Forensic anthropology: its contribution to forensic cases submitted to the University of Montana for analysis

Ana M. Byrne

The University of Montana

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FORENSIC ANTHROPOLOGY: ITS CONTRIBUTION TO
FORENSIC CASES SUBMITTED TO THE UNIVERSITY OF
MONTANA FOR ANALYSIS

By
Ana M. Byrne
B.A, The University of California at Davis, 2003

Presented in partial fulfillment to the requirements
For the degree of
Master of Arts
The University of Montana
July 2006

Approved by:

[Signature]
Chairman, Graduate Committee

[Signature]
Dean, Graduate School

Date
ABSTRACT

Byrne, Ana M., M.A. July 2006

Forensic Anthropology: Its Contribution to Forensic Cases Submitted to the University of Montana for Analysis

Chairman: Dr. Randall R. Skelton

The Anthropology Lab at the University of Montana is regularly consulted by law enforcement agencies throughout the state of Montana on cases suspected to involve skeletal human remains. In this paper, how specifically Forensic Anthropology contributes to these cases is examined. Cases submitted to the UM Lab for analysis between the years of 1971 and 2004 are followed up and the agencies involved are asked specific questions regarding each case. Agencies responded to questions regarding 97 of the UM’s 238 total cases. Results of this study show that of those cases containing contemporary human remains about 18% were identified after the UM performed their analysis, and about 60% had not been identified. With modern day forensic technology advancing at such a rapid rate, this paper aims to show that in Montana, Forensic Anthropology is a tool that has become less useful in its ability to assist in determining an unknown decedent’s identification, while being most useful in determining if a case in question is one that involves contemporary human remains to begin with.
ACKNOWLEDGEMENTS

I would like to acknowledge my great appreciation to Dr. Randy Skeleton, my thesis advisor, and the members of my thesis committee, Dr. Ashley McKeown and Dr. Richmond Clow, for their support and expertise. I am sincerely grateful to all the law enforcement agencies that took the time to participate in this study. I would like to thank my friends and family for their support, and especially my husband Kevin and my daughter McKenna for their inspiration and motivation.
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Chapter 1
Introduction

Today there are several sciences that can assist in obtaining a positive identification when only skeletal tissue remains and no personal affects such as medical implants are present: forensic anthropology, facial reconstruction, DNA analysis, and radiographic comparison including dental x-rays. This study hopes to show what place Forensic Anthropology has in the field of Forensic Science by examining what it has done in the past.

Forensic Anthropology

In 1939 W.M. Krogman published ‘A Guide to the Identification of Human Skeletal Material’ marking the beginning of what would eventually become the field of Forensic Anthropology. Krogman’s guide was followed by T.D. Stewart’s 1979 book ‘The Essentials of Forensic Anthropology: Especially as Developed in the United States’, and then in 1986 Krogman and M.Y. Iscan defined the ‘big four’ in forensic anthropology for identification of skeletal remains in criminal investigations: age, sex, race, and stature. This provided the foundation from which Forensic Anthropology has developed, and since then numerous texts and articles have been published, and research occurs around the world.

Today, Forensic Anthropologists are consulted in many different ways. A forensic anthropologist might be on the staff at a particular law enforcement
agency as either a full-time or part-time employee. Additionally, a Forensic Anthropology professor at a university might be consulted, and in some cases paid, for their expertise and assistance on a case. This dynamic puts Forensic Anthropologists in the unique position of being able to work on cases in various settings, and with or without pay. The other interesting aspect of this field is that when a forensic anthropologist isn’t available locally, materials are sent to one, or an individual might come to the location when needed. For the purpose of this study, having one Forensic Anthropology department receive all cases needing a forensic anthropological analysis for the entire state of Montana provided an remarkable opportunity to get a good understanding of how this type of analysis assists in making positive identifications.

In order to understand what direction the future of forensic anthropology might have with modern forensic cases involving contemporary human remains, it was necessary to look at how it had helped in the past. In order to do this all cases that had been sent to the University of Montana for analysis from 1971 to 2004 were examined to see how the forensic anthropological analysis had assisted, and in what way. With this knowledge, it would be possible to surmise what role forensic anthropology would have in future cases. Over the past few years, research in Forensic Anthropology has covered all aspects of the field that investigators would find useful in determining identity, including the ‘big four’ age, sex, height and race, as well as time since death. Skeletal trauma can also prove useful in identifying an
individual, but because this is something not always found in all skeletal remains, this element of Forensic Anthropology will not be discussed here. Only a few papers on some of the most current research will be discussed in this paper.

Age at Death

Bass (1995) notes that age at death is always provided in a range to account for the anatomical variation between individuals. (1995 Bass) Buckberry and Chamberlain (2002) developed a new method for recording age-related stages for various features of the auricular surface of the ilium, which when combined provide a more accurate estimate for age at death than the Lovejoy method. Their method is a revised version of the 1985 method developed by Lovejoy et al. that aims to not only be more accurate but also easier to use, and thereby reduces the potential for observer error. One of the drawbacks that Buckberry & Chamberlain noted is that their method actually widens the range of age at death, and pointed out that there is not currently a method of estimating age that is both precise and accurate, and that such a method is unlikely to be developed in the foreseeable future due to the wide array of variables that affect the biology of skeletal aging.

Sex

Sex determination is not as difficult to determine as age, especially when a complete skeleton is available. (Krogan 1939; Stewart 1979) When
skeletons are found incomplete or fragmentary, sex determination becomes more challenging and success rates vary according to which parts of the skeleton are available for analysis. Analysis of the os coxae has long been considered the most accurate method for determining sex (Krogman et al. 1986). A study by Bruzek (2002) developed a new technique that involved visual assessment of points on the entire hip bone, and concluded that this method provided results that were 98% accurate. Research of the long bones for sex indicators has proven very successful as well (Iscan 2001). Steyn et al. (1997) did a study on South African human cadavers and measured the femora and tibia, and developed a formula that was accurate between 86% and 91% of the time.

