



Eradication of the non-native *Poa pratensis* colony at Cierva Point, Antarctica: A case study of international cooperation and practical management in an area under multi-party governance



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ABSTRACT

The on-going introduction of non-native species to Antarctica due to expanding human activity presents an increasing threat to biodiversity. Under the Protocol on Environmental Protection to the Antarctic Treaty, all introduced non-native species should be removed from the Antarctic Treaty area. The non-native grass *Poa pratensis* was first introduced to Cierva Point (Danco Coast, Antarctic Peninsula), along with substantial quantities of non-Antarctic soil, in the mid-1950s. Consistent with the Protocol, in January 2015 an internationally coordinated team undertook the eradication of the grass. Immediately prior to removal of *P. pratensis*, factors affecting its establishment, persistence and impacts upon local indigenous species was examined within the international management framework of the Antarctic Treaty System. The underlying soil had a high organic content of 15.5%, which may have contributed to the successful establishment of *P. pratensis* and restricted, at least initially, its vegetative growth to the enriched area. Examination of *P. pratensis* expansion from the original introduction sites showed that the plant colony intricate root system facilitated little or no coexistence of other native plants within its extent. The non-native plant colony also constituted a novel habitat for soil fauna within Antarctic terrestrial environments. The *P. pratensis* plant colony provided an unfavorable habitat for two of the locally endemic soil invertebrates, *Cryptopygus antarcticus* and *Belgica antarctica*. These observations led to the selection of an appropriate eradication approach, where the plants were targeted for physical extraction along with all underlying soil. During the eradication, c. 500 kg of soil and plant material from the *P. pratensis* colony was removed from the site. Monitoring one year later showed no evidence of re-establishment. Consistent with the Committee for Environmental Protection 'Non-native Species Manual', we recommend development and implementation of rapid response protocols following the discovery of a non-native plant colony to limit future impacts on indigenous species and local habitats.

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1. Introduction

Due to increasing human activity in Antarctica, the region is experiencing on-going non-native species introductions (Frenot et al., 2005; Chown et al., 2012; Huiskes et al., 2014). Most non-native organisms introduced to Antarctica fail to establish; however, some manage to persist and may go on to become invasive (Hughes et al., 2005; Hughes and Worland, 2010; Molina-

Montenegro et al., 2012). Vascular plant species may not readily establish in the extreme environmental and climatic conditions of Antarctica, as demonstrated by the existence of only two native species: *Deschampsia antarctica* Desvaux (Antarctic hair grass) and *Colobanthus quitensis* (Kunth) Bartl. (Antarctic pearlwort) (Smith, 1984). However, the physiological flexibility of plant species that are commonly invasive in other parts of the world may help them to colonize Antarctic environments with resulting negative impacts upon indigenous species and local habitats (Hughes et al., 2013; Molina-Montenegro et al., 2014). Currently, all known non-native plant introductions within the Antarctic Treaty area –the area south of latitude 60°S– have resulted in management

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actions, i.e. all known non-native plants have been removed from Antarctica, with the only exception being *Poa annua* L. in the vicinity of Admiralty Bay, King George Island, South Shetland Islands, where on-going eradication work is underway (Hughes et al., 2015; Poland 2015, 2016; Galera et al., 2016). To date, the area of Antarctic ground colonised by non-native plants has mostly been in the range 1–10 m², requiring only small-scale eradication events (Hughes and Pertierra, 2016). However, in general, little information is available on biosecurity considerations during eradication work within Antarctica and information on the impact of non-native plants is available only for *Poa annua* (Molina-Montenegro et al., 2014).

The non-native grass *Poa pratensis* L. (also known as the smooth or common meadow-grass) was introduced inadvertently to Cierva Point, Danco Coast, Antarctic Peninsula, during transplantation experiments in 1954–55 (Corte, 1961). The introduction occurred as a result of an experiment to transplant two Patagonian tree species: *Nothofagus antarctica* (Antarctic beech) and *N. pumilo* (Lenga beech). These tree specimens were planted on Cierva Point with some non-Antarctic soil from Tierra de Fuego to assess their capacity for survival under Antarctic conditions. Although the trees did not survive, the accompanying grass (*Poa pratensis*), which was introduced inadvertently with the soil, became established within the original experimental plot, and endured locally for the next six decades forming a small but compact colony. Since 1995, the plant colony was reported to extend beyond the original plot by lateral growth (i.e. increasing from 40 cm to over 1 m in diameter a during the last two decades), although under the local climatic conditions the non-native plants were not able to develop fertile flowers, disrupting sexual reproduction and hence natural seed dispersion (Smith, 1996; Pertierra et al., 2013). The location where this non-native grass colony established was near the Antarctic Specially Protected Area (ASPA) No. 134 Cierva Point, Danco Island, Antarctic Peninsula, which was designated to protect diverse plant communities and bird populations (Hughes et al., 2016). Some persistent non-native species can adapt to new environmental conditions and initiate invasions following a prolonged lag phase (Ellstrand and Schierenbeck, 2000) thereby causing substantial impacts to native ecosystems and altering habitats to make invasion by other non-native species potentially more likely (Shaw et al., 2010). Invasion of ASPA No. 134 Cierva Point by *P. pratensis* would impact upon the values of this protected area, as well as other terrestrial communities in the vicinity. Therefore, effective management of the plant colony was deemed a priority due to the recent acceleration of vegetative growth as well as the trend in climate warming observed in the Antarctic Peninsula region (Turner et al., 2005), which could eventually cause environmental conditions to become appropriate for sexual reproduction of this species (Hughes and Convey, 2010). Annex II to the Protocol on Environmental Protection to the Antarctic Treaty is the main legal text devoted to the conservation of the marine and terrestrial ecosystems in the Antarctic region, and Article 4 (4) states that 'Any other plant or animal introduced into the Antarctic Treaty area not native to that area, including any progeny, shall be removed or disposed of, by incineration or by equally effective means, so as to be rendered sterile, unless it is determined that they pose no risk to native flora or fauna'. Therefore, within this legislative framework, and in a context of current climate change, scientists and environmental managers from Argentina, Spain and the United Kingdom collaborated with the aim of protecting Antarctic biodiversity from the impacts of this non-native grass.

