hooker espousing its health benefits (Hooker, 1847, p. 249): "For 130 days our crews required no fresh vegetable but this, which was for nine weeks regularly served out, with the salt beef or pork, during which time there was no sickness on board." Hooker had wanted to name the plant *Rossia kerguelensis*, in recognition of Captain Ross (1800–1862), and the island on which it was found (Huxley, 1918, p. 78). Instead, "at Mr [Robert] Brown's suggestion," (Robert Brown, Scottish Botanist 1773—1858; Hooker, 1847, p. 249), Hooker lent the "trivial" name of *antiscorbutica* ("against scurvy", in Latin) to the species, in recognition of its ability to prevent and cure scurvy (Hatt, 1949). He described *P. antiscorbutica* as "perhaps the most interesting plant procured during the whole voyage in the Antarctic" (Hooker, 1847, p. 249). These early descriptions by Anderson and formal naming by Hooker ensured *Pringlea antiscorbutica* maintained its associations with the prevention and cure of scurvy.

Culinary contrasts

Early explorers, sealers, whalers, castaways, and naturalists all had varying views on the suitability of Kerguelen cabbage for sustenance, including whether it was better eaten raw or cooked, and the method of cooking (Thieret, & Young 1988). Differing opinions and views towards *Pringlea* as a vegetable (Table 1) likely reflect the diversity of personal taste, cultural attitudes of the time, as well as a question of necessity. Despite its acrid taste (attributed to the oil in the leaves), most sailors recognised the antiscorbutic properties of *Pringlea*. The mere presence of a recognisably edible cabbage on such a remote southern island (compared to South Georgia, for example, with a more desolate flora) would have heightened its value alone. It is likely the Kerguelen cabbage was placed in higher esteem due to Cook and Anderson's success at preventing and curing scurvy, and more accessible published writings on this topic by Cook (1785). Its perceived nutritional and health benefits likely increased its culinary reception among eighteenth and nineteenth-century sailors.

Not all found the plant favourable, however, due to its bitter taste when eaten raw. British crew of the *Princess of Wales* cutter, shipwrecked on the Îles Crozet in 1821, ultimately found the cabbage "so bitter that we could make no use of it" (Goodridge, 1847, p. 80; Fig. 2). While the historical popularity of vegetables in the Western diet is still debated (Knapp, 1996; Ross, 1993), a possible paucity of vegetables in the eighteenth–nineteenth-century European diet may have contributed to this unfavourable reception. A lack of understanding of nutrition may also explain the crew's unwillingness to include the plant in their diet. The second *Princess of Wales* party, separated from the main crew, on another island on the Îles Crozet, "either using more sagacity or more patience" had found *Pringlea* to be a very useful vegetable once boiled for three or four hours, where it became quite sweet (Goodridge, 1847, p. 80). Emil Werth (1869–1958), scientist on the German South Pole Expedition 1901–1903, led by Erich von Drygalski aboard the *Gauss*, found that eating a large amount of the spicy, "mustard oil-tasting leaves" raw would cause digestive complaints, and also advocated cooking the plant, preferring the cooked heart leaves of larger plants (Fig. 3) to provide a better flavour, resembling savoy cabbage (Werth, 1911, p. 251). However, these attempts to make the vegetables more palatable would have rendered them useless for scurvy prevention or cure, as boiling destroys their vitamin C content.

Contemporary understanding of nutritional value

Research into the chemistry of *P. antiscorbutica* last century has revealed the pungent oil found in the leaves contains large amounts of vitamin C, and the leaves themselves have high levels of potassium and glucosinolates (GLs). Hatt (1949) investigated the ascorbic acid content of the cabbage, after the establishment of the Australian National Antarctic Research Expedition on Heard Island in 1949. Using live plants obtained on the island and brought back to Australia in pots, they extracted ascorbic acid from the heart, middle, and outer leaves, as well as old and young rhizomes. Heart leaves were shown to be the richest in ascorbic acid containing an average of 150 mg per 100 g, similar to that found in broccoli leaves, flowers, and parsley. The author contended that when eaten raw, the high ascorbic acid content of the heart leaves made it a valuable antiscorbutic. This corroborates the practical evidence found by Cook, Anderson, Hooker, and Taylor: eating the plant raw provided a cure for scurvy. Cooking the plant decreases its vitamin C availability, lending those who did so a less effective antiscorbutic.

