5.3 One-Way ANOVA Results

A one-way ANOVA test was performed to see if there were any statistical differen between the means of the adolescents, young adults, and middle adults, for each feature ex puncture pits and hypercoarse scratches. This test cannot be used for determining the diffe between sexes because it requires three or more groups to compare. One-way ANOVA ass that the dental microwear features are equal for all age groups. By looking at the significa values for the test of homogeneity of variance (Table 5.4) this can be determined, and the can be validated. All of the significance values for the dental microwear features analyzed not violate the assumption of homogeneity of variance because the p- values are greater th 0.05 ($p > 0.05$) as assessed by Levene's Test of Homogeneity of Variance. Next it was determined that there was no significant between-group variation as noted by the ANOVA significant values (Table 5.4). Because these values are not less than 0.05 ($p < 0.05$) the be group variation is not statistically significant. The Tukey post- hoc test can be used when t assumption of homogeneity of variance is not violated and to compare all possible combi of group differences. It was found that any increase or decrease in the number of features between age groups for all features were not statistically significant. For example, the incr small pits from adolescents to young adults was an increase of 0.00263 (95% CI, -0.3860 0.3912) was not statistically significant ($p = 1.000$). Also the decrease in small pits from y adult to middle adult, a decrease of -0.138, (95 CI, -0.5173 to 0.2422) was not statistically significant ($p = 0.620$).

Table 5.4

Significance values for One-Way ANOVA Test

	Homogeneity of Variance	ANOVA
Features		
Small Pits	0.247	0.526
Large Pits	0.428	0.291
Total Pits	0.817	0.698
Fine Scratches	0.125	0.359
Coarse Scratches	0.847	0.910
Total Scratches	0.124	0.804

5.4 Two-Way ANOVA Results

A Two-Way ANOVA was used to compare the means of the dental microwear features between both the age groups and sex. This ANOVA only requires two or more groups for the independent variable (age group and sex). Ultimately this test is used to determine if there is any interaction between the independent variables and the microwear features. First, homogeneity of variance was concluded with Levene's Test of Equality of Error Variances. Homogeneity of Variance was met for all features because the significance values (Table 5.5) were not statistically significant ($p > 0.05$). The second set of significance values in Table 4.6 represents the interaction effect (agecategory*sex). There was no statistically significant interaction because the p- values were greater than 0.05. This means that any effects that sex had on dental microwear was not dependent on age, and any effects that age had on microwear was not dependent on sex.

Table 5.5

Significance values for Two-Way ANOVA Test

	Homogeneity of Variance	agecategory*sex
Features		
Small Pits	0.223	0.946
Large Pits	0.069	0.276
Total Pits	0.098	0.550
Fine Scratches	0.122	0.373
Coarse Scratches	0.454	0.995
Total Scratches	0.080	0.145

5.5 Mann Whitney U Test Results

A Mann Whitney U Test determines the differences between two independent groups (in this case sex) based on dependent feature (in this case puncture pits or hypercoarse scratches). The overall distribution does not need to be normal for this test, but the distribution of the traits within the male group and female group do need to be normally distributed. The results show that the distribution of small pits, puncture pits, fine scratches, coarse scratches, hypercoarse scratches, and total scratches was the same for males and females (see Table 5.3). Large pits and total pits were not similarly distributed for males and females.

5.6 Principal Component Analysis

A principal component analysis (PCA) is used to remove any unrelated variables, reduce redundancy, and reduce a large set of variables into smaller ones that explain any variation. This

analysis was first run on all of the data (n =41), and the correlation table (Appendix D) was analyzed to determine if a PCA was appropriate for the data. The correlation table revealed that all features were strongly correlated ($r \geq 0.3$) with the axes CPC1 and PC2, except puncture pits. Puncture pits were eliminated from the analysis, and the test was executed again to obtain more accurate results with a Kaiser- Meyer- Olkin (KMO) test. This test is a measure of sample adequacy, and looks for linear relationships to determine if a PCA is relevant for data since PCA assumes there is a linear relationship. The KMO test had a value of 0.161. This test needs minimally to have a value of 0.6 or higher to run a PCA, thus a PCA cannot be run for this data set.