In January 2015, eradication of the grass was undertaken by mechanical removal of the plant colony and underlying soil following a strict protocol agreed among the three national Antarctic programmes. Immediately prior to this work, details of the non-native plant colony and associated soil characteristics

were recorded and samples were taken to investigate the diversity of the local soil fauna. *Poa pratensis* is a rhizomatous species with an intricate root system that may prevent growth of other plants (Bosy and Reader, 1995; Hendrickson and Lund, 2010) and which could have negative impacts upon local flora if outcompeted. Indigenous Antarctic invertebrates often show a preference for specific edaphic conditions (Tilbrook 1967; Russell et al., 2014), so the presence of a non-native plant may alter the habitat and potentially alter the structure of the edaphic community. In this paper, we investigated the soil conditions of the site that could have facilitated the long-term survival of the *P. pratensis* colony at the site together with its impacts on soil indigenous biota. We also described the means of eradication, with a particular emphasis on the biosecurity measures employed.

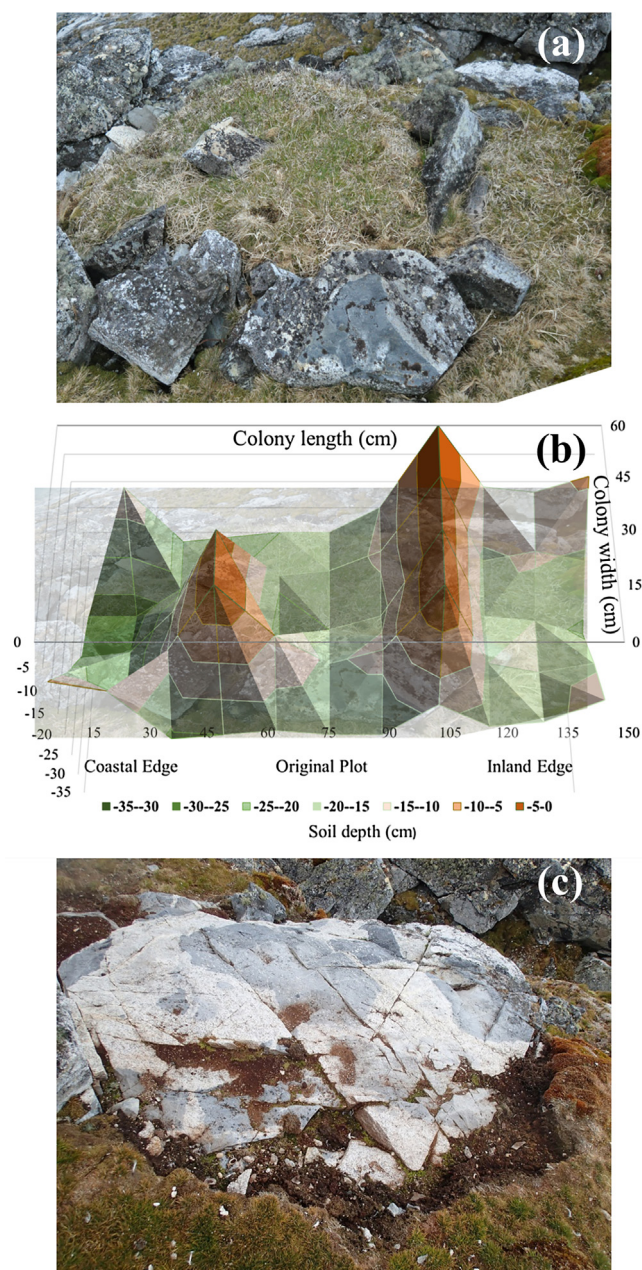


Fig. 1. Images of the *Poa pratensis* mat at Cierva Point. (a) 2015, prior to the eradication. (b) Soil depth profile (centimeters) of the *P. pratensis* colony: lateral view from the coastal edge (left) and the inland edge (right), and (c) one year after the eradication work (Feb 2016).

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