A contemporary French study (Delaveau et al., 1973) found high levels of dehydroascorbic acids (oxidised ascorbic acids, a source of vitamin C) in *P. antiscorbutica* leaves harvested from Îles Crozet during 1970–1971. More recent work by Barillari Iori et al. (2005) examined the amount of glucosinolates in the seeds and leaves using High Performance Liquid Chromatography. The plant

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Table 1. Eighteenth-nineteenth-century sailors used *Pringlea antiscorbutica* as a vegetable and scurvy remedy.

Sailor	Circumstances	Quote
Cook, Anderson	Discovery Expedition, 1785	Boiling gave it a *"rank flavour,"* which some did not mind.
		Anderson saw its potential as a kitchen garden herb, but no ripe seeds were available to preserve and bring back to England. —Cook, 1785, pp. 84–85.
John Nunn (1803–1860)	Castaway, *Favorite*, Kerguelen, 3.5 years, 1825	Leaves useful in the crew's *"culinary operations when cut in slices and boiled"*, which dampened *"pungent essential oil"* present. —Nunn, 1850, p. 203.
		Root-stock like *"dark sticks of horse-radish, and equally acrid in flavour."* Often eaten with elephant seal, the core of the castaway diet. —Nunn, 1850, p. 203.
Hooker (1814–1911)	Ross' crew on *Erebus* and *Terror*, Christmas Harbour, Kerguelen, 2.5 months, 1840	Daily trips to collect cabbage. *"An inestimable blessing to ships touching at this distant isle"* —Hooker, 1847, pp. 86–87.
		Used *"either cooked by itself or boiled with the ship's pork" . . . "the essential oil gives a peculiar flavour which the majority of the officers and the crew did not dislike, and which rendered the herb even more wholesome than the common cabbage for it never caused heartburn . . . "* —Hooker, 1847, p. 249.
		Tasted of horseradish, the young heart leaves like coarse mustard and cress; seeds eaten by island's ducks —Hooker, 1840, as quoted in Huxley, 1918, p. 77.
Captain Joseph J. Fuller (1839–1920)	Castaway, *Pilot's Bride*, Kerguelen, 11 months, 1873	*"You can eat the cabbage raw or cooked, and I have an idea that it would make excellent kraut"* —Fuller, n.d., as quoted in Busch, 1980, p. 77.
American Transit of Venus party	*Swatara*, 1874–1875	Observed by Capt. Fuller making trips by steam launcher to gather plants, which *"raised havoc among that year's crop,"* —Fuller, n.d., as quoted in Busch, 1980, p. 295.
		Ate leaves as cabbage *"with relish"* and used the plant as *"the staple food of the livestock brought to the island"* —Kidder, 1876, p. 22.
Hugh Blackwell Evans (1874–1975)	British sealer *Edward*, 1897	*"Unpalatable but antiscorbutic"* —Evans, 1973, p. 790.
Captain Raymond Rallier du Baty (1881–1978)	Charting Kerguelen islands, 1906–1907, *J. B. Charcot*	*"Peculiar plant"* had *"most rank and bitter taste, very much like the most powerful horse-radish"* when eaten raw —du Baty, 1922, pp. 189–190.
		Recognised the need for green vegetables to *"keep . . . blood pure"* (prevent scurvy). Resorted to boiling *P. antiscorbutica* twice to lessen bitterness: *"in the first boiling the water becomes of a dark yellow colour, but in the second boiling it is fairly clear and the cabbage then becomes eatable. We made sauces with it, and chopped it up with our tinned meats for the stew-pot."* —du Baty, 1922, pp. 189–190.
		Dinner often consisted of *"Soup (from tins), Fish, Tinned meat, Rabbit or Duck, Vegetables (from tins), Kerguelen Cabbage, Coffee"* —du Baty, 1922, p. 258.

