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Is a Translocation of Indigenous Plant Material Successful in the Maritime Antarctic?

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Abstract: During the 30th Polish and 10th Ukraine Antarctic expeditions (09 November 2005 through 09 February 2006) we attempted three translocations of vegetative material of *Deschampsia antarctica* and two of *Colobanthus quitensis* around the Polish Henric Arctowski Station (King George Island, South Shetland Archipelago) in order to mimic dispersal of plants by birds. The results show that the factor limiting the establishment of these vascular plants in the region is probably the availability of fresh water, because only at plots near the glacier where melt water was present during all of the austral summer the plants were able to get settled. The other sites were apparently too dry, particularly in this respective summer season.

Zusammenfassung: Während der 30. Polnischen und der 10. Ukrainischen Antarktisexpedition (09. November 2005 bis 09. Februar 2006) wurden drei Verpflanzungen von *Deschampsia antarctica* und zwei von *Colobanthus quitensis* auf dem Gebiet der polnischen Station Henric Arctowski (King George Island, Südshetland-Inseln) durchgeführt. Die Ergebnisse bestätigen, dass das Vorhandensein von Süßwasser der limitierende Faktor für die zufällige Verbreitung von Gefäßpflanzen in der Region ist. Nur auf der Versuchsfläche nahe dem Gletscher, an welchem während des gesamten Südsommers genügend Wasser vorhanden war, überlebten alle Pflanzen.

INTRODUCTION

During the last 50 years the region of Antarctic Peninsula and adjacent archipelagos, also known as Maritime Antarctic (CONVEY 2003), experienced notable climate warming. Therefore spreading of two native species of vascular plants *Deschampsia antarctica* Desv. and *Colobanthus quitensis* (Kunth.) Bartl over previously unoccupied territories was observed (FOWBERT & LEWIS SMITH 1994, LEWIS SMITH 1984, 1994, ALBERDI et al. 2002). There are different hypotheses about the time span of initial invasion of these species to this region. It may well have happened either after Pleistocene glaciations (LEWIS SMITH 2003, MOSYAKIN et al. 2007) or even before the maximal ice sheet formations (PARNIKOZA et al. 2007). Being successful, the two vascular plant species must be effectively adapted to spread in ice-freed areas isolated by water-bodies or glaciers. But the way of settlement was rarely studied till now. Their seeds may have been imported by wind or by birds. However, it was recorded that the quantity of dispersed seeds was rapidly decreased with distance (HOLDINSKY et al. 2003). Whereas winds most probably disperse larger diaspores within habitats, birds may carry even tufts from one island to another or from nearby South America. Although there are a number of suggestions in the literature that vegetative plant material is dispersed by birds (LEWIS SMITH 2003, GERICHAUSEN et al. 2003), the conditions necessary allowing the perdurance of the transported plant isolates was not yet studied in detail.

With this in mind, we imitated bird-dispersal of the two plant species in the ice-free area near Arctowski station.

MATERIALS AND METHODS

During the 30th Polish and the 10th Ukrainian expeditions we worked in ice-free areas near the Polish Arctowski Station, King George Island. We transplanted vegetative material of *Deschampsia antarctica* to three and *Colobanthus quitensis* to two different locations. In every case, three tufts of the plant after measuring of their size (Tab. 1) and with peaces of substrate on roots were transferred to each location and were attached to or planted into the soil or debris at the site. We chose generative visibly undamaged specimens. The length of the sprouts was about 4 cm for *D. antarctica* and 2 cm for *C. quitensis.* They were pulled-out from soil with roots, as it is done by kelp gull *Larus dominicanus* Lichtenstein. Both species were collected in habitats of Antarctic herb tundra formation according to LINDSAY (1971) where the birds *Larus dominicanus* Lichtenstein and *Catharacta antarctica* Lesson. regularly gathered plant material to build their nests. In 1989-90 the bird's population here consisted of 50-60 pairs (MYRCHA 1992). It's abundance in whole Admiralty Bay region remained high and unchanged till now (SANDER et al. 2006). *Catharacta antarctica* is another bird that uses the vascular plants for nest building. Also, *Macronectes giganteus* Gmelin. was reported to add grass as nesting material (FURNESS 1996, PEKLO 2007).

The tufts were transferred and included in background cenosis: in rock places roots of the tufts were anchored in the soil in ledges, and in lowland places plants were disposed directly in the ground. This approach was attempted to mimic the distribution of tufts by birds. The chosen sites of inoculation are subjected to different environmental conditions (see Fig. 1).

Plant survival was been monitored subsequently within periods of one to three months after the transfer.

