

# THE IMPACT OF DNA ANALYSIS TECHNOLOGY ON THE RATE OF NAGPRA REPATRIATIONS

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## \* ABSTRACT

This paper investigates whether recent advancements in DNA analysis technology have impacted the rate with which Native American remains are repatriated, or returned, to linear descendants or culturally affiliated tribes. The purpose of this study is to determine whether DNA analysis technology has effected repatriation rates specifically in Native American Grave Protection and Repatriation Act (NAGPRA) cases. This paper compiles information for all NAGPRA notices published in the National Register to conduct a statistical analysis of the rate of repatriations between 2011 and 2021. The resulting figures demonstrate that DNA analysis technology had an extremely slight effect on the rate of repatriation. The paper then concludes that this may be due to the difficulties in implementing DNA analysis as a culturally acceptable Archaeological methodology.

## 1 INTRODUCTION

The Native American Grave Protection and Repatriation Act (NAGPRA), signed into law on November 16, 1990, establishes a system for return of "human remains, funerary objects, sacred objects, or objects of cultural patrimony" that can be identified as "Native American" or "Native Hawaiian" to their lineal descendants or to a culturally affiliated present-day Indian tribe or Native Hawaiian organization (43 - NAGPRA). Such a system, which intertwines the theory-based practices of Archaeology and the precision of the law, only requires archaeologists to be able to prove lineal descent or cultural

affiliation of remains by a preponderance of evidence (43 - NAGPRA).

Although the use of DNA for identification began in the 1980's, the use of DNA to determine genetic links between subjects of study and present-day populations in NAGPRA cases did not begin until the 2010's. For more than 20 years, remains found in the United States were repatriated under NAGPRA based on more subjective identification methods like oral history, location of remains, physical analyses, and cultural similarities between ancient remains and present-day groups. However, a NAGPRA case, referred to in this paper as "Kennewick Man", gained international attention when craniometric and dental analyses (methods of analysis that measure the skull and assess the teeth of an individual, respectively) made beginning in the 1990's were disproven by DNA analysis in 2015 (Rasmussen 455). Widespread interest in this particular case prompted the study of the effect that DNA analysis technology has had on other NAGPRA cases in the remainder of this paper.

The following paper seeks to investigate the overall trend in the use of DNA analysis in NAGPRA cases to determine the linear descent or cultural affiliation of human remains. This paper will derive its information from the notices that are required to be published in the Federal Register by NAGPRA law. Using notices published in the last ten calendar years, this paper will demonstrate the frequency with which DNA analysis is used in NAGPRA cases. It will also reveal the significance of DNA analysis in the overall rate of repatriations. Finally, it will discuss the implications of my findings on the future use of DNA analysis in the determination of linear descent or cultural affiliation in NAGPRA cases.

## 2 CASE STUDY: KENNEWICK MAN

"Kennewick Man" refers to a male Native American from the Early Holocene whose remains were found on July 28, 1996 along the Columbia River in Kennewick, Washington (Rasmussen 455). Upon the discovery of these remains, multiple Native American groups from the Pacific Northwest claimed that Kennewick Man was their ancestor and sought to rebury him (Rasmussen 455). In 2004 case



*Bonnichsen v. United States*, the United States Court of Appeals for the Ninth Circuit ruled that Kennewick Man's remains could not be repatriated under NAGPRA solely based on their estimated age of 8,340-9,200 years old and could, therefore, be studied by scientists (United States Court of Appeals and Rasmussen 455). At the time of the court's ruling, DNA analysis technology was not advanced enough to extract ancient DNA from Kennewick Man's remains. Instead, scientists continued to use craniometric analysis to attribute these remains to the Ainu, a native group of Japan, and Native Polynesians (Owsley).

In 2015, a laboratory in Denmark extracted ancient DNA from Kennewick Man's remains and found that he is more closely related to Native Americans than to any other living group in the world (Rasmussen 455). This was determined by the presence of mitochondrial haplogroup X2a and the Y-chromosome haplogroup Q-M3, both of which are uniparental lineage groups that share a common ancestor (Rasmussen 455). These haplogroups are found almost exclusively in modern Native Americans (Rasmussen 455). Kennewick Man's remains were repatriated to the Confederated Tribes of the Colville Reservation because their gene sample shared enough similarities with Kennewick Man's DNA to prove they were direct descendants of the population to which Kennewick Man once belonged (Rasmussen 457). The remains were returned on February 17, 2017 and buried the following day.