material was gathered in 2001 and 2002 from a selection of ten plants from a monitored population on Île Australia, Kerguelen Islands. High concentrations of GLs and a low instance of unhealthy GLs bearing a β-hydroxylated aliphatic side chain (found in other Brassicaceae such as broccoli) were found in the leaves. The authors concluded that *Pringlea antiscorbutica* can be considered a good dietary source of GLs and of high nutritional value. The value of *Pringlea,* theorised, recognised, and utilised by sailors since its first observations by Europeans in 1776, has been confirmed by contemporary phytochemistry.

Cultivation attempts

Given the plant's use as an antiscorbutic and its nutritional value, there have been several attempts to cultivate the plant outside of the sub-Antarctic region over the past two centuries. Captain Fuller postulated that the "slight bitter taste" could surely be removed by "a little cultivation" (Fuller, n.d., as quoted in, p. 295), attempting to import the *P. antiscorbutica* to the Americas. This attempt was unsuccessful, with those planted in the Bahamas "putting in a withered appearance," (Fuller, n.d., as quoted in, p. 295). Due to the apparent hardiness of the plant, Fuller dismissed the change in temperature as the reason for its failure and instead blamed the difference in the quality of the "water or atmosphere" compared to The Desolation Islands. Earlier efforts at cultivating the plant in England, Scotland, Ireland, and Tasmania, Australia had failed (Hooker, 1879; Huxley, 1918), with the plants succumbing to the summer heat and fungal attack. Further attempts were made by both American and French scientific voyages to cultivate and acclimatise Kerguelen cabbage, with seeds being brought to America in 1919 (Thieret & Young, 1988), and France in 1927 (Anthony, 1929, translation provided by J. H. Beattie, pers. comms., May 22, 2019). No records have been found of the seeds being planted in America.

Despite initial success at growing plants from seed while on ship, Hooker's attempts at cultivation failed once transplanted in Tasmania, and the seed brought back to Kew never germinated (Huxley, 1918, pp. 77–78). Having sent *Pringlea* seed to Kew, his father Sir William Jackson Hooker (1785–1865), then Director of the Gardens, was unable to germinate any of the seeds, which met with consternation from his son.

> "*I had fifty plants of it from seed. I had it growing in a bottle! (hanging to the after rigging), on a tuft of Leptospermum during all our second cruise on the Ice, and brought it alive to the Falklands. It was sprouting before the Cape Horn plants went home, from seeds I scattered under the little trees.*" (Hooker, as quoted in Huxley, 1918, p. 77).

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Figure 2. *Pringlea antiscorbutica*, from Charles Medyett Goodridge's narrative of being castaway on Îles Crozet with the shipwreck of *Princess of Wales* (Goodridge, 1843, p. 80).

The crew had apparently amused themselves by planting *P. antiscorbutica* on many of the lands they visited during Ross' voyage "here and there where we go," although no specifics are given. Hooker planned to send a Wardian case (early form of terrarium used to transport live plants across the seas in the nineteenth century; see Keogh, 2019; Rigby, 1998) back to Britain, filled with Southern Hemisphere native plants and Kerguelen cabbage seeds sown amongst them. Certain that his father would find success if the seeds were cool and damp enough, Joseph Hooker suggested attempting to germinate the seeds in a "black vegetable mould" (Hooker, as quoted in Huxley, 1918, p. 77), like peat, in a cool, very wet, and shaded position. Despite these efforts, all further cultivation attempts failed, suggesting that the seeds may not be viable for extended periods.

