URAP 2012-2013

The Andean Maize Collection
McCown Laboratory Report #75

Donna Bui and Quyen To Huynh

Objective:

The purpose of this URAP project is to create a searchable database of the Andean Maize Collection housed in the UC Paleoethnobotany lab collected by Christine Hastorf and others from the 1970's into the 2000's. The Filemaker Pro database includes photographs of the various maize types accompanied by specific information about each sample, including collection area, common names, and measurements of the maize's physical characteristics.

Procedures:

First, the maize was photographed with a metric ruler, color scheme, and the corresponding collection number. Each cob was photographed individually. In the case that there were only kernels in the sample, five kernels were placed and aligned across the paper to show the kernel shape and color. The fifth kernel was turned to the side to show the length of the kernel. Each specimen was photographed twice in order to choose the clearest photo. Most of the maize had different sizes and colors but there was internal correspondence within the same variety.

In order to present all of the different maize varieties and their features within one collection sample, we labeled them with A, B, C, D, etc. These letters were chosen arbitrarily but the numbers were labeled from the collection number that Christine Hastorf had given them. For example, maize with the collection number 123 had four different cobs, we would label each cob 123A, 123B, 123C and 123D. This allowed us to show the distinguishing features within the collection sample.

After photographing the maize, the pictures were uploaded from the camera onto the computer and in a FileMaker Pro file. The program allowed us to upload pictures as well as the corresponding data to create a searchable database that can be uploaded to the web and be used to look up any particular maize.

For the purpose of strengthening the database, more information about the maize was recorded to examine the patterns within the collection. The most important features about the maize are: the row number, length, width and kernel color. The row number was determined by counting the rows on the cob starting from the midpoint. Unlike North American corn, the maize from South America does not often have distinct linear rows. Our technique to determine row number is to follow the kernels as best as was possible. Each cob was counted twice to ensure we would had the most accurate number. The length and width of the maize were measured using a metric ruler. The length was measured from the tip of the ear to the base of the ear, so the stems were not included. Since the width may vary throughout the ear of the maize, we measured the width at the midpoint of the ear. After measuring each cob in the maize collection, we inputted all of these measurements into FileMaker Pro and exported them into MS Excel in order to formulate graphs and see if any interesting patterns would arise.

The graphs were formulated to see if there are distinguishing patterns about row number, length and width within the collection. First, we made graphs that showed the length, row number and width variability over the South American countries. Afterwards, we wanted to show the patterns within the collection. To further unpack the data, we looked at the maize data by individual country to show how the length, row number and width changed within different collection regions. With this intention, we wanted describe the maize collection as much as possible to see the distinguishing characteristics that the South American variety has to offer.

As of January 2013 there are 222 maize samples in the McCown lab collection. Ninety-nine samples were collected in Peru, 94 from Bolivia, 6 from Argentina, 3 from Brazil, 2 from Chile and 18 from the US, but mainly from the USDA Andean collections (Figure 1).