### 3 RESEARCH QUESTIONS

This paper seeks to answer three primary questions: (1) Since the initial citation of DNA analysis technology as an Archaeological tool in NAGPRA cases, a trend in how frequently NAGPRA cases have been decided using genetic evidence be observed?; (2) Has the use of DNA analysis in NAGPRA cases contributed to the rate of repatriations overall? (3) What conclusions can be drawn from the frequency with which genetic information has been used in the determination of linear descent of human remains in NAGPRA cases regarding the

effectiveness and accessibility of DNA analysis technology?

### 4 METHODS

The findings of this paper are drawn from notices published regarding the repatriation or transfer of human remains and cultural items to Native American or Native Hawaiian groups. There are three types of notices that may be required, depending on the nature of the items in question ("Notices"). Notices of inventory completion are published by the Federal Register "when a museum or federal agency determines human remains and associated funerary objects are culturally affiliated or offers to transfer human remains that are not culturally affiliated" ("Notices"). Notices of intent to repatriate are published by the Federal Register "when a request for repatriation of unassociated funerary objects, sacred objects, or objects of cultural patrimony is received and accepted" ("Notices"). And finally, Notices of intended disposition are published in newspapers "when a Federal agency has identified the appropriate person or group with priority for disposition of the human remains or cultural items" ("Notices"). The research conducted in this paper will only focus on notices of intent to repatriate and notices of inventory completion for two reasons. First, notices of intent to repatriate and notices of inventory completion require summaries of remains in question to contain "sufficient detail so as to enable the recipients to determine their interest", whereas notices of intended disposition require only "information as to the nature and affiliation" of remains in question (43 - NAGPRA). And second, notices of intent to repatriate and notices of inventory completion can be accessed by the public through the website of the Federal Register, whereas notices of intended disposition are published in newspapers surrounding the area where the remains in question were discovered, which do not all grant the public access to their articles (43 - NAGPRA).

First, relevant documents were compiled by conducting an advanced search on the website of the Federal Register. This utilized keyword searches of "NAGPRA, DNA" and "NAGPRA, genetic" and a

selection of “notices” under “Document Category”. This search yielded a list of 28 NAGPRA notices that cited the use of DNA/genetic analysis in the discussion of the remains in question.

Then, an additional search was conducted on the website of the Federal Register using a keyword search of “NAGPRA” and a selection of “notices”. This search yielded a list of all NAGPRA notices published by the Federal Register. This search yielded notices published to make corrections to those previously published; such notices were included in the total because corrections could have been made to information regarding the use of DNA analysis. This search yielded notices published to withdraw previously published notices entirely; these were not included in the total because the information they contained did not contribute to a successful repatriation. For the same reason, all notices that were withdrawn were also excluded from the total.

## 5 FINDINGS

These searches yielded 28 notices published in the Federal Register that cited the use of

DNA analysis in the determination of lineal descent or cultural affiliation. On average, 3 notices citing DNA analysis were published each year for the last ten years. However, most often only one notice citing DNA analysis was published per year. The highest amount of notices citing DNA analysis published (five) occurred in 2015, which was the year that Kennewick Man’s case gained international attention. But despite this momentary boom in cases, DNA analysis did not continue to see increased use in NAGPRA cases. In fact, the lowest amount of notices citing DNA analysis published (zero) occurred later in 2018.

Furthermore, the years with the highest and lowest number of notices published citing the use of DNA analysis did not coincide with the years with the highest and lowest number of total notices published. In fact, the highest number of notices published per year (212) occurred in 2018, the same year that yielded zero publications citing DNA analysis. The lowest number of notices published per year (131) occurred in 2011, the first year that DNA analysis was cited in a NAGPRA notice. On average, 172 NAGPRA notices have been published per year since 2011.