5.7 Association between Occlusal Microwear and Macrowear Patterns

Turner (2008) found marked variation in occlusal macrowear, using coding standards from Buikstra & Ubelaker (1994). Some individuals had significant wear with loss of occlusal enamel and had the formation of secondary dentine. This variation in concert with isotopic variation suggests that macrowear represents diet-induced wear prior to relocation to Machu Picchu. Therefore a Spearman correlation test was used to see if macrowear patterns have any association with microwear patterns, and to see if previous wear has any effect on the progression of microwear patterns. Like a PCA the correlation test also assumes a linear relationship. Macrowear, carious lesions, and abscesses were compared with each dental microwear feature in a scatter plot to determine linear relationships. None of these scatter plots resulted in a significant linear relationship, and the Spearman correlation test confirmed this with weak correlation coefficients. The only relationship that had a significant correlation was hypercoarse scratches and abscesses, but the correlation was not strong ($r_s = 0.420$, $p = 0.009$).

5.8 Associations between Microwear Patterns and Isotopic Data

Turner and colleagues (2010) compared dentine and bone collagen $\delta^{13}C$ and $\delta^{15}N$ in a subset of the Machu Picchu population. The sample size started small (n=13) because of very different sampling strategies, and the fact some of the bone study sample did not have sufficient dentition for the tooth study. Based on comparison Turner and colleagues (2008) tentatively suggest a shift toward a diet that included more maize. Out of the thirteen individuals only nine were available for dental microwear analysis. The nine individuals did not have a normal distribution, and the only way to achieve normal distribution would be removing an outlier. Performing any tests that required an independent variable (age or sex) would reduce the sample size further; therefore only a Spearman's correlation test was performed on these data. All of the microwear except fine scratches and total scratches did not have a significant correlation. Fine scratches had a strong positive correlation ($r_s = 0.856$, $p = 0.007$), and so did total scratches ($r_s = 0.846$, $p = 0.008$).

A Spearman's correlation test was also run on 13 individuals who had strontium values that suggested they were originally from the coast and 5 individuals who had oxygen levels that suggested they were from the highlands (Turner et al. 2009). None of correlations were strong between strontium values and dental microwear features; all correlations coefficients were below 0.4. None of the correlations were found to be significant. The correlations between oxygen isotopes and microwear features (Table 5.6) were all negative except for large pits. Small pits, total pits, fine scratches, coarse scratches, and total scratches have strong negative correlations, but total number of pits was the only feature that was significant.

Table 5.6

Spearman's correlation test for oxygen isotopes and dental microwear features

	Correlation Coefficients	p- value
Features		
Small Pits	-0.700	0.188
Large Pits	0.000	1.000
Puncture Pits	-0.224	0.718
Total Pits	-0.975	0.005**
Fine Scratches	-0.718	0.172
Coarse Scratches	-0.564	0.322
Hypercoarse Scratches	-0.354	0.559
Total Scratches	-0.600	0.285

** significant

CHAPTER 6: CONCLUSIONS AND FUTURE RESEARCH

6.1 Findings

This study's goal was to better understand the consumption patterns of the *yanacona* and *acllacona* in the population from Machu Picchu, and how maize was incorporated into their diets. The role of maize in diets of these individuals is complicated. These individuals do not have an increased number of large pits and scratches that has been associated with maize consumption in previous studies (Organ et al. 2005, Teaford and Lytle 1996). However, the previous studies only investigated the effects of maize that had abrasives introduced to it during preparation. Organ and colleagues (2005) found an increased number of small pits as well, but their isotopic analysis did not see values associated with maize. The overall isotopic trend at Machu Picchu (Turner 2008) points to a significant increase in maize consumption later in life, and historical records and other archaeological analyses of Inca cultures describe maize being a large component of the diet. Maize consumption in this area has not been linked to grinding stones, but mainly to other forms such as, *chicha*, *mote,* and hominy. Microwear features were also compared for the individuals that had $\delta^{15}N$ values. Fine scratches and total number of scratches have a positive correlation with $\delta^{15}N$ values. It can be concluded, based on isotopic analysis, that this population from Machu Picchu was eating maize, and it was not eaten in a form that included abrasives from grinding stones. Also, the type of maize being consumed was not abrasive due to the increased number of fine scratches as nitrogen values increase, and the frequency of small pits being higher than any other microwear feature. The correlation between strontium and oxygen isotopes and dental microwear features remains unclear. Oxygen isotopes and total pits was the only correlation that was significant and it was a strong negative correlation.