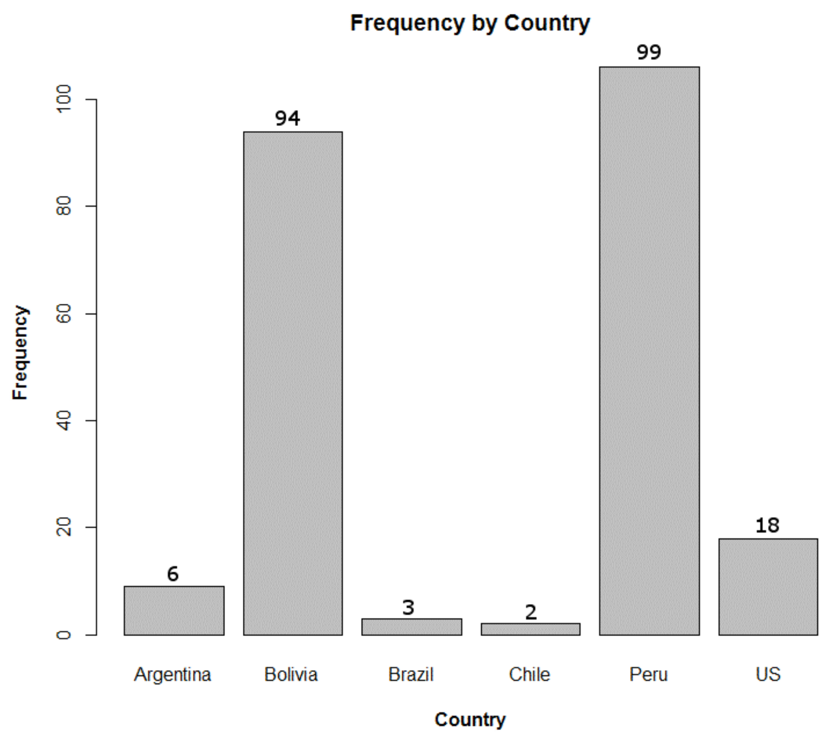

Figure 1.

The width and length of the cobs were measured, but do not demonstrate any thing noteworthy from the collection (Figures 2 and 3).

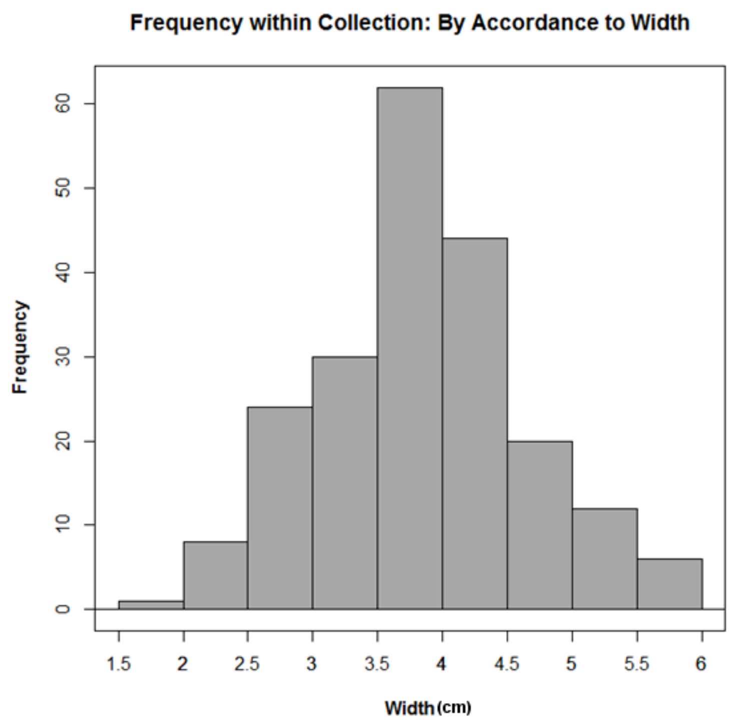

Figure 2.