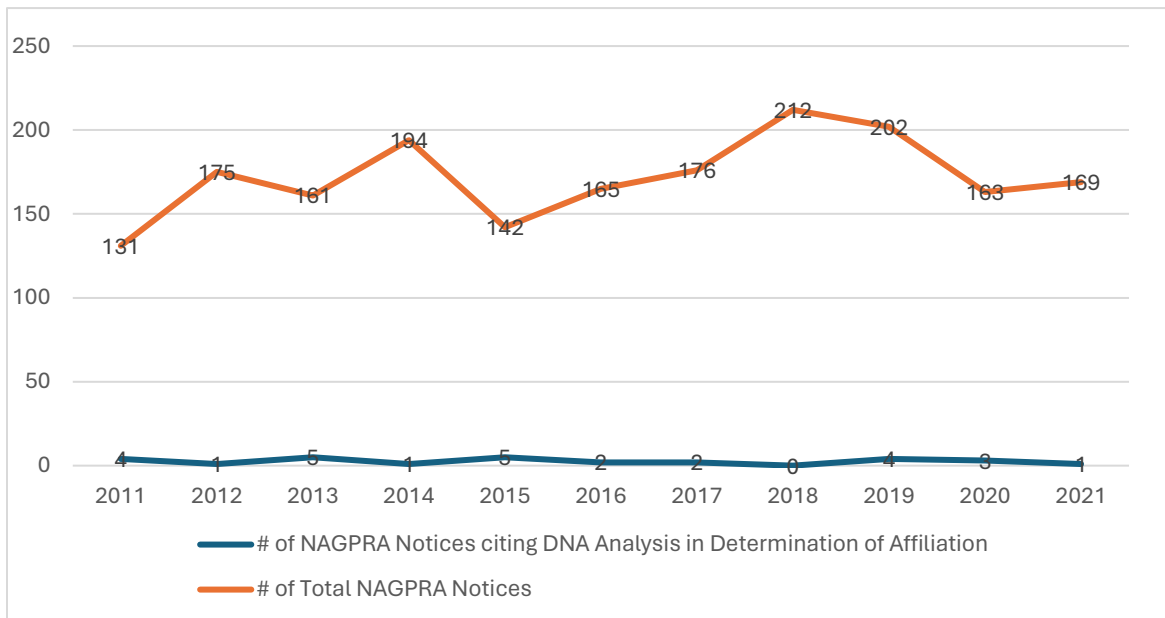


FIGURE 1: Frequency of NAGPRA Notices Published Per Year Compared to Frequency of NAGPRA Notices Citing DNA Analysis Published Per Year

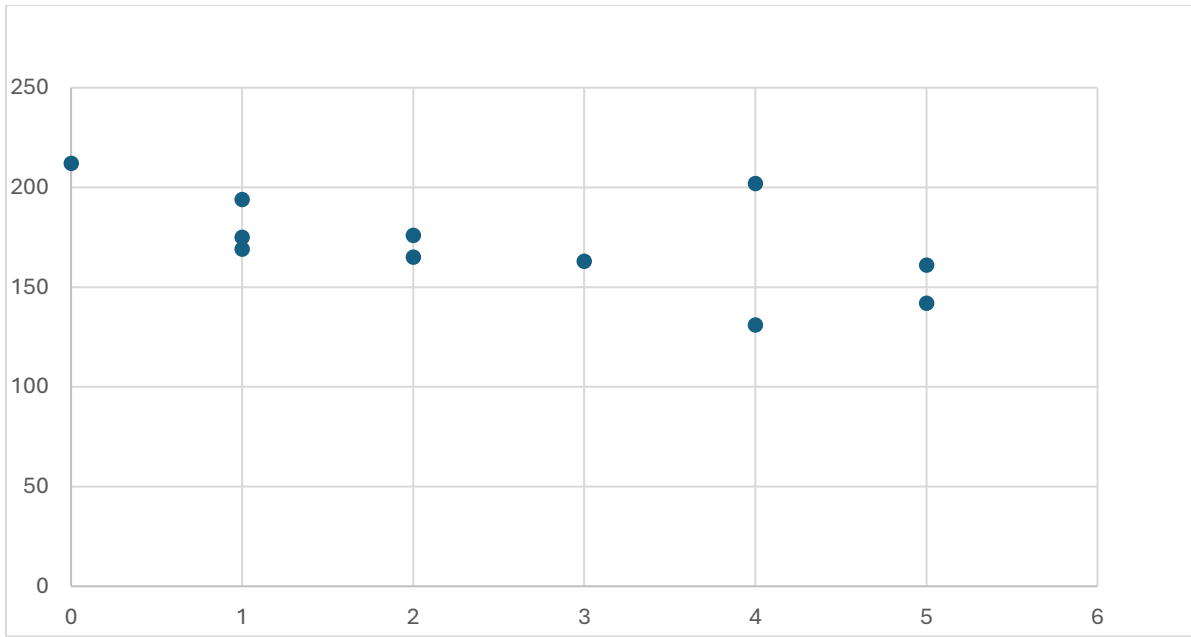


FIGURE 2: Scatter Plot of Number of NAGPRA Cases Citing DNA Analysis Per Year Versus Number of Total NAGPRA Cases Per Year