RESULTS AND DISCUSSION

The results of the transplant experiments are shown in Table 2. Both species survived transplantation only within the periglacial region outside the herb tundra formation which provides sufficient soil moisture under the influence of melt water from the glacier (D, C). It may be surprising that the transplantation within in tundra formation in case (E) was not successful. But this may due to problems with moisture regime for the trans-

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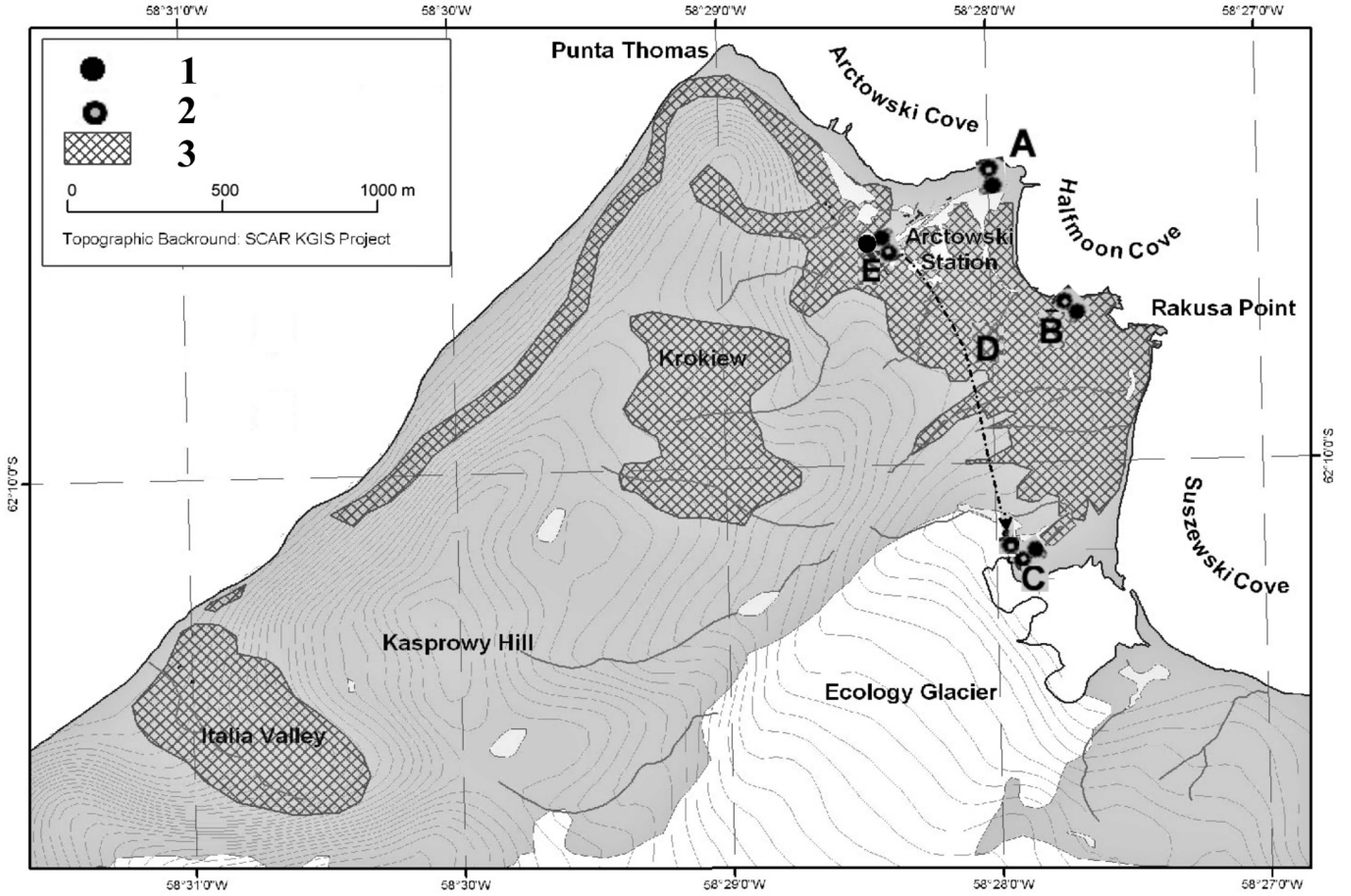

Fig. 1: The area of transplant experiments with *Deschampsia antarctica* and *Colobanthus quitensis* near Arctowski station. A – E are the sites where transplantation took place: (1) = location of origin, (2) = location of transplant, (3) = area of distribution of Antarctic herb-gras tundra formation.