Details have been published about a small-scale French cultivation trial by R. Anthony in 1929. Receiving 100 seeds in 1927 from the Director of the French General Company of Îles Kerguelen, Saint-Paul, and Amsterdam, most failed to germinate in pots. One potted plant survived frosts and thrived for approximately two months, before showing "worrying signs" and dying (Anthony, 1929, p. 451). Anthony argues that had the plant not been attacked by nematodes, it would have likely survived and recognises the limits of his small sample size. Several other cultivation attempts in France (Bois, 1927) proved unsuccessful. Further laboratory and field research (Dorne & Bligny, 1993) suggested that the higher water content of the leaves (eighty-three per cent) prevents the plant from growing in areas with lower soil-water content than the saturated soils of the sub-Antarctic. This also suggests that *Pringlea* may be more susceptible to root pathogens, once removed from the cold climatic conditions of its native range. This has been demonstrated in several Australasian alpine plant species in glasshouse trials (Rigg et al., 2018). Essentially, Anthony (1929) proposed that *P. antiscorbutica* was unable to support water deprivation and may be specifically adapted to the sub-Antarctic climate. This supports Fuller's 1873 theory of "water or atmosphere" being the greatest limiting factor to plant growth and survival and demonstrates a sophisticated ability to conceptualise the natural world for a non-naturalist.

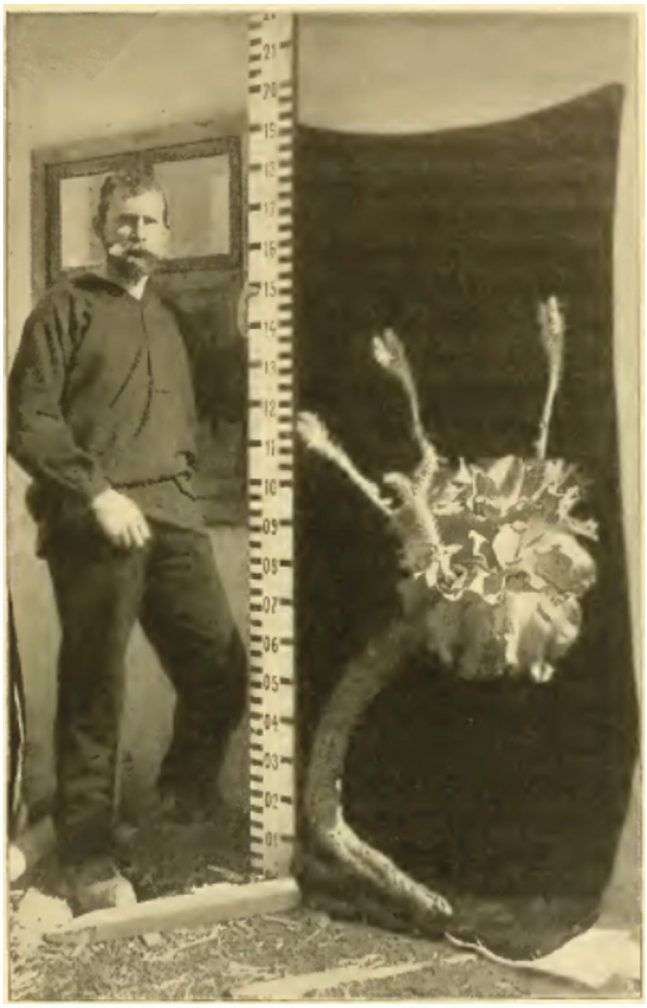

Figure 3. Werth with a large 24-year-old specimen of *Pringlea antiscorbutica* on Kerguelen Island as part of the 1901–1903 *Gauss* Expedition, showing the plant's stem and four flower spikes (Werth, 1911, p. 247).