- 1) Pearson r Equation:    2) Calculate  $\Sigma X$ ,  $\Sigma Y$ ,  $\Sigma X^2$ ,  $\Sigma Y^2$ ,  $\Sigma XY$     3) Calculate  $M_x$ ,  $M_y$ :

$$r = \frac{\frac{\Sigma XY}{N} - (M_x)(M_y)}{(SD_x)(SD_y)}$$

X-Values	X <sup>2</sup> -Values	Y-Values	Y <sup>2</sup> -Values	XY-Values
4	16	131	17161	524
1	1	175	30625	175
5	25	161	25921	805
1	1	194	37636	194
5	25	142	20164	710
2	4	165	27225	330
2	4	176	30976	352
0	0	212	44944	0
4	16	202	40804	808
3	9	163	26569	489
1	1	169	28561	169
$\Sigma X = 28$	$\Sigma X^2 = 102$	$\Sigma Y = 1890$	$\Sigma Y^2 = 330586$	$\Sigma XY = 4556$

$$M_x = \frac{\Sigma X}{N} \quad M_y = \frac{\Sigma Y}{N}$$

$$M_x = \frac{28}{11} \quad M_y = \frac{1890}{11}$$

$$M_x = 2.55 \quad M_y = 171.82$$

- 4) Find the Standard Deviation:

$$SD_x = \sqrt{\frac{\Sigma X^2}{N} - M_x^2}$$

$$SD_x = \sqrt{\frac{102}{11} - 2.55^2}$$

$$SD_x = 2.59$$

$$SD_y = \sqrt{\frac{\Sigma Y^2}{N} - M_y^2}$$

$$SD_y = \sqrt{\frac{330586}{11} - 171.82^2}$$

$$SD_y = 172.86$$

- 5) Plug Values Into Pearson r:

$$r = \frac{\frac{\Sigma XY}{N} - (M_x)(M_y)}{(SD_x)(SD_y)}$$

$$r = \frac{\frac{4556}{11} - (2.55)(171.82)}{(2.59)(172.86)}$$

$$r = -0.05$$

FIGURE 3: Calculation of Pearson r

Findings regarding the lack of coincidence between the minimum and maximum values in each of these data sets leads to the next research question: Has the use of DNA analysis in NAGPRA cases contributed to the rate of repatriations overall? In other words, what is the correlation, if any, between the number of NAGPRA cases published citing DNA analysis and the total number of NAGPRA cases? This information will illustrate how the use of DNA analysis has contributed to the ease with which repatriations can be made. It is evident in FIGURES 1 AND 2 that the number of NAGPRA notices published citing DNA analysis has little to do with the total number of NAGPRA notices published in a given year, but calculation of the Pearson  $r$  value will reveal exactly how interrelated these two data sets are by yielding a value between  $-1.00$  (strong negative correlation) and  $+1.00$  (strong positive correlation), with a value of  $0.00$  indicating no correlation.

The above calculation of Pearson  $r$  shows that the correlation between the number of NAGPRA cases citing DNA analysis and the total number of NAGPRA cases in a given year is extremely slight. When the value of the Pearson  $r$  is squared, it yields the coefficient of determination, a value that represents the percent of information contained in the  $Y$  value that can be learned from the  $X$  value (Sprinthall 277). In the context of this paper, only  $0.0025\%$ , the value of  $r$  squared, of the information represented by the value of total NAGPRA cases in a given year can be learned from the number of NAGPRA cases per year that cite DNA analysis. This means that the use of DNA analysis in the determination of lineal descent or cultural affiliation has had almost no effect on the overall rate of repatriations taking place.

## 6 DISCUSSION

The findings of this paper state that Notices of Intent to Repatriate and Notices of Inventory Completion do not demonstrate a relationship between the number of notices

published citing DNA analysis and the total number of notices published in a given year because the values of Pearson  $r$  and the coefficient of determination were too low to suggest a relationship of any significance. But it is also important to acknowledge some of this paper's more obvious limitations before generalizing any further. One cannot make any claims regarding all NAGPRA cases from the past ten years because the entirety of that information is not accessible to the public. One also cannot use notices of intent to repatriate and notices of inventory completion as a sample and generalize our findings to the entire population of notices published. Each type of notice is published for different types of NAGPRA cases, making them inherently different. Therefore, the sample would not be representative of the population if it only included two of the three types of notices. One also cannot make any claims as to the cause of the relationship between the number of notices published citing DNA analysis and the total number of notices published in a given year. However, one can use the information that the data provides to support more qualitative assertions and inform an approach to NAGPRA cases in the future.

