CHANGE OF ALTITUDINAL VEGETATION ZONES COMPARING PAST AND PRESENT TIME PERIODS IN HIGH ELEVATION MONTANE FOREST AT MOUNT KINABALU, SABAH

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Abstract

This study investigates the changes of altitudinal vegetation zones of the high montane tropical subalpine forest at Mount Kinabalu by comparing upper and lower critical limits of plants in the present time period versus historical accounts. Smith in 1979 did a census of the plants that grew from 3260 meters upwards which is the baseline reference point for this study. Altitudinal vegetation zones are the highest and lowest elevations that a particular species occurs at.

Keywords: Altitudinal vegetation zones, critical altitude, range shift, tropical subalpine forest.

Introduction

One of the potential effects of climate change is an upward elevation shift of habitable zones for thermally sensitive species in tropical mountains, putting them at risk of mountaintop extinctions (Telwala *et al.*, 2013). Mountains are especially susceptible to these events due to having a large amount of biodiversity in a small area, making studying the interaction between vegetation and the environment easier (Kitayama, 1992). Elevation shifts due to climate change has already been proven for Lepidoptera (Chen *et al.,* 2009) and various bird species (Harris *et al.,* 2012) at Mount Kinabalu, which is the tallest mountain in the Sundaland biodiversity hotspot region.

Objectives

1. To assess the current elevation ranges that vegetation are presently occurring at the species level.
2. To find out if there is a range shift in altitudinal vegetation zones that is significant over the past decades.

Methods

A stratified systematic random sampling approach was used. Starting at 4095 m, 10 transects at 100 m intervals to 3260 m was surveyed (Morueta-Holme, *et. al*, 2015). At each 100 m, a horizontal transect was placed out. These transects are 100 m long and parallel to the elevation contour, the plot was based on them with 20 m widths from the transect line. There were three 4x4 quadratic subplots (samples) established at the beginning, centre and end of each plot by using plastic poles, raffia string and tape measures (Morueta-Holme, *et. al*, 2015). Each of the sample frame size measured at 4 m X 4 m. The quantity of subplots per transect line at stratified elevation was three (Figure 1). A paired t-test was run with historical data sourced from an inventory done in 1979 (Smith, 1980).