Abb. 1: Gebiete in der Nähe der Arctowski-Station, in denen die Verpflanzung von *Deschampsia antarctica* und *Colobanthus quitensis* durchgeführt wurden. A – E = Orte der Verpflanzungen: (1) = ursprünglicher Standort, (2) = Standort der Aussetzung, (3) = Verbreitung der Antarktischen Kraut-Gras-Tundren-Gesellschaft.

planted tufts. In site (B) the soil on the neighbouring rock slope was obviously too shallow and sun irradiance too strong, so that the tufts were killed. It should be emphasized also that the unusually high temperatures and drought of the Austral summer of 2005-06 might have negatively influenced our experiment. A moister summer season may well have favoured establishment of the transplanted tufts in (B) and (E), however, flushes of water in a rainstorm could also be adverse as was shown in (A). As a consequence, the success of establishment of larger diaspores of vascular plants depends on the incidence of various spatial and temporal conditions. Of course, the major factor is the presence of sufficient moisture as is the case with many other plant species in other climates.

Notably, *Larus dominicanus* begins to collect material for nests in middle November (PEKLO 2007), which is generally earlier then our attempts took place. The conditions for survival of vascular plants may be more benign at the period of gulls' nest-building. Most of our experiments occurred when *Catharacta antarctica* was building nests (the end of November to beginning of December) (PEKLO 2007).

Principally, smaller or larger vegetative parts of Antarctic vascular plants are able to survive transportation by birds and can be successfully settled under suitably humid conditions in yet uncolonised locations. This may be particularly the case with *Larus dominicanus,* the main carrier of such plant material, but depends on the weather of a year. Therefore, vegetative dispersal of tufts must be rare and its success is irregular. Removal of plant material may also break isolation of plant populations and increase genetic variability of the species. However, because of the paucity of transplantation's performed, our results should be considered as preliminary. More substantiated conclusions need further studies.

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Site	Date	Number of tufts	Tuft diameter in two dimensions (cm)	Location of origin (1)	Location of transplant (2)
Deschampsia antarctica					
A	12-16.11. 2005	3	6x8 (a) 18x8 (b) 11x8 (c)	Tuft (a) from rock crevasse 5m off the shoreline (horizontal) (S62°09.480' W58° 27.953'), and (b) and (c) on small rocks near lakes, along penguin tracks. (62°09.480' S, 58°27.953' W)	All tufts were transferred 10m northeast from original site (1) on horizontal rock face covered by lichens only. 62°09.478' S, 58°27.928' W
B	23.11.2005	3	9x9 (a) 9x8 (b) 9x9 (c)	Within the region of the herb-grass tundra formation. North exposed rock slope, 50 m off the shoreline, in front of a penguin colony. 62°09.765' S, 58°27.871' W	Tuft (a) was transferred 60 cm northwest on nearest bare rock, and (b) and (c) ones – 5 m northwest from original site on lowland place (1). 62°09.765' S, 58°27.871' W
C	09.12.2005	3	7x7 (a) 5x5 (b) 5x5 (c)	Lowland periglacial region (50 m off the margin of the glacier, which covered this site 20 years ago). 62°10.160' S, 58°27.900' W	(a) – (c) tufts together were transferred 40 m south-east and inserted in distance 0.7 m from each other in periglacial wetland. 62°10.167' S, 58°27.177' W
Colobanthus quitensis					
D	23.12.2005	3	3x3 (a) 2x2 (b) 3x3 (c)	Lowland region of the herb-grass tundra formation. 62°09.587' S, 58°28.428' W	(a) – (c) tufts together were transferred 500 m southeast and inserted in distance 0.7 m from each other on place without any vegetation. 62°10.167' S, 58°27.177' W
E	04.01.2006	3	2x2 (a) 2x2 (b) 2x2 (c)	Site near D, lowland region of the herb-grass tundra formation. 62°09.584' S, 58°28.480' W	(a) – (c) tufts together were transferred 20 m south-east and placed at distances 0.7 m from each other. 62°09.587' S, 58°28.480' W

Tab. 1: Material and sites characteristics for *Deschampia antarctica* and *Colobanthus quitensis* in the Arctowski ice-free-area.

Tab. 1: Beschreibung von Standorten und Material für die Verpflanzung von *Deschampia antarctica* und *Colobanthus quitensis* im eisfreien Gebiet der Arctowski-Station.

Site	Date	Results
A	23.11.2005	Negative: two tufts (a and c) became washed out during a storm, the third died after exposure to seawater.
B	22.01.2006	Negative: all tufts dried out.
C	03.03.2006	Positive: all tufts survived.
D	03.03.2006	Positive: all tufts survived. An unintentionally transferred immature specimen of *D. antarctica* became the most viable of all.
E	14.01.2006	Negative: all tufts dried out.

Tab. 2: Success of transplantation of *Deschampia antarctica* and *Colobanthus quitensis* in the ice-free area near Arctowski station.

Tab. 2: Ergebnisse der Verpflanzung von *Deschampia antarctica* und *Colobanthus quitensis* im eisfreien Gebiet von Arctowski.

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