

Using Cementum Annuli to Estimate Age in Island Foxes – the results!

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In partnership with Friends of the Island Fox, Safari West, National Park Service, Santa Barbara Museum of Natural History, and UC Davis

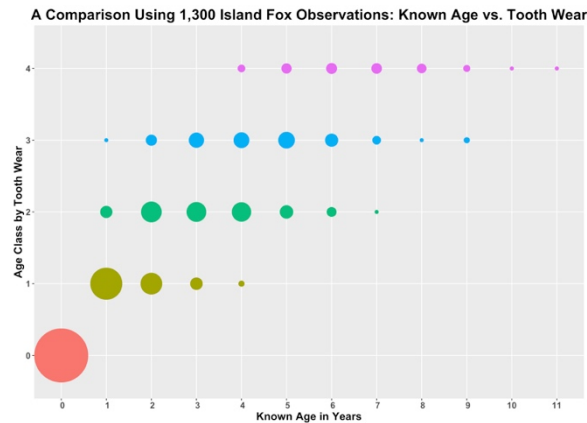
The Island Fox teeth have returned from Matson's Laboratory, and the lab-determined age has been compared to the known age. So the core question remains, can cementum annuli be used to determine age in years in island fox? The short answer is, for the most part, yes! But of course, there's a bit more to it.

Purpose

This study sought to determine if island foxes could be aged post-mortem using cementum annuli, which are tree-ring like formations in mammal teeth that are deposited each year throughout the animal's life. Once extracted, a tooth can be sliced, stained, and the annuli can be counted to determine age of the animal (for information on cementum aging, visit <https://matsonslab.com/the-science/cementum-aging/>). However, the reliability of this technique varies between species, and had not yet been tested on island fox until now.

Materials and Methods

As part of the Inventory and Monitoring Program at Channel Islands National Park, annual trapping and mortality monitoring is conducted to estimate population and mortality rate of the island fox. All foxes captured during trapping are given a PIT-tag (or microchip) to identify each individual, and a subset of foxes are given VHF radio collars to track for mortality. The foxes are also given a health check, during which time the fox is assigned an "age class" by examining the level of wear on the first upper molar. As described in the article on April 27, 2020 (<http://www1.islandfox.org/2020/04/>) determining the age of an island fox by tooth wear is not accurate beyond the first year of age. That is, pups can be identified with high accuracy, but beyond that is highly variable. Thus, foxes caught and tagged as pups are considered to be of known age, as their year of birth is known and recorded. However, adult foxes caught for the first time are estimated with a high margin of error, and their true age is unknown.