**Stature**

Stature is generally estimated mathematically from the long bones using the Trotter and Gleser (1952) tables or Giles and Klepinger (1988) simple linear regression formulae. Like age, stature is expressed in a range to account for individual variability. (Bass 1995) In cases where a complete skeleton is available, the anatomical method of Fully (1956) can be used. Raxter et al. (2006) published a study on a revised Fully method and their findings resulted in 95% of their samples being estimated correctly to within 4.5cm. They also noted that when using the anatomical method it is important to be consistent with measurements, and explained that in cases where either method could be utilized, the disadvantage in using the mathematical method is that it is unable
to account for disproportionate individuals in the way that the anatomical method can. Mendonca (2000) published a study researching stature estimation using the mathematical method with measurements of long bones. It was determined that the ideal long bones to use are the femora and the tibia, and that when those are not available the humerus may be used but should be measured in its entirety. Fragmentary long bones did not provide satisfactory results, and the regression formulae are more accurate than table estimations.

Race [Ancestry]

Determining race is considered to be an important aspect of forensic anthropology, and information that law enforcement agencies find useful when searching for an identity. Yet, determining race is one of the biggest challenges faced by forensic anthropologists today. Historically, three primary race categories were developed - Mongoloid, Negroid and Caucasoid, and subsequently formulae were developed for determining which one of the three categories an unknown decedent fell into. (Stewart 1979). Being able to inform detectives that the deceased individual may have fallen into one of three ‘racial’ categories could prove very useful to determining an identity. The difficulty of this determination, however, is the fact that people don’t generally fit into one of those three racial categories as neatly as the science would allow. In fact, in the United States today people continue to blend together genetically so much so that providing information on race in a forensic case is often determined to not be possible by forensic anthropologists. Brace
(1995) explains that skeletal analysis doesn’t assess skin color, but it does estimate geographical origin with a good degree of accuracy: “Africa of course entails ‘black’, but ‘black’ does not entail African.” For this reason Brooks (1990) has initiated a trend towards referring to ‘race’ as ‘ancestry’, and providing some information as to an individual’s ancestry continues to be part of the forensic anthropological analysis.

*Time Since Death*

When estimating time since death there are many variables that need to be considered, including such things as whether the body was buried or not, dressed or not, in a warm or cold climate, in a vehicle, submerged in water, etc.[Bass 1984; Mann et al. 1990] In order to make this determination accurately it would be best if a forensic anthropologist had information on the postmortem interval (PMI) that was specific to its location in order to try to control for some of those variables. Bass (1997) reported on rate of decomposition specific to the state of Tennessee, for example.

Swift (1998) estimated postmortem intervals of 15 to 77 years from skeletal remains by quantifying two naturally occurring isotopes, 210Po and 210Pb. They found that a comparison between the abundances of the two could potentially provide time since death fairly accurately due to the natural abundance of 210Po in the environment and because the primary source of 210Pb within bone is radioactive decay from 210Po. Disadvantages were the
cost, the effect that smoking and shellfish consumption have on the level of 210Pb levels, and diagenesis. Swift concluded that further studies in this area need to be done, and that the composition of the soil, including moisture level, should be considered when determining the decomposition rate. Megyesi (2005) did a study on the decomposition process of human remains to determine the PMI by factoring in the temperature when calculating the accumulated degree-days. The study approached the process from a quantitative aspect, considering the decomposition process as continual rather than staged. The results showed that when the temperature is considered throughout the decomposition process, a more accurate and precise time since death can be determined.

These studies provide more evidence to the fact that there is a vast array of variables that can affect decomposition rates and subsequently the time it takes for a body to become completely skeletonized, and therefore state-specific data would be invaluable to forensic anthropologists and law enforcement agencies.

**Facial Reconstruction**

Facial reconstruction is a technique currently being used to help identify human skeletal remains by combining science with art. Currently there are two methods utilized - a clay method and a computerized method. Facial reconstruction, like forensic anthropology, can not directly lead to a positive
identification, but the facial image that results can be used to elicit public recognition and hopefully narrow down the possibilities of an identity to just a few potential matches. As technology advances it becomes easier to collect more data more efficiently, using less invasive means. This fact holds true with all sciences but proves especially beneficial for the purposes of research in forensic anthropology and facial reconstruction since in its early years data could primarily be collected only from postmortem remains. Today, research on the human face has become more scientific and the data obtained is more reliable as a result. (Iscan 2001) Claes et al. (2006) proposed a new flexible facial model for facial reconstruction which involved acquiring three dimensional tissue depths in an upright position that including an account of the body mass, gender and ancestry of the individual, statistical modeling, and then fitting the statistical model to the cranio- facial skeleton. The identification success rate when comparing the signature of every reconstruction with the signature of every original face was 100% accuracy, and the success rate when comparing the generated two dimensional images to the three dimensional models was 81.15%. (Claes et al, 2006)

**DNA analysis**

DNA analysis, using both nuclear DNA and mitochondrial DNA, is currently a tool being used to identify unknown human remains. Investigation into a missing or unknown person case and identifying victims of mass disaster are two of the ways that DNA analysis is currently being applied. Forensic bone
samples have traditionally proved challenging for the extraction of usable DNA due to the presence of PCR inhibitors and degraded DNA (Haglund et al. 1990), and in order to positively identify an unknown person once usable DNA is obtained a comparison must be made to a potential relative. Yet, despite these disadvantages DNA analysis is a very reliable method that is quickly expanding as technology improves. In 1986 DNA was used in the first United States court case, and it has been used around the world ever since. (Scharf et al. 1986; Jeffreys et al. 1988). After the DNA Identification Act of 1994, the FBI was able to establish a national criminal database and the National DNA Index System (NDIS) in 1998 as part of the Combined DNA Index System (CODIS). (Roby et al. 2005) As of December 2005, every state in the United States was actively participating in NDIS and Roby and Jones (2005) reported that by August 2005 more than 2.6 million DNA samples had been entered into CODIS, aiding over 27,000 investigations and resulting in 25,100 positive matches. Researchers at the Armed Forces DNA Identification Laboratory (AFDIL) have increased their sample collection by developing automated methods for processing mitochondrial DNA from skeletal remains. (Edson et al 2004) Applying DNA typing techniques to successfully establish the identity of a decomposed homicide victim was first published in 1990 (Easteal 1991) and techniques involving mitochondrial DNA have since been developed to allow identification of human remains that date back to the historic period (Edson et al 2004).
Radiographic analysis