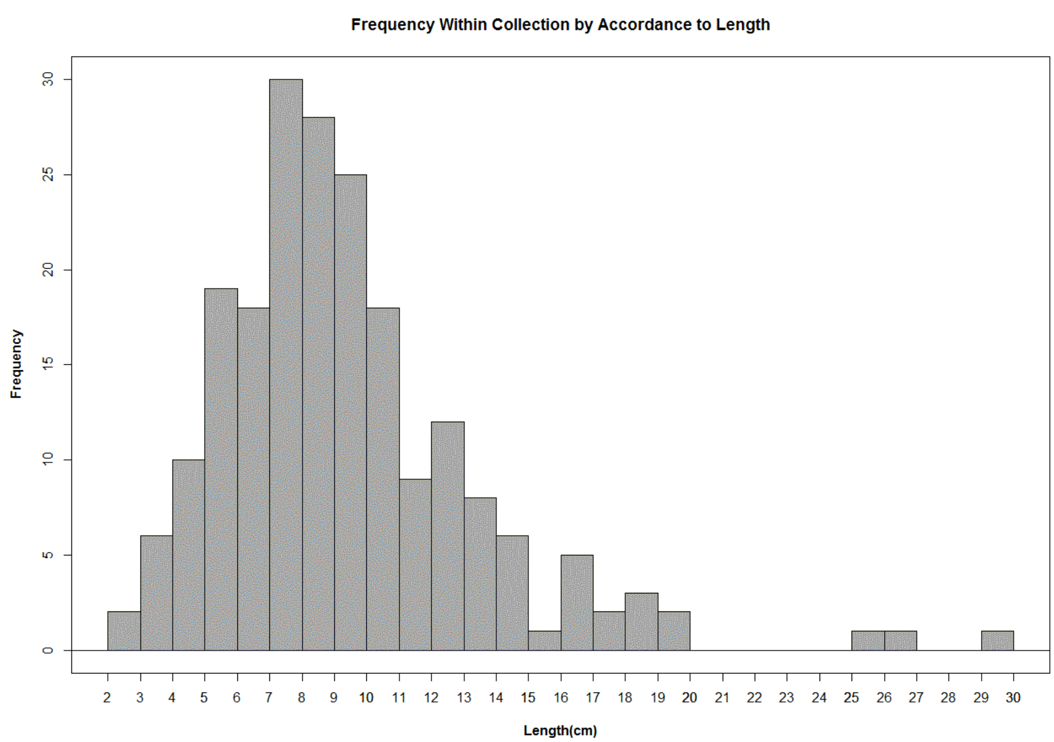

Figure 3.

The dates of collections were also helpful in understanding the lineages of the maize. The collection dates range from 1977-2010 (Figure 4), linked to Hastorf's times in South America.

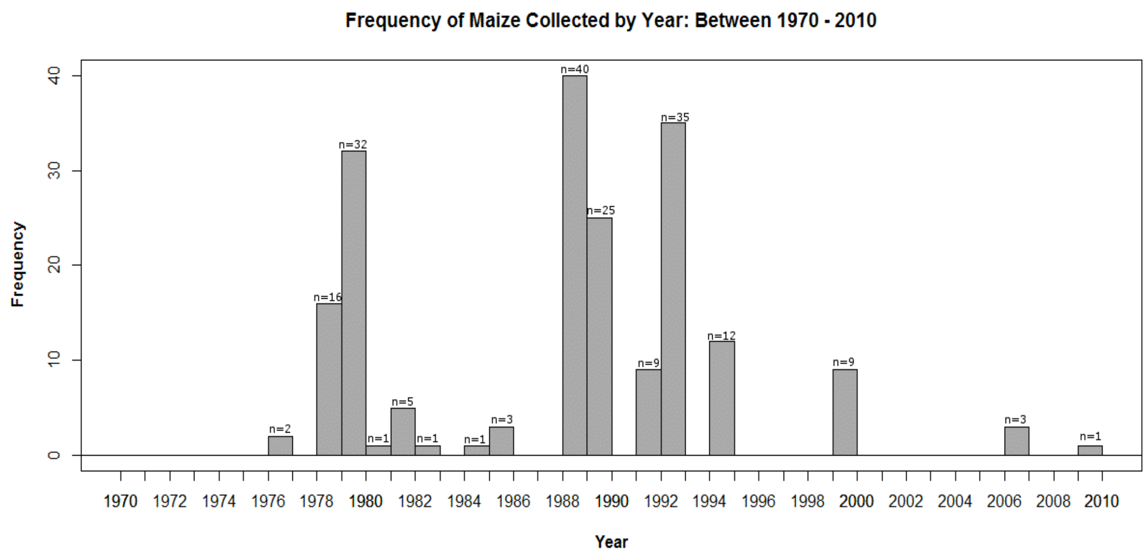

Figure 4.

The following graphs we found useful.