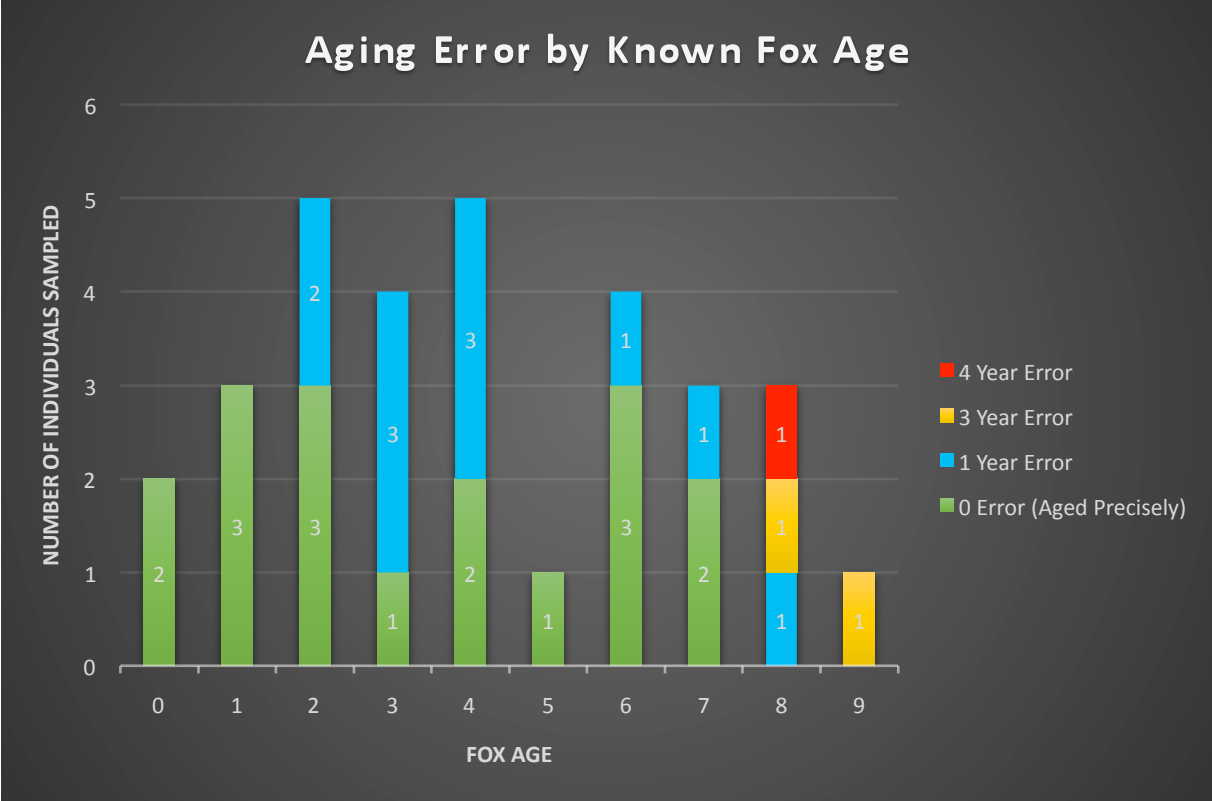


The plot above shows data from 1300 exams of island foxes compared with their known ages. Dot size represents the number of individuals which fell into that category. Plot by Juliann Schamel, 2020.

When a fox with a VHF collar dies, their body is collected and a necropsy is conducted to determine cause of death as well as investigate parasite/disease prevalence. This allows the Park to maintain knowledge of threats to the species and monitor the population for extinction risk. Knowing the age of a fox at death is important, because threats can impact different age stages differently and this in turn has varying implications for the survival of the species as a whole. For this study, a total of 31 teeth of known-age individual foxes from Santa Rosa and San Miguel Island were collected post-mortem (ranging from 0 to 8 years of age at death) and sent to Matson’s Laboratory for analysis. The age estimated by the lab was then compared to the known age.

