

Resolving Commingled Skeletal Remains

1 Scope

This document describes procedures for resolving commingled skeletal remains to include sorting and estimating either the minimum or likely number of individuals present by Anthropology Examiners within the Trace Evidence Unit (TEU).

2 Equipment/Materials/Reagents

- Sliding calipers capable of measuring items up to 200mm within +/- 0.5mm (Mitutoyo Digimatic Absolute Digital Calipers 500-172-20 CD-8"CX, or equivalent)
- Spreading calipers (digital or analog) capable of measuring items up to 300mm within +/- 0.5mm (Paleo-Tech Digital Linear Spreading Calipers with Mitutoyo Digimatic Absolute Digital Scale 572-213-10, or equivalent)
- Personal protective equipment (lab coat, gloves, eye protection or better, as needed)
- Reversible adhesive (Paraloid B-72 or equivalent)
- Permanent adhesive (cyanoacrylate or equivalent)
- Osteometric board (Paleo-Tech Field Osteometric Board or equivalent)
- Mandibulometer (Paleo-Tech Mandibulometer or equivalent)
- Tape measure
- Sand
- Wooden struts

3 Standards and Controls

Not applicable.

4 Sampling

Not applicable.

5 Procedures

The Forensic Anthropological Examinations Procedure will be followed. When there is reason to believe that more than one individual is present (e.g., through investigative information, duplication of skeletal elements determined in the skeletal inventory, differences in estimated biological features of skeletal elements), field recovery records (e.g., written documentation,

photographs, maps) will be reviewed if available. Such records may provide evidence of direct association of skeletal elements.

The examination will proceed to segregating and sorting the remains, and estimating the minimum or likely number of individuals represented. Provenience information collected during the recovery will be retained. Elements that were articulated at the time of recovery will be maintained as a unit throughout the analytical process where possible.

5.1 Procedure for Sorting/Segregating Commingled Remains

5.1.1 The skeletal remains will be inventoried and, at the discretion of the examiner, may be recorded on the Dental Chart and/or Skeletal Inventory Form, as appropriate, located in the appendices of the Forensic Anthropological Examinations Procedure.

5.1.2 Fragmented bones will be reassembled where appropriate and to the extent possible. In cases where reassembly will be facilitated by affixing fragments (e.g., extreme fragmentation or a large number of specimens), temporary adhesive and stabilizing equipment such as sand and struts may be used.

5.1.3 Bones will be sorted by element, side, size, estimated biological features and other criteria where applicable.

5.1.4 Bones will be associated with each other where possible using any or all of the following techniques:

- Visual pair-matching - the association of left and right elements based on similarities in morphology and size
- Articulation - the association of congruent elements based on closeness of fit at the joint or juncture with another bone
- Osteometric comparison - the association of elements based on statistical evaluation of size and shape relationships
- Taphonomy - the association of elements based on similarities in preservation (e.g., color, condition)

5.2 Procedure for Estimating the Number of Individuals

Estimating the number of individuals represented is typically determined by calculating the Minimum Number of Individuals (MNI). If preservation is good, another option is to calculate the Most Likely Number of Individuals (MLNI). Extremely fragmentary or poorly preserved remains may not be amenable to any meaningful quantification technique.

5.2.1 Minimum Number of Individuals

The MNI is the estimate for the minimum number of individuals that contributed to the sample. MNI is calculated by counting the most repeated element (or portion thereof), after sorting by element and side. When calculating MNI from fragmentary remains, every fragment used to

calculate the MNI must share a specific landmark. Additional individuals may be added to the MNI estimate based on differences in estimated biological features.

5.2.2 Most Likely Number of Individuals

The MLNI is used to estimate the *actual* number of individuals, as opposed to the *minimum* number. It is calculated based on the number of paired and unpaired bones. The formula for calculation of the MLNI is:

$$MLNI = [(L+1)(R+1)/(P+1)] - 1$$

where R= right, L= left, and P= pairs. Good preservation is necessary because it is critical that elements are accurately pair-matched.

5.3 Records

5.3.1 Case Notes

The case notes will include the elements present, the sorting and association techniques used, the number of individuals estimated, the basis of the estimate, and the method(s) and/or reference(s) used.

5.3.3 Reports

The FBI *Laboratory Report* (7-1, 7-1 LIMS) will include the number of individuals estimated, the method(s) used, and the basis of the estimate. For example: “*The minimum number of individuals present is 10, based on the repeated occurrence of complete right femora.*”

6 Calculations

Calculations carried out as part of commingling analysis will be performed according to appropriate reference data.

7 Measurement Uncertainty

7.1 The measurement uncertainty with calipers is approximately ± 0.02 mm or better, depending on the calipers used. Refer to instrument manuals for uncertainty for a particular caliper. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

7.2 The measurement uncertainty with an osteometric board is approximately ± 0.5 mm. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

8 Limitations

The conclusions that can be reached from anthropological examinations for resolving commingling are dependent on the condition and completeness of the remains. Results based on fragmentary or poorly preserved material may be inconclusive.

9 Safety

9.1 While working with physical evidence, laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to biological and radiological hazards may be associated with the examination techniques performed. Safety procedures related to specific instruments or equipment (e.g., wafering saws, X-ray units) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- Forensic Anthropological Examinations, Trace Evidence Procedures Manual (current version)
- Scientific Working Group for Forensic Anthropology guidelines for Resolving Commingled Human Remains (current version).
- FBI Laboratory Safety Manual (current version)

Rev. #	Issue Date	History
1	02/07/2018	Updated throughout removing references to TEU where appropriate; added forensic anthropologists to the Scope in Section 1. Updated Section 2. Removed Section 4 Calibration and renumbered document. Added 'Sample Selection' to new Section 4. Updated Sections 5.1.1, 5.1.2, 5.1.3 for clarity. Updated Section 5.2.1 to add information about additional individuals may be added to the MNI estimate. Updated Section 5.3 to changes from Documentation to Records. Removed Section 5.3.2 on confirmation. For Section 5.3, added FBI Laboratory report to replace report. Updated Section 7 for consistency with Quality Assurance Manual.
2	02/10/2020	Updated references in Section 10. Changed 'forensic anthropologist' to 'Anthropology Examiner' in Scope and 'examiner' throughout. Removed 'Sample Selection' from Section 4 title. Updated wording in Section 5.1.2.

Approval

Redacted - Signatures on File

Trace Evidence Unit
Chief

Date: 02/07/2020

Anthropology Technical
Leader

Date: 02/07/2020