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Environmental controls on C, N and S cycling in plants of the Namib Desert

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Nutrient cycles (C, N and S) in the Namib Desert are investigated through a survey of δ^{15}N, δ^{13}C and δ^{34}S of plant material and soils along a fog gradient. The coastal Namib Desert in southwestern Africa is hyper-arid in terms of rainfall, but receives up to 100 days of fog each year. This climate regime leads to interesting water relations among the desert flora and fauna. Among many enigmatic characteristics, photosynthesis in W. mirabilis has puzzled researchers since the 1970's. Although it is predominantly a C3 plant, δ^{13}C ranges from -17.4 to -24.2 ‰ in natural habitats, and can be as enriched as -14.4 ‰ under artificial growing conditions. Recently the CAM pathway has been confirmed, but it is dominated by CAM-cycling rather than primary CAM fixation, and the driver for CAM utilization has not been identified. Literature values of δ^{13}C are replotted across a 150 km aridity gradient for comparison with new data from Hope Mine, showing a significant correlation that appears to be explained by rainfall (R^2 = 0.25, p<0.001). Within the Hope Mine community, there are significant positive relationships among stem size, N, δ^{13}C and δ^{15}N. The responsible mechanism needs further investigation, but high levels of CAM-cycling and photorespiration along with recycling of N could explain the observed patterns. In addition, there appears to be a reversal of the trend between rainfall and δ^{15}N found in Kalahari C3 plants, as more depleted δ^{15}N values were found closer to the coast.