Forensic radiology is an important tool in forensic science. Radiographs can assist forensic anthropologists in determining age at death, and the comparison of ante-mortem radiographs with post-mortem radiographs has become an indispensable and fundamental basis of positive identifications of human remains. Typically x-rays of the teeth and hands are used in determining age up to approximately 16 years, but age cannot be estimated correctly in adults over the age of 25. (Tanner 1991) Using post-cranial x-rays of specific ossification areas can be useful in determining age in older individuals, however. (Kahana 1999) When utilizing x-rays for identification purposes, Kahana (1999) reports that in his experience an average of 10% of medico-legal cases involve unidentified remains, and 80% of those are identified using x-rays. Riepert et al. (2001) designed a computer program that could assist in making positive identifications using the already established FoXSIS (Riepert 1995) that could make a better comparison of x-ray images in different positions as well as establish a criteria for the validity of the identification. “The presented results demonstrate that the comparison of x-ray images can be undertaken in an objective way by quantifying the probability of identity even under circumstances where the comparative images were made under different conditions...” Riepert et al. (2001)

Comparison of dental x-rays is another method of utilizing radiography to identify an unknown decedent. Dental features are unique to the individual,
and survive in situations where other identifiable features of the human body might not. (Pretty 2001) Zhou and Abdel-Mottaleb (2004) presented an automated system for identification using dental x-rays. Their system extracted the contours of the teeth and then archived the ante-mortem images based on contours and gum lines in a database. Once a postmortem image is run through the database, this system finds the best matches, and results showed that of the ten postmortem images used as queries, six were correct matches ranked first, three were ranked second, and the remaining one was ranked third.

In summary, each method has its advantages and disadvantages, and its limitations, however with technology advancing at such a rapid rate, it might be tomorrow that these limitations are overcome. Forensic Anthropology today is a different field from what it was when it first began, and part of this is due to research and advances made within the field itself, while another part is due to the field of forensics that surrounds it. As the field of Forensic Anthropology looks toward the future, it is crucial that it is understood specifically how the field of forensics is changing, and how the field of Forensic Anthropology is changing with it. This study hopes to determine how forensic anthropology is actually applied in law enforcement cases by examining its use in the past, and using that information to consider how the field might adjust to remain a useful for the future.
In order to find out specifically how Forensic Anthropology assists in forensic cases, cases handled by the University of Montana’s Anthropology Department from 1971 to 2004 were followed-up. This provided a unique opportunity in that the state of Montana had one state crime lab and one university with a Forensic Anthropology program, the University of Montana, both of which are located in Missoula. Therefore, any case coming through the crime lab could easily be submitted to the UM Anthropology department for analysis by its Forensic Anthropology professors and graduate students.

The case records were in print form and the information had not yet been transferred to an electronic database. It was determined that in order to be as accurate as possible with case information, a database needed to be established. Microsoft Excel was chosen for its ease of use and widespread distribution in Microsoft Office; Excel is used by student, teacher and professional alike, and for those preferring other data entry programs, Excel files can still be readily opened and viewed by just about anyone using Microsoft Office on their computers. Only basic information was collected in consideration of time, resulting in a one page case overview. (Appendix 1) In most cases, this information could easily be obtained from the first page of the agency’s case write-up and the final analysis submitted by the University of
Montana, and it was entered into the database accordingly. In quite a few cases one or the other was missing from the file and so a search of the entire case file was required. Many of the older cases did not have a significant portion of the information as there had not been a protocol established for case analysis. It was important to this study to ascertain early on which cases contained what kind of material - human or non-human skeletal remains. Further, it was noted if there were human remains whether they determined them to most likely represent those of a historic/prehistoric Native American burial, and if there were non-human remains to what degree were they identified. Assessing how Forensic Anthropology assisted forensic cases included making this type of determination because it directly affected whether or not a case was considered to be contemporary and possibly that of a crime, and therefore remained an active investigation, or was closed and determined not to be a case for law enforcement agencies.

Therefore, questions one through three were included on the case overview and answered according to the information present in the file. In total there were 238 cases that the University of Montana provided analysis for. The cases were broken down by year (Table 1) and while some contained either incomplete

<table>
<thead>
<tr>
<th>TABLE 1 Forensic Cases per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004   - 10</td>
</tr>
<tr>
<td>2003   - 11</td>
</tr>
<tr>
<td>2002   - 15</td>
</tr>
<tr>
<td>2001   - 9</td>
</tr>
<tr>
<td>2000   - 14</td>
</tr>
<tr>
<td>1999   - 11</td>
</tr>
<tr>
<td>1998   - 14</td>
</tr>
<tr>
<td>1997   - 12</td>
</tr>
<tr>
<td>1996   - 15</td>
</tr>
<tr>
<td>1995   - 19</td>
</tr>
<tr>
<td>1994   - 13</td>
</tr>
<tr>
<td>1993   - 7</td>
</tr>
<tr>
<td>1992   - 15</td>
</tr>
<tr>
<td>1991   - 6</td>
</tr>
<tr>
<td>1990   - 5</td>
</tr>
<tr>
<td>1989   - 4</td>
</tr>
<tr>
<td>1988   - 5</td>
</tr>
<tr>
<td>1987   - 3</td>
</tr>
<tr>
<td>1986   - 4</td>
</tr>
<tr>
<td>1985   - 8</td>
</tr>
<tr>
<td>1984   - 10</td>
</tr>
<tr>
<td>1983   - 8</td>
</tr>
<tr>
<td>1982   - 9</td>
</tr>
<tr>
<td>1981   - 2</td>
</tr>
<tr>
<td>1980   - 2</td>
</tr>
<tr>
<td>1979   - 3</td>
</tr>
<tr>
<td>1977   - 1</td>
</tr>
<tr>
<td>1976   - 1</td>
</tr>
<tr>
<td>1974   - 1</td>
</tr>
<tr>
<td>1971   - 1</td>
</tr>
</tbody>
</table>

Total cases - 238
or no data other than a case name or number, each was printed out and organized by agency.

