Simon Fraser University
Museum of Archaeology and Ethnology

Bone Artifact Guide

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Note: This Guide does not contain images of human remains. All images are of zooarchaeological remains.

Please address any comments and corrections to museum@sfu.ca.

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Bone Artifact Guide

Introduction

The content of this guide derives from multiple online and published resources; see Scholarly References section below. Hyperlinks are provided for web resources where possible (Accessible as of 2020).

What This Manual Is

This guide is meant to provide a means for Museum volunteers and/or work study students to develop a greater understanding of bone artifacts and tool types, and the variation in their manufacture in British Columbia. This will benefit description and accurate identification of specimens in the future. This is accomplished through:

- Focus on the identification of different types of zooarchaeological bone.
- Clarification on the types of bone tools which exist on the northwest coast.
  - Bone tool typologies.
  - Further aid in identification of species/class for research and cataloguing purposes.
- Consideration of common osteological artifact and element types within British Columbia.
  - Students have different levels of artifact knowledge therefore, only basic object information for record keeping is expected as part of the cataloguing process in order to reduce the potential for error in the museum database and facilitate access for object care and research.
  - To maintain a level of accuracy for collections management purposes we suggest the use of broad, class terms for cataloguing throughout this guide to simplify the cataloguing process.
  - To assist in object identification and description, images are provided.
  - Broad terminology (in addition to database descriptions and references to reliable supplemental texts) helps researchers identify and access objects of potential interest.
    - Please see the Useful Terminology Glossary for more information on descriptive words.
What This Manual Is Not

- A comprehensive osteological guide for identification of zooarchaeological remains.
- A comprehensive osteological guide for identification of osteological remains.

What to do in the case of finding human remains?

- Do not disturb any archaeological finds or remains that you may encounter.
- Contact the BC Archaeology Branch at 250 953-3334

For those interested in museum ethics and standards of practice please gain access to the ICOM Practical Handbook for Running a Museum¹ and research the ICOM Code of Ethics for Museums,² or Natural History Museums.³ The ICOM Code of Ethics for Museums encourages the recognition of shared values by the international community through the standardization of a minimum professional standard. This online reference tool provides guidance through serious principles supported by guidelines for professional practice. ICOM members must accept and comply with the rules of the Code. Please also review the ICOM Code of Professional Ethics.⁴

The ICOM address numerous diverse museum-related topics such as acquisition procedures, compliance with legislation, management of resources, security, returns and restitutions. The Code also advocates strong principles playing a key role in the fight against illicit traffic, for instance concerning due diligence and provenance. Furthermore, the ICOM provides detailed descriptions on the process of a museum loan, educational and cultural programs, and documentation.

Another useful resource for research museum methodology is the Canadian Heritage Information Network Introduction to Documentation of Heritage Collections.⁵

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Handling Bone Artifacts

Much like material culture artifacts, the most common method of breaking a bone is by handling, moving, or touching them. This encompasses the process from excavation and/or primary acquisition, to the exhibition of artifacts. Moreover, similarly to cultural artifacts, bone has a natural position of rest based on factors like bone fragility, fragment, and element shape.

![Figure 1. Gloved hand holding bone fragment, culturally modified through burning.](image)

Handling Skeletal Material: Procedures

The following procedure is a standard in reference to zooarchaeological bone materials

1. Wear gloves in all cases excluding special circumstances.
   a. Bone has large amounts of fragile trabecular bone showing.
   b. Bone is part of a teaching kit and used for educational purposes.
2. When using comparative and archaeological specimens, only remove elements you are asked to remove to prevent unnecessary contact with delicate specimens. Handle all bones carefully.
3. Make sure that both the specimen number, and the location of the museum specimen is noted. Without internal organization, collection identification and comparison may be impossible and make it difficult for future researchers.
4. Only use pencils when working around bone tools and artifacts unless you are specifically directed to do otherwise. Ink may permanently stain specimens.

5. Specimens must remain over the table, tray, and mat so that they do not break.
   a. Note: Specimens will break at their weakest points. When repairing bone artifacts, refrain from strongly adhering pieces together so that is artifact is damaged the damage is to areas which were already broken.

Figure 2. Image depicts an example of poor artifact preservation exhibiting warped glue and loss of trabecular bone accompanied by leftover glove fibers in the glue. Could be due to poor technique or conditions.

Bone Storage

An equilibrium is required for maintaining the integrity of bone specimens whether from waterlogged, or arid sites. (White and Folkens 2005).

- Ideal humidity conditions for most organics is 50%, with no more than a 5% daily fluctuation (White and Folkens 2005).
Labelling Bone

Note: Thorough photographic and written documentation must be done before, during, and after any conservation treatments, such as reconstruction, are performed. This process also pertains to archaeological collections being accessioned into museums.

Freshly excavated bone can be gently rinsed to remove excess soil if burial conditions were moist. Bone may not soak under any circumstances. However, if the bone is very fragile, do not get it wet. Clean bone by brushing off loose dirt with a dry artist’s brush or toothbrush.

Bone should be labelled in a non-diagnostic, discrete location following standard labelling methods including the Borden and Accession Number. (i.e., brush barrier layer such as Acryloid B-72, apply accessioning number, seal using acrylic gloss/sealant layer)

Figure 3. Artifact shown is an Ulnae Awl with a label on the flat lateral portion of the proximal head.
An object may become inaccessible without its catalog number. For this reason, directly label all stable artifacts larger than the size of a dime. The number must be durable to remain legible over time, ideally removable should the need arise to make a change in the future, and never cause harm to the object. Bone artifacts should be labelled using the standard MAE cataloguing methodology including the MAE tripartite or Borden number. Within the systems catalogue object type, material type, description, location, condition, and culture should also be recorded.