The priority of the remainder of this section will be to demystify the reasons why the seemingly simple integration of DNA analysis into NAGPRA has not occurred on a scale that would suggest this apparent simplicity. Upon hearing the story of Kennewick Man, one could easily assume that DNA analysis is an easy way to minimize error in the field of Archaeology and exceed the standard of proof required in NAGPRA regulations. However, there are a multitude of factors that limit its use in most institutions. One example of such limitations is the quality of preservation of the remains in question. DNA degrades when exposed to ultraviolet radiation, moisture, temperature fluctuations, and soil acidity, therefore poor environmental factors can automatically eliminate the possibility of using DNA analysis on remains to determine lineal descent or cultural affiliation

(Schablitsky). Another possible limitation is contamination of DNA. As Schablitsky et. al. state, DNA contamination can occur in the field or in the lab. To prevent DNA contamination by handling remains, sterile tools and DNA tests of handlers may be required (Schablitsky). Cross-contamination can also occur when handling multiple artifacts containing genetic information or when using chemicals to enhance degraded DNA (Schablitsky). It is recommended that Archaeologists only use laboratories that follow "DNA clean" procedures and to conduct testing multiple times and different laboratories (Schablitsky). The addition of extra equipment, higher sterility standards, and additional testing can present budgetary issues for institutions looking to use DNA analysis in NAGPRA cases.

In addition to the practical complications that the use of DNA analysis presents, using genetic information to determine lineal descent or cultural affiliation in NAGPRA cases presents additional cultural complications. In a paper by Ann M. Kakaliouras, "Aboriginalism", the concept which suggests that "indigenous people form a class of humans with unique qualities and abilities that are not shared by nonaboriginals" is introduced as a concern regarding indigenous archaeology, the term "aboriginal" referring to indigenous people and the term "nonaboriginal" referring to Western, nonindigenous people. But we can certainly extrapolate that this concern would only be amplified by the introduction of genetic information. As stated by Schablitsky et. al., "Although the genetic variation within traditional conceived races is much greater than that between them, differences exist in the frequencies with which certain genetic variants occur in populations of differing biogeographic ancestry." However, the cultural implications of such research can have the negative effect of implying genetic difference between races to general audiences. Even the use of genetic information to determine cultural affiliation can be misguided because genetic similarities are not a requirement for affiliation with the group. Genetic information can even be used to

negate cultural evidence of affiliation, therefore creating a hierarchy of evidence that places modern science over ancient indigenous beliefs (Kakaliouras). Furthermore, the overall effect that these conditions can have on the relationship between scientists and Native Americans limits archaeologists' ability to facilitate the necessary collaborations to conduct genetic testing in NAGPRA cases.

## 7 CONCLUSION

While the overall impact that DNA analysis technology has had on the rate of repatriations under NAGPRA may be meager, the information gleaned from this research will have many applications for future archaeologists. First, existing data demonstrates that the rate of successful repatriations can increase without the aid of DNA analysis technologies so scientists and Native American organizations need not worry about increasing the use of DNA analysis to facilitate more repatriations of remains and associated funerary objects. And second, even if a new technology provides stronger evidence than previous methods of analysis, procedural and financial barriers may exist which limit its implementation. However, seemingly effective technologies can have unforeseen repercussions for the people they aim to help. In the case of DNA analysis, rather than pushing the technology to be used more frequently, a better course of action would be to assess its cultural significance within Native American communities to see if it aligns with that of Westernized (and predominantly white) science. Such conversations should occur during conferences with indigenous groups required by NAGPRA legislation and should become commonplace before any revisions are made to the budgets of individual institutions or to NAGPRA regulations as a whole ■

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Emily Kane is a class of 2024 graduate from Rutgers School of Arts and Sciences. She majored in anthropology and minored in archaeology, art history, and psychology. Her interest in anthropology and archaeology is focused on North American archaeology and Indigenous archeology. In her time at Rutgers, Emily has assisted with research in The Department of Anthropology Laboratory for MicroArchaeology (ALMA) under anthropology professor Dr. Dan Cabanes, working on FTIR analysis, phytolith analysis, and charcoal analysis. Separately, she conducted literature-based research on the Indigenous archeology movement and how it has and will impact North American archeology for a class taught by anthropology professor Dr. Pilar Rau, titled "Indigenous Rights and Wrongs". She is currently completing an honors thesis on the bias in methods of sex estimation of the human pelvis. Emily has interned at the U.S. Army Corps of Engineers, New Jersey State Museum, and Middlesex County Division of Historic Sites to pursue a career in which her knowledge of anthropology and archaeology can be applied in a practical setting. She will be attending the University of Florida in the fall of 2024 to earn a master's in anthropology.