

Getting to the Root: Testing the Caries-Attrition Hypothesis in two Paleo-Indian Populations.

Bobbie Benavidez^{1,2}, David Hunt PhD¹



¹ Department of Physical Anthropology, Smithsonian Institution, Washington, D.C., ² Department of Anthropology, California State University Dominguez Hills, CA

INTRODUCTION

While attrition and caries both occur on the occlusal surface, the correlation between rates of dental attrition and occlusal surface caries remains in question. Known as the caries-attrition hypothesis, the analysis of a Dutch whaling station (17th and 18th century) suggested that a high level of attrition inhibits caries development.³ Whereas, contradicting research from a Portuguese Mesolithic population conclude that caries and attrition develop independently of each other.⁴ However, the relationship between caries and attrition will reflect diet in any given population.³ To test the caries-attrition hypothesis' population specificity and reliability, molar occlusal wear and caries were observed in two Paleo-Indian populations: Indian Knoll, KY (n=55) and Millstone Bluff, IL (n=54).

Paleo-Indian Diets

1. Indian Knoll, KY (Eastern Archaic period; 8000-2000 BC): mounds of discarded shells indicate a diet consisting primarily of ground acorns and bivalve mollusks.⁷
2. Millstone Bluff, IL (Late Woodland period; 600-900AD): as incipient agriculturalists but primarily hunter-gatherers: small animals, fish, domesticated plants, and wild plants comprised their diets.⁸



Figure 3. Upper left molars. Level 1 attrition, healthy teeth.



Figure 4. Lower left molars. Level 5 attrition (left), level 4 attrition (right).



Figure 5. Lower left molars. Level 6 attrition (far left). Two occlusal surface caries (middle) with level 8 attrition and pulp cavity exposure.



Upper left molars. Level 8 attrition, pulp cavity exposure.