Figure 4. A fragmented Projectile Point labelled clearly on a non-diagnostic flat surface.
Preparing Your Assemblage for Identification

Adapted from *Identifying and Interpreting Animal Bones: A Manual* (Beisaw, 2013)

1. Organize bags of bone artifacts by provenience.
2. Create a checklist to organize your collection using an inventory of these bags and their provenience.
3. Inspect the collection before beginning for an understanding of its scope and diversity.
4. Use one or trays to hold the bones of a single bag while analyzing them.
   a. Be sure to keep the provenience information with the bones
5. Use a fine, soft bristle brush and dull-tipped wooden picks or dental picks to remove dirt as needed.
6. Use 10X magnification loop to inspect the bone as needed.
7. Group bones with like characteristics in order to best identify commonalities and establish animal class, element, and tool type.
8. Remove any non-bone materials from bagged collections.
9. Inspect the bones for fresh breaks and make any mends that are possible. Consult specialist or conserver when the repairing a bone artifact appears to be a necessity.
Organization: Sorting Bone from Non-Bone

Bone can also be identified by its microscopic composition. As with identifying individual elements, deciding a material is bone is based on a number of hierarchal decisions. Can we see identifiable dense cortical bone, or a delicate trabecular cortex? Does the material look organic, does it have a homogenous opaque thickness?

See the Figure 5 for a comparative example. Remember to use comparative samples from bone, ceramic, stone, and shell collections to ensure accuracy.

*Figure 5. The comparison of a mammalian and ceramic cross section. Note the similarity in color and outer texture.*
Figure 6. Ceramic shard with small, drilled perforation bearing a striking resemblance to bone. Note the texture and colour, as well as the material thickness.

Knowledge for the Identification of Bone Artifacts

- The initial stage of any identification or zooarchaeological study—much like lithic studies—is to establish typologies and group artifacts into meaningful categories.
  - Bones are grouped by considering a variety of attributes, with multiple attribute states.
  - The groups are exclusive and depend on a variety of genetic attributes which can be further researched after general speculation.
  - For the identification of bone artifacts, students and volunteers must have a comprehensive understanding of bone and tool typologies to accurately categorize and describe bone artifacts.
- Identification via taxa, element, manufacture, tool use can be useful for future research and cataloging purposes.
Figure Bone fragment showing the nature of cortical and trabecular mammal bone. Note the delicate woven texture of the inner material versus the

**What Can the Identification of Animal Osteological Artefacts Tell Us?**

- What can the representation of different bone artifacts in a collection tell us or future researchers?

The presence of specific bones at different sites or during different occupation periods can be indicative of cultural practices or traditions. Bone artifacts uncovered during excavation can help researchers gather information pertaining to the archaeological record and ethnographic history of a traditional community. Information like:

  - Cultural practices
  - Food
  - Trade circles
  - Biodiversity or abundance of food sources
Common Errors in Identification

What can't we do?

- Be too specific.
  - The over analysis rule—sometimes we try to get as specific as we can with bone artifacts to analyze collection. But we do not always have the answer.
- Theory of classification.
- Interpretive and classificatory error.
  - Degree of standardization.

Throughout Zooarchaeological and Museological work there is a marked lack of standardized terminology when dealing with the categorization of irregular artifacts. This makes it difficult for individuals to make statistical or observational comparisons between data from different sites. Adhering to a standard terminology when dealing with archaeological specimens is crucial and individuals should consult the Glossary for methods of categorization.

Confidence and Accuracy in Identifications

Adapted from Identifying and Interpreting Animal Bones: A Manual (Beisaw, 2013)

1. If you are unsure check your intuition against a reliable source. The use of reference collections and online resources in the identification of bone artifact typologies and element/class types is essential. “Reliable data is what you know, not what you think.” (Beisaw, 2013)

2. Exclusion is as important as inclusion. Checking other site lists, or the biodiversity from an area or Borden site may give you a better understanding of the type and manufacture of bone artifact you are dealing with.

3. If you are going to make an unusual identification, you need to be 100 percent certain. For example, do not identify animals not indigenous to the area.

4. Don’t make an identification just to avoid admitting you are not sure what it is!

In museum cataloguing, the most important part is the consistency and standardization of practices not only in nomenclature and data, but also in the accuracy of information. If you interpret an artifact incorrectly, future research or the exhibit potential of the specimen may be comprised.
PART I: Identifying and Interpreting Animal Bones for Collections Management

Identifying and Interpreting Animals Bones

Below I have listed the key features for the identification of Mammals, Birds, Fish, Amphibians, and Reptiles, along with what to look for in the identification of different skeletal elements and fragments. The following information is drawn from The Vertebrate Skeleton (Reynolds, 2013), Identifying and Interpreting Animal Bones: A Manual (Beisaw, 2013), lecture material from Archaeology 340: Zooarchaeology, and supplementary online guides listed in the resources section.

The attribution of an animal specimen to a taxon relies on morphological and biometrical observations of taxon-specific traits, based on the researcher’s experience and comparisons with anatomical atlases and reference collections (see A Note on Reference Collections). Biometrical analyses can be employed to distinguish between taxa that are difficult to separate on morphological grounds. For further classification, techniques such as aDNA can be used.

Vertebrae Typology

Adapted from Reynolds 2013.