Following this a brief questionnaire was created that would accommodate all cases regardless of the findings of the case. (Appendix 2) It was designed to be short enough to avoid non-response due to the survey being perceived as overwhelmingly long and complex. The resulting questionnaire consisted of ten questions, not all of which would apply to each case, but which could provide answers to what happened with the case after the UM submitted its analysis regardless of what the case might have consisted of.

There were a few cases that were problematic for this study. Two cases were field surveys that resulted in no skeletal evidence being recovered. There were three cases that contained no skeletal material, and nine cases that were missing data – either a UM analysis or details regarding where the case came from (agency, etc.). Of these cases, if it seemed possible that the agency might have the missing information a survey was sent. If the case seemed too old and likely that it would be difficult to retrieve, it was not sent. Ten surveys could not be sent simply due to lack of information regarding which agency or private individual requested the forensic analysis. At final count 17 cases of the 238 were not mailed surveys.
With this total now available, an equal number of questionnaires was printed. One letter to each agency was drawn up requesting their time in assisting with this study, and as a courtesy a self-addressed stamped envelope was included. It was requested that completed surveys be returned by January 1\textsuperscript{st}, 2006, allowing two month’s time for completion. Following the mailing of these surveys, the Excel database was developed further in order to accommodate the responses from the surveys. (Appendix 3)
Chapter 3

Results

Once the case file information was entered into the Excel database it was possible to break the cases down into categories based on the information already recorded for each case. Graph 1 shows how many cases the UM received per year. Of the 238 cases, 128 involved only human skeletal remains, 82 involved only non-human skeletal remains, 15 contained both human and non-human skeletal remains, 4 cases contained neither, and 9 were missing.
analysis so the findings are unknown. (Chart 1) A side by side comparison of human cases versus non-human cases is displayed in Graph 2.
Out of the 143 cases that involved human remains, 36 were determined to represent remains from a historic/prehistoric Native American burial. (Chart 2)

Of the 97 cases containing non-human remains, 8 cases were identified only as being non-human, 16 were identified to the level of order, and 73 were identified to the level of genus. (Chart 3)

By January 1st, 2006, 97 surveys had been received. 52 surveys were received regarding cases involving only human remains, 42 surveys were received regarding cases involving only non-human remains, and 3 cases were
received regarding cases involving both human and non-human remains. (Chart 4)

Specific questions regarding the cases involving non-human remains were as follows:

Question 4 asked whether the non-human remains were identified to the agency’s satisfaction. Out of the 45 surveys received regarding cases involving non-human remains, 44 responded yes, 0 responded no, and 1 had no response. (Chart 5)
Question 5 continued with the non-human cases and asked if the UM’s findings lead to a closure in the case. Of the 45 surveys, 40 responded yes, 4 responded no, and 1 had no response. (Chart 6)

Question 9 asked whether or not the anthropological analysis [on the non-human remains] was helpful to the case. Of the 45 cases, 38 responded yes, 0 responded no, and 7 provided no response. (Chart 7)
Specific questions regarding the cases involving human remains were as follows:

55 surveys regarding human remains were received. Of the 36 total UM cases that most likely contained human remains representing a historic or prehistoric Native American burial, 17 surveys were received. Question 6 asked if the remains had been determined to be most likely belonging to a historic/prehistoric Native American burial, had they then been repatriated. 10 replied yes, 5 replied no, and 2 were not answered. (Chart 8)

![Chart 8 - Question 6](image)

Of the 55 surveys received regarding cases involving human remains, 38 pertained to contemporary human remains. Question 7 asked if the remains were of a contemporary human, was the individual(s) positively identified. 23 responded that no identification was made, 6 responded that the identity was known before the remains were submitted for analysis by the UM, 7 responded
that the identity was determined after the remains were analyzed by the UM, and 2 provided no response. (Chart 9)

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not identified</td>
<td>61%</td>
</tr>
<tr>
<td>Known before</td>
<td>18%</td>
</tr>
<tr>
<td>Known after</td>
<td>16%</td>
</tr>
<tr>
<td>Not answered</td>
<td>5%</td>
</tr>
</tbody>
</table>

Question 8 (Table 2) asked for a written response regarding how the remains were positively identified. Of the 38 surveys pertaining to cases involving contemporary human remains, it was determined in Question 7 (Chart 9) that at most 15 of those were positively identified. Only 10 responses were received: 3 were identified by dental analysis, 1 was identified by personal affects associated with the remains, 3 were identified by non-specific x-ray analysis, and these might include dental x-rays, 2 were identified by medical implant devices, and one was identified using DNA.
Table 2 - Question 8

<table>
<thead>
<tr>
<th>Identification Method</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental analysis</td>
<td>3</td>
</tr>
<tr>
<td>Non-specific comparison</td>
<td>3</td>
</tr>
<tr>
<td>Medical Implant</td>
<td>2</td>
</tr>
<tr>
<td>DNA</td>
<td>1</td>
</tr>
<tr>
<td>Personal affects</td>
<td>1</td>
</tr>
<tr>
<td>No response</td>
<td>5 [of maximum 15 positive IDs]</td>
</tr>
</tbody>
</table>

Question 9 also pertained to cases involving human remains, asking if the agency felt as though the anthropological analysis was helpful to the case. Of the 55 surveys received pertaining to cases involving human remains, 52 responded yes, 0 responded no, and 3 provided no response. (Chart 10)

Chart 10 - Question 9 [Human]

- 95% responded yes
- 0% responded no
- 5% provided no answer
Question 11 asked if the human remains are still unidentified and the case is still unsolved if the agency would be interested in having the UM perform a second analysis. 23 of the cases reported not having made a positive identification (refer back to Question 7); of those 23 only 1 requested a second analysis (Chart 11).

The remaining questions pertained to all cases and results are as follows:

Question 10 asked that if the agency had found the anthropological analysis helpful, in what way specifically was it helpful. Not every survey contained a response to this question. There were 59 responses in total (Table 3). The most common response was that the analysis helped in determining that the remains were non-human. The second most common response was that the analysis helped determine age. Following in third place is that the analysis helped determine that the case involved historic/prehistoric Native American
remains. The responses are recorded as they were written in the survey, and as a result some responses are similar in nature.

