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Variation in bird's originating nitrogen availability limits High Arctic tundra development over last 2000 year (Hornsund, Svalbard)

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Arctic and subarctic regions play important roles in the global carbon balance. However, nitrogen (N) deficiency is a major constraint for organic carbon sequestration in the High Arctic. Hence, the identification of the relative contributions from different N-sources is critical for understanding the constraints that limit tundra growth.

The stable nitrogen composition of the three main N-sources and numerous plants were analyzed in ten tundra types (including those influenced by seabirds) in the Fuglebekken catchment (Hornsund, Svalbard, 77°N 15°E). The percentage of the total tundra N-pool provided by seabirds' feces (from planktivorous colonially breeding little auks Alle alle), ranged from 0–21% in Patterned-ground tundra to 100% in Ornithocoprophilous tundra. The total N-pool utilized by tundra plants in the studied catchment originated from birds (36%), atmospheric deposition (38%), and N2-fixation (26%). The results clearly show that N-pool in the tundra is significantly supplemented by nesting seabirds. Thus, if they experienced climate change induced substantial negative environmental pressure, it would adversely influence the tundra N-budget (Skrzypek et al. 2015).

The growth rates and the sediment thickness (<15cm) in different tundra types varied considerably but the tundra age was similar in the whole area, <450 cal BP. The only exception was Ornithocoprophilous bird-N rich tundra with very diverse ages ranging from 235 to 2300 cal BP and thickness up to 110 cm. The growth rates for this tundra (62 cm core, 18 AMS 14C dates) were high (1.5-3.0 mm/yr) between 1568 and 1804 AD and then substantially declined for the period between 1804 and 1929 AD (0.2 mm/yr). These findings deliver an additional argument, that the organic matter accumulation is driven not only directly by climatic conditions but also by birds' contribution to the tundra N-pool.

Skrzypek G, Wojtuń B, Richter D, Jakubas D, Wojczulanis–Jakubas K, Samecka–Cymerman A, 2015. Diversification of nitrogen sources in various tundra vegetation types in the high Arctic. PLoS ONE 10(9): e0136536.