The ANOVA test found there was no significant variation in dental microwear traits between males and females except for puncture pits and hypercoarse scratches. The Mann Whitney U test also found that hypercoarse scratches and puncture pits show no significant variation between males and females. This means the microwear features point to diets with similar components for both males and females. If there was any labor division based on food preparation it did not seem to affect the diet of the individuals based on microwear. Differential access to a non-abrasive dietary source, such as *chicha,* is unknown since the type of microwear this drink leaves behind, if any, is also unknown. This trend of no variation in diet is also seen when microwear is compared between different age groups. Any increase or decrease in the frequency of traits between age groups was not considered significant. Therefore there was no differential access to food based on age. It would seem that even though these non- elite individuals had a varied dietary background presumably before arriving at Machu Picchu (Turner et al. 2010), their diets all became similar due to their similar social context.

Macrowear (attrition, carious lesions, abscesses, etc.) should be considered when analyzing microwear. Schmidt (2009) found a correlation between macrowear and scratch width, and found that larger scratches result in the removal of more enamel compared to pits. In the Machu Picchu population there was a significant positive association between hypercoarse scratches and abscesses, but not for any other features. These results confirm Schmidt's (2009) findings that an increase in scratches can lead to an increase in macrowear features, in this case abscesses, but pits cannot.

6.2 Future Research

The research presented here provides some additional insight into dietary patterns of the Machu Picchu individuals and contributes to the understanding of dental microwear in bioarchaeological populations. Additional research would benefit this and other studies. Teaford and Lytle's (1996) experimental study has been pivotal in this and other research, which tries to understand the relationship between maize and dental microwear. Additional experimental studies on maize in various forms of preparation (*mote*, hominy, *chicha*) would provide insight into the exact type of microwear left behind; and allow for even more specific conclusions about not just maize being consumed, but in what form. Continued analysis of the variation in microwear should be done to see if the pattern of no differences in diet between sexes and age groups is exclusive to Machu Picchu, administrative centers, or non-elite populations, etc.

6.3 Conclusion

Human subsistence patterns are an important aspect of the reconstruction of past human lifeways (Grine 2007, Turner et al. 2010), and this multi-faceted analysis of a skeletal sample provides continued opportunities for testing and evaluating to confirm or negate previous analyses. Augmenting analyses is an integral component of scientific analysis, which is not always done due to funding and time constraints. This study contributes to better understanding the application of dental microwear analysis in the study of bioarchaeological populations, where only a limited amount of research has been focused on this topic. It also demonstrates the importance of using microwear, macrowear, and isotopic analyses together to complement each other. By utilizing multiple analytical methods more specific conclusions about what individuals ate in the past can be made.

REFERENCES

Baker G, Jones LHP, and Wardrop ID. 1959. Cause of wear in sheep teeth. *Nature*. 184:1583-4.

Bartolomé de las Casas. 1939 [1552]. Las antiguas gentes del Perú. Colección de Libros y Documentos Referentes a la Historia del Peru, Tomo XI. Lima: Liberia e Imprenta Gil, S.A.

Bingham H. 1979 [1930]. Machu Picchu: Citadel of the Incas. New York: Hacker Art Books.

Bordieu P. 1973. The Berber House. *In* Rules and Meanings. M Douglas ed. Harmondsworth: Penguin Books, Pp 98-110.

Bray TL. 2003. Inka pottery as culinary equipment: food, feasting, and gender in imperial state design. *Lat Am Antiq*. 14: 3-28.