<table>
<thead>
<tr>
<th>Way in which helpful</th>
<th>No. of times this response appeared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determined remains non-human</td>
<td>14</td>
</tr>
<tr>
<td>Age</td>
<td>9</td>
</tr>
<tr>
<td>Historic/Prehistoric remains</td>
<td>7</td>
</tr>
<tr>
<td>Determined human</td>
<td>5</td>
</tr>
<tr>
<td>Helped identify individual</td>
<td>5</td>
</tr>
<tr>
<td>Determined not a homicide</td>
<td>3</td>
</tr>
<tr>
<td>Confirming an active case</td>
<td>2</td>
</tr>
<tr>
<td>Eliminated scene as a possible burial site</td>
<td>2</td>
</tr>
<tr>
<td>All info was useful</td>
<td>2</td>
</tr>
<tr>
<td>Provided a time frame</td>
<td>2</td>
</tr>
<tr>
<td>Lead to the closure of the case</td>
<td>2</td>
</tr>
<tr>
<td>Determined time since death</td>
<td>1</td>
</tr>
<tr>
<td>Determined a possible homicide</td>
<td>1</td>
</tr>
<tr>
<td>Provided a facial reconstruction</td>
<td>1</td>
</tr>
<tr>
<td>Determined not a historic case</td>
<td>1</td>
</tr>
<tr>
<td>Determined it was a teaching specimen</td>
<td>1</td>
</tr>
<tr>
<td>Located the individual</td>
<td>1</td>
</tr>
</tbody>
</table>

Questions 12 [no graphic] asked if [from the agency’s experience with the UM Anthropology Department] there was anything that the UM might do to improve or make the analysis more beneficial. There were only 13 responses to this question out of the 97 received surveys, and of those 13 only one provided a ‘yes’ response and specifically requested that information about services and prices be made more readily available.

Question 13 [no graphic] provided space for general comments or other notes. Not many took the time to respond to this question, however a few did thank the UM for their service, as well as commented on what a great resource
the UM was to their agency. Overall, comments referred to their appreciation of the UM’s help.

Finally, question 14 asked if the agency would be interested in receiving results from this study. The results are as follows in Table 4:

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billings Curation - David Wade</td>
<td>Chouteau CO</td>
</tr>
<tr>
<td>Billings PD - Det. Blake Richardson</td>
<td>Fergus CO</td>
</tr>
<tr>
<td>Gallatin CO</td>
<td>Flathead CO</td>
</tr>
<tr>
<td>Great Falls PD</td>
<td>Helena PD</td>
</tr>
<tr>
<td>Granite CO</td>
<td>Lewistown PD</td>
</tr>
<tr>
<td>Helena National Forest</td>
<td>Livingston PD</td>
</tr>
<tr>
<td>Hill CO</td>
<td>Miles City PD</td>
</tr>
<tr>
<td>Kootenai CO, ID</td>
<td>Pondera CO</td>
</tr>
<tr>
<td>Madison CO</td>
<td>Stevensville PD</td>
</tr>
<tr>
<td>Missoula PD - Attn. B. Fortunate</td>
<td>Stillwater CO</td>
</tr>
<tr>
<td>Missoula CO - Cap. Greg Hintz</td>
<td>Thompson Falls PD</td>
</tr>
<tr>
<td>MT DCI - Reed Scott</td>
<td>Whatcom CO</td>
</tr>
<tr>
<td>MT DCI - Joe Uribe</td>
<td></td>
</tr>
<tr>
<td>Park CO</td>
<td></td>
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<tr>
<td>Powell CO</td>
<td></td>
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<tr>
<td>Richland CO - Attn. Marv Johnson</td>
<td></td>
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<tr>
<td>Whitefish PD - Daniel Frank</td>
<td></td>
</tr>
<tr>
<td>Wilbaux CO</td>
<td></td>
</tr>
<tr>
<td>Larry Weatherman</td>
<td></td>
</tr>
</tbody>
</table>
Below in Table 5 is a list of the agencies that were either unable or chose not to participate in this study:

<table>
<thead>
<tr>
<th>Table 5</th>
<th>Agencies that did not provide survey responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaconda Deer Lodge Law Enforcement</td>
<td></td>
</tr>
<tr>
<td>Beaverhead CO</td>
<td></td>
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<tr>
<td>Big Horn CO</td>
<td></td>
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<tr>
<td>Blackfeet Law Enforcement/ BIA</td>
<td></td>
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<tr>
<td>Blaine CO</td>
<td></td>
</tr>
<tr>
<td>Butte Silver-Bow Law Enforcement</td>
<td></td>
</tr>
<tr>
<td>Bureau of Land Management</td>
<td></td>
</tr>
<tr>
<td>Cascade CO</td>
<td></td>
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<tr>
<td>Dawson CO</td>
<td></td>
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<tr>
<td>Fort Belknap</td>
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<tr>
<td>Garfield CO</td>
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<tr>
<td>Glacier CO</td>
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<tr>
<td>Golden Valley CO</td>
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<tr>
<td>Jefferson CO</td>
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<tr>
<td>Lake CO</td>
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<tr>
<td>Lewis &amp; Clark CO</td>
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<tr>
<td>Lincoln CO</td>
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<tr>
<td>McCone CO</td>
<td></td>
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<tr>
<td>Mineral CO</td>
<td></td>
</tr>
<tr>
<td>MT State Burial Board</td>
<td></td>
</tr>
<tr>
<td>Musselshell CO</td>
<td></td>
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<tr>
<td>Phillips CO</td>
<td></td>
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<tr>
<td>Powder River CO</td>
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<tr>
<td>Ravalli CO</td>
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<tr>
<td>Roosevelt CO</td>
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<tr>
<td>Rosebud CO</td>
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<td>Sanders CO</td>
<td></td>
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<tr>
<td>Sweetgrass CO</td>
<td></td>
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<tr>
<td>US Dept of the Interior</td>
<td></td>
</tr>
<tr>
<td>Wolf Point Sheriff’s Office</td>
<td></td>
</tr>
<tr>
<td>Yellowstone CO</td>
<td></td>
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<tr>
<td>HRA</td>
<td></td>
</tr>
<tr>
<td>MCIB</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 4
Discussion

