Submitted Abstract

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Abstract

Retreating glaciers, icons of climate change, induce profound geomorphological and hydrological impacts on the surrounding ecosystems. First, glacial shrinkage releases a significant amount of glacial meltwater, thereby increasing aquatic habitats, but above a critical glacier volume, these habitats will be limited. On the other side, the reduction in glacier area leads to both the creation of new terrestrial habitats and the loss of ice habitats. Improving our knowledge on the mountain communities living at the edge of the glacier and our understanding on the processes involved becomes urgent in order to identify and quantify the ecological impacts of glacier retreat and propose mitigating measures. Based on a field-based study (in Ecuador) and a literature-based study (worldwide), we examined the successional pat-terns of aquatic and terrestrial algae, plants, and invertebrates in glacier forelands. Using taxonomical and molecular identification, we sampled and characterised aquatic and terrestrial communities along a gradient of glacial influence and compared the successional pat-terns across multiple taxa. We analysed the effects of both environmental conditions and age since deglacierization on community composi-tion (Pearson's correlation) and compared our field-based tropical observations to the literature-based worldwide observations. In both aquatic and terrestrial habitats, we observed an overall increase in density and diversity with decreasing glacial influence and increasing age since deglacierization. This relationship has been documented worldwide, independently of the altitude and the latitude (mixed-effect models), indicating strong environmental filtering locally linked to the glacial influence. Thus, glacier foreland colonisation in the trop-ics exhibits common characteristics to higher latitudes. However, our random-effect model highlighted significant heterogeneity in the ecological response to glacial influence, which varied across the taxonomic groups, in particular according to their functional traits. Indeed, the pioneer communities observed close to the glacier were mainly composed of environmental specialists (adapted to the harsh glacial habitat, especially to the permanently cold temperatures), feeder generalists (exhibiting flexible feeding strategies), with high dispersal capacity (mainly passive, transported by wind). Thus, while global warming and associated glacier retreat will benefit to generalist species colonising from downstream, thereby increasing the local diversity and productivity of the high altitude ecosystems; the regional diversity will be affected by the loss of species associated to glacier-influenced habitats. Finally, these losses might be accelerated in the tropics where the lack of persistent snowfields precludes cold habitats as well as a supplementary seasonal water supply after the complete disappearance of glaciers contrary to high-latitude regions.