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Stress Resilience of the Polar Streptophyte Green Microalga *Klebsormidium Flaccidum* from Svalbard, High Arctic

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A b s t r a c t

Polar regions are generally considered to have extreme environmental conditions: nutrient-deficient soils, low temperatures and frequent freeze-thaw cycles in winter, and desiccation in summer. These factors are highly demanding for biological soil crusts microalgae to develop various adaptation strategies. The novel experimental strain of the widespread green streptophyte microalga *Klebsormidium flaccidum* CCALA 1182, found in terrestrial and freshwater habitats, was isolated from biological soil crusts in Svalbard (High Arctic). The study aimed to explore *Klebsormidium flaccidum* CCALA 1182 stress resilience to desiccation, nitrogen starvation, low temperatures, and freezing using laboratory-simulated conditions that mimic natural, through a physiology and transcriptomic approach. We discovered that metabolic activity was altered by nitrogen limitation, whereas low temperatures and des-

iccation had a more subtle effect. Furthermore, low temperature hardening stimulated resilience to desiccation and freezing, in contrast to nitrogen deficiency, which intensified the detrimental effect of these treatments. Overall, the experimental strain *Klebsormidium flaccidum* CCALA 1182 demonstrated its ability to acclimate to unfavourable conditions, with constant stress-related gene expression, and highlighted the limited information available about the mechanisms of resistance to freezing stress of this microalga.

Keywords: polar biological soil crusts, desiccation, *Klebsormidium flaccidum*, nitrogen starvation.

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