

Eradication of New Zealand flax *Phormium tenax* on Inaccessible and Nightingale Islands, Tristan da Cunha

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SUMMARY

New Zealand flax *Phormium tenax* was introduced to Tristan da Cunha, an island in the central South Atlantic Ocean, in the 1800s. During the following century it was transferred to two other islands in the Tristan archipelago: Inaccessible and Nightingale Islands. Although not an aggressive invader, flax spread on both islands threatening their status as among the least disturbed temperate islands remaining in the Southern Ocean. In 2004 an eradication programme was initiated on both islands to clear flax using a combination of uprooting, cutting, crushing and spraying with herbicide. Despite some regrowth, follow-up operations greatly reduced the number of flax plants. Established plants are now confined to about 300 m of cliffs at the Waterfall on Inaccessible Island where clearing is hampered by the steep terrain. Further follow-up management is planned until the plant is eradicated from both islands.

BACKGROUND

Tristan da Cunha is a small archipelago of three main islands in the central South Atlantic Ocean. It is one of the United Kingdom's Overseas Territories, with a small resident population of 280 people on the main island of Tristan forming the world's most remote human community (Ryan 2007). Inaccessible and Nightingale Islands are both uninhabited, and are unusual among temperate islands in lacking introduced mammals. Although various domestic animals have been taken to the islands, and feral populations of pigs, goats and sheep have occurred on Inaccessible Island in the past (Ryan & Glass 2001), neither island has ever supported any rodents. The islands are home to some alien plants, with 23 species recorded from Inaccessible and seven from Nightingale (Roux *et al.* 1992, Ryan 2007). These include the New Zealand flax *Phormium tenax*.

Flax was introduced to the main island of Tristan in the 1800s for fibre and roofing. Although no longer used for either purpose, it is widely planted around Edinburgh-of-the-Seven-Seas, the island's sole settlement, where it serves as a windbreak (Ryan 2007). Flax has spread from this settlement to the adjacent 1961 lava flow, the spring at Pigbite and the Sandy Point area (Gremmen & Halbertsma 2009). Flax was probably taken to Inaccessible Island during the abortive attempt to settle the island in the 1920s, as the centre of its distribution is near the old hut at the Waterfall where the settlement was based (Fig. 1). It is not known when it reaching Nightingale Island, where it is found in the vicinity of First Pond (Fig. 2). Although not an aggressive invader, flax spread over a considerable area on Inaccessible Island, and was identified as a priority for control/eradication in the island's

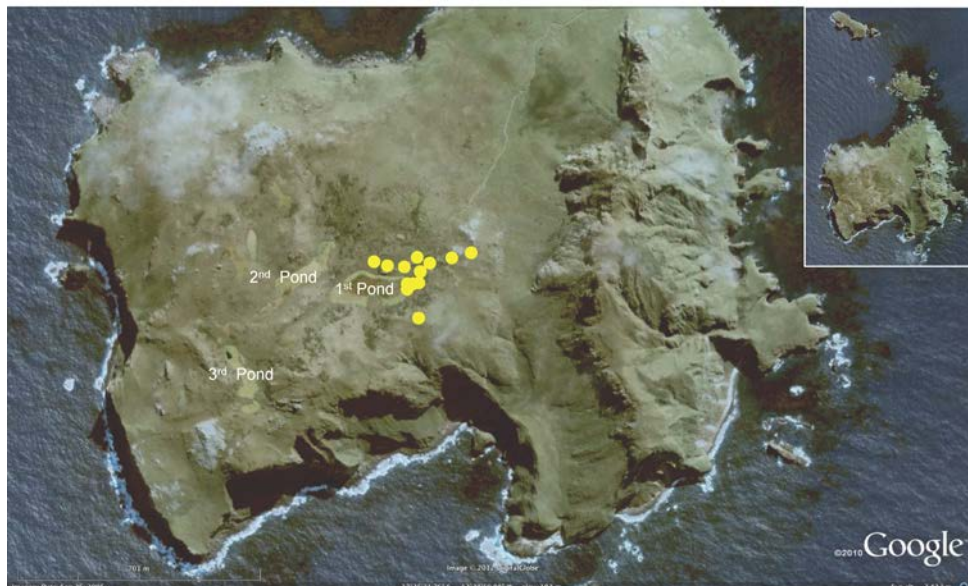


Figure 1. The northeast sector of Inaccessible Island showing areas where flax plants occurred, and the approximate distribution of remaining plants (adapted from Google Earth).