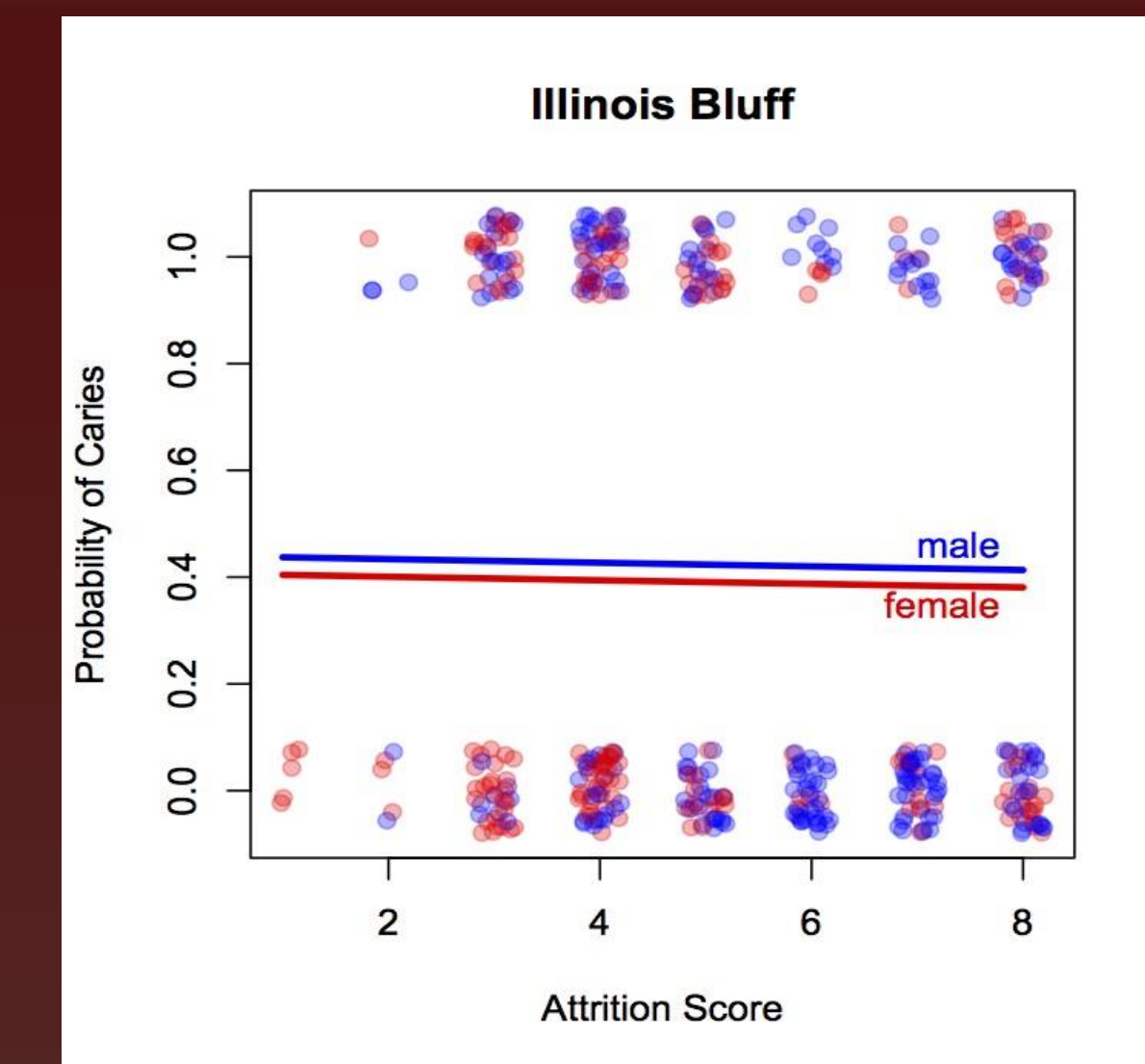


Upper Right Molars. Interproximal carious lesions (middle and far right) eating away at the occlusal surface. Level 8 attrition.