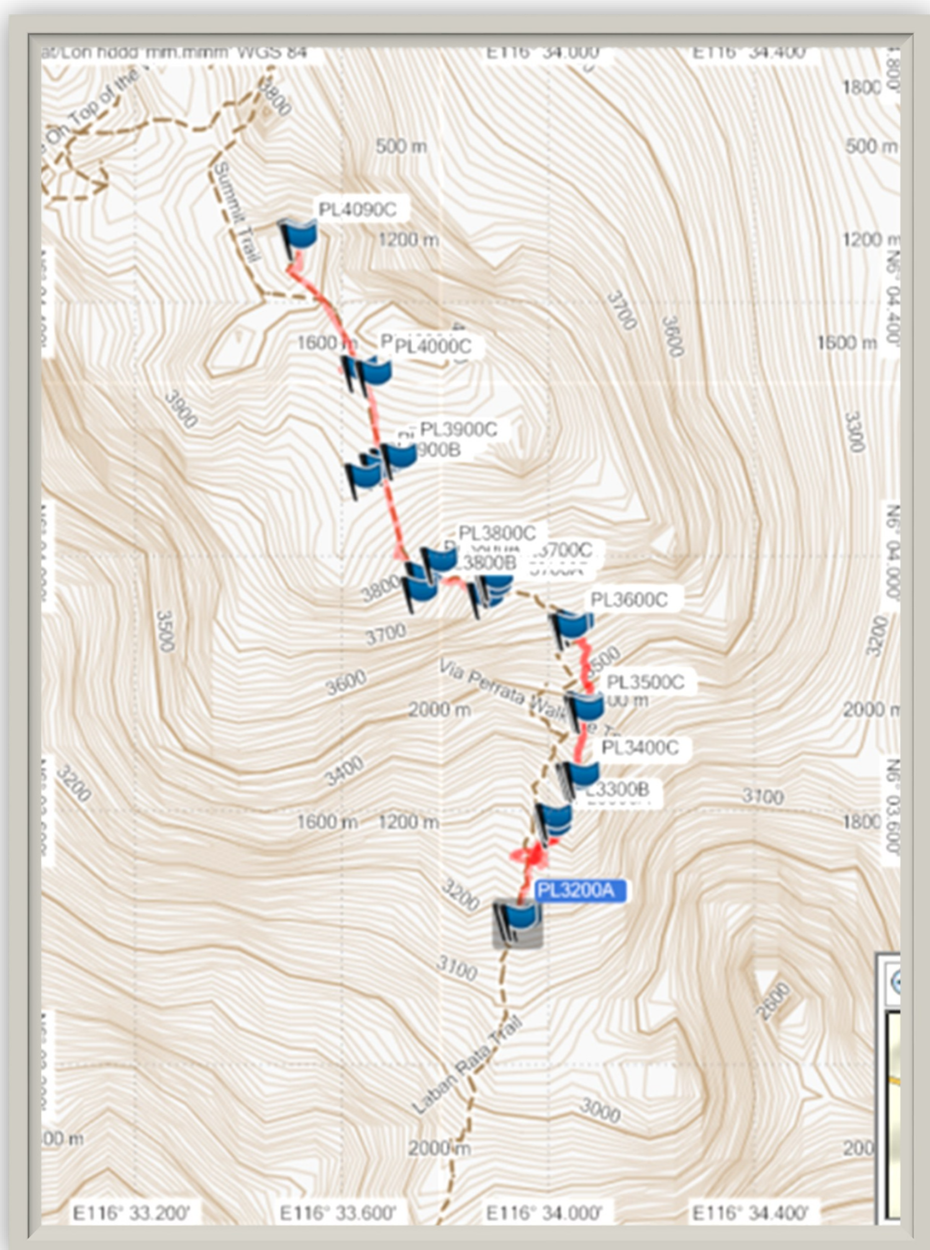

Figure 1: Plots showed on contoured map. (Source: Garmin Basecamp)

Results and Discussion

Out of the 2091 individuals comprising of 59 species, 29 species were selected to be compared with each other (Figure 2). The yellow bars represent historical data while the blue bars represent present data. 9 species are found to be occurring higher than their previous maximum elevation. 24 species have shifted higher than their minimal elevations indicating a range shift upwards. Five species have actually went counter to the expectation of moving up and instead could be found lower than the minimal elevations in Smith's recordings. It is hypothesized that competition at higher altitudes is pushing less competitive species lower down.

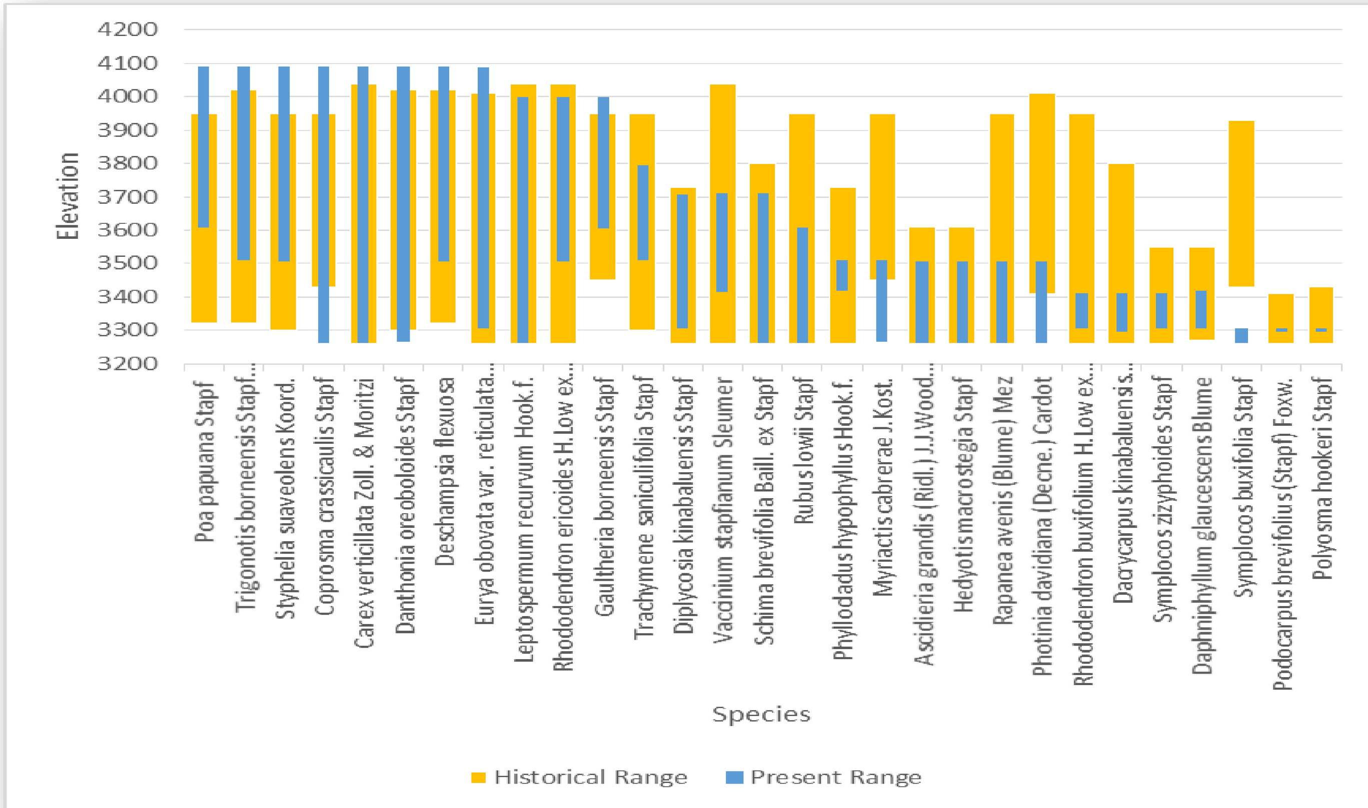

Figure 2: Observable difference in elevations of historical and present time periods.