Especially interesting is the row number information. Overall we see a wide range of row numbers across the collection, from 8 to 24 (Figure 5). Looking at these same data by country in a box and whiskers graph (Figure 6), we can begin to see regional traits in the row number, although the collection is not a systematic on from any country, but rather based solely on where Hastorf traveled and worked. The Peruvian and Bolivian maize is primarily from the highland regions which clearly show low row numbers, whereas the Brazilian maize is Amazonian and has very high row numbers.

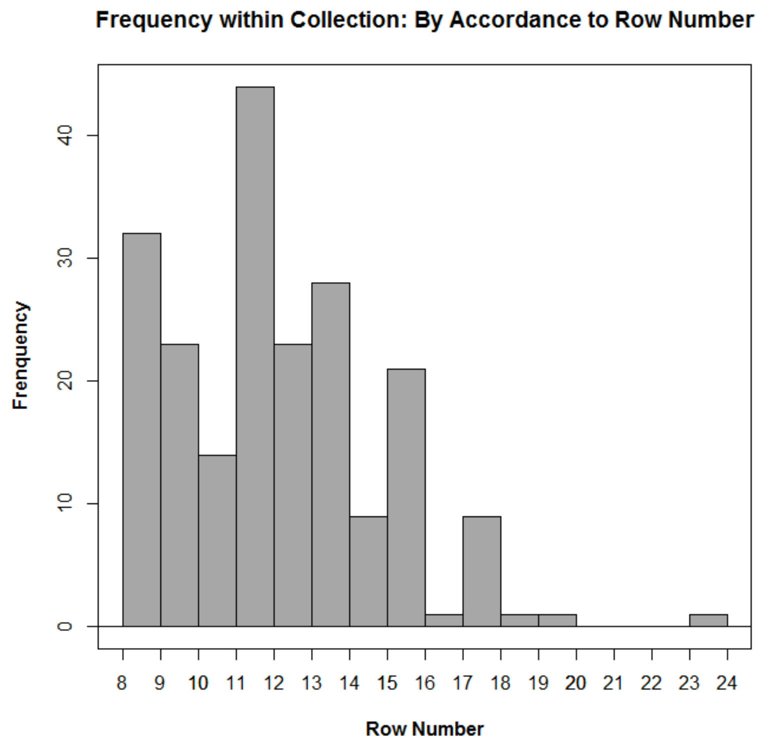

Figure 5.

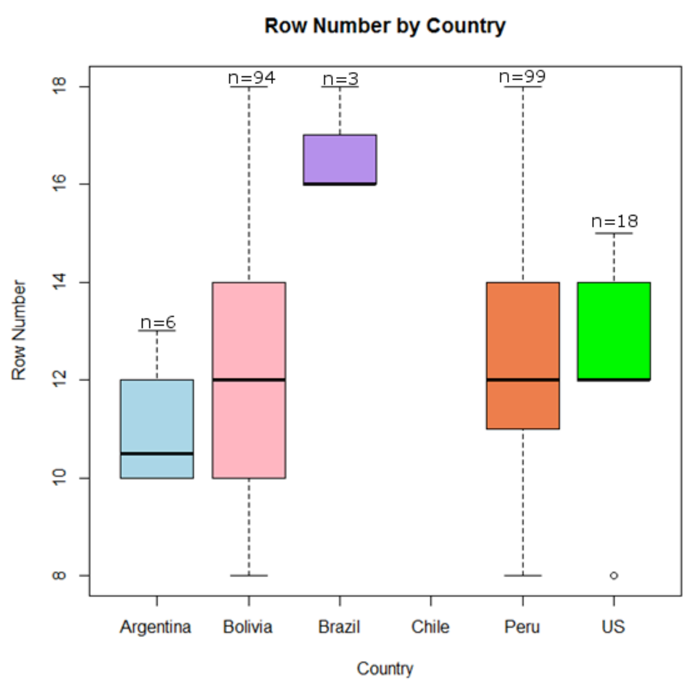

Figure 6.