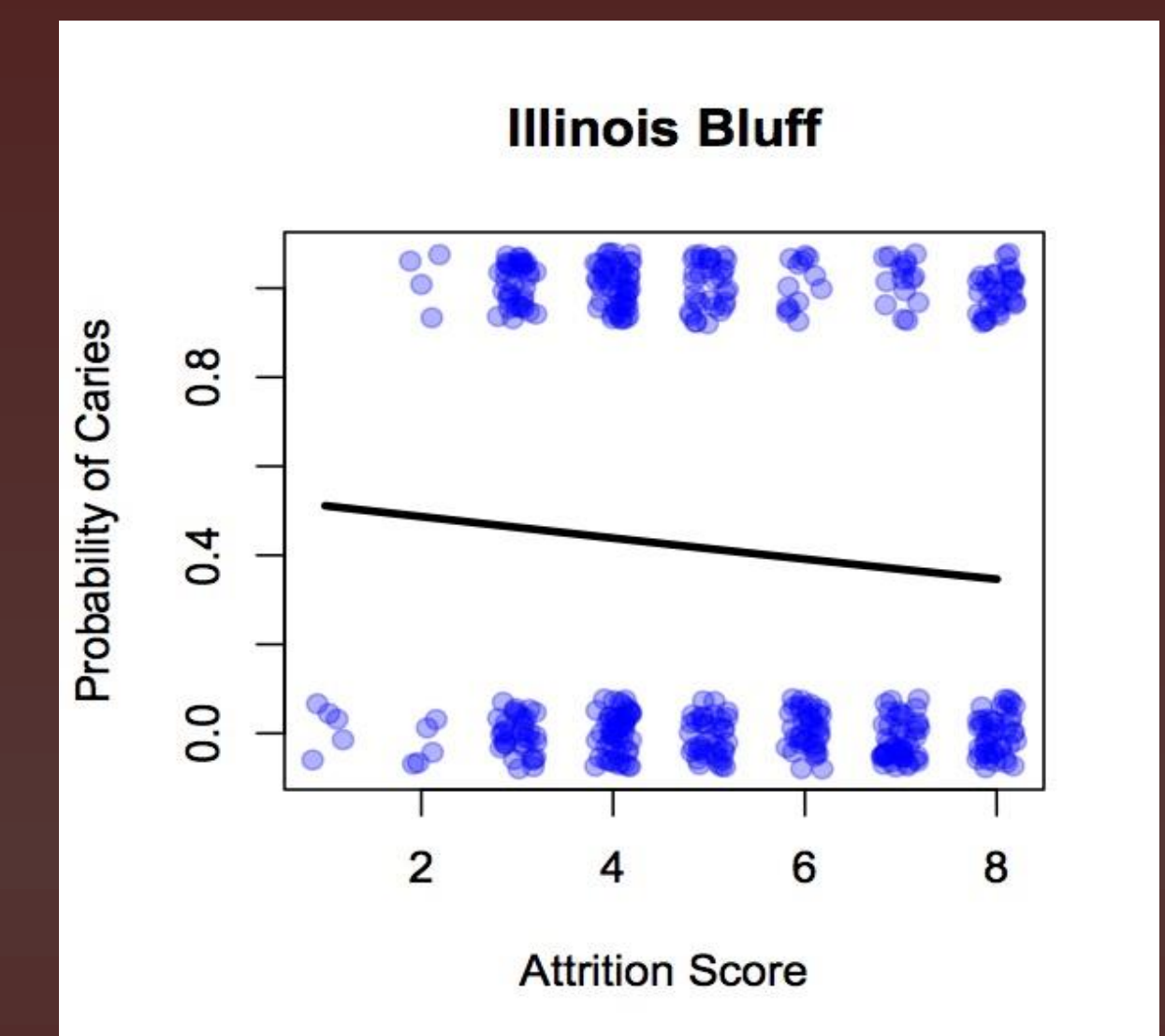


Lower left molars. Middle: Severe buccal surface carie into the occlusal surface. Level 8 attrition.

