MASARYK UNIVERSITY

STRUCTURE AND FUNCTION OF ANTARCTIC TERRESTRIAL ECOSYSTEMS

Electronic Conference on Interactions between Antarctic Life and Environmental Factors, IPY-related Research
Brno, October 22th-23th, 2009

Book of Abstracts and Contributed Papers

Brno 2009

Comparative study on utilization of vascular plants by Antarctic birds

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Key-words: *vascular plants, birds, maritime Antarctic*

Introduction:

During the last 50 years, the region of Antarctic Peninsula and adjacent archipelagos, also known as the Maritime Antarctic, experienced significant climate warming. As a consequence, populations of the only two vascular plants native to the Antarctic, i.e. the Antarctic hairgrass *Deschampsia antarctica* Desv. and the Antarctic pearlwort *Colobanthus quitensis* (Kunth.) Bartle. dispersed and established over previously unoccupied territories [1, 2, 3]. There are different hypotheses about the time span of their initial invasion of the Maritime Antarctic region. It may well have happened either after Pleistocene glaciations [4, 5] or even before the maximal ice sheet formation [6]. Being successful, both vascular plant species must be effectively adapted to spread over ice-free areas isolated by vast seas and/or glaciers. Their seeds may have been imported by wind or by birds. However, it has been recorded that the quantity of dispersed seeds rapidly decreases with distance [7]. While winds most probably disperse only larger propagules within habitats, birds may carry also tufts and they can disperse them not only among the (sub-)Antarctic islands but also from South America. There is a number of indications that birds can effectively disperse vegetative plant parts [4, 8]. Smaller or larger vegetative parts of Antarctic vascular plants are able to survive a several days-lasting transportation by birds and can, therefore, successfully established in suitable environmental conditions in yet uncolonized locations [9]. However, the bird species involved, the manner(s) of plants' engagement, and itineraries of their travels remain unclear. This information is very important for investigation of the history and modern aspects of the biology of both native Antarctic vascular plants. This implies a question: What species of birds could have been the carriers of *D. antarctica* and *C. quitensis* during their initial colonization and later dispersal? For example, small migratory birds of the genus *Muscisaxicola* (Tyrannidae), which are common on the bogs where *C. quitensis* thrives in the Andes, have been put forth as an exotic candidate carrier of the Antarctic vascular plants from South America to the maritime Antarctic [10]. Based on the literature data, it seems likely that only three species of the Antarctic birds are probably capable of distributing the vascular plants, i.e.: the Kelp Gull (*Larus dominicanus*), and two skua species the South Polar Skua (*Catharacta maccormiki*), and the Brown Skua (*Catharacta lonnbergi*) [11]. In addition, Southern Giant Petrel (*Macronectes giganteus*) has also been reported to use the grass as nesting material [12, 13]. However, this species is known to be very vulnerable to human disturbance. There are evidence that one breeding colony of this species from the Point Thomas area (King George Island) was completely abandoned due to human disturbance [14]. Therefore, to avoid any disturbance to occupied nests we did not included this species into our investigations. Potentially, all these bird species are long-distance migrants between South America and Antarctica, or even within a wider range [13, 15]. The aim of the present study was to investigate utilization of vascular plants in the nests of *L. dominicanus* and both *Catharacta* species at two distant locations in the Maritime Antarctic.

