Antarctic Science 23(2), 153–154 (2011) © Antarctic Science Ltd 2011 doi:10.1017/S0954102010000982

Short Note
The first appearance and establishment of an alien vascular plant in natural habitats on the forefield of a retreating glacier in Antarctica

MARIA OLECH[1,2] and KATARZYNA J. CHWEDORZEWSKA[1]*

[1]*Department of Antarctic Biology, Polish Academy of Science, Ustrzycka 10/12, 02-141 Warsaw, Poland*
[2]*Institute of Botany, Jagiellonian University, Kopernika 27, 31-501 Cracow, Poland*
**Corresponding author: kchwedorzewska@go2.pl*

Received 17 September 2010, accepted 26 November 2010, first published online 26 January 2011

A striking feature of the Antarctic is the lack of diversity of vascular plants. *Deschampsia antarctica* Desv. and *Colobanthus quitensis* Bartl. have inhabited the maritime Antarctic for *c.* 5000 years. Pollen grains of both species and macroremains of the grass have been identified in mid-Holocene peat deposits on the South Shetland Islands (Birkenmajer *et al*. 1985). However, there is no evidence from palaeorecords that any other vascular plants existed in this region during the Holocene, despite the fact that a major source of potential immigrants is located only 900 km to the north in Tierra del Fuego (Smith 2003). With the current trend in regional warming in the maritime Antarctic (King *et al*. 2003) and a growing number of visitors there is an increasing probability that plants, previously unable to flourish because of adverse climatic conditions, will be able to become established.

During our long-term botanical monitoring at King George Island we have recorded the appearance of a third vascular plant species, firstly only in the anthropogenic zone (Olech 1996), but more recently in natural habitats. This is an alien species, annual meadow grass *Poa annua* L., which has currently colonized the moraines of the retreating Ecology Glacier (Fig. 1). Species usually associated with this habitat are the two native vascular plants, and mosses such as *Bryum pseudotriquetrum* (Hedw.) P. Gaertn., B. Mey. & Scherb. and *Ceratodon purpureus* (Hedw.) Brid.

Results and discussion

Poa annua L. has spread across areas in the vicinity of the Polish Antarctic Station Arctowski. The species was initially recorded in summer of 1985–86 (Olech 1996). At Arctowski *P. annua* colonized places disturbed by human activities, where the soil structure was destroyed, preferring sites sheltered from the wind (Olech 1996, 1998). This anthropogenic population of *P. annua* was probably introduced by expeditioners either through soil from the greenhouse or with cargo or personal equipment. *Poa annua* flowers and sets seed successfully (Fig. 2) often a couple of times during the growing season and has a continuum of life-history types ranging from annual to long-lived perennial forms. Our genetic studies show high variability in the population around the station. This may be related to the increased human activity favouring probably several separate immigration events from different sources (Fig. 2) (Chwedorzewska 2008). In the summer 2008–09 an extensive population of *P. annua* was recorded in a new habitat (approximately 70 individuals on 100 m^2), 1.5 km from the station on the deglaciated moraines of the Ecology Glacier (Fig. 1). The demographic study shows clearly that this population has been stable for at least two years. The most probable dispersal vector was the wind, which blows *P. annua* seeds from the station area.

Poa annua has already colonized anthropogenic and natural habitats on most of the sub-Antarctic islands (e.g. Walton 1975, Frenot *et al*. 1997), but in Antarctica it has occurred only temporarily in places strongly changed by human activity (e.g. Smith 1996, Chwedorzewska 2009). For 25 years at Arctowski Station a large population of *P. annua* has grown, set seed and spread without any attempts to control it. The rapid regional warming in the South Shetland Islands (King *et al*. 2003), has resulted in an amelioration of environmental conditions, which appear to have been sufficient to allow the successful establishment of this alien plant in natural habitats.

The Polish Antarctic Station is at present considering what might be done to solve the problem of *Poa* and what

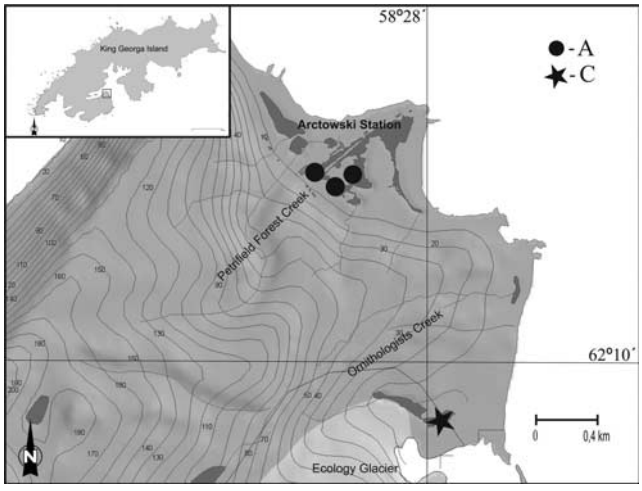

Fig. 1. Location of *Poa annua* in the vicinity of Polish Antarctic Station Arctowski. A = anthropogenic site, C = natural site (source: http://www.kgis.scar.org/).