Figure 7. Illinois Bluff Results

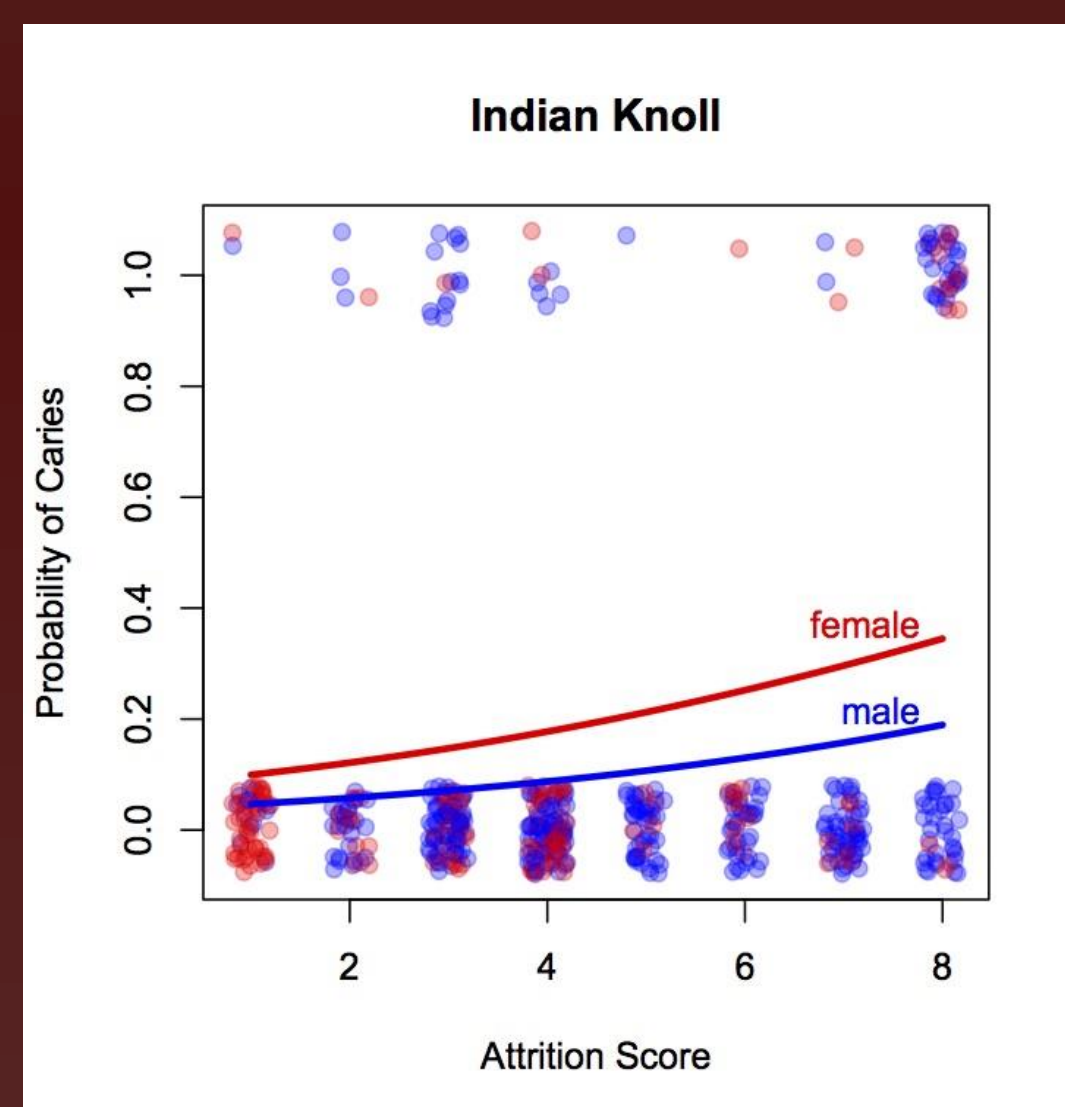


A. Logistics Plot of Millstone Bluff, IL, depicting the relationship of caries and attrition between the sexes. No significant differences between males and females were shown in the analysis.