Buikstra JE, Ubelaker DH. 1994. Standards for Data Collection from Human Skeletal Remains. Fayetteville, Arkansas: Arkansas Archaeological Survey Report Number 44.

Burger RL.1989. An overview of Peruvian archaeology (1976-1986). *Annu Rev Anthropol*. 18: 37-69.

---- 1992. Chavin and the Origins of Andean Civilization. London: Thames and Hudson.

---- 2008. Scientific insights into daily life at Machu Picchu. In *Machu Picchu: Unveiling the Mystery of the Incas*. RL Burger and LC Salazar, eds. New Haven, CT: Yale University Press.

Burger RL, Lee-Thorp JA, and Van der Merwe NJ. 2003. Rite and Crop in the Inca State Revisited: An Isotopic Perspective from Machu Picchu and Beyond. In *The 1912 Yale Peruvian Scientific Expedition Collections from Machu Picchu*. RL Burger and LC Salazar, eds. New Haven: Yale University Publications in Anthropology, Pp. 119-137.

Chepstow-Lusty AJ, Bennett KD, Fjeldsa J, Kendall A, Galiano W, and Tupayachi-Herrera A. 1998. Tracing 4,000 Years of Environmental History in the Cuzco Area, Peru, From the Pollen Record. *Mt Res Dev.* 18: 159-172.

Chepstow- Lusty AJ, Frogley MR, Bauer BS, Bush MB, Herrera AT. 2003. A late Holocene record of arid events from the Cuzco region, Peru. *J Quaternary Sci*. 18(6): 491-502.

Covert HH, Kay RF. 1981. Dental microwear and diet- implications for determining the feeding behaviors of extinct primates, with a comment on the dietary pattern of *Sivapithecus*. *Am J Phys Anthropol.* 55: 331-336.

Dahlberg AA, Kinzey W. 1962. Etude microscopique de l'abrasion et de l'attrition sur la suface des dents. *Bulletin du Groupement Internationale Pour la Recherche Scientifique en Stomatologie.* 5: 242-251.

D'Altroy, TN. 1992. Provincial Power in the Inka Empire. Washington D.C: Smithsonian Institution.

D'Altroy TN, Earle TK. Staple finance, wealth finance, and storage in the Inka political economy. *Curr Anthropol.* 26(2): 187-206.

Dansgaard W. 1964. Stable isotopes in precipitation. *Tellus* 16: 436–468.

Eaton GF. 1916. Collection of Osteological Material from Machu Picchu. Nabu Press.

Gat JR. 1996. Oxygen and hydrogen isotopes in the hydrologic cycle. *Annu Rev Earth Pl Sc.* 24: 225–262.

Goodman AH, Rose JC. 1990. Assessment of Systemic Physiological Perturbations From Dental Enamel Hypoplasias and Associated Histological Structures. *Yrbk Phys Anthropol*. 33: 59- 110.

Gordan KD. 1984. Hominoid dental microwear: complications in the use of microwear analysis

to detect diet. *J Dent Res*. 63: 1043-1046.

---- 1986. Dental microwear analysis to detect human diet. *Am J Phys Anthropol.* 69: 206-207.

---- 1988. A review of methodology and quantification in dental microwear analysis. *Scanning Microscopy*. 2: 1139-1147.

Gordon KD and Walker AC. 1983. Playing "possum": a microwear experiment. *Am J Phys Anthropol.* 60: 109-112.

Grine FE. 1977. Analysis of early hominid deciduous molar wear by scanning electron microscopy: a preliminary report. *Proceedings of the Electron Microscopy, Society of South Africa*. 7: 157-158.

Grine FE. 2007. Introduction to Dentition and Diet. In *Dental Perspectives on Human Evolution.* SE Bailey and JJ Hublin, eds. New York: Springer- Verlag, Pp 291-302.

Hartmann H. 1981. The family as the locus of gender, class, and political struggle: the example of housework. *Signs*. 6(3): 366-394.

Hastorf CA. 1996. Gender, space, and food in prehistory. *In* Contemporary Archaeological Theory: A reader. RW Preucel, I Hodder, eds. Cambridge, MA: Blackwell Publishers, Pp 460- 484.