Further looking at the variability within each country the following two box and whiskers graphs show from where the maize came from within the countries of Peru (Figure 7) and Bolivia (Figure 8). Again higher row numbers are from warm eastern slopes regions (Uchubamba). The only region that stands out is the maize row number from the Isla del Sol in the Titicaca Lake, Bolivia. Why does it have maize with such high row numbers, especially when comparing that to Chiripa also from the same region? Did the Inka bring high row numbers to the lake a long time ago, or do the residents trade to the eastern Amazon regularly? Some of these locations have markets that sell maize from a range of locations, making those locations less tied to the actual place and elevation. In Peru these are Cusco, Huancayo, and La Molina. In Bolivia the markets where maize was purchased is in Tiwanaku and La Paz.

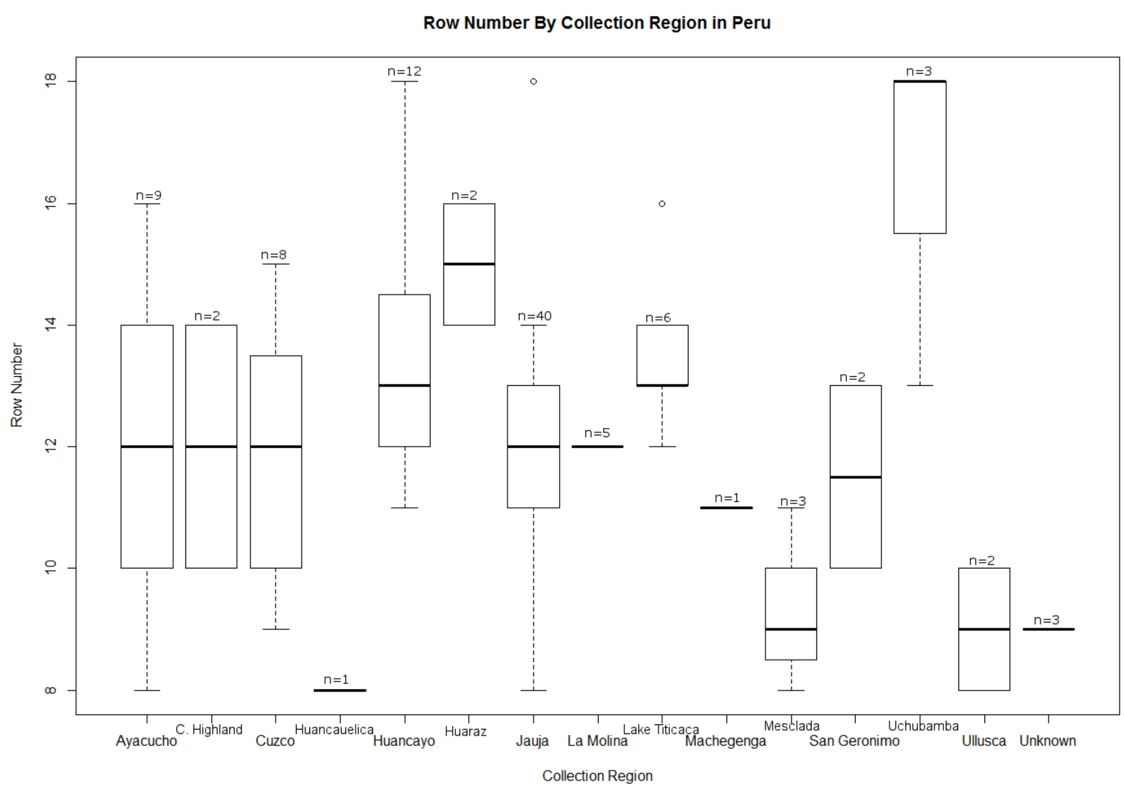

Figure 7.