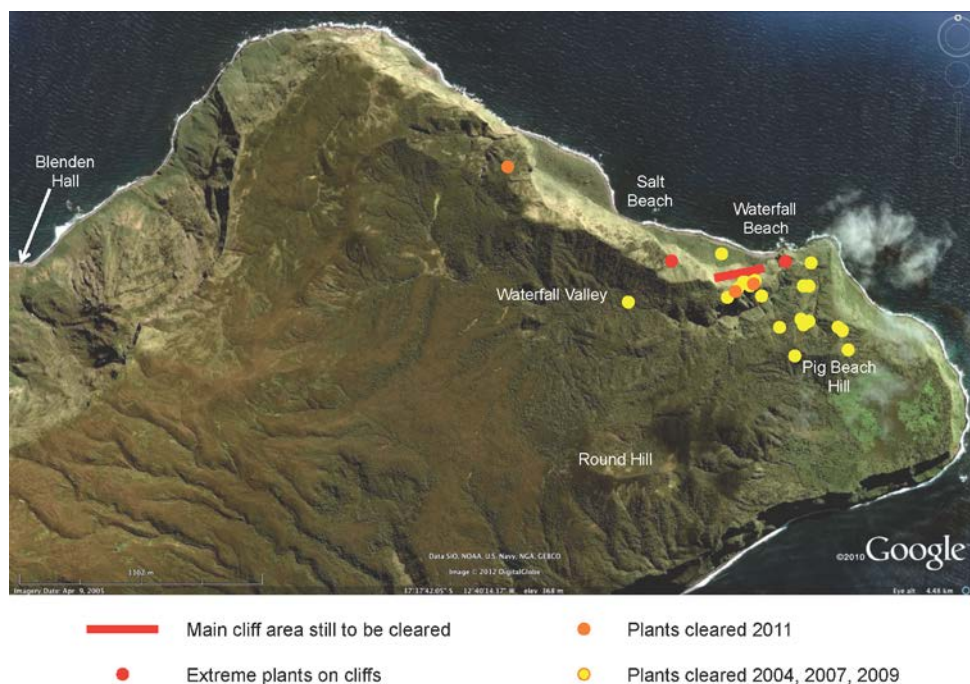


Figure 2. Areas where flax plants occurred on Nightingale Island; inset shows Nightingale and offshore islets (adapted from Google Earth).

management plan (Ryan & Glass 2001). Funding was secured from the UK Overseas Territories Environment Programme (OTEP) to initiate flax control at both islands in 2003.

ACTION

Inaccessible Island: Initial eradication clearing took place in spring 2004 (Ryan *et al.*

2004). A team of four workers spent from 10-29 September based at the Waterfall. The team, including two high-altitude specialists from the South African *Working for Water* programme, was landed by helicopter from the *S.A. Agulhas*. The expedition stores were left on the beach near the old hut, where the base camp was established. Then the team was dropped with ropes, metal I-beam stakes (for anchoring ropes) and climbing equipment at

roughly 280 m elevation on the edge of the plateau. Fixed ropes were set up, allowing work on the cliffs as well as access to the plateau from the coast.

Because of the extremely tough, fibrous nature of the leaves, most large plants were broken down into 'hands' of intact leaves at the base with hand axes and all roots removed. Not all plant bases were removed for some large plants, but these were sprayed with herbicide (5% glyphosate solution). Some large plants on the coastal lowlands were cut back with a petrol-powered weed cutter. One especially large stump was treated with a combination of herbicide and 20 litres of used engine oil from a fishing boat operating off the island. A second visit to the island in 2004 from 10 November to 3 December continued this work. Two workers based at Blenden Hall on the west side of the island were able to access the area, where flax occurred, from a temporary camp at Denstone Hill (Ryan *et al.* 2004). One large plant in Waterfall Valley and several on Pig Beach Hill on the island plateau were also cut down. Between these two expeditions, all large flax plants located were removed and every effort was made to remove all small plants and seedlings, although some probably escaped detection. Seedlings occurred at densities of *ca* 20 plants/m² in places on the lower cliff, making detection and removal of all seedlings impossible in the time available. Overall, some 2000-3000 plants were removed, excluding seedlings.

Initial follow-up was conducted in 2007, when a team of five was deployed on Inaccessible Island by boat from Tristan for 12 days from 5-16 October (Ryan *et al.* 2007). Access to the plateau was made using a rope left *in situ* since 2004, but this was badly frayed in places; future work on the cliffs should set new ropes, either by helicopter, or by carrying them from Blenden Hall on the west coast. There was more re-growth of flax than anticipated, both from plants where the stumps had not been removed entirely, but merely sprayed with herbicide, and from cut leaf rosettes that had been left intact (mainly in wetter areas). Also, the density of seedlings remained high in some areas of the main cliff (up to 20 plants/m²), similar to that experienced in 2004. We estimated that the number of plants had been reduced by *ca* 50%, but their volume was only some 10% of that cut in 2004. Fortunately, only a few plants had flowered since the initial clearing in 2004. In this follow-up exercise, every effort was made to remove all roots, and to either cache the cut plants on an expanse of

exposed boulders above the beach, or to crush the leaf bases, which were then cached *in situ*. The success of this approach was demonstrated in subsequent visits, when virtually no regrowth was found in cleared areas.