Amphicoelous
Centrum concave on both anterior and posterior surface, characteristic of bony and cartilaginous fishes. (Figure 8a)

Opisthocoelous
Good for weight bearing. The centrum in convex on the anterior surface, concave on posterior surface, and characteristic of mammals. (Figure 8a)

Procoelous
Concave centrum on anterior surface, convex on posterior surface, characteristic of other reptiles and amphibians. (Figure 8a)

Acoelus
Lacking cavities; anterior and posterior surfaces are generally flattish and characteristic of mammals. (Figure 8a)

Heterocoelous
Saddle-shaped articular surfaces are interlocking and allows vertebrae to flex vertically and horizontally, found in the necks of birds and some turtles. (Figure 8b)
Figure 8 a, b. Image A (left): sketches of [clockwise from top left] Opisthoceolous, Procoelus, Acoelous, and Amphicoelous vertebral types. Image B (right): sketch of Heterocoelous. Credit: Brynn Bishop

Figure 9. From left to right showing Acrodon, Pleurodon and Thecodont tooth types. Credit: Brynn Bishop
Distinguishing Dentition

Acrodont
Found in most Fish and some amphibians, these teeth do not have a root attachments or sockets and may fall out easily. (Figure 9)

Pleurodont
Diagnostic of most Snakes, Lizards, and Frogs. The formation of teeth is fused by their sides, so they do not have as strong an attachment to the jaw as Thecodonts. (Figure 9)

Thecodont
This tooth type is found in mammals and crocodiles. The tooth root is completely enclosed in deep socket of alveolar bone. (Figure 9)

General Mammalian Identification

Figure 10. Look for thick cortical bone, with delicate trabecular bone in medullary cavity.
Look for:

- Form of the leg.
- Thick cortical bone (Figure 10).
- Development of the clavicle in mammals who use their arms (i.e., flying bats, moles, gibbons; Figure 11).
- Mammalian skeletons vary greatly due to adaptation.
  
  - Ex. Plantigrades, like humans, walk with their entirety of their foot on the ground while Digitigrades walk on phalanges. Ungulates are single hooved.

*Figure 11. Image depicts showing a mammalian clavicle. Note the distinct “s” shaped curve.*
Axial Skeleton

(Reynolds, 2013)

Vertebrae

Mammal vertebrae are large, with a complex shape and large central foramen. The centrum enables flat articular surfaces. (Figure 12)

Rib Fragments

Squarish or rectangular in cross-section, the inner spongy bone is more organized and less dense than in long bones. Rib fragments can often be mistaken for the clavicle. (Figure 13)

Figure 12. Large Mammalian vertebrae.

Figure 13. Mammalian Rib Fragment. Note the ridge and slight curve flattening towards the distal and (right of the image).

Pelvic Girdle

Complex shape with thin to thick outer cortex and irregular spongy bone throughout the interior. Pelvis has a deep acetabulum and large obturator foramen.
Identifying Upper Elements

Figure 14. Comparative diagram displaying the variation and similarity of mammal arm bones and shoulder girdles. From left to right: An aerial mammal with highly flexible articulated wings efficient for energy expenditure (ex. Bat), an arboreal brachiator (e.g., Gibbon), and a semi-terrestrial aquatic mammal (e.g., Sea Lion). Credit: Brynn Bishop

Shoulder girdles

Large fragments of flat bone with no clear interior surface are normally mammalian scapulae, which appear triangular and present as very thin. (Figure 14)
Humerus
Proximal articulation is convex to form rounded shoulder joint. Distal end is a complex with multiple articulation points for radius and ulna.

Ulna
The proximal end of the ulna is hook-like. The shaft is relatively thin but is almost entirely hard cortex while the distal end tapers to a point.

- Radio-ulna
  Proximal articulation is cupped or concave to form elbow.

Radius
Proximal articulation is relatively flat in profile but relatively ovular or D-shaped in cross view. Distal end flares out.

Identifying Lower Limb Fragments of Mammals
Zooarchaeology materials Giovas (2018), initial references from Reynolds (2013)

Femur
Shaft is very round in cross-section; distal end has two large, rounded condyles.

Tibia
Proximal shaft is triangular in cross-section while to distal shaft is D-shaped in cross-section. Proximal end has two articular surfaces separated by a small ridge. Distal articular end has a projection that is positioned medially.

Fibula
Shaft is long and relatively thin and sometimes is fused to the lateral shaft of the tibia depending on the species.

Identifying Metacarpal and Metatarsal Fragments of Ungulates
Both have a very dense outer cortex with little interior spongy bone. Interior may show remnants of the fusion of two bones together; this is also sometimes evident on the exterior of the bone. (Reynolds, 2013)

Metacarpals
Proximal articulation is D-shaped.

Metatarsals
Proximal articulation is square.
Characteristics of Mammal Metapodials

(White and Folkens, 2005)

Carpals

Often resemble small rocks but have many smooth surfaces in between rough surfaces.

Tarsals

Larger size and more complex shape make them easier to identify than carpals.

![Figure 15. Distal ungulate metapodial.](image)

Metacarpals and Metatarsals

Distal end has knob shape or pulley shape.

Phalanges

Proximal end is concave; distal end is convex; a small shaft is in between.
Identifying Antler and Horn Fragments

(Reynolds, 2013)

Antler

Very wood-like or bark-like exterior surface and very dense outer cortex and inner spongy bone, no interior cavity.

Horn

Very dense exterior and interior surfaces are porous with holes penetrating from the exterior surface into the interior.