Macquarie island cabbage – *Azorella polaris*, (Apiaceae)

A plant of many names

Azorella polaris (Hombr., & Jacquinot ex Hook.f.) A.Gray (1854) Macquarie Island cabbage; Apiaceae (historically Araliaceae) is a long-lived sub-Antarctic herb, endemic to the Auckland, Campbell, and Macquarie Islands, that, like *Pringlea*, proved a historically important antiscorbutic and source of sustenance to sub-Antarctic sailors and castaways. The plant has large, fleshy, rhubarb-like leaves, individuals growing up to two metres in height, and diameter (Allan, 1961) with umbels of white and purple waxy flowers (Fig. 4). Like *P. antiscorbutica,* Macquarie Island cabbage is a distinctive sub-Antarctic endemic, locally abundant, bearing edible and antiscorbutic rhizomes and leaves. Its range does not overlap with that of *Pringlea*, so it possesses a unique association with historical visitors to the sub-Antarctic islands.

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Figure 4. *Azorella polaris* is endemic to Auckland, Campbell, and Macquarie Islands, where it grows from an edible rhizome up to 4 cm in diameter, to a plant up to 2 m in height (top). It has broad, fleshy, lobed leaves, with hairs, up to 40 cm wide; its flowers occur in umbels (bottom left), and individual florets have waxy yellow petals, some with a purple centre (bottom right). Photographs by Karri Horton Hartley, Campbell Island, 2019.

This has created a divergent cultural history, with a unique influence on contemporary botanical research. Macquarie Island cabbage is also known as pūnui in Te Reo Māori (a name shared with Aotearoa's mainland species *Azorella lyallii,* syn. *Stilbocarpa lyallii*), known historically among pākehā (European New Zealanders) as Māori cabbage, and to nineteenth-century sealers and castaways simply as "root". The variety of common and cultural names signifies its importance to the diversity of visitors to the islands on which it occurs. A recent scientific name change to *Azorella polaris* (Hombr., & Jacquinot ex Hook.f.) G. M. Plunkett, & A. N. Nicolas (2016) reflects a new phylogenetic classification, which synonymised several related genera within *Azorella,* including *Stilbocarpa*, and placed them within the Apiaceae family (see also Mitchell et al., 1999). Here, we trace the history of European taxonomic naming, botanical, and morphological descriptions by early scientists and sailors, and focus on the use of *A. polaris* for food and scurvy prevention and cure among nineteenth-century sailors and castaways to the Auckland Islands/ Motu Maha, Campbell Island/Motu Ihupuku, and Macquarie Island.

Morphology and taxonomic history of discovery

Macquarie Island cabbage was first taxonomically described by Hooker as *Aralia polaris* Hombr., & Jacquinot ex Hook.f. (1844), (Araliaceae) after Ross' voyages to the Auckland and Campbell Islands in 1840. Although Hooker was certain the plant was a different genus to *Aralia* proper (Hooker, 1953, p. 95), he was hesitant to separate it before the primarily woody Araliaceae family was revised. After the 1843 publication of *Aralia polaris* from the South Island of New Zealand by Hombron and Jacquin (in Dumont d'Urville, & Jules-Sébastien-César, 1845), Hooker established the *Aralia* subgenus *Stilbocarpa* "in allusion to the shining fruit" (Hooker, 1953, p. 95). Hooker assigned the Macquarie Island cabbage to this subgenus in the *Flora of New Zealand* (Hooker, 1953, p. 95). American botanist Asa Gray (1810–1888) for the 1840 United States Exploring Expedition under Wilkes aboard the *Porpoise*, elevated the species to a new genus, *Stilbocarpa,* in the 1854 account of the botany of the voyage, due to its distinctive imbricate (overlapping) petals (Gray, 1848, p. 714). Hooker proclaimed the plant, "one of the most beautiful and singular of the vegetable productions of the island it inhabits, growing in large orbicular masses on rocks and banks near the sea, or amongst the dense and gloomy vegetation of the woods" (Hooker, 1847, p. 20). He observed introduced mammals such as goats, pigs, and rabbits eating the whole plant "greedily," perhaps one of the earliest published statements recognising the impacts of introduced mammals on the sub-Antarctic islands. *Azorella polaris* appeared so abundant in marshy habitats that Hooker documented the animals frequently living "entirely amongst it" (Hooker, 1847, p. 20), forming tracks between the patches of cabbages, nests from its trampled leaves and stems, and "grubbing up" the roots for sustenance.