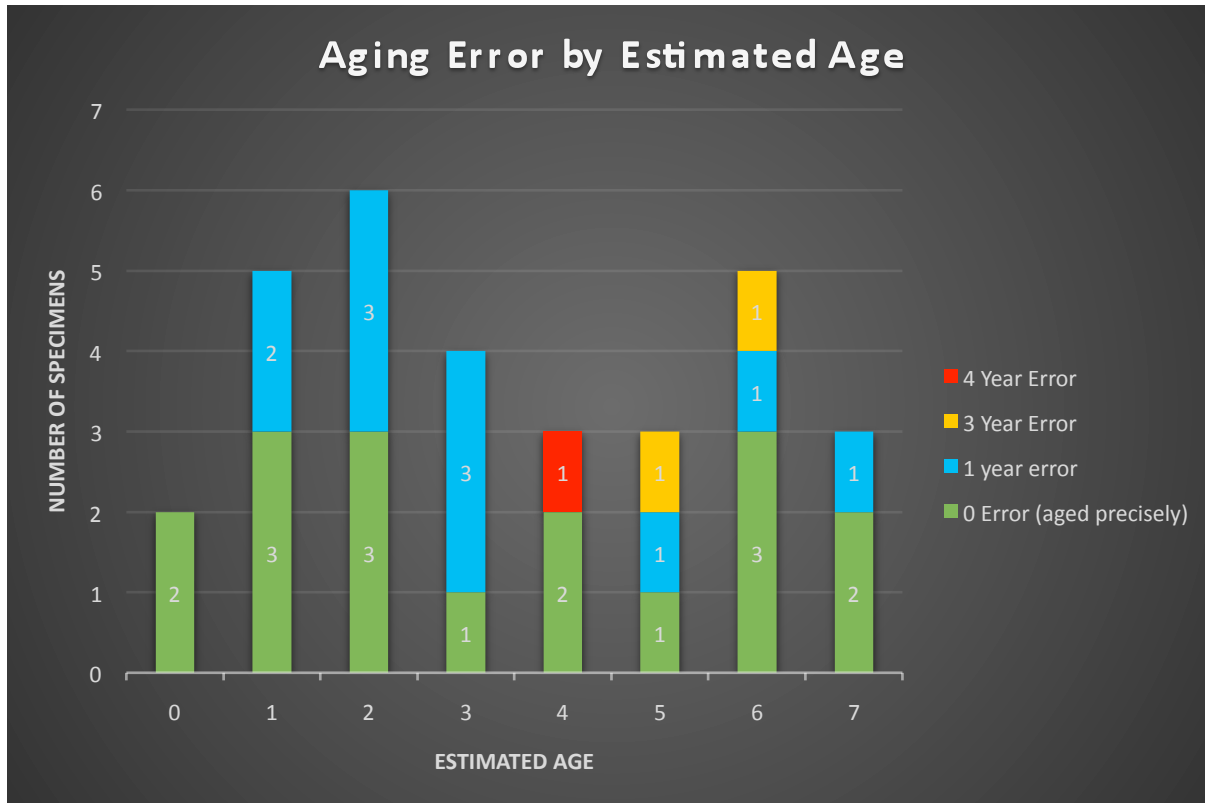
Result Summary

Of the 31 known-age teeth, 28 (90%) were aged by the lab within 1 year of accuracy (17 estimated to the year, 11 estimated as 1 year younger). 2 teeth were under-estimated by 3 years, and one was underestimated by 4 years. In all instances when a tooth was not estimated to the year, the age was always under-estimated. This was most common in older individuals. Some of the teeth were determined to be in less favorable condition for aging, and in these cases, the lab provided a 1-year range of potential ages (for example “6-7 years old”). Since no ages were over-estimated, the upper end of any range estimates was used for analysis.



The chart above shows the estimate error range for foxes of a given known age. All foxes between 0 and 7 years were either aged to the correct year, or under-estimated by one year. At age 8 and 9, errors ranged from 1 to 4 years under. Plot by Stacy Baker, 2021

It should be noted that viewing the results in this way demonstrates the *observed* accuracy of the data. That is, the estimates are viewed through the lens of already knowing the answer, or exact age, of the individual. While this is useful in order to see what ages are problematic for accurate estimates, the purpose of the study is to be able to later determine foxes of unknown age. To inform that aspect, one must look at the error based on the estimated age, not the known age.



The chart above now shows the error based on the returned age estimate. From this chart, one can see that a fox estimated at 1 year of age may be either 1 or 2 years old in reality, just as foxes aged 2-3 years may actually be 3-4 years old, respectively. Thus, from this dataset, we would infer that teeth returned with an assigned age between 1 and 3 are accurate within 1 year, but teeth aged 4 years and older have a higher chance of being off by a greater degree. This can be referred to as the predictive accuracy, which informs us which estimated ages are assumed to be most accurate (and to what extent) in instances when we do not know the actual age.

Discussion

Overall, using cementum annuli to age island foxes post-mortem is, for most specimens, accurate within one year. With the knowledge that under-estimating is prevalent, it should be noted that when an age range is estimated using this method, the higher age is most likely to be accurate.

However, based on the results of this study, it also has become apparent that more data may be needed to accurately assess the accuracy of using cementum annuli as a method of aging of older foxes. That is, the sample size of foxes over 7 years of age is too small to determine if there are other anomalies that are unaccounted for. Tooth condition may perhaps play a role, as two of those teeth out of four were determined to be of lower quality for aging according to Matson's Lab. This also may be unavoidable, since broken and decayed teeth become more prevalent as individuals age. Still, the lower accuracy of older foxes warrants further investigation with a larger sample size.