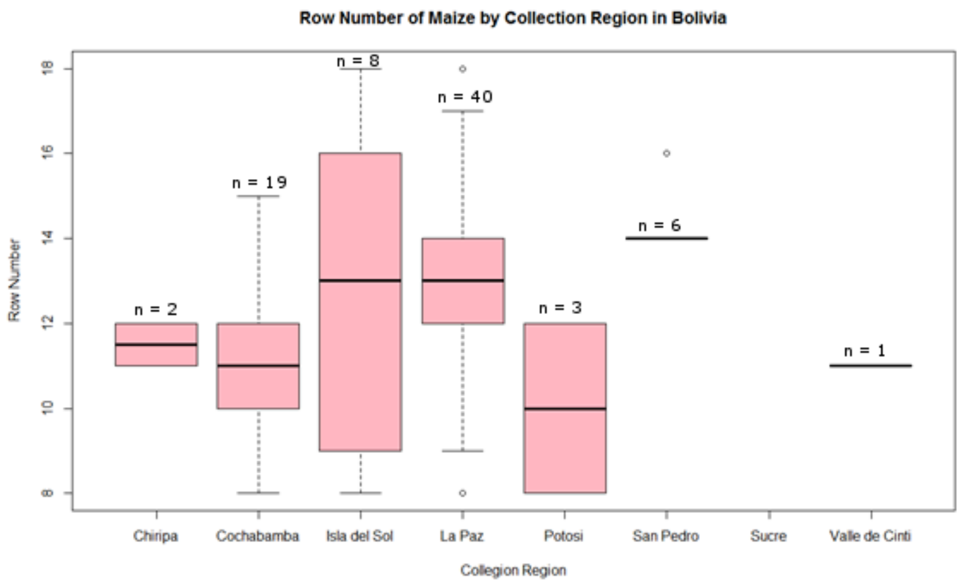
Row Number of Maize by Collection Region in Bolivia
Row Number
Collegion Region
Chiripa
Cochabamba
Isla del Sol
La Paz
Potosi
San Pedro
Sucre
Valle de Cinti
n = 2
n = 19
n = 8
n = 40
n = 3
n = 6
n = 1
8
10
12
14
16
18

Figure 8

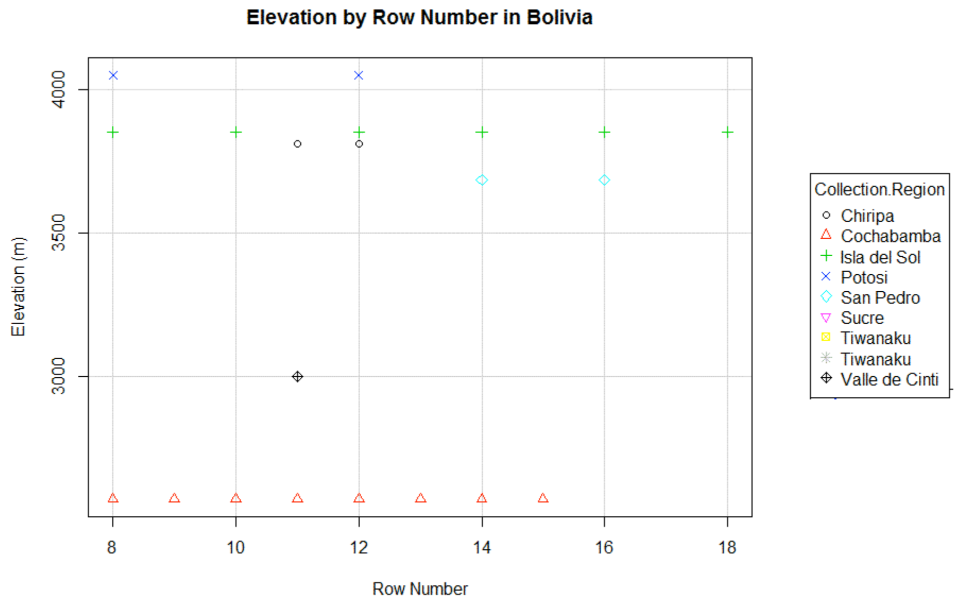

Figure 9
Maize does not grow in Tiwanaku (La Paz, Bolivia), so the maize collected in Tiwanaku came from a market. We could not provide elevation for this maize due to the fact that we do not know where these maize varieties were grown. However, the elevations for the other locations are provided in order to show if there are any interesting patterns. Figure 9 shows that there is no relation to row number and elevation with the maize collected from Bolivia.