English sailor Robert Holding, of the shipwrecked crew of the *Invercauld*, marooned on the Auckland Islands/Motu Maha for over a year in 1864, provided a description of *A. polaris* or "root," one of their chief foods. According to Holding, its leaves were similar to that of the northern hemisphere plant marshmallow, but larger, "up to a foot across," and the root tasted like sweet turnip when eaten raw (Holding, 1864, as quoted in Allen, 1997, pp. 81, 139). Some plants were two feet high and the root "was of a scaly nature and at every year's growth there formed a knotty substance of fibre" (Holding, 1864, as quoted in Allen, 1997, p. 81). Marshmallow or marsh mallow plant, *Althaea officinalis*, Malvaceae, is a herbaceous perennial with broad, lobed, edible leaves (indeed like that of *A. polaris*) and tuberous roots, used in herbal medicines and culinary purposes, and is indigenous to Europe, West Asia, and North Africa.

Holding's comparison with familiar northern hemisphere plants reflects his British background, as well as the crew's attempts at gardening and cultivation. Holding observed that the cabbage "varied in size and utility, according to the locality of their growth," with plants in the lowlands taller and more tender to eat (Holding, 1864, as quoted in Allen, 1997, p. 139). The crew relocated to one of the smaller islands off the main Auckland Island in March 1845, in search of food, shelter, and a better chance at rescue. Hoping to cultivate the root as food, the castaways planted seeds, collected from the main island, in a small patch of cleared ground (Holding, 1864, as quoted in Allen, 1997, p. 31). The fate of these seeds is unrecorded.

Sustenance and antiscorbutic for sailors

Macquarie Island cabbage's sugary rhizomes, more palatable when cooked, proved a necessary vegetable component in the diet of travellers to these regions, as well as an important remedy for scurvy. Sailors' use of the name "Macquarie Island cabbage", despite the plant not being in the cabbage family, may reflect the known association between members of the "cabbage" family and

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Table 2. The perceptions and use of *Azorella polaris* as a scurvy remedy amongst eighteenth-nineteenth-century sailors.

Sailor	Circumstances	Quote
Sealers, Macquarie, 1820	Sealing on Macquarie Island	*"Sealers scrape the stalks and roots, cut them up very fine and make soup of them"* – Bellingshausen, 1820, in Debenham, 1967, p. 368.
Bellingshausen (1778–1852)	Russian Antarctic Expedition, *Vostock* and *Mirny*, 1819–1821	Ship's crew preserved plants, made *"very tasty"* shtshi (Russian cabbage soup), ate the roots (starchy rhizomes) pickled, were *"sorry we had not prepared more"* —Bellingshausen, 1820, in Debenham, 1967, p. 368.
George Frederick Ainsworth (1878–1950)	Mawson's 1911–1914 Antarctic Expedition	*"Edible, though somewhat stringy and insipid."* Introduced sheep ate it readily *"even nibbling the roots after the plant had been cropped down"* —Ainsworth, 1998, p. 345.
Dundonald castaways	*Dundonald* castaways, Disappointment Island, Auckland Island/Motu Maha, 1907	Starving crew discovered its rhizomes, resembling *"the white briony of England."* [Eurasian perennial climber *Bryonia cretica* subsp. *dioica*, Cucurbitaceae]. "Root" main food source when meat scarce. Ate raw or thrown on fire, where tasted like *"boiled turnip"* . . . *"a good deal more appetizing than seaweed"* —Escott-Inman, 1980, pp. 156–157.
Andrew Smith (dates unknown), First Mate, *Invercauld*	*Invercauld*, marooned on Auckland Islands/Motu Maha, over 1 year, 1864	*"We were always crawling about on the rocks searching for something to eat . . . The roots we ate heartily, not knowing whether they were good as food or not, and little caring, as long as they for a time, satisfied our hunger"* —Smith, 1866, pp. 10–11.
		"It was always roots and limpets, limpets and roots, day after day, but we had to rest contented with what we could get, although our hunger was never satisfied" —Smith, 1866, p. 22.
Captain Thomas Musgrave (1832–1891)	Castaway on Auckland Islands/Motu Maha, *Grafton*, 20 months, 1864.	Abundant over the island, *"very good substitute for bread and potatoes,"* inferred, *"a great deal of sugar in it"* —Musgrave, 1866, p. 17.
		After three months on the island, Musgrave proclaimed *"so long as we can get to the roots we shall not starve"* —Musgrave, 1866, p. 21.
François Édouard Raynal (1830–1898)	Castaway on Auckland Islands/Motu Maha, *Grafton*, 20 months, 1864.	The *"heart of the stem was composed of a pulpy, sugary substance,"* called the plant "sacchary." Attempted to brew beer, but abandoned idea for fear of *"fatal consequences,"*, threw away liquid. —Raynal, 1880, p. 111.