*Interpretation of results*

These findings show that the number of cases overall increased from 1971 to 2004. The number of cases containing non-human remains increased as well, and interestingly from 1998 to 2004 non-human cases either matched or surpassed the number of cases containing human remains. Arguably the most valuable piece of information learned from this study was that law enforcement agencies felt the greatest benefit the University of Montana Forensic Anthropology department provided them was simply its ability to distinguish between human remains and non-human remains. Table 3 evidenced this fact by asking in which way specifically was the UM analysis helpful to the case; the most common response was that it determined the remains to be non-human. A large percentage - 34% of the total cases analyzed by the University of Montana involved non-human remains only, with an additional 6% containing both non-human and human remains. From the survey responses received, 89% of the non-human cases were closed as a result of UM analysis (Chart 6). This is a remarkable finding because it suggests that being able to identify remains as non-human has a profound impact on overall case load with law enforcement agencies, and quite possibly is the most substantial contribution the UM provides, at least quantitatively speaking.
The results further show that of the cases containing human remains, 25% were determined to most likely belong to a prehistoric or historic Native American burial. When such a case was brought to the UM for analysis, it was handled according to Montana State Law’s Human Remains and Burial Site Protection Act and noted as such in the forensic analysis submitted to the agency, and this study [Chart 8] showed that following receipt of said analysis, 59% were then repatriated. This figure is particularly gratifying because historically the Native American population in the United States has had a labored relationship with anthropologists and it is befitting that forensic anthropology (as well as all the disciplines of anthropology) be able to work in a congruous way with the Native American community, even if it is now required by law that historic and prehistoric Native American burials be handled with respect and reburied according to cultural tradition.

The responses to question 10 [Table 3] showed specifically what the agencies felt was the most beneficial to the case. Determining the age of the remains was the most common response second to determining if the remains were human or not. This response is ambiguous, however, so unfortunately it can not be determined whether or not age in this response means ‘age at death’ or ‘age of the remains’, otherwise referred to as time since death. The third most common response was the determination that the remains are most likely from a historic/prehistoric Native American burial. Again, since ‘age’ in this question could also mean ‘time since death’ - the UM determining the
remains to be from the historic or prehistoric era - it is possible that really the second most beneficial contribution to agencies is the forensic anthropologist’s training in recognizing remains that are most likely not from the contemporary period. It is this author’s opinion that this is likely to be the case given the fact that these two particular responses were very closely scored. Adding up all the responses associated with ‘time’ or ‘age’: ‘Age’-9, ‘Historic/Prehistoric’-7, ‘provided a time frame’-2, ‘determined time since death’-1, and ‘determined not a historic case’-1 - totals 34% of the responses. This does assume, however, that all responses of ‘age’ were in fact ‘time since death’ as opposed to ‘age at death’ of the individual. Accounting instead for those ‘age’ responses implying age at death, the responses associated with time since death amount to 19% of the responses, and remain the second most important type of information provided to law enforcement agencies as found by this study.

The Contribution of Forensic Anthropology

It was originally presumed by this author that forensic anthropology provided information that ultimately resulted in the identity being established in a large majority of the cases, so it was surprising to learn that 61% of the cases containing contemporary human remains had not been positively identified despite the UM’s analysis(Chart 9). Only 18% of all the cases containing contemporary remains were positively identified after the forensic anthropological analysis. Further it was learned that another 16% of the cases
already were identified before being submitted for analysis. In addition, 8% of the responses for Question 10 stated that helping to identify the individual was the most helpful. Table 2 shows that 40% of the cases that were positively identified were done so using dental analysis or other comparison technique, and here we find another ambiguity. It can be assumed that when ‘dental analysis’ was written as a response to question 8 it probably entailed the use of comparative radiographs, yet when the word ‘comparison’ was written, it is not clear what type of comparisons these were, and whether or not they involved the use of dental radiographs. This survey should have been more specific when asking which method was used and whether it had been used before or after analysis. It would be interesting to learn what specific method had been used after forensic anthropological analysis, and how that compared to the methods used to obtain a positive identification before forensic anthropological analysis.

In hindsight it became clear that one of the flaws of this study was to not ask for more specific answers. A solution would have been to create two different surveys - one with questions for non-human remains, and one for human remains. While this would have made things a little more complicated when organizing the cases for distribution, and those cases with both human and non-human remains would have had two surveys attached to them, it would have resulted in more thorough answers. Questions were frequently skipped over as a result of assuming the question didn’t pertain to their
particular case. It would also have been preferable to specify which questions applied to contemporary human remains cases and which applied to historic/prehistoric Native American remains. Perhaps making a separate survey for Native American burial cases would have eliminated the confusion.

This study has shown that forensic anthropology clearly has helped with law enforcement agencies who believe they have cases containing human skeletal remains. A quick examination by a forensic anthropologist can determine whether or not there is skeletal material, and if so whether it is human or non-human; just this information alone is instrumental to how the agency proceeds with the case from there. Once it is determined that there are human skeletal remains present, a forensic anthropological analysis can determine if the remains are those of a contemporary human or of a prehistoric or historic Native American burial. These first steps in an anthropological assessment are invaluable, dependent on a trained eye and not likely to be replaced by technology. Once the remains are determined to most like be contemporary human remains the estimation for age, sex, stature, and ancestry seems to be helpful but the time since death aspect of the analysis seems to be of the most use.

**Future outlook**

As advancing technology becomes more accessible to both academic research and the applied sciences, forensic anthropology is a field that finds
itself questioning its future usefulness to law enforcement agency cases. Recently, DNA analysis has been becoming more and more prevalent in the field of forensic science, and is being used to identify the deceased in any condition - recently passed or almost entirely decomposed. However, despite the success of DNA analysis, in general it appears that a forensic anthropological analysis allows for a relatively fast and accurate broad estimation about the identity of the victim, and this information provides a profile that can be utilized to help narrow down search parameters and provide a selection of individuals to test DNA or compare radiographs.