Figure 16. Cross-section of a horn.
Differentiating Between Terrestrial and Aquatic Mammals

Differentiating between terrestrial and aquatic mammal elements may be helpful in the identification of function and type of bone tool. Sea mammals often have adapted limbs to accommodate swimming.

Figure 17. Semi-terrestrial aquatic mammal. Note the adherence to familiar mammalian skeletal structure with adaptations for movement (i.e., swimming). Credit: Brynn Bishop
Identifying Bird Bone

Bird bone is pneumatized to allow for flight. This means that bones are filled with air cavities to reduce weight. Looking at a cross section of the bone, air pockets in the medullary cavity are evident, while cortical bone may appear thinner and denser. Furthermore, form follows function and there are many skeletal adaptations to allow for flight and flying motions.

Figure 18. General bird skeletal structure for reference. Credit: Brynn Bishop
Differentiating Bird Vertebrae

A bird’s spine is composed of multiple types of vertebrae. Cervical small centrum with three foramina, or small holes, and rear-facing thin bone projections. Thoracic vertebrae have a larger centrum; large neural arch and spinous process and may be fused together. Lumbar vertebrae are fused to each other and fused to the sacral vertebrae and pelvis. Sacral vertebrae are fused to the pelvis as part of the synsacrum. Caudal vertebrae have a small centrum with spinous and transverse processes while the Pygostyle has a vertebral body with a finlike projection.

Note: Bird vertebrae are robust and are often fused together or to other bones, making breakage difficult.
Ribs
Usually flat, some are forked near mid-shaft for the uncinate process.

Pelvis
Fused together to form synsacrum; three foramina form diagnostic pattern.

Identifying Upper Limb Fragments

Shoulder Girdles
Scapula fragments resemble rib fragments without uncinate process. Coracoids break below proximal articulation, leaving blade fragments that are relatively flat but often with shallow depressions or raised lines (Beisaw, 2013).

Humerus
Proximal articulation is rounded and contains a diagnostic fossa and/or crest; distal articulation resembles a clenched fist (Beisaw, 2013).

Ulna
Shaft is relatively round in cross-section and may have a column of raised quill knobs along shaft. The proximal articulation is sloped while the distal articulation is W-shaped (Beisaw, 2013).

Radius
Shaft is relatively round in cross-section; proximal articulation is roundish with a small facet just below it (Beisaw, 2013).

Carpometacarpus
Very dense and complex-shaped bone; proximal articulation resembles a pulley; shaft is split in two; distal articulation may have stepped appearance (Reynolds, 2013).
Figure 20. Image features raised quill knobs along the edge of an Ulnar shaft.

Figure 21. Sketch of a carpometacarpus bone. Credit: Brynn Bishop
Identifying Lower Limb Fragments

Femur
This bone resembles mammal femur but has much thinner walls and is lighter in weight. Additionally, it is less distinctive in shape than a mammal.

Tibiotarsus
The proximal articulation is very angular while the distal shaft has a shallow canal running down it. The distal articulation resembles that of a femur but with less-prominent condyles. Although the proximal end of could be mistaken for a femur, the distal end is more tibial.

Tarsometatarsus
The distal end has three-pronged shape or three trochleae’s; proximal articulation resembles that of a mammal tibia but has two foramina, one on the medial and one lateral side of the anterior shaft surface.

Note: The following section will detail the skeletal structure of Fish, Amphibians, and Reptiles. These bones, although valuable, are often very small and fragmented and individual characterization may be difficult or impossible. Users should attempt to identify specimens into species and then use online and SFU Library sources listed at the back of the book to cross reference if they are unsure.
Identifying Fish Bone

Fish bone is diagnostically waxy and translucent in appearance. Bone biology is very thin and may only be confused with thin flat bone such as scapulae.

The following is an abridged overview of fish elements focusing on those archaeologically abundant in the Northwest Coast. References include http://hbs.bishopmuseum.org/frc/types.html and Beisaw 2013.

Figure 22. Fish skeleton. Source: Wheeler and Jones 1989.

Fish Elements

Vertebrae

Have roundish solid centrum with little or no central foramen. Often mistaken for beading.

Types of Fish Vertebrae include:

- **Atlas**—Anterior-dorsal portion exhibits facets for attachment to the neurocranum; many taxa lack fused neural spine.
- **Anterior/precaudal**—neural spine plus transverse processes extending out to sides.
- **Caudal**—neural spine plus haemal spine extending downward.
- **Penultimate**—only a short neural spine.
- **Ultimate**—no spines, support for tail fin present.
Rib fragments
Long, thin, and curved with transparent to translucent character.

Pelvis
Located near cranium; has irregular looking fin support structures; shaped like a wishbone.

Note: Fish have no scapulae, and many shoulder girdle bones are fused to cranium and resemble neurocranial fragments.

Identifying Amphibian Bone
(Beisaw, 2013)

Axial Skeleton
Vertebrae
Small central foramen, ovular central body with relatively flat articular surfaces, with large lateral projections. Vertebrae are small and robust, making breakage difficult.
Pelvic girdle
Density of the acetabulum and ilium makes these the most common fragments that are still identifiable.

Pelvis
Ilium tends to be the most prominent component of the pelvis.

Shoulder girdle
Small size and density make them resistant to breakage. Furthermore, it resembles pelvic girdle but with longer and thinner elements.

Upper Limb Fragments of Amphibians

Humerus
Proximal shaft has a crest but otherwise has a tube-like appearance and some curvature; distal end is rounded, and ball shaped.