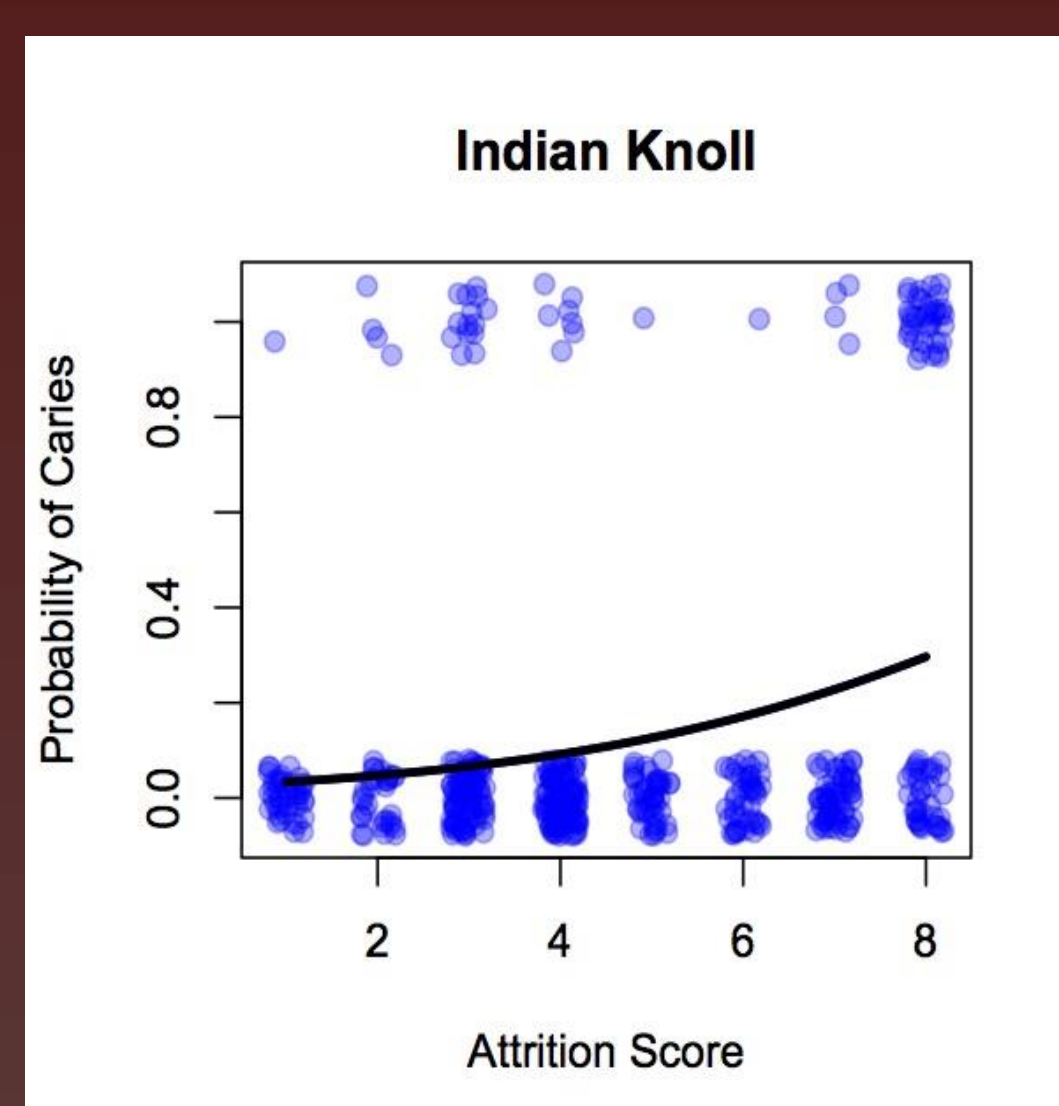


B. Logistics Plot of Millstone Bluff, IL, depicting the relationship of caries to attrition without sex and age as variables. There is a slightly negative correlation of caries and attrition.

Figure 6. Indian Knoll Results.



A. Logistics Plot on Indian Knoll, KY, depicting the relationship of caries and attrition. A significant difference between males and females show females as having a higher number of caries than males. Both showed a positive correlation.



B. Logistics Plot of Indian Knoll, KY, depicting the relationship of caries and attrition. There is a positive correlation between the number of caries and rate of attrition.

RESULTS

Figure 6. Indian Knoll Results. There is a positive correlation between caries and attrition for the Indian Knoll population. Of the 541 teeth observed, 66 had caries to the sexes varying degrees and 46 exhibiting high levels of wear. The analysis shows that caries are more likely to occur on teeth that are heavily worn. Differences between sex were also significant, females demonstrated a higher number of caries than men at median age. Omitting sex and age from the sample did not change the results.

2. Figure 7. Millstone Bluff Results. Drastically different to Indian Knoll, Millstone Bluff did not have a significant correlation between caries and attrition, with no differences between . Of the 452 teeth observed, 229 were carious with 169 showing medium to heavy attrition scores. However, when removing the sex and age variables, there shows a slightly negative correlation between caries and attrition. Although 59 teeth were carious with light attrition scores, the number of caries increased while intensity significantly decreased. Millstone Bluff had more than double the amount of unobservable teeth due to antemortem loss and post mortem loss.

DISCUSSION

Both caries and attrition are strong indicators of diet in any past population. The positive correlation in Indian Knoll and insignificant results found in Millstone Bluff show that the caries-attrition hypothesis is inconsistent and unreliable when applied to Paleo-Indian populations. It has been suggested that although a positive correlation may exist, it should not be assumed that caries are a result of attrition.⁴ The sex difference observed in Indian Knoll may be due to poor diet and child-rearing, which can lead to bone loss and a weakened immune system.⁸ Furthermore, a significantly high number of caries with moderate attrition scores in Millstone Bluff is consistent with a diet of wild fruits, berries, squash and maize, based on the conclusions of paleo botanic studies.⁷ Testing the caries attrition hypothesis on Native American populations provides a new insight to the underlying idea that diet influences both wear and caries separately.

Future Directions

Areas for further analysis include running a Bonferonni correction since not all molars are independent variables. Furthermore, the dental caries correction factor in both populations would account for antemortem tooth loss. An analysis using these factors would be applied to the entire dental arcade, as well as scores for carious lesions which may be affected by attrition.

ACKNOWLEDGMENTS

We would like to thank Elizabeth Cottrell, Virginia Power, and Gene Hunt for organizing the NHRE internship. Additional thanks to Gene Hunt for assistance with statistical analyses. A special thank you to Dr. Sarah Lacy and Rita Austin for their input on the project. Funding thanks to NSF REU Site, EAR-1560088.