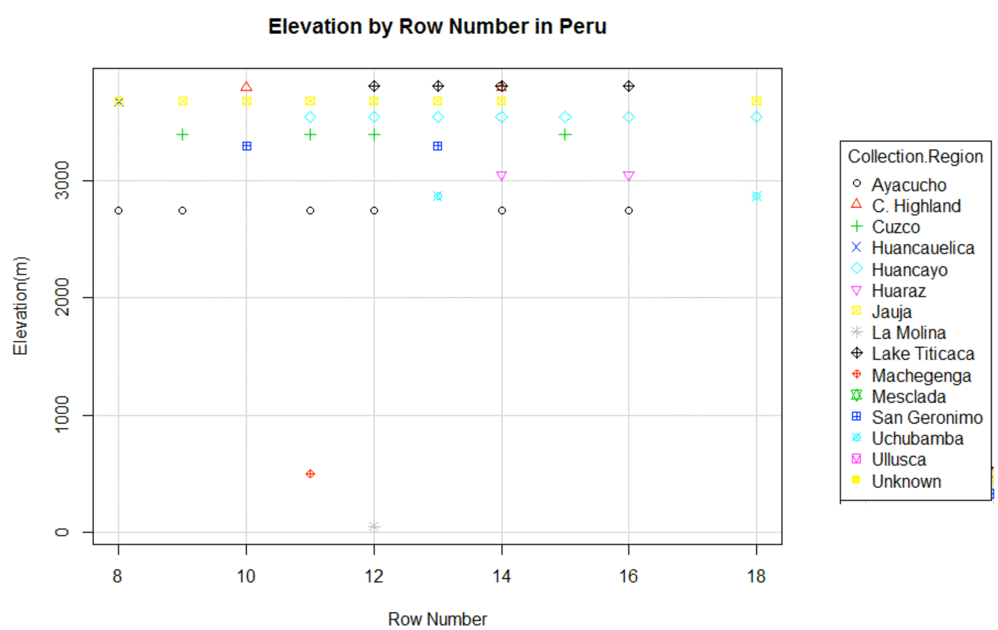

Figure 10
Similarly to Figure 9, Figure 10 also shows that there is no relation to row number and elevation with the maize collected in Peru.

The final plot is to see if the size of the cob varies with elevation and yield is often thought to do so, the higher one goes the less productive the yield. If we assume that length is a general indicator of the overall size of the cob and therefore the amount of kernels available, Figure 11 shows us little relationship to length and elevation in Peru and Figure 12 in Bolivia.