Radio-ulna
Proximal end is concave, and shaft is clearly two shafts fused together; distal end is tube-like, but two tubes fused together.

Identifying Lower Limb Fragments of Amphibians

Femur
Long and thin with no clear features. Not diagnostic.

Tibiofibula
Resembles a long, thin, and compact X shape with a depression or foramen at the center.
Identifying Reptilian Bone

*Figure 24. Reptilian skeleton.*

**Vertebrae**
Small central foramen, roundish central body with a ball-like projection at one end and a depressed articular surface at the other (turtles have two lobes on central body) vertebra are small and robust, making breakage difficult.

**Pelvis**
Density of the acetabulum and ilium makes these the most common fragments that are still identifiable.

**Shoulder girdles**
Resembles pelvic girdle but with longer and thinner elements small size and density makes them resistant to breakage.

**Identifying Upper and Lower Limb Fragments of Reptiles**
*All are relatively paddle-shaped with a dense outer cortex. Articular ends are relatively shapeless when compared to those of mammals.*
PART II: Northwest Coast Bone Tool Identification

Bone Manufacture Methods

Manufacture features are regularly obscured by later use wear marks (Stewart, 2003)

Softer than most stone and harder than wood, the hardness and resilience of bone made it particularly useful. Fresh bone can be split, broken, and splintered. Relatively fresh bone can be modified in various ways, depending on the form and size of the bone and the type of tool desired. (Stewart, 2003)

**Abrading**
The use of abraders, or shaped and sharpened implements. Sharp points on bone tools such as needles, blanket pins, awls, and other items were abraded on a grooved abrader (Morrow, 2016). Look for polished use-wear areas, especially on the tips.

![Figure 25. Image depicts sharpened long bone carver.](image)

**Adzing**
Used on large or tough material, like large mammal antler or bone, chopping marks on artifact may be diagnostic of adzing. (Stewart, 2003)

**Bone Breaking**
See Splintering. Modified by using an anvil and hammerstone. (Morrow, 2016)
Carving
The use of chisels, gouges and/or mallets to carve or incise bone. (Morrow, 2016)

Figure 26. Mammalian vertebral disc likely perforated with a drill, likely to create a pendant.

Drilling
Using a sharp key shaped implement to perforate bone creating a small hole or opening. (Stewart, 2003)

Graver Tip
The graver or engraving tip is a common name given to a small protrusion on a small flake or blade. Gravers are made from almost any flake or chip of chert including broken projectile points. The tell-tale indication that a piece of material or point has been used as a graver is the small, sharp tip that protrudes from the body of the material. Pressure flaking is most often present around the protrusion to make it stand out. Heavy use ware is typically evident at the point of the tip. At times, graver points were an added feature on another tool type.
Figure 27. Image depicts action of splitting long bone shaft. Credit: Brynn Bishop

**Grooving and Splitting**
For some delicate bone tools, it is first necessary to score the parent bone. Grooves outlining the intended tool's form are cut through the hard outer bone to the spongy cancellous tissue using stone tools such as sharp pointed gravers and chisel ended burins. The piece can then be broken free with relative ease and made into an awl or needle. Grooving bone with a modified flake tool can be slow. Soaking the bone in water for a few days can speed up the process by temporarily softening the bone, making cutting and scraping easier. Once the bone is dry, it will return to its hard, resilient state. (Morrow, 2016)

**Ground**
Manufacture is produced by grinding bone with coarse grained stone. Diagnostic striations can be found microscopically. Ground bone tools may also be produced using another bone or organic material. (Stewart, 2003)
Incising
Producing lines or patterns by cutting into or engraving a surface. (Morrow, 2016)

Sawing
Bone can be sawed into sections with a serrated bifacial stone knife or flake tool. After the saw cuts have been made to an enough depth, the bone can easily be broken by hand. Stone drills, either handheld or attached to shafts, may be used to bore holes through bone for making such tools as arrow-shaft wrenches. The small eyes of sewing and matting needles can be made by a sawing or twisting motion with a graver tip.

Scoring
Method used for engraving or scoring bone, antler, or ivory prior to splitting. (Stewart, 2003)

Sectioning
Bone and antler were split or sectioned by driving a stone wedge into an incised groove (Stewart, 2003)

Splintering
Bone smashed with a hammer stone may produce long splinters suitable for needle, fishhook, and barb making among other tools. (Stewart, 2003)

Whittling
The use of knives to shape, shave or incise bone. (Morrow, 2016)
Tools and Decorative Bone Artifact Types

Adze
A tool like an axe, with an arched blade at right angles to the handle, used for cutting or shaping large pieces of wood. Manufactured by sectioning and grinding to shape then abrading the sharpened end. Adzes generally have an asymmetric working blade edge with a moderate edge angle between 50-70° (Koopman 2000). To form an adze, beveled bone was set in a wooden haft. (Stewart 2003)

Figure 30. An antler tine pressure flaker. Credit: Brynn Bishop

Antler Tine Pressure Flaker
Used for knapping lithic materials.
Figure 31. An awl fashioned from an angulate metapodial.

Awl
A small, pointed tool used for piercing holes, especially in leather, and for basketry. Splinters of rib and long bone were also ground into awls (Morrow, 2016). Hollow bird bones also were sometimes broken and split to form awls. Additionally, Ulnar awls were very common, using splitting and grinding to shape the end. (Stewart, 2003) The ulnae of deer could be cut, and then ground and polished to form a sharp tip.