Some areas of the plateau were not visited during the 2007 follow-up exercise because it was planned to move to Blenden Hall after leaving the Waterfall. However, bad weather and logistical issues prevented this happening, so follow-up in these areas only took place in November 2009 when a team of two was again based at Blenden Hall (Ryan & Ronconi 2009). Once again there had been considerable regrowth from plants in 2004, but these were all crushed; several new plants found on the south side of Pig Beach Hill also were destroyed. On 7 December 2009, the team landed at the Waterfall and removed 18 plants (all small, <1 m with at most three 'hands') from the foot of the cliff, as well as 8-10 small (<0.5 m) plants from the lower slopes of the cliff. The lack of regrowth in areas cleared in 2007 confirmed that crushing open all 'hands' of flax and their large, corm-like roots effectively kills them. There also was no regrowth in the beach area where plants removed at the bottom of the cliff were cached in 2007.

The most recent follow-up took place in September-October 2011, when a team of three was again based at Blenden Hall (Ryan *et al.* 2011). No flax plants were found on Pig Beach Hill, or at the outlier in Waterfall Valley, but one small seedling and two larger plants apparently overlooked during earlier checks were found on the scarp above the Waterfall. A new outlier was found on the scarp edge northwest of Denstone Hill, almost 1 km from the nearest other site on the scarp (Fig. 1). All plants were destroyed.

Nightingale Island: Initial eradication work took place in November 2004, when a team from Tristan was based on Nightingale for 10 days. A block and tackle was used to winch large flax plants out of the boggy ground. They were then sprayed with herbicide and left upside down to dry out and die. Smaller plants were uprooted and left to dry. Approximately 15 large plants and 20 smaller plants were removed.

Some follow-up was conducted by Tristan islanders, but this was not documented. In 2007, three members of the flax eradication team from Inaccessible were based on Nightingale for 17 days (Ryan *et al.* 2007). A

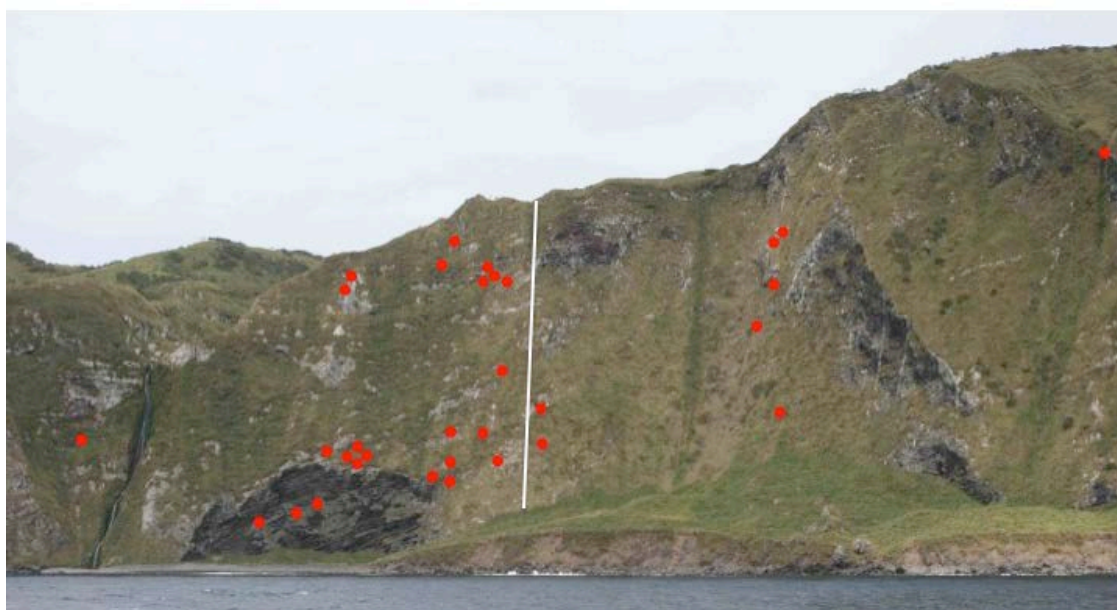


Figure 3. The cliffs adjacent to the Waterfall at Inaccessible Island showing the distribution of the remaining large flax plants, based on observations in 2009 and 2011. The white line shows the fixed rope (220 m long).

thorough search of the area around First Pond found about 20 flax plants, most of which were small or medium-sized, although one large plant had been overlooked among dense rocks and tussock along the ridge on the path to First Pond. All these plants were chopped apart and crushed, as done on Inaccessible Island. The large plants pulled out in 2004 were mostly completely dead. A few stumps showed signs of limited re-growth; these were broken open and either crushed or allowed to dry out.