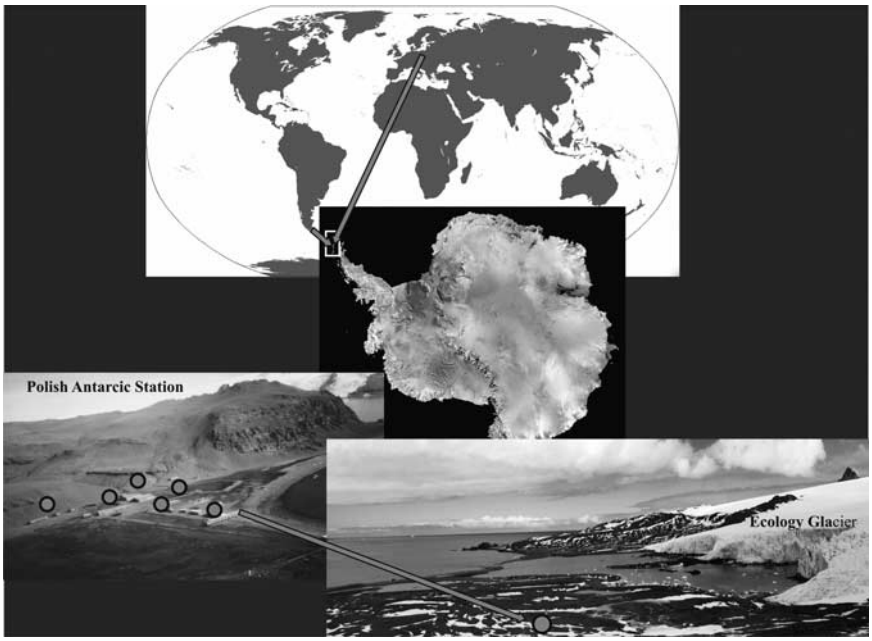

Fig. 2. Colonization of *Poa annua* in the Antarctic.

bio-security procedures are needed to avoid alien introductions in the future. This spread and persistence of *P. annua* highlights the need for constant vigilance against alien species in any cargo and personal effects, as well as in imported soil.

In Antarctica the start of an invasion has been recorded, and there are undoubtedly other aggressive alien species (*P. annua* is not yet displacing native species) which could be a serious threat to the terrestrial communities of indigenous organisms. Annex II of the Protocol on Environmental Protection to the Antarctic Treaty states clearly that non-indigenous species should be "disposed of by incineration or equally effective means that eliminates risk to native fauna or flora". The main goal of this paper was to focus international attention on the problem of current invasions in Antarctic ecosystems due to the increasing of amelioration of environmental conditions and the systems needed to stop new introductions and exterminate established species (Hughes & Convey 2010).

Acknowledgements

The work was financed by the Ministry of Scientific Research and Higher Education grant IPY/27/2007. We thank the reviewers whose comments were most helpful in revising this paper.

References

Birkenmajer, K., Ochyra, R., Olsson, I.U. & Stuchlik, L. 1985. Mid-Holocene radiocarbon-dated peat at Admirality Bay King George Island (South Shetlands, West Antarctica). *Bulletin of the Polish Academy of Sciences*, **33**, 7–12.

Chwedorzewska, K.J. 2008. *Poa annua* L. in Antarctic - searching for the source of introduction. *Polar Biology*, **31**, 263–268.

Chwedorzewska, K.J. 2009. Terrestrial Antarctic ecosystems in the changing world - an overview. *Polish Polar Research*, **30**, 263–273.

Frenot, Y., Gloaguen, J.C. & Trehen, P. 1997. Climate change in Kerguelen Islands and colonization of recently deglaciated areas by *Poa kerguelensis* and *P. annua*. *In* Battaglia, B., Valencia, J. & Walton, D.W.H., *eds. Antarctic communities: species, structure and survival*. Cambridge: Cambridge University Press, 358–366.

Hughes, K.A. & Convey, P. 2010. The protection of Antarctic terrestrial ecosystems from inter- and intra-continental transfer of non-indigenous species by human activities: a review of current systems and practices. *Global Environmental Change*, **20**, 96–112.

King, J.C., Turner, J., Marshall, G.J., Conolley, W.M. & Lachlan-Cope, T.A. 2003. Antarctic Peninsula climate variability and its causes as revealed by analysis of instrumental records. *Antarctic Research Series*, **79**, 17–30.

Olech, M. 1996. Human impact on terrestrial ecosystems in West Antarctica. *Proceedings of the NIPR Symposium on Polar Biology*, **9**, 299–306.

Olech, M. 1998. Synantropization of the flora of Antarctica: an issue. *In* Faliński, J.B., Adamowski, W. & Jackowiak, B., *eds. Synantropization of plant cover in new Polish research. Phytocoenosis 10, Supplementum Cartographiae Geobotanicae*, **9**, 269–273.

Smith, R.I.L. 1996. Introduced plants in Antarctica: potential impacts and conservation issues. *Biological Conservation*, **76**, 135–146.

Smith, R.I.L. 2003. The enigma of *Colobanthus quitensis* and *Deschampsia antarctica* in Antarctica. *In* Huiskes, A.H.L., Gieskes, W.W.C., Rozema, J., Schorno, R.M.L., van der Vies, S.M. & Wolff, W.J., *eds. Antarctic biology in a global context*. Leiden: Backhuys, 234–239.

Walton, D.W.H. 1975. European weeds and other aline species in the sub-Antarctic. *Weed Research*, **15**, 271–282.