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ABSTRACT BOOK

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Diet and habitat of *Mammuthus columbi* (Falconer, 1857) from two Late Pleistocene localities in Central Western México

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In México, there are few studies with stable isotopes of carbon and oxygen and dental microwear for inferring diets and the habitat of fossil mammal populations, while in the World there are some studies assaying together the two methods. It is considered that it could be important to apply both two methods to complement the information obtained in each case.

This study aims to infer the diet and the habitat of mammoths from La Cinta-Portalitos (LC-PT) and La Piedad-Santa Ana (LP-SA) (Michoacán-Guanajuato, Mexico), using those two methods.

La Cinta-Portalitos is located on the northern side of Cuitzeo Lake within the coordinates 20 ° 05 '09 "N. and 101 ° 09 ' 31 "W. La Piedad-Santa Ana is located on the banks of the Lerma River, within the coordinates 102 ° 02'-102 ° 54 ' N and 20 ° 23' -20 ° 19 ' W. The distance between each other is approximately of 94.33 km (Fig. 1)

For the isotopic analysis, of *M. columbi*, 6 from LC-PT and 5 from LP–SA were used. A sample of 40 to 50 mg of enamel per molar was extracted and were treated using the method proposed by Pérez-Crespo et al. (2011) Finally samples were sent to the Institute of Geophysics (UNAM) to obtain the isotope ratios. A Chi square test (X2) was performed to compare values between localities. An analysis of variance (ANOVA) and a Tukey-Kramer test were assayed to compare the values with populations of *M. columbi* from localities in the USA (Koch et al., 1998; 2004) and Mexico (Pérez-Crespo et al., 2012). To infer habitat preferences, it was used a model proposed by Feranec and MacFadden (2006).

For samples of dental microwear, epoxy molds of 3 M3 from LP-SA and 3 M3 of LC-PT were made, following the methodology proposed by Solounias and Semprebon (2002) and Rivals et al. (2012).

Stable Isotopes: It is observed two individuals as grazers and four as mixed feeders in LC –PT and the five from LP -SA

Table 1. Isotopic ratios for Mexican *Mammuthus columbi* from LP-SA and LP-SA

| Catalog number | Locality | δ ¹³ CVPDB (‰) | δ ¹⁸ OVPDB (‰) | %C4 | |
|-------------------|----------|------------------------------|------------------------------|-------------|--|
| CPOEI 282 | LP- SA | -5.752281275 | -7.735903393 | 44.9847915 | |
| CPOEI 283 | LP- SA | -4.266389308 | -5.955051537 | 54.89073794 | |
| CPOEI 284 | LP- SA | -4.23427621 | -6.506577877 | 55.10482527 | |
| CPOEI 285 | LP- SA | -4.089704299 | -5.796894178 | 56.06863801 | |
| CPOEI 286 | LP- SA | -3.765321602 | -6.029544624 | 58.23118932 | |
| UM 725 | LC-PT | -4.600491469 | -4.233540322 | 45.07462422 | |
| UM 726 | LC-PT | -4.351646437 | -5.491840265 | 52.66339021 | |
| UM 52 | LC-PT | -3.359162787 | -5.634308414 | 54.32235709 | |
| UM 8 | LC-PT | -4.117273635 | -3.814803036 | 60.93891475 | |
| UM 9 | LC-PT | -1.050066658 | -4.804263072 | 55.88484243 | |
| UM 148 | LC-PT | -2.131919215 | -4.245966467 | 76.33288895 | |



Fig. 1. Location of LC-PT and LP-SA.

as mixed feeders (Table 1). The Chi square test (X2) with δ^{13} C showed no significant differences between populations (X2=0.9924, DF=1, Prob> X2=0.3191). However, for the values of δ^{18} O there are significant differences (X2=6.9736, DF=1, Prob> X2=0.0083).

The ANOVA and Tukey-Kramer showed no significant differences in δ^{13} C values between populations from localities in the USA and Mexico (ANOVA Prob>F=0.00161) and it was observed significant differences in δ^{18} O values (ANOVA Prob>F=0.0001). The results shows that both LC–PT and LP-SA populations preferred open habitat areas (Fig. 2). Dental microwear analysis shows that the populations of M. columbi are grazers in both sites (Table 2; Fig. 3)

The results of isotopic analyses show both grazers and mixed organisms. Grazers individuals have a high percentage consumption of C4 plants at 69% and 76% for LC–PT and LP-SA, respectively. In addition, no significant differences in diet between populations of *M.columbi* in both study areas were observed, showing on average a mixed diet and a habitat preference for open areas. However, the δ^{18} O values show significant differences between both study areas and localities of Mexico and the United States, perhaps this may be because the source of water supply and weather conditions were different.

Analysis of dental microwear reveals that populations were grazers, with not differences between them. When comparing the results of both techniques it is observed that the isotopic ratios also reveal a high percentage of consumption of C4 plants so we can conclude that these populations of M. columbi were mixed feeders with a tendency to be grazers, since the dental microwear shows the characteristics of the last meal of the animal (Rivals et al., 2012)

The populations of *Mammuthus columbi* from La Piedad -Santa Ana and La Cinta- Portalitos were mixed feeders with a tendency for grazing, and an habitat preference for open areas, so both localities had both grassland and forested areas during the late Pleistocene.



Fig. 2. Isotopic ratios of *M. columbi* from LC-PT (red diamond), LP-SA (green triangle), USA (black circle), and México (blue circle); and organisms that lived in closed areas (black square) (*Mylohyus, Mammut, Tapirus,* and *Odocoileus*).



Fig. 3. **A**, Average pits and scratches of browser, Mixed feeder and grazer organisms (Solounias and Semprebon 2002; Rivals et al.2012). **B**, Percentages of organisms within 0 and 17 scratches per area.

Table 2. Average values of the populations of each locality.

| | | - | | | | | | | | |
|----------|---|-----------------|----------------------|----------------------|-----------------|-------------|---------------------|-----------------------|----------------------|-----------|
| Locality | N | Average pits | Average scratches | % Cross scratches | % Large Pits | % Gouges | % Fine Scratches | % coarse Scratches | % Mixed scratches | % 0-17 |
| LC-PT | 3 | 13.67 | 26.67 | 100 | 0 | 100 | 43.75 | 16.25 | 40.00 | 0 |
| LP-SA | 3 | 14 | 24.67 | 100 | 0 | 0 | 48.65 | 18.92 | 32.43 | 0 |

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