Bark Beater
Tools used to pound tree bark making the bark softer for the processing of materials used for making paper, and clothing. Many variations through indigenous traditions. Most bark beaters can be described as having a parallel grooved pounding surface that is attached to a short handle. Many are made from whale bone, which can be identified by the coarse trabecular tissue and modified mammalian shape (See figure below).

Beads
Often bird or fish bone, already pneumatized and delicate. Beads are small, perforated objects that are often discoidal, but may be square, or tubular, and made of stone, glass, bone, antler, or shell.
Blade

Refers to the cutting edge of a tool. Otherwise known as that portion of a projectile point or knife which extends beyond the haft element. These may be used as is or used as the basis to produce other tools. (Manitoba)

Blanket Pins

Like needles but with no eye.

![Figure 32. Anterior and posterior views of bone chisels.](image)

Chisel

A tool with a characteristically shaped cutting edge of blade on its end, for carving or cutting a hard material such as wood. Manufactured by sectioning and grinding to shape then abrading the sharpened end. Like an adze, long beveled wood would often be set in hafted wood to chisel bark (Stewart 2003)
Figure 33. A club fashioned out of the shaft of a large mammal, probably whale.

**Clubs**
A short staff or stick. Northwest coast clubs were made in such a wide variety of sizes and designs that many of them seem to have been made as one-of-a-kind styled clubs. But there are many that do seem to follow a certain typology. Although clubs on the Northwest coast were often made of stone or wood, those of the bone club variety were made from large mammal elements, predominantly whale. ([http://www.lithiccastinglab.com/gallery-pages/2014januarnorthwestcoastclubs.htm](http://www.lithiccastinglab.com/gallery-pages/2014januarnorthwestcoastclubs.htm))

**Combs**
Treated or modified by the application of a toothed instrument of wood, bone, metal, etc. A comb may be used to smooth and/or decorate pottery or to arrange and disentangle hair.

**De-fleshers**
Refers to a chisel-shaped, often toothed, implement of bone, stone or metal used to remove the fat and flesh from the inner surface of a freshly skinned hide. (Manitoba) These are commonly made from the long bones of large animals, particularly the metatarsals of ungulates. By splitting the bone longitude then cutting the distal end off at an angle and then sharpening and often serrating the exposed edge, the tool could be used to strip the fatty tissues from hides.
**Drill**
Bone which has been sharpened to a point so that it is able to make a hole in other organic materials such as wood, bone or plant. Drills commonly have a bifacially worked point, and a bit that is typically longer, narrower and thinner than other perforators (Rosen in Kooyman 2000: 104) intended to create holes or grooves. Drills can be hafted or unhafted (Kooyman 2000).

**Fishhooks**
Baited hooks used for fishing. Less commonly made of bone, variation in hook style such as barbed. (Morrow, 2016)

**Harpoon Point**
A harpoon is a long spear-like instrument used in fishing, whaling, sealing, and other marine hunting to catch large fish or marine mammals such as whales. It accomplishes this task by impaling the target animal and securing it with barb or toggling valves, allowing individuals to use a rope to the projectile to catch the animal. (Stewart 2003)

*Figure 34. A barbed harpoon point.*
Needle
Like an awl or blanket pin, needles would have likely been made by using a flint tool. Splinters of bone would have been cut out and trimmed roughly into a pointed shape. (Stewart, 2003)
**Net Gauges**

A net gauge is an essential tool used in the making and repair of nets. Net gauges are used to give the net mesh its uniform size. Gauge size is selected by the size of net mesh determined by the size of the designated prey species.

*Figure 37.* An anthropomorphic pendant with a large, whittled hole and groove on one end.

**Pendant**

A carved bone worn as a necklace or amulet.

**Pestles**

A club-shaped or cylindrical object used to crush and grind various materials in a mortar.
Points
Vary in size and function. Where function is reasonably discernable, they can be classified as *projectile points*, otherwise when function is unclear the term "point" is advisable (Kooymann 2000: 105). Point is the term used at the MAE. A point is the sharp tip that is attached to a weapon such as an arrow, spear, harpoon, or dart. (Stewart, 2003)

Scrapers
Refers to an artifact used to remove the fat from the underside of a hide or to smooth wood. The "end" may be defined as the shorter of the edges in a rectangular specimen or the end which initially formed part of the striking platform or the edge opposite it. (Manitoba)
Figure 39. Sketch featuring the basal portion of an antler to be used for soft hammer percussion during flint knapping. Credit: Brynn Bishop

**Soft Hammer Batons-Basal portion of Antler**
Used for soft hammer knapping of lithic materials.

**Tinklers**
Ornamental. Often fashioned from stone, metal, or shell, triangular bone tinklers made from mammal scapulae were used to make a light tinkling sounds on garments.

Figure 40. A valve used for fishing.

**Valve**
Used for composite toggling during fishing.
Figure 41. A wedge used to split workable sections of cedar, often sharpened using an adze or through abrasion. Credit: Brynn Bishop

**Wedge**

Material having one thick end and tapering to a thin edge, that is driven between two objects or parts of an object to secure or separate them. On the Northwest coast the wedge served to split off workable sections from straight grained cedar (Stewart 2003). Wedges were also used to split smaller pieces of wood, or hollow out wooden bowls (Stewart, 2003, pg. 116)

Figure 42. Pneumatized bird bone long bone shaft perforated and used as a whistle.

**Whistles**

Often bird bone, already pneumatized.
PART III: Resources

A Note on Reference Collections

As stated before, the use of a reference collection in zooarchaeology is essential as a means of accurate identification. Individuals attempting to narrow down the bone type or element of an artifact for further description should make use of multiple reference guides as well as lab or museum specimens for comparison when possible.