As we head into the future, it is likely that access to medical and dental care will increase and this will result in an increase in the number of individuals that have ante-mortem radiographs available for comparison with post-mortem ones. Based on the background research for this study, it would appear that databases for radiographs are currently being established. Along with a national database for DNA already established and its sample size increasing at a phenomenal rate, it should become more accessible to positively identify someone by either radiographic comparison or DNA fingerprinting as we advance into the future. Facial reconstruction will also most likely continue to be useful in helping to generate public recognition and thereby locating potential matches that can be confirmed with DNA or radiographic material. As computer software programs become more
advanced, providing more accurate images of computerized facial reconstructions will help aid this process.

At this time, forensic anthropology is only able to provide information about age and stature in ranges, sex can be determined as more likely one than the other, and ancestry is becoming little more than an educated guess, especially within the United States where cultures are increasingly blending more and more together. Current research in forensic anthropology is becoming more and more technological, and it is possible that one day soon there will be computer programs that, when provided with just a few measurements, would be able to provide a profile to account for age, sex, stature and ancestry. It is this author’s opinion, however, that based on the findings of this study and since individual morphological variation will always be a factor in any database of averages, and while research in these areas should continue to take place, forensic anthropology would do well to focus its efforts in improving its techniques for determining time since death. This is the area that seems to have the most value to law enforcement agencies. Research should ideally be done throughout the U.S. to control for the varying temperatures, climates, geography and circumstances that a body might find itself in, and techniques for determining time since death after all but the skeletal tissue remains should be further developed. Further, courses in non-human skeletal identification should be mandatory in all forensic anthropology programs so that when skeletal remains are submitted for analysis or are being
collected at the scene, determination as to whether or not they are human can quickly be ascertained.
This study was unique in that it followed up on all cases that were sent to the University of Montana’s forensic anthropology lab from 1971 to 2004. This approach enabled a broad perspective into how forensic anthropology is applied to law enforcement cases in the state of Montana. This study showed that of all the cases submitted, forensic anthropological analysis provided the most help by determining that the case did not contain human skeletal remains. Of the cases containing human remains, the biggest contribution was determining time since death, and if the case contained historic or prehistoric Native American remains, recommending that they be repatriated according to Montana State Law. Providing information on time since death is significantly beneficial to cases containing contemporary human remains as well. Following these, providing information pertaining to the individual’s identity was beneficial, but clearly was not the greatest contribution forensic anthropology makes in cases in the state of Montana.
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Iscan MY


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Appendix 1 - UM Forensic Case Database Pg. 1
CASE #

Agency:

Investigating Officer:

Agency Address:

Contact Phone Number(s):

Agency Case Number or Name:

Date evidence was received by UM:

Details of evidence submitted:

Other Information or Summary of UM Analysis:

1. Type of skeletal remains?
   □ Human
   □ Non-human

2. If non-human remains, how specifically were they identified?
   □ Only designated as non-human
   □ At least some were identified to the level of the order
   □ At least some were identified to the level of the genus

3. If there were human remains, were they identified to be those most likely belonging to a historic/prehistoric Native American burial?
   □ Yes
   □ No
Appendix 2 - Blank Survey sent to law enforcement agencies
4. If the remains were non-human, were they identified to your satisfaction?
   □ Yes
   □ No

5. If the remains were non-human, did the UM’s findings lead to a closure of the case?
   □ Yes
   □ No

6. If the remains were a historic/prehistoric Native American burial, were they repatriated?
   □ Yes
   □ No

7. If the remains were of a contemporary human, was the individual(s) positively identified?
   □ Not identified
   □ The individual’s identity was known before the remains were submitted for analysis
   □ The individual’s identity became known after the remains were analyzed

8. If the remains were positively identified, how was this done? (dental analysis, DNA, etc.)

9. Does the agency feel as though the anthropological analysis was helpful to the case?
   □ Yes
   □ No

10. If yes, in what way? [by providing a time frame, helping identify the individual, providing information about possible cause of death, etc.]

11. If the human remains are still unidentified and the case unsolved, would the agency be interested in having the department perform a second analysis on the case?
    □ Yes
    □ No

12. From your experience dealing with the UM’s Anthropology Department, is there anything that you think might help to improve it or make its analysis more beneficial? If so, please explain (for more space you may use the back of this form):

13. General comments or other notes? Please use the back of this form if more space is needed.

14. Would you like a complimentary copy of the results of this study?
    □ Yes (will be mailed out Summer 2006)
    □ No

Thank you for your time!
Updated Case Information as of Jan 2006

Updated agency case #:
Updated agency/mailing address:

4. If the remains were non-human, were they identified to your satisfaction?
   □ Yes
   □ No

5. If the remains were non-human, did the UM's findings lead to a closure of the case?
   □ Yes
   □ No

6. If the remains were a historic/prehistoric Native American burial, were they repatriated?
   □ Yes
   □ No

7. If the remains were of a contemporary human, was the individual(s) positively identified?
   □ Not identified
   □ The individual’s identity was known before the remains were submitted for analysis
   □ The individual’s identity became known after the remains were analyzed

8. If the remains were positively identified, how was this done? (dental analysis, DNA, etc.)

9. Does the agency feel as though the anthropological analysis was helpful to the case?
   □ Yes
   □ No

10. If yes, in what way? [by providing a time frame, helping identify the individual, providing information about possible cause of death, etc]

11. If the human remains are still unidentified and the case unsolved, would the agency be interested in having the department perform a second analysis on the case?
    □ Yes
    □ No

12. From your experience dealing with the UM's Anthropology Department, is there anything that you think might help to improve it or make its analysis more beneficial?