Materials and Methods:

The field survey was conducted during the austral summer seasons 2006/07 and 2007/08 within the 11th and 12th Ukrainian Antarctic expeditions. We involved investigations of nesting habits of the Kelp Gull (*Larus dominicanus*) and two skua species, the South Polar Skua (*Catharacta maccormiki*) and the Brown Skua (*Catharacta lonnbergi*) at two distant locations, i.e.: the Point Thomas area (Admiralty Bay, King George Island, South Shetland Islands) and the Argentine Islands region. The latter included some of the Argentine Islands: Galindez (where Faraday/Vernadsky Station is located), Skua Island, and several islands of the nearby archipelago: Berthellot Is., Petermann Is. and Yalour Is. as well as a few sites on the western shore of the Antarctic Peninsula. All accessible nests of *L. dominicanus, C. maccormiki*, and *C. a. lonnbergi* were inspected for presence of parts or whole vascular plants. On average, 20 nests of each bird species were investigated in each region. However, the number of nests inspected was limited by the size of the local breeding populations. For example in case of the Kelp Gull (*L. dominicanus*) in the Argentine Islands region, a total of 35–40 nesting pairs have been reported, but only 3–5 pairs are known from the Galindez Island [13]. Moreover, nests of this species are often difficult to reach. Hence, the real number of accessible nests was only about ten [Chesalin, Dyyky personal communications]. In the Point Thomas area, the number of breeding pairs is also relatively low and amounts 13–22 pairs [14, Trivelpiece W. & Trivelpiece S., personal communication]. In case of the South Polar Skua (*C. maccormiki*), approximately 100 pairs nest in the Argentine Islands region, 21–37 of which nest on Galinez Island [13; Dyyky personal communications]. *C. maccormiki* is also fund in the Point Thomas area where its population was estimated for 19 pairs [13, Trivelpiece W. & Trivelpiece S., personal communication]. On the other hand, breeding pairs of the Brown Skua (*C. a. lonnbergi*) occurs only the Point Thomas area, where its population was estimated at 37 breeding pairs [Trivelpiece W. & Trivelpiece S., personal communication]. To avoid disturbances to occupied nests their inspections were performed with a special care and in short sessions only. All the investigated nests were photographed. In addition, photographs of *L. dominicanus* nests (kindly provided by Malgorzata Korczak and Anna Gasek) from the Point Thomas area taken during the summer season 2008/09 were analyzed. Furthermore, 10 photographs of *C. maccormiki* nests published Peklo [13] were also included into the analysis.

Results and discussion:

The data provide evidence that the investigated birds contribute significantly to dispersal and establishment of the Antarctic vascular plants. The results also demonstrate significant differences in utilization of vascular plants between the Kelp Gull (*Larus dominicanus*) and both skua species (*Catharacta* spp.). *L. dominicanus* at both investigated regions use vascular plants for nest building on a regular basis. Besides dried fragments of both vascular plant species, alive and well rooted clumps were also observed in the gulls' nests. The utilization of plants by the gulls, therefore, seems to be independent of the geographic location. In favorable weather conditions, breeding season of *L. dominicanus* starts already at the beginning of October [13]. The gulls mate, defend their breeding territories and collect material for their nests when most of their breeding territories and the surrounding areas are still covered with snow. Facing shortage of a nest material, they might be forced to collect it from distant locations, even from other islands. Thus they may contribute to dispersal and establishment of plants in new locations. In addition, gulls significantly fertilize the soil around their breeding territory, both with their droppings and food remains (*e.g.* shells from cracked limpets). It is well known that, although *D. antarctica* has a wide ecological amplitude, the most favorable conditions for its growth occur in moderately manured areas near bird breeding sites [3, 16]. Therefore, after the introduction of