Hastorf CA, Johannessen S. 1993. Pre-Hispanic political change and the role of maize in the central Andes of Peru. *Am Anthropol*. 95(1): 115-138.

Hillson S. 1996. Dental Anthropology. Cambridge: Cambridge University Press.

Hodder I. 1982a. Theoretical Archaeology: A Reactionary View. In *Symbolic and Structural Archaeology.* I Hodder, ed. Cambridge: Cambridge University Press.

---- 1982b. The contextual analysis of symbolic meanings. In *The archaeology of*

contextual meanings. Cambridge: Cambridge University Press.

Hogue SH, Melsheimer R. 2008. Integrating dental microwear and isotopic analyses to understand dietary change in east- central Mississippi. *J Archaeolog Sc.* 35: 228-238.

Holm, O. 1966. Money axes from Ecuador. *Folk*. Vols 8-9. Copenhagen.

Hosler P, Lechtman H, Holm O. 1990. Axe monies and their relatives. Washington D.C: Dumbarton Oaks.

Hutchinson DL, Larsen CS, Schoeninger MJ, Norr L. 1998. Regional variation in the pattern of maize adoption and use in Florida and Georgia. 63(3): 397-416.

Hutchinson DL, Norr L. 1994. Late prehistoric and early historic diet in gulf coast Florida. In *In the Wake of Contact: Biological Responses to Conquest*. CS Larsen, GR Milner, eds. New York: Wiley- Liss, Pp 9-20.

Katzenberg AM. 2011.The Ecological Approach: Understanding Past Diet and the Relationship Between Diet and Disease. In *A Companion to Paleopathology*. AL Grauer, ed. Wiley-Blackwell, Inc., Ch. 6.

King T, Humphrey LT, Hilson S. 2005. Linear Enamel Hypoplasias as Indicators of Systemic Physiological Stress: Evidence from Two Known Age-at-Death and Sex Populations From Postmedieval London. *Am J Phys Anthropol.*128: 547-559.

Larsen CS. 2000. Reading the Bones of La Florida. *Sci Am*. 282(6): 80-85.

---- 1984. Health and disease in prehistoric Georgia: the transition to agriculture. In *Paleopathology at the origins of agriculture*. MN Cohen and GJ Armelagos, eds. London: Academic Press, Pp 367-392.

Larsen CS, Hutchinson DL, Schoeninger MJ, Norr L. 2001. Food and stable isotopes in La Florida: diet and nutrition before and after contact. In *Bioarchaeology of Spanish*

Florida: the Impact of Colonialism. CS Larsen, ed. Gainsville: University Press of Florida, Pp 52-81.

Lucas PW. 1991. Fundamental physical properties of fruits and seeds in the diet of Southeast Asian primates. In *Primatology Today*. A Ehara, T Kimura, O Takenaka, and M Iwamoto, eds. Amsterdam: Elsevier Science Ltd,. Pp 125-128.

Mahoney P. 2006. Brief Communication: Intertooth and intrafacet dental microwear variation in the archaeological sample of modern humans from the Jordan Valley. *Am J Phys Anthropol.* 128: 39-44.

McEwan GF. 2006. The Incas: New Perspectives. Santa Barbara, CA: ABC-CLIO, Inc.

Mead M. 1943. The Problem of Changing Food Habits, 1941-1943. Washington: National Academy of Sciences, National Reserach Council, Bulletin 108.

Morris C. 1998. Inka Strategies of Incorporation and Governance. In *Archaic States*. GM Feinman and J Marcus, eds. Santa Fe: School of American Research Press.

Murra JV. 1960. Rite and Crop in the Inca State. In *Culture and History*. S Diamond, ed. New York: Columbia Press, Pp 393-407.

---- 1980. The economic organization of the Inka state. Greenwich, CT: JAI Press, Inc.

Murúa FM de. 1964 [1600]. Historia general de Perú. Madrid: Colección Joyes Bibliograficas, Biblioteca Americana Vetus.