13. General comments or other notes?

14. Would you like a complimentary copy of the results of this study?
    □ Yes (will be mailed out Summer 2006)
    □ No
Appendix 3 - Tallied results as raw data
Forensic Cases per Year

2004 - 10
2003 - 11
2002 - 15
2001 - 9
2000 - 14
1999 - 11
1998 - 14
1997 - 12
1996 - 15
1995 - 19
1994 - 13
1993 - 7 (150)
1992 - 15
1991 - 6
1990 - 5
1989 - 4
1988 - 5
1987 - 3
1986 - 4
1985 - 8 (200)
1984 - 10
1983 - 8
1982 - 9
1981 - 2
1980 - 2
1979 - 3
1977 - 1
1976 - 1
1974 - 1
1971 - 1

Total cases - 238

Total number of cases that involved just human remains: 128 [54%]
Total number of cases that involved just non-human remains: 82 [34%]
[Total number of cases that involved both: 15] [6%]

Total cases with either human and/or non-human remains: 225 [94%]
Total number of cases containing neither human nor non-human remains: 4 [2%]
Total number of cases missing a UM analysis so findings are unknown: 9 [4%]

Total number of surveys returned with responses-97 [97/238 = 41% of UM Cases]

NON-HUMAN FINDINGS
Total number of non-human cases that were only identified as non-human: 8 [8%]
Total number of non-human cases that were identified to level of order: 16 [16%]
Total number of non-human cases that were identified to level of genus: 73 [75%]
[Total: 97 Non-human cases]

Total surveys received regarding non-human cases: 42 [42/97 = 43%]
Total surveys received regarding both: 3 [3/97 = 3%]
Total - 45

15. If the remains were non-human, were they identified to your satisfaction?
   □ Yes 44 [98%]
   □ No 0
   No response 1 [2%]

16. If the remains were non-human, did the UM’s findings lead to a closure of the case?
   □ Yes – 40 [89%]
   □ No – 4 [9%]
   No response 1 [2%]

9. [Non-Human] Does the agency feel as though the anthropological analysis was helpful to the case?
   □ Yes 38 [84%]
   □ No 0
   No response – 7 [16%]

HUMAN FINDINGS
Total number of human cases that were identified to belonging to historic/prehistoric Native American burial: 36
36/143 = 25% - 25% of all the human cases were burials

Total surveys received regarding human cases: 52 [52/97 = 54%]
Total surveys received regarding both: 3 [3/97 = 3%]
Total - 55

Total number of surveys received regarding historic/prehistoric: 17
Total number of surveys received regarding contemporary: 38

17. If the remains were a historic/prehistoric Native American burial, were they repatriated?
   □ Yes 10 [59%]
   □ No 5 [29%]
   Not answered 2 [12%]

18. If the remains were of a contemporary human, was the individual(s) positively identified?
   □ Not identified 23 [61%]
   □ The individual’s identity was known before the remains were submitted for analysis 6 [16%]
   □ The individual’s identity became known after the remains were analyzed 7 [18%]
   Not answered 2 [5%]

19. If the remains were positively identified, how was this done? (dental analysis, DNA, etc.)
   Dental analysis 3
   Personal affects 1
   Other Comparison (such as x-ray of bone break or photographic) - 3
   Medical implant - 2
   DNA - 1

20. [Human] Does the agency feel as though the anthropological analysis was helpful to the case?
    □ Yes 52 [93%]
11. If the human remains are still unidentified and the case unsolved, would the agency be interested in having the department perform a second analysis on the case? [Total 23]
   □ Yes 1
   □ No or not answered 22

ALL SURVEYS

21. If yes, in what way? [was the anthropological analysis helpful] [by providing a time frame, helping identify the individual, providing information about possible cause of death, etc.]
   Not every survey provided an answer for this question
   Age 9 [Age of individual at death or ‘age’ of case not made clear]
   Helped identify the individual - 5
   Determining case was non-human 14
   Determination of historic/prehistoric Native American Burial/Remains 7
   Determining Human 5
   Determining not a homicide 3
   Confirming the agency had an active case 2
   Eliminating scene as a possible burial site 2
   All info was beneficial 2
   Providing a time frame 2
   The information lead to the closure of case 2
   Determining time since death 1
   Determining a possible homicide 1
   Providing a facial reconstruction 1
   Determining not a historic case 1
   Determining it was a teaching specimen 1
   Locating the individual - 1

12. From your experience dealing with the UM’s Anthropology Department, is there anything that you think might help to improve it or make its analysis more beneficial? If so, please explain (for more space you may use the back of this form):
   Not every survey provided an answer for this question
   No 13
   Yes 1 [More info about services and prices, please]

13. General comments or other notes? Please use the back of this form if more space is needed.
   Not every survey provided an answer for this question
   Thank you
   Great resource
   Very helpful

14. Would you like a complimentary copy of the results of this study?
   □ Yes: [a few were blank surveys]
   Billings Curation - Attn. David Wade 5
   Billings PD - Det. Blake Richardson 2
   Gallatin CO 4
   Great Falls PD 5
   Granite CO 1
   Havre, MT (County?) 1 (from ‘unknowns’)
Helena National Forest 2
Hill CO 3
Kootenai CO, ID 1
Madison CO 1
Missoula PD - Attn. B. Fortunate 6
Missoula CO - 19 Cap. Greg Hintz
MT DCI - Reed Scott 3
MT DCI - Joe Uribe 3
Park CO 13
Powell CO 5
Richland CO - Attn. Marv Johnson 2
Whitefish PD - Daniel Frank 1
Wilbaux CO 1
Larry Weatherman - PO Box 1462, Seeley Lake, MT 59868

No thanks: [a few were blank surveys]
Chouteau CO 4
Fergus CO 2
Flathead CO 11
Helena PD 1
Lewistown PD 1
Livingston PD 1
Miles City PD 1
Pondera CO 1
Stevensville PD 1
Stillwater CO 1
Thompson Falls PD 1
Whatcom CO 1

Agencies that did not respond or only returned blank surveys: 134
Anaconda Deer Lodge Law Enforcement 3
Beaverhead CO 1
Big Horn CO 2
Blackfeet Law Enforcement/ BIA 3
Blaine CO 1
Butte Silver-Bow Law Enforcement 5
Bureau of Land Management 1
Cascade CO 7
Dawson CO 1
Fort Belknap 1
Garfield CO 1
Glacier CO 1
Golden Valley CO 1
Jefferson CO 3
Lake CO 13
Lewis & Clark CO 22
Lincoln CO 3
McCone CO 1
Mineral CO 5
MT State Burial Board 1
Musselshell CO 1
Phillips CO 2
Powder River CO 2
Ravalli CO 6
Roosevelt CO 3
Rosebud CO 6
Sanders CO 1
Sweetgrass CO 4
US Dept of the Interior 1
Wolf Point Sheriff’s Office 1
Yellowstone CO 9
HRA 1
MCIB 1
Agencies 'Unknown' - 21