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ACCUMULATION OF CARBON AND NITROGEN IN VEGETATION AND SOILS OF DEGLACIATED AREA AND MUDBOILS IN ELLESMERE ISLAND, HIGH-ARCTIC CANADA

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Arctic terrestrial ecosystems are important to global carbon (C) balance because of the large C stocks present in soils and the presumed sensitivity of accumulation or loss of soil C and nitrogen (N) to climate change. In the present study, biomass and C and N mass were investigated in the proglacial field of the southern front of Arklio Glacier in the Kreiger Mountains near Oobloyah Bay, Ellesmere Island, Canada. Two spatial scales were adopted for the sampling of vegetation and soil in the high-Arctic site. At the first scale, study plots were established along a line transect from near the glacier snout to the farthest moraines (ca. 4 km apart) to include dry (moraine) and wet (hummock) habitats located on five terrain with different time since glacier retreat. Biomass, C, and N in aboveground and belowground parts of vegetation, surface litter, and soil were measured along this primary succession on the glacier foreland, and the relative effect of age of terrain and moisture condition on the C and N accumulation was examined. Biomass, C, and N in these compartments were generally lower on the moraines and hummocks developed 250-400 years ago (i.e., Little Ice Age) than the older habitats. Besides, N mass in aboveground and belowground biomass and in soil was significantly greater at wetter hummocks than at drier moraines. Principal component analysis suggested two pathways of biomass C and N accumulation in the glacier foreland: xeric and mesic pathways on moraines and hummocks, respectively, which were characterized by the C and N accumulation in aboveground biomass and surface litter and by those in belowground biomass and soil, respectively. These two pathways were similar in that C and N increased rapidly during the early stages of primary succession. At the second scale, we focused on the mudboils as the agent of local disturbance in the vegetation and soil of the glacier foreland. Biomass, C, and N in aboveground vegetation, surface litter, biological soil crust, and surface soil were measured on mudboils, and the effect of the stage of inactivation of mudboils, moisture condition, and relative age of terrain on C and N accumulation was examined. Biomass, C, and N in these compartments were generally increased with the stage of mudboils inactivation. Biomass, C, and N in aboveground vegetation and surface litter were generally greater at xeric than at mesic habitats, whereas those in biological soil crust and surface soil were greater at mesic habitats. The effect of relative age of terrain on C and N accumulation was relatively minor. Biological soil crust was the first to colonize the center of mudboils at which the eruption of fresh mud ceased and contributed to the accumulation of C and N in surface soil. Vascular plants established at the rim first and then at the center, later than biological soil crust, leading to the C and N accumulation in aboveground biomass at later stage of mudboil inactivation, demonstrating the primary succession and concomitant soil development at the scale of less than one meter.