Niles SA. 2008. The Nature of Inca Royal Estates. In *Machu Picchu: Unveiling the Mystery of the Incas*. RL Burger and LC Salazar, eds. New Haven, CT: Yale University Press.

Organ JM, Teaford MF, Larsen CS. 2005. Dietary inferences from dental occlusal microwear at mission San Luis de Apalachee. *Am J Phys Anthropol*. 128: 801-811.

Ortner DJ. 2003. Identification of Pathological Conditions in Human Skeletal Remains, 2nd edition. London: Academic Press.

Palubeckaite Z, Jankauskas R, Boldsen J. 2002. Enamel Hypoplasia in Danish and Lithuanian Late Medieval/ Early Modern Samples: A Possible Reflection of Child Morbidity and Mortality Patterns. *Int J Osteoarchaeol*. 12: 189-201.

Pease FGY. 1982. The Formation of Tawantinsuyu: Mechanisms of Colonization and Relationship with Ethnic Groups. In T*he Inca and Aztec States: Anthropology and History*. GA Collier, RI Rosaldo and JD Wirth, eds. New York: Academic Press, Pp 173-198.

Peters CR. 1982. Electron-optical microscopic study of incipent dental microdamage from experimental seed and bone crushings. *Am J Phys Anthropol.* 57: 283-301.

Pizarro P. 1921[1571]. Relation of the Discovery and Conquest of the Kingdoms of Peru. PA Means, trans. New York: Cortes Society.

Puech PF. 1979. Diet of early man- evidence from abrasion of teeth and tools. *Curr Anthropol*. 20: 590-592.

Puech PF, Prone A. 1979. Mechanical process of dental wearing down by abrasion, reproduced by experimentation and applied to fossil man and his paleoecological surroundings. *CR Acad Sci D Nat.* 289: 895.

Rensberger JM. 1978. Scanning electron microscopy, of wear and occlusal events in some small herbivores. In *Development, Function, and Evolution of Teeth*. PM Butler and KA Joysey, eds. New York: Academic Press, Pp 415-438.

Roberts C, Manchester K. 2005. The Archaeology of Disease. 3rd edition. Ithaca, NY: Cornell University Press. Ch. 4.

Robinson JT. 1972. Early Hominid Posture and Locomotion. Chicago: University of Chicago Press.

Rostworowski de Diez Canseco M. 1999. History of the Inca Realm. HB Iceland, trans. Cambridge: Cambridge University Press.

Rowe JH. 1946. Inca Culture at the Time of the Spanish Conquest. In *Handbook of South American Indians, Vol. 2: The Andean Civilizations*. JH Steward, ed. Bureau of American Ethnology Bulletin 143(2): 183-330.

---- 1982. Inca policies and institutions relating to the cultural unification of the empire. In *Inca and Aztec States, 1400-1800: Anthropology and History*. GA Collier, RI Rosaldo, JD Wirth, eds. New York: Academic Press, Pp 93-118

Sanson GD, Kerr SA, Gross KA. 2007. Do silica phytoliths really wear mammalian teeth? *J Archaeolog Sc.* 34(4): 526-531.

Salazar LC. 2001. Inca Religion and Mortuary Ritual at Machu Picchu. In *Mortuary Practices and Ritual Associations: Shamanic Elements in Prehistoric Funerary Contexts in South America*. EJ Currie and JE Staller, eds. Oxford: Archaeopress, Pp. 117-127.

Schmidt CW. 2001. Dental microwear evidence for a dietary shift between two nonmaize- reliant prehistoric human populations from Indiana. *Am J Phys Anthropol*. 114: 139-145.

---- 2010. On the relationship of dental microwear to dental macrowear. *Am J Phys Anthropol*. 142: 67-73.

Schoeninger MJ, DeNiro MJ. 1984. Nitrogen and Carbon Isotopic Composition of Bone-Collagen from Marine and Terrestrial Animals. *Geochimica Et Cosmochimica Acta* 48:625-639.

Sealy J, Armstrong R, Schrire C. 1995. Beyond lifetime averages: tracing life histories through isotopic analysis of different calcified tissues from archaeological human skeletons. *Antiquity.* 69(263): 290-300.