D. antarctica and *C. quitensis*, brought with the nesting material, development of the Antarctic herb tundra formation becomes possible. Nesting sites may then be abandoned and overgrown with the grass, allowing for development and establishment of the vascular plant communities in a new location. Therefore, *L. dominicanus* seems to be particularly important vector transferring seeds and other propagules among the islands. In case of skua, vascular plants were also found to be important component of their nests. In the Point Thomas area, some vascular plants were found in all the investigated skuas' nests (the species have not yet beed distinguished). On the other hand, skuas' nests from the Argentine Islands region contained almost exclusively mosses. It seems that only *C. maccormiki* is present on the Argentine Islands region, while in the Point Thomas area both *Catharacta* species occur, (*C. maccormiki* and morphologically similar but larger *C. a. lonnbergi*). Although all vascular plants, mosses and lichens are utilized by these birds, the use of vascular plants in nests building appears to be species-specific. However, the differences may result from the fact that both species and their hybrids use only plants collected directly within their breeding territories and their immediate surroundings [Trivelpiece W. & Trivelpiece S., personal communication]. At the beginning of their breeding season, most of the ground is already snow-free. Thus, it is not necessary for these birds to search for nesting material away from their breeding sites. Therefore, the species-specificity in the use of vascular plants may arise only from the plant communities available in the neigbourhood of their nesting sites. On the Barton Peninsula (King George Island), nests of *C. a. lonnbergi* are situated closer to the shoreline and at lower elevation than those of *C. maccormiki* (mixed pairs also tend to occupy lower sites) [17]. Observations from the Fildes Peninsula (King George Island) [15] also support that view. *C. maccormiki* use more often lichens (*Usnea sp.*) to build their nests, but *C. a. lonnbergi* seems to prefer mosses as a nests material. This depends on the surroundings, if it is wet or dry, as well as altitude and type of vegetation present in their breeding territories. The bigger and stronger *C. a. lonnbergi* usually occupies territories closer to penguin colonies, and partly in lower, moister areas where mosses are more abundant. *C. maccormiki* is smaller than *C. a. lonnbergi*, and therefore seems to be forced to use the remaining areas, such as locations at higher elevations where plant communities are usually dominated by lichens [Peter, personal communication]. In the Point Thomas area, both species of skua occur. The Antarctic herb tundra formation is well-developed and occupies significant area here. As a consequence, vascular plants are found in nests of both species. The birds preference to collect plants (as a nest material) found only within their breeding territories is also evident from the observations done at Barton and Fildes Peninsula. Although at both these locations both species of vascular plants occur, they were not found in skuas' nests [15, 17]. Such a finding might be explained by location of nests and their distance from vascular plant communities. The nests of *C. maccormiki* may include vascular plants, though such cases are rare, as this species usually nests in sites located on higher elevation where vegetation is dominated by lichen and moss communities (both at the Point Thomas area and on the Argentine Islands), while most sites with such plant communities in the Argentine Islands region occur at low elevation close to the sea-shore. Therefore, the skuas nesting there seem to contribute only to local rejuvenation and mixing of clumps but not to long-distance dispersal which is probably accomplished by other means. All these observations indicate differences in the use of vascular plants in nest building between *L. Dominicanus* and *Catharacta* species. *L. dominicanus* seems to collect selectively tufts of *D. antarctica* among which, parts of *C. quitensis* might be sometimes found. On the other hand, *Catharacta* species are probably not selective in choosing nest building material. They probably use only plant material available in close vicinity of their nest. Thus, the composition of the plant material in their nests corresponds to the composition of the nearby plant communities. Differences in nest material preferences between *C. a. lonnbergi* and *C. maccormiki* might be explained

solely on locations of their breeding territories. In spite of the fact that a series of reports on the nature of the investigated subject are available [17, Peter, personal communication], the issue requires further investigation. Among the investigated bird species, *L. dominicanus* seems to be the most important vector distributing vascular plants and/or their parts over the maritime Antarctic. The distance of such transport needs more detailed investigation. Both *Catharacta* species, on the other hand, are probably responsible only for local propagation, mixing or rejuvenation of the vascular plants populations.

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Acknowledgments: We thank Peter H-U, Dykyy I., W. Trivelpiece & S. Trivelpiece, S. Loparev, M. Chesalin, G. Millinevsky. Our fieldwork was supported by National Scientific Antarctic Center of Ukraine and Department of Antarctic Biology PAS, particularly by prof. S. Rakusa-Suszczewski. This work was also supported under the agreement on scientific cooperation between National Academy of Sciences of Ukraine and Polish Academy of Sciences.