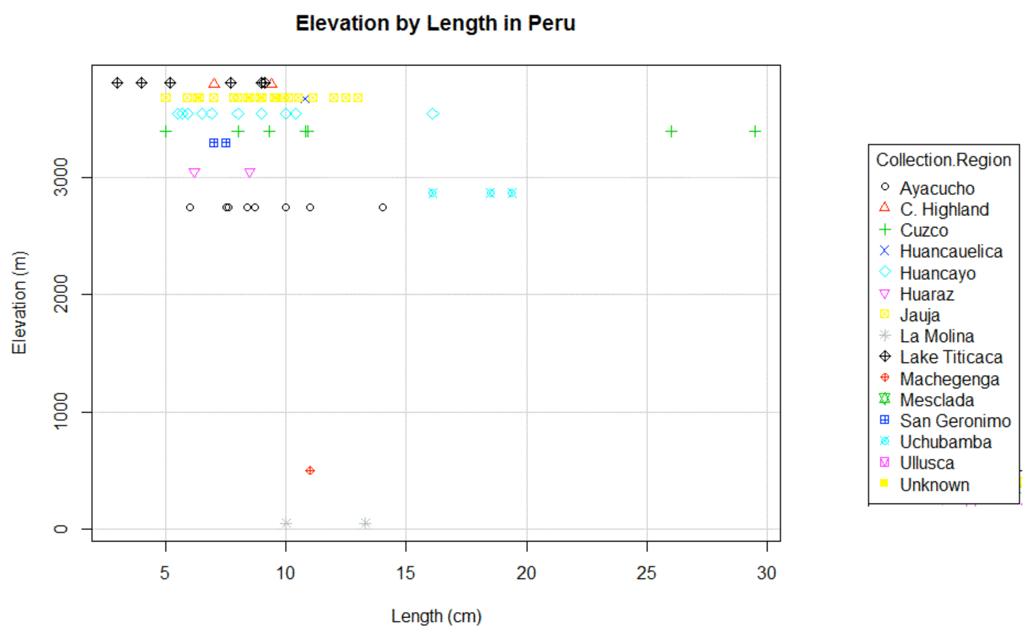

Figure 11

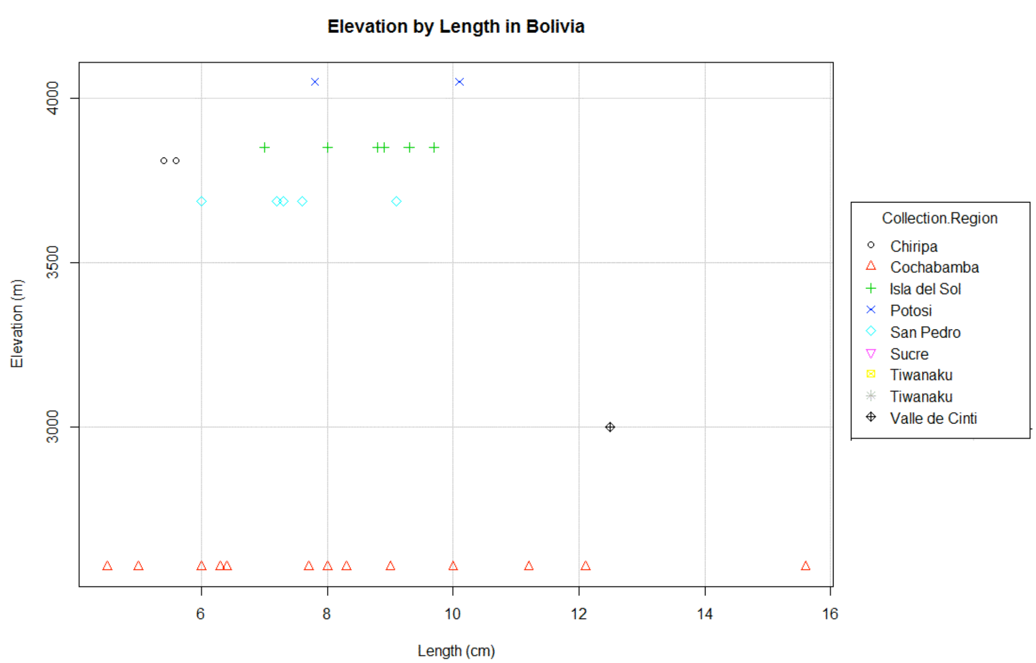

Figure 12

These two graphs do, however, point out how different some of the Cusco maize is from all of the other Peruvian and Bolivian varieties, These extra long types clearly were heavily selected for length and perhaps have been interbred with the Amazon types where more hybrids are grown.

Acknowledgements

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References:

Add races of maize in Peru.

Brieger, F.G. et al. 1958. *Races of Maize in Brazil and Other Eastern South American Countries.* National Academy of Sciences – National Research Council, Publication 593.

E., Ricardo Ramirez et al. 1960. *Races of Maize in Bolivia*. National Academy of Sciences – National Research Council, Publication 747.

Grobman, A et al. 1961. *Races of Maize in Peru.* National Academy of Sciences-National Research Council, Publication 915.

Johannessen, S. and Hastorf, C. 1994. *Corn and Culture in the Prehistoric World.* Westview Press, Inc.