Scholarly References

Beisaw, April M.

Black, Riley

Driver John C.

Kooyman, Brian P.

Morrow, Toby

Stewart, H.
Online Reference Guides


General Bone Identification (Mainly Mammalian)


Animal Diversity Web https://animaldiversity.org/


The Digital Morphology Library http://www.digimorph.org/

Glossary of Skullogical Terminology http://www.skullsite.co.uk/glossary.htm


Fish Identification

Archaeological Fish Resource http://fishbone.nottingham.ac.uk/

FishBase www.fishbase.org/
Useful Terminology

**Abrader**: a rough tool used to rub or wear away by friction

**Anterior**: situated near or toward the head or part most nearly corresponding to a head.

**Anthropomorphic**: Common descriptor for objects that depicts a human-like form or traits (c.f. Loy and Powell 1977).

**Antler**: one of the paired deciduous solid bony processes that arise from the frontal bone on the head of an animal of the deer family

**Astragalus**: Artiodactyl specific, synonymous with Talus, one of the bones in the ankle. Has upper and lower rounded articulations (areas of contact of bones) and no constricted neck, instead of simply one rounded articulation above a neck, as in other mammals. (Britannica)

**Atlas**: the first vertebra of the neck (White and Folkens, 2005)

**Axis**: the second vertebra of the neck (White and Folkens, 2005)

**Barb**: a small point which faces the opposite direction to the main point on an object such as a fishhook or arrow tip. (Stewart, 2003)

**Beveled**: A word used to describe the shape of the slope of a plane from one surface to another (Loy and Powell 1977). The word may be used to describe the edge of a tool, such as a chisel or adze.

**Bifacial**: Descriptor for a object that has been worked on both sides (Loy and Powell 1977).

**Calcaneum**: a tarsal bone. (White and Folkens, 2005)

**Cancellous**: bone matrix having porous structure (White and Folkens, 2005)

**Canine**: a conical pointed tooth, situated between the lateral incisor and first premolar (White and Folkens, 2005)

**Carpals**: the bones of the hand or wrist. (White and Folkens, 2005)

**Caudal**: directed toward or situated in or near the tail or posterior part of the body. (White and Folkens, 2005)

**Cervical**: the first vertebra in the spinal column, usually 7. (White and Folkens, 2005)

**Class Term**: A broad overarching term used to categorize objects with similar characteristics.
**Cortical**: The dense outer surface of bone that forms a protective layer around the internal cavity. This type of bone also known as compact bone makes up nearly 80% of skeletal mass and is imperative to body structure and weight bearing because of its high resistance to bending and torsion. (White and Folkens, 2005)

**Cranium**: the bones of the skull except for the mandible (White and Folkens, 2005)

**Deciduous teeth**: a temporary tooth of a young mammal (White and Folkens, 2005)

**Diagenesis**: chemical, physical, and biological changes in bone over time. (White and Folkens, 2005)

**Diaphysis**: the shaft of a long bone (White and Folkens, 2005)

**Distal**: situated away from the point of attachment or origin or a central point especially of the body

**Dorsal**: relating to or situated near or on the back especially of an animal or of one of its parts or caudal, directed toward or situated in or near the tail or posterior part of the body

**Enamel**: a layer of hard brittle material that covers the crown of the tooth (White and Folkens, 2005)

**End Use Tools**: tools which have been retouched or used to their full potential.

**Engraved**: Common descriptor for an object that has striations or furrows purposefully etched onto the surface.

**Epiphysis**: the cap at the end of a long bone which develops at the end of an ossification center (White and Folkens, 2005)

**Femur**: the proximal bone of the hind or lower limb that extends from hip to knee. (White and Folkens, 2005)

**Fibula**: the outer and usually smaller of the two bones between the knee and ankle in the hind or lower limbs of vertebrates. (White and Folkens, 2005)

**Foreshafts**: the forward portion of the shaft of an arrow. This is the portion which the arrowhead is attached to through design or using a secondary material. (Morrow, 2016)

**Grinding stone**: grinding stone, whetstone, any coarse-grained stone used to sharpen, dull, shape or polish other tools by abrasion. (Stewart, 2003)

**Haft**: the handle of a knife, ax, or spear. (Stewart, 2003)

**Handle**: the part by which a thing is held, carried, or controlled. (Meriam Webster)

**Horn core**: The bony inner shaft of a typical horn
Horn: one of the usually paired bony processes that arise from the head of many ungulates and that are found in some extinct mammals and reptiles (Stewart, 2003)

Humerus: the long bone of the upper arm or forelimb extending from the shoulder to the elbow (White and Folkens, 2005)

Ilium: the broad, dorsal, upper, and largest of the three principal bones composing either half of the pelvis (White and Folkens, 2005)

Incisor: a front tooth adapted for cutting, located in mammals between the canines when canines are present (White and Folkens, 2005)

Ischium: the lower and posterior of the three principal bones composing either half of the pelvis (White and Folkens, 2005)

Lash Grooves: Grooves on an object that are a result of wear from organic material wrapped around an object to attach it to another object (e.g., a haft).

Lateral: away from the center, or sagittal line, of an animal

Lipping: outgrowth of bone in liplike form at a joint margin. (White and Folkens, 2005)

Lumbar: The final and largest vertebral bones, which support the increasing weight of the body. (White and Folkens, 2005)

Mandible: a lower jaw consisting of a single bone or of completely fused bones, or either the upper or lower segment of the bill of a bird (White and Folkens, 2005)

Margin: The edge or outer edges of a bone, flake, or tool.