Semprebon GM, Godfrey LR, Solounias N, Sutherland MR, Jungers WL. 2004. Can low magnification stereomicroscopy reveal diet? *J Hum Evol.* 47: 115-144.

Stanish C, de la Vega E, Moseley M, Williams PR, Chavez CJ, Vining B, LaFavre K. 2010. Tiwanaku trade pattern in southern Peru. *J Anthropol Arch*. 29(4): 524-532.

Teaford MF. 2007. What Do We Know and Not Know about Dental Microwear and Diet? In *Evolution of the Human Diet*. PS Ungar, ed. Oxford: Oxford University Press, Pp 106-131.

Teaford MF, Lytle JD. 1996. Brief Communication: diet- induced changes in rates of human tooth microwear: a case study involving stone- ground maize. *Am J Phys Anthropol.* 100: 143-147.

Turner BL. 2008. The Servants of Machu Picchu: Life Histories and Population Dynamics in Late Horizon Peru. Ph. D dissertation. Department of Anthropology, Emory University.

Turner BL, Kamenov GD, Kingston JD, Armelagos GJ. 2009. Insights into Immigration and social class at Machu Picchu, Peru based oxygen, strontium, and lead isotopic analysis. *J Archaeolog Sc.* 36: 317-332.

Turner BL, Kingston JD, Armelagos GJ. 2010. Variation in dietary histories among the immigrants of Machu Picchu: Carbon and Nitrogen isotopic evidence. *Chungara*. 42(2): 515-534.

Turner BL, Kingston JD, Milanich JT. 2005. Isotopic Evidence of Immigration Linked to Status During the Weeden Island and Suwanee Valley Periods in North Florida. *SE Archaeolog* 24: 121-136.

Ungar PS, Grine FE, Teaford MF, El Zaatari S. 2006. Dental microwear and diet in African early *Homo*. *J Hum Evol*. 50: 78-95.

Ungar PS, Scott RS, Scott JA, Teaford MT. 2008. Dental microwear analysis: historical perspectives and new approaches. In *Technique and Applications in Dental Anthropology.* JD Irish and GC Nelson, eds. Cambridge: Cambridge University Press, Pp 389-425.

Van Gerven DP. 1982. The contribution of time and local geography to craniofacial variation in Nubia's Batn el Hajar. *Am J Phys Anthropol.* 59(3): 307-316.

Verano JW. 2003. Human Skeletal Remains from Machu Picchu: A Reexamination of the Yale Peabody Museum's Collections. In *The 1912 Yale Peruvian Scientific Expedition Collections from Machu Picchu: Human and Animal Remains*. RL Burger and LC Salazar, eds. New Haven, CT: Yale University Publications in Anthropology, Pp. 65-117 and Appendix A.

Walker A, Hoeck HN, Perez L. 1978. Microwear of mammalian teeth as an indicator of diet. *Science*. 201: 908-910.

Williams FL, Holmes NA. 2011. Evidence of terrestrial diets in Pliocene Eurasion Papioins (Mammalia: Primates) inferred from low-magnification stereomicroscopy of molar enamel use-wear scans. *PALAIOS.* 26: 720-729.

White CD, Spence MW, Stuart-Williams HLQ, Schwarcz HP. 1998. Oxygen isotopes and the identification of geographical origins: the valley of Oaxaca versus the valley of Mexico. *J*

Archaeol Sci 25: 643–655.

Wright LE, Schwarcz HP. 1998. Stable Carbon and Oxygen Isotopes in Human Tooth Enamel: Identifying Breastfeeding and Weaning in Prehistory. *Am J Phys Anthropol.* 106:1-18.

Wright LE, Zegarra AV, Crowley C. 2000a. Archaeological Exploration of the Inca Trail, East Flank of Machu Picchu and Palynology of Terraces. Final Report, Instituto Nacional de Cultura. Denver, CO: Wright Paleohydrological Institute.

Wright KR, Zegarra AV, Wright RM, McEwan G. 2000b. Machu Picchu: A Civil Engineering Marvel. American Society of Civil Engineers.