antiscorbutic properties. Possessing distinguishable dark foliage and flavour like cultivated cabbage, it provided an easily accessible natural remedy to scurvy (Table 2). The *Grafton* castaway crew exhibited more curiosity in the uses of *A. polaris* than other marooned sailors, a luxury afforded by their better-rationed food due to their higher levels of discipline and leadership, which were vital for their survival and self-rescue (Allen, 1997; see Table 2).

Contemporary understanding of nutritional value

Contemporary botanical understanding of the nutrient content of Macquarie Island cabbage is less advanced than that of *Pringlea*. However, studies provide insight into the chemistry behind the historic consumption of the plant by sailors. In 1998, a report commissioned by the Australian Rural Industries Research and Development Corporation (Dawson, 1998), considered the feasibility of introducing three sub-Antarctic species, *P. antiscorbutica*, and *A. polaris*, and the cress-like *Callitriche antarctica* (Plantaginaceae), to the Australian consumer market as new commercial salad and vegetable crops. The focus on the potential of *A. polaris* for development as a commercial vegetable reflects a curiosity borne from its historical use as food for sub-Antarctic sailors. In assessing the nutrient composition of the species, Emmerson, Greenfield, and Sagum (in Dawson, 1998, pp. 32–25) reported that cooking *A. polaris* in boiling water for twenty minutes resulted in the plant losing its entire vitamin C content (Table 3), whereas *Pringlea* boiled for five minutes still contained a relatively high proportion of vitamin C. The authors chose to cook Macquarie Island cabbage longer to render it edible. Sailors did record cooking the Macquarie Island cabbage for hours to make it more palatable (Bellingshausen, in Debenham, 1967), similarly for *Pringlea* (Goodridge, 1847) but this would have rendered both species useless for scurvy prevention or cure. According to Dawson (1998), both cooked *Pringlea* and *Azorella* contained useful levels of carotenoids; the lower levels of β-carotene reported for *Azorella* (Table 3) were attributed to the longer cooking method.

Table 3. The varying nutrient, mineral, and vitamin compositions of P. antiscorbutica and A. polaris from tests conducted by Emmerson, Greenfield, and Sagum in Dawson (1998), pp. 32–25. Values are per 100 g edible portion.

	Pringlea antiscorbutica (boiled for 5 min)	*Stilbocarpa Polaris* (boiled for 20 min)
Vitamin C (mg)	154	0
β-carotene (μg)	147.9	33
Starch (g)	0.4	4
Energy (kJ)	121	165
Potassium (mg)	203	241

While the authors claim the long cooking of *Azorella* was necessary to render it edible for commercial use, this method does not reflect that used by all nineteenth-century sailors, some of whom did eat the plant raw. Raw plant parts, and those cooked for a shorter time, are likely to contain higher levels of vitamin C and be more effective scurvy remedies. According to Dawson (1998; Table 3), the amount of starch in cooked *A. polaris* was higher than that of *Pringlea*, so contained a higher level of energy, revealing its value as a staple foodstuff for castaways. In comparing levels of minerals in both species, cooked Macquarie Island cabbage contained a higher level of potassium than cooked Kerguelen

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cabbage. More research is needed to further reveal the chemistry behind the nutritional and sustenance value of *A. polaris* and to contrast the vitamin and mineral levels with that of Kerguelen cabbage using the preparation methods performed by sailors, in line with contemporary studies conducted by Hatt (1949); Delaveau et al. (1973); and Barillari et al. (2005).