No flax plants were found during brief visits to Nightingale in December 2009 (Ryan & Ronconi 2009), but a follow-up visit in September 2011 found two small shoots growing from base of an old, upended stump and 23 small plants in *Phylica* woodland adjacent to First Pond (K. Herian in litt.). The latter plants were uprooted and wedged upside down into tree branches to dry out. Further searches on 14 December 2011 found no new plants (K. Herian in litt.), but one plant was found in the First Pond woodland in September 2012 (H. Ortmann & O. Whitehead in litt.).

CONSEQUENCES

Sporadic effort from 2004 to 2011 has resulted in the removal of virtually all flax plants from Nightingale Island as well as from the coastal plain and plateau of Inaccessible Island.

Although a few plants may have eluded detection, it is believed that large, established flax plants are now confined to approximately 300 m of coastal cliffs adjacent to the Waterfall on Inaccessible Island. Scanning from the beach (2009) and the plateau edge (2009 and 2011) indicates that about 40 large flax plants remain on these cliffs (Fig. 3), roughly half of which had flowered by 2009. Tackling plants in this area requires climbing equipment. Unfortunately, there is no easy ascent of these cliffs from the east side of Inaccessible Island, so any further work at this site requires the initial placement of top-ropes either by helicopter, or by landing at Blenden Hall on the western side of the island and carrying the rope across the island plateau to above the Waterfall Beach. We estimate that once a top rope was in place it would take a team of 2-4 qualified rope-access workers 1-2 weeks to tackle the remaining plants (Ryan *et al.* 2011). Thereafter some continued follow-up would be required to eliminate flax from the islands. Seedlings appear to struggle to establish under dense tussock grass *Spartina arundinacea*, so the main areas to check for seedlings is on the cliff at Inaccessible Island and in more open areas under *Phylica* woodland around First Pond on Nightingale Island.

The flax eradication programme has facilitated control measures against other localized alien plants. At Inaccessible Island, repeated spraying of herbicide on the small areas of

couch grass *Cynodon dactylon* on the boulder beach at the Waterfall in 2004, 2007 and 2009 has reduced its extent by more than half. Weeding of all turnips *Brassica* sp. around the old hut at Waterfall Beach took place in 1999, 2004 and 2007, and in December 2009 only four plants were found (compared to hundreds in 1999 and 2004 and tens in 2007). On Nightingale Island, the invasive brass button *Cotula australis* was weeded in November 2007 and December 2009. It is largely confined to the areas around the huts and patchily along the 'roads' cut through the tussock, although it is spreading into more open areas under *Phyllica* woodland between First and Second Ponds, and a small patch was found recently near Fourth Pond (K. Herian in litt.). Further follow-up is needed to eradicate these species from the islands.

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REFERENCES

- Gremmen, N. & Halbertsma, R.L. (2009) Alien plants and their impact on Tristan da Cunha. Part 2: Species accounts. Data-Analyse Ecologie, Diever, NL.
- Roux, J.P., Ryan, P.G., Milton, S.J. & Moloney, C.L. (1992) Vegetation and checklist of Inaccessible Island, central South Atlantic Ocean, with notes on Nightingale Island. *Bothalia*, **22**, 93-109.
- Ryan, P.G. (2007) *Field guide to the animals and plants of Tristan da Cunha and Gough Island*. Pisces Publications, Newbury.
- Ryan, P.G. & Glass, J.P. (2001). *Inaccessible Island Nature Reserve Management Plan*. Government of Tristan da Cunha, Edinburgh, Tristan da Cunha.
- Ryan, P.G. & Ronconi, R.A. 2009. Inaccessible Island trip report: 5 October to 7 December, 2009. Unpublished report to the Tristan da Cunha Conservation Department (10 pp).
- Ryan, P.G., Barendse, J., Chiloane, L.A. & Moreku, G.L. (2004) Clearing invasive flax *Phormium tenax* on Inaccessible Island. Royal Society for the Protection of Birds, UK.
- Ryan, P.G., Sommer, E., Breytenbach, E., Glass, W. & Repetto, C. (2007) Managing alien plants on the outer islands of Tristan da Cunha: follow-up flax eradication efforts. Report on activities: October-November 2007. Unpubl. rpt to UK Overseas Territory Environment Programme.
- Ryan, P.G., Melo, M. & Stervander, M. (2011) Inaccessible Trip Report: 15 September to 6 October 2011. Unpublished report to the Tristan da Cunha Conservation Department (7 pp).