REFERENCES

1. Buikstra, J.E. and Ubelaker, D.H. 1994. Standards for Data Collection from Human Skeletal Remains. Arkansas Archaeological Survey Research Series #44.
2. Hillson, S. 1988. Teeth. Cambridge: Cambridge University Press.
3. Maat, G.J.R. and Van der Velde, E.A. 1987. "The caries-attrition competition." *International Journal of Anthropology* 2(4): 281-292.
4. Melkijohn, C. and Wyman, J.M., 1992. "Caries and attrition: dependent or independent variables?" *International Journal of Anthropology* 7(1): 17-22.
5. Molnar, S. 1971. "Human tooth wear, tooth function, and cultural variability." *American Journal of Physical Anthropology* 34:175-190.
6. Morey, D.F., Crothers, G.M., Stein, J.K., Fenton, J.P., Hermann, N.P. 2002. "The fluvial and geomorphic context of Indian Knoll, and Archaic shell midden in West-Central Kentucky." *Geochronology* 17: 521-553.
7. Titterton, P. 1935. "Certain Bluff Mounds of Western Jersey County, Illinois." *American Antiquity* 1(1): 6-46.
8. Webb, W. S. 1974. Indian Knoll. University of Tennessee Press, Knoxville.

METHODS AND MATERIALS

From the Indian Knoll site (Figure 1) 39 males and 13 females were observed; compared to the 29 males and 23 females from Millstone Bluff (Figure 2). Age and sex were determined by the innominate, cranial features, epiphyseal fusion of long bones, dentition, and cranial suture closures.^{1,2} The average age at death in both populations fell between 20-40 years.

Each molar (n=993) was scored individually under a magnifier for rate of attrition, slope of attrition, abscesses, hypoplasia, antemortem tooth loss, lesions, and various carious lesion types.¹ Pathologies were simplified for analysis as: none, slight, moderate, or severe based on visual observations.^{2,3} Multi surface caries, or caries progressing into the occlusal surface, were included.³ Attrition was scored based on an 8 point scale divided into four separate categories: score of 1-no attrition (Figure 3), scores 2 to 3-light attrition, scores 4 to 5-medium attrition (Figure 4), and scores 6 to 8-heavy attrition with either complete dentin or pulp cavity exposure (Figure 5).^{1,3,4,5}