Maxilla: an upper jaw especially of humans and other mammals in which the bony elements are closely fused, or either of the two bones that lie with one on each side of the upper jaw lateral to the premaxilla and that in higher vertebrates bear most of the teeth (White and Folkens, 2005)

Medial: being towards the center, or sagittal line, of an animal

Medullary Canal: the marrow cavity of a bone found, for example, in the diaphysis or shaft of long bones. (White and Folkens, 2005)

Metacarpal: a bone of the part of the hand or forefoot between the carpus and the phalanges (White and Folkens, 2005)

Metatarsal: being the part of the human foot or of the hind foot in quadrupeds between the tarsus and the phalanges (White and Folkens, 2005)

Molar: a tooth with a rounded or flattened surface adapted for grinding, a cheek tooth in mammals behind the incisors and canines

Ossification: the natural process of bone formation (White and Folkens, 2005)
**Pedicle**: antler pedicle is an area on the frontal bone that generates antler. It is a permanent feature of the skull and remains after the antler is cast off. It is the perennial source of the regenerating antler.

**Pelvis**: a basin-shaped structure in the skeleton of many vertebrates that is formed by the pelvic girdle and adjoining bones of the spine. (White and Folkens, 2005)

**Perforated**: a hole or pattern made by or as if piercing, drilling or boring. (Stewart, 2003)

**Permanent teeth**: any of the second set of teeth of a mammal that follow the milk teeth, typically persist into old age, and in humans are 32 in number (White and Folkens, 2005)

**Phalanx**: one of the digital bones of the hand or foot of a vertebrate (White and Folkens, 2005)

**Pneumatized**: Bird bone is pneumatized to help with flying. Pneumatic bones are hollow bones which contain air spaces, and having air-filled cavities helps make the skeleton light in weight.

**Polished**: Descriptor of an object that has been worked on using fine grained abrasive material to remove minute irregularities; giving the surface a smooth finish (Kooyman 2000: page 175).

**Posterior**: situated behind.

**Premolar**: being or relating to those teeth of a mammal in front of the true molars and behind the canines when the latter are present (White and Folkens, 2005)

**Proximal**: next to or nearest the point of attachment or origin, a central point, or the point of view

**Pubis**: the ventral and anterior of the three principal bones composing either half of the pelvis (White and Folkens, 2005)

**Radius**: the bone on the thumb side of the human forearm (White and Folkens, 2005), a corresponding part of vertebrates above fishes

**Reduction Process**: Methods in which pieces or objects go through levels of wear whether purposely or naturally (LG).

**Rib**: any of the paired curved bony or partly cartilaginous rods that stiffen the walls of the body of most vertebrates and protect the viscera. (White and Folkens, 2005)

**Sacral**: The vertebrae that lie between the lumbar and the caudal vertebrae in the vertebral column. The function of the sacral vertebrae is to articulate securely with the pelvic girdle, and they are usually fused to form a single bone (the sacrum) to provide a firm support. (White and Folkens, 2005)
Scapula: either of a pair of large triangular bones lying one in each dorsal lateral part of the thorax. (White and Folkens, 2005)

Serrated: notched or toothed

Skull: the bones of the head including the cranium and mandible (White and Folkens, 2005)

Spatulate: having a broad rounded edge. (Stewart, 2003)

Stemmed: descriptor of a protrusion out of the base of a projectile.

Sternum: a compound ventral bone or cartilage of most vertebrates other than fishes that connects the ribs or the shoulder girdle or both. (White and Folkens, 2005)

Sub-class: A secondary or smaller category beneath a wider or more generalized topic – meant to specify in more detail objects or classifications (LG).

Suture: Articulations along skull bones, interlocking, saw tooth or zipper like articulations (White and Folkens, 2005)

Tarsal: the part of the foot in vertebrates between the metatarsus and the leg (White and Folkens, 2005)

Thoracic: The middle vertebra between the cervical and lumbar vertebra. Attachment site for ribs. (White and Folkens, 2005)

Tibia: the inner and usually larger of the two bones of the vertebrate hind or lower limb between the knee and ankle. (White and Folkens, 2005)

Tine: A pointed branch of an antler.

Trabecular: Composed of trabeculated bone tissue, otherwise known as cancellous. Found at the ends of long bones where bone is full of holes connected by thin rods and bone tissue. (White and Folkens, 2005)

Typology: study of or analysis or classification based on types or categories (Reference)

Ulna: the bone on the little finger side of the human forearm (White and Folkens, 2005)

Unifacial: A tool with only one face of the object having been worked (Kooyman 2000, page 177).

Use wear: The wear evident on a stone tool resulting from use. It may include small flakes being detached from the edge of tool, the formation of polish, or abrasion leaving striations (Kooyman 2000:177).
**Ventral**: abdominal, being or located near or on the anterior or lower surface of an animal opposite the back

**Vertebra**: one of the bony or cartilaginous segments composing the spinal column, consisting in some lower vertebrates of several distinct elements which never become united, and in higher vertebrates having a short more or less cylindrical body whose ends articulate by pads of elastic or cartilaginous tissue with those of adjacent vertebrae and a bony arch that encloses the spinal cord (White and Folkens, 2005)

**Zoomorphic**: Similar to Anthropomorphic in describing objects that have human-like characteristics, however zoomorphic entails general animal features rather than just human (LG).