The mean for the lower boundary shifted from 3300.66 m to 3350.17 m, which is a 49.51 m increase. While the upper boundary mean shifted from 3860 m to 3719.62 m which is a decrease of 140.38 m (Figure 3).

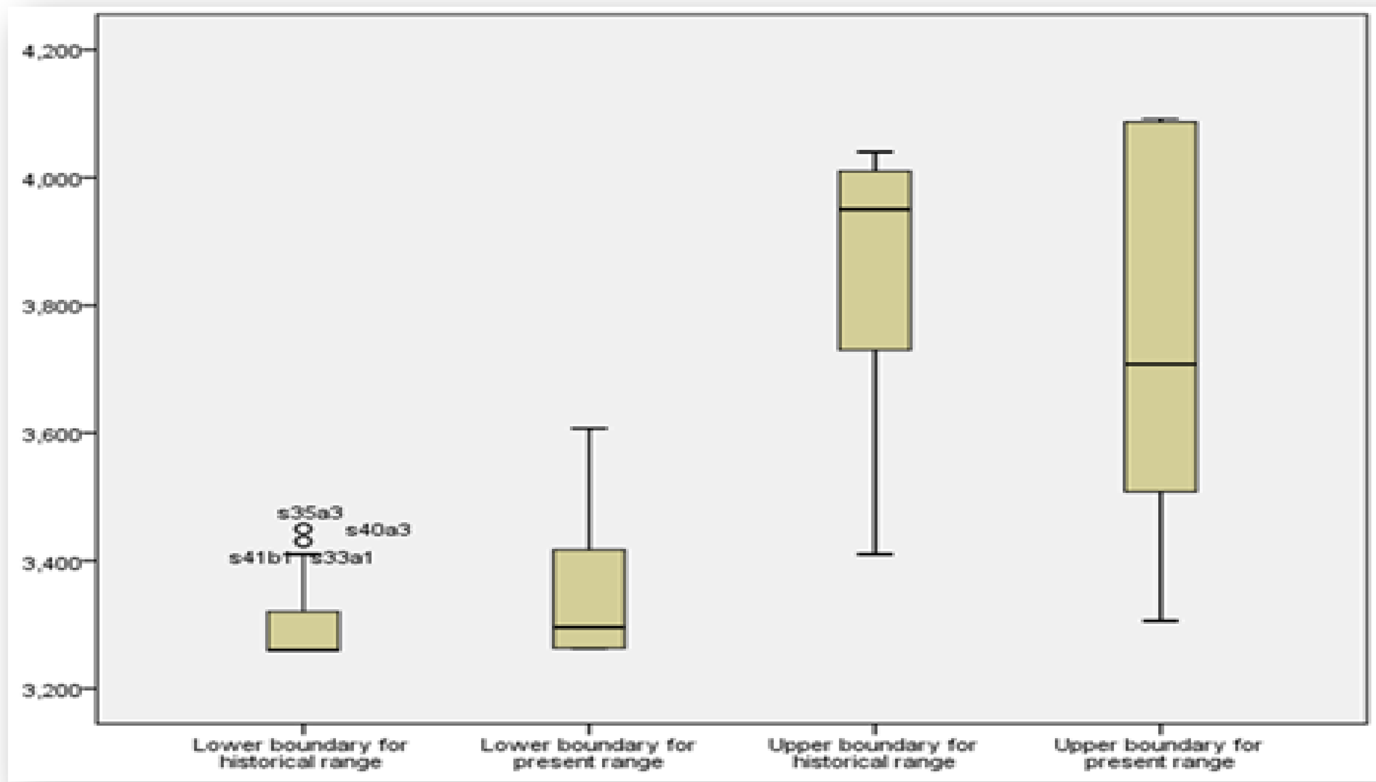

Figure 3: Statistical t-test showing changes in mean of lower and upper boundaries.

Conclusion

Results indicated there is a shift upwards of the lower boundary in the present period (Mean = 3350.17 ± 115.227) compared to that of the historical period (Mean = 3300.66 ± 65.533), t = 2.157, df = 28, p = 0.04 and a decrease in the upper boundary in the present period (Mean =3719.62 ± 299.14) compared to the historical period (Mean = 3860 ± 195.92), t =3.406, df = 28, p = 0.002, for the vegetation surveyed. As a conclusion from the study, it appears that the range shift is significant. The implications of this study suggest that permanent sampling plots (PSP) should be placed into Mount Kinabalu to continue long term monitoring in more detailed measurements as rare and endemic plants are susceptible to mountaintop extinctions threatened by global warming.

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