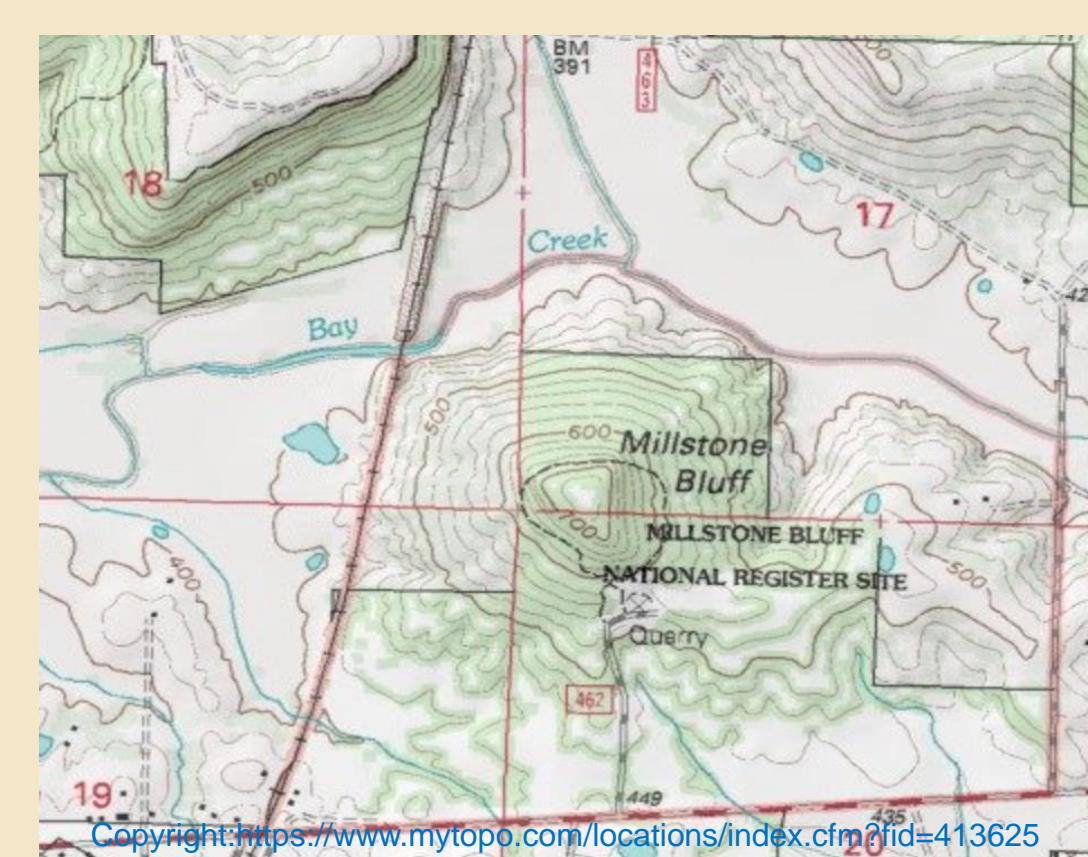


Figure 1 (top left) Millstone Bluff archaeological site in Illinois, Jersey and Pope County.

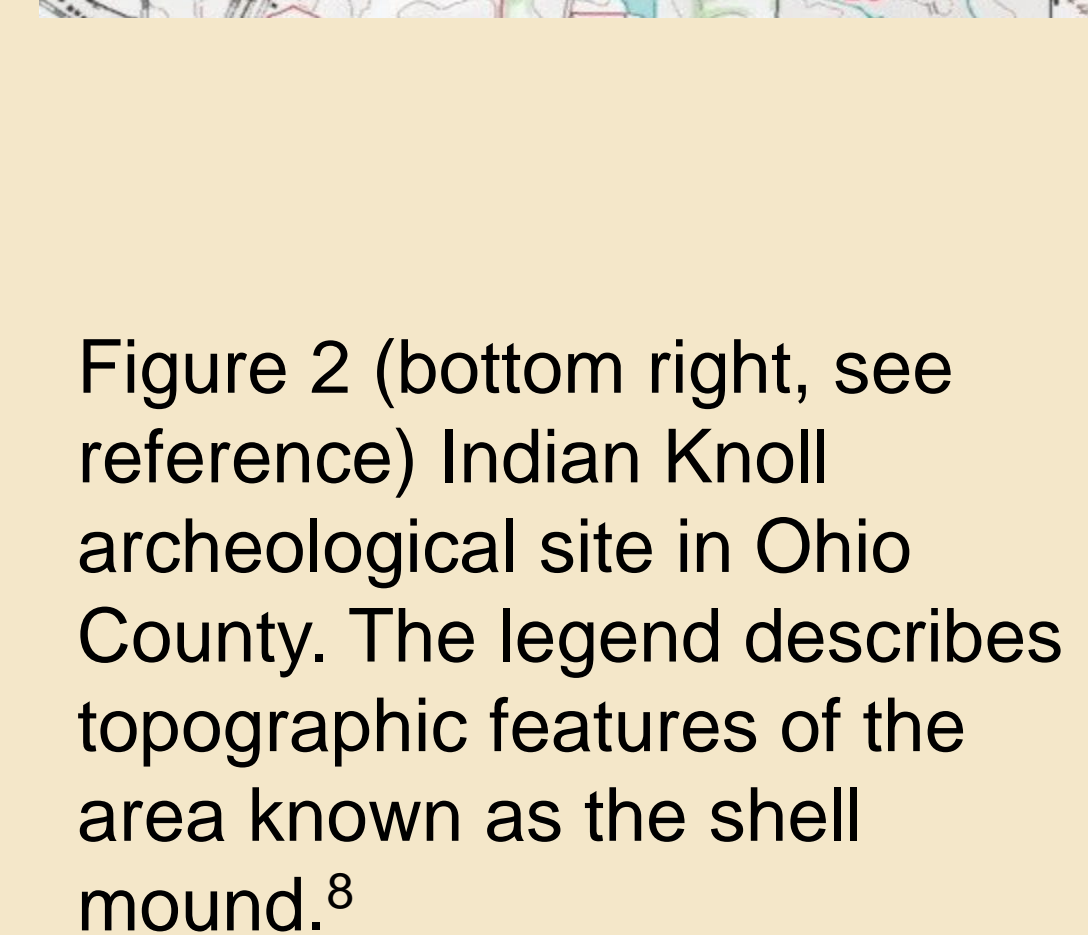


Figure 2 (bottom right, see reference) Indian Knoll archeological site in Ohio County. The legend describes topographic features of the area known as the shell mound.⁸