Contemporary research into the cultivation of Macquarie Island cabbage outside of the sub-Antarctic region found that it can be grown in greenhouses and in field trials (Dawson, 1998). It was not able to be germinated from seed and was instead propagated from cuttings. Australian commercial tests (Dawson 1998) found *A. polaris* too slow-growing to be commercially practicable but recommended further study with *Pringlea*. The Botanical Gardens in Nipaluna/Hobart, Australia maintains live specimens of *A. polaris*, as does the sub-Antarctic garden at Queens Park in Waihōpai/Invercargill, Aotearoa New Zealand.

The history of human association with *A. polaris* has influenced the contemporary botanical understanding of the species. Contemporary research on the Australian and Aotearoa New Zealand sub-Antarctic region has been strongly influenced by the leadership these countries have shown in island conservation (Scott, & Kirkpatrick, 2008; Young, 1995), and additionally on Macquarie, the threat of introduced mammals (Whinam et al., 2014). Correspondingly, research has focused on endangered mega-fauna, with botanical research limited to surveys and studies of the impact of introduced species (Copson & Whinam, 1998; Frenot et al., 2005; Brown et al., 2022; Sindel et al., 2022), and climate change (Chapuis et al., 2004; Chau et al., 2019; Scott, & Kirkpatrick, 2012). With such a conservation focus, there has been no perceived need to investigate the nutritional value of *A. polaris*, or its autecology. For example, only two studies have been published on the pollination biology and breeding system of the species (Lord, 2012; Lord et al., 2013). In contrast, contemporary studies of *Pringlea* have focused on its physiological adaptations to the cold and windy climate (Aubert et al., 1999; Hennion, Frenot, & Martin-Tanguy, 2006; Hummel et al., 2004), and nutritional content (Barillari et al., 2005) stemming from its fame as a high latitude antiscorbutic. However, like *A. polaris*, little is known about the reproductive biology of *Pringlea* (Schermann-Legionnet et al., 2007).

Conclusions

The historical legacy of *A. polaris* as an antiscorbutic is arguably less than that of *P. antiscorbutica*, although the importance and value of the plant as food for sealers, whalers, and castaways is demonstrably similar. Cook and Anderson's use, description, and advocation of Kerguelen cabbage as a remedy for scurvy, and Anderson and Hooker's reference to this in its scientific name, established its legacy as an essential scurvy remedy, promoting its use by castaways. Both plants aided the survival of sealers, whalers, and shipwrecked crews in the eighteenth and nineteenth centuries, providing a nutritious and carbohydrate-rich staple part of their diets. The rhizomes, stems, and leaves of both plants were eaten raw and cooked, with preparation methods and opinions on edibility influenced by the cultural backgrounds of the sailors. Initial impressions of both species were formed in the context of the cultural botany of voyagers' predominantly northern hemisphere origins, e.g. calling both species "wild cabbage." Contemporary research into these two species has differed according to historical context and contemporary research focus of claimant countries for the islands on which these two species are found. *Pringlea's* prominence in the reports of early explorers like Cook led to more historic and modern cultivation attempts compared to *A. polaris*. The promotion and fame of *Pringlea* as a scurvy remedy since the eighteenth century likely also led to recent studies examining its cultivation and nutritional value. While cultivation trials have been unsuccessful for both species, they have provided some insight into the species' ecology. Examining the past context of, and cultural influences on knowledge and understanding of *P. antiscorbutica* and *A. polaris* highlights further research gaps and increases their cultural and ecological value as intrinsically linked to human association with the sub-Antarctic islands.

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