ZOOARCHAE-OLOGY
MODULE

Table of Content

Zooarchaeology

Vocabulary

Adaptation:
An evolutionary change in a species in response to changing environmental conditions or moving into/utilizing a new habitat.

Articulate:
To intersect with another bone, either in a relatively mobile joint like a hip or shoulder, or a relatively immobile joint like ribs articulating with vertebrae.

Cancellous bone:
The inner portion of bone that is filled with a fine network, or lattice, of bony struts

Cortical bone:
The dense outer layer of a bone

Diaphysis:
The main shaft portion of a bone

Distal:
The end of a longbone that is oriented away from the core of the body

Epiphysis:
The end portion of bones; in juvenile animals the epiphysis and diaphysis are separate bones that gradually fuse together as the individual matures

Epiphyseal plate:
A thin layer of cartilage between the epiphysis and the diaphysis; this is where most bone growth occurs

Femur:
The thigh bone, or upper leg bone

Humerus:
The upper arm bone

Island biogeography:
The scientific study of the distributions of animal species living on islands

Linnaean Hierarchy:
The system used to organize all living things in a way that reflects their evolutionary histories

Medullary bone:
The hollow inner portion of a longbone shaft; medullary bone is filled with marrow, oil, or air

Ossification:
The process of converting cartilage into bone

Paleontology:
The scientific study of animal remains that reflect natural (i.e., non-human) patterns of animal activities or behavior

Phytogeography:
The scientific study of the distributions of different plant species

Proximal:
The end of a longbone that is oriented towards the core of the body

Quadrupedal:
Uses all four limbs for walking

Zooarchaeology:
The scientific study of animal remains that reflect patterns of human activities or behavior

Introduction:

This module introduces students to the discipline of **zooarchaeology** (pronounced either "zoh-ark-e-ol'-o-gee" or "zew-ark-e-ol'-o-gee") and highlights how zooarchaeology has been used in the Kurils Biocomplexity Project. Students will

- Examine and identify bones
- Learn how to determine age and sex of the bones, and
- Analyze zooarchaeological data from their lab work and (optional) data from the KBP Expeditions.

Zooarchaeology is an interdisciplinary field that combines zoology (the study of animals) and archaeology (the study of past human activities). Like its sister discipline, **paleontology**, zooarchaeology is focused on the study of bones, teeth, and shells. The difference between the two disciplines is that zooarchaeological samples are found in association with human activities and reflect human behavior (the "archaeology" part). Paleontological samples come from deposits that reflect natural geological processes but do not have any evidence of human activity.

How does zooarchaeology work?

The first step in any zooarchaeological analysis is to identify what animal the bone or shell sample has come from. Zooarchaeologists rely on the fact that animals that are closely related to each other tend to have similar-looking skeletons. Animals that are not closely related tend to have different-looking skeletons. The degree of difference or similarity usually scales with how closely related two species are.

Once a bone has been identified, there is a wide range of data that are typically documented for any given bone, including age-at-death, degree of fragmentation, presence of any cultural modifications such as cut-marks or burning, and so on.

One incredibly important aspect about zooarchaeological data is that the kinds of data recorded depend entirely upon what the research question is. If a zooarchaeologist is working in a region where little or nothing is known about how prehistoric peoples made a living, simply documenting what species of animals were used for food would be a significant contribution to our understanding of that culture.

In contrast, in an area where the basic diet is well-known, as in many areas of the Pacific Northwest, more elaborate research questions can be addressed, such as "How did the occurrence of tsunamis affect the availability of shellfish?" or "How did deer populations respond to human hunting pressure?" The kinds of data needed to answer these types of questions can vary quite a bit. But it all starts with being able to identify what species any given bone (or shell) comes from.

How to distinguish **fish** from **birds** from **mammals**

Introduction:

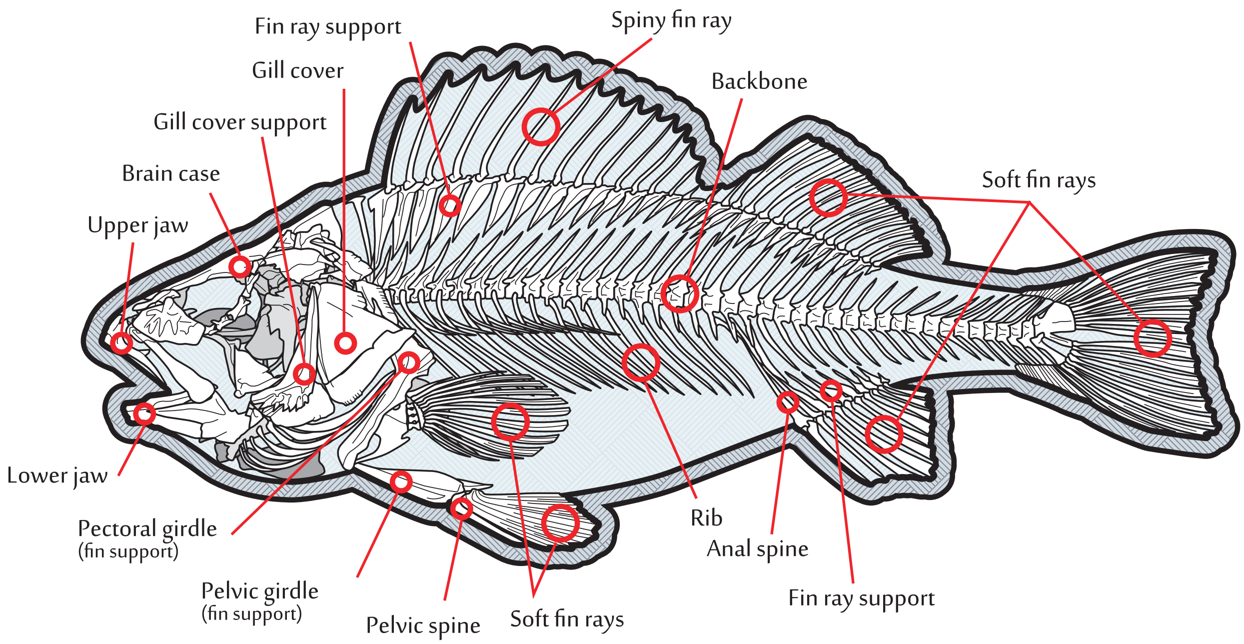
One of the most difficult aspects of teaching zooarchaeology is how to describe the ways to distinguish the bones from various classes of vertebrates (birds, fish, mammals). Fish bones, for the most part, are easily recognizeable because their skeletons are dramatically different from birds and mammals.

Look at the examples of fish bones provided, and you will see that this shows up in the individual bones, whether they be the vertebrae (cylindrical, often with spines projecting from them) or the cranial (skull) bones (usually thin, flat bones).

Teaching students how to distinguish bird bones from mammal bones is often much more difficult. Almost everyone has probably heard that bird skeletons are uniquely adapted for flight, with thin, hollow bones. While this is generally true, unfortunately, this characteristic alone can't be used to reliably distinguish bird bones from mammal bones. This is because there is a lot of overlap between birds and mammals in the external and internal structure of their bones.

First, let's look at the body plans of birds and mammals. Birds and mammals both evolved from a common ancestor that was quadrupedal (had four legs). Although some bone structures have changed over millions of years of evolutionary divergence, the overall body plan is still much the same in both groups.

This module will focus on only two skeletal elements: the **humerus**, or upper arm bone and the **femur**, or thigh bone (both of which are shaded black in the diagrams of the skeletons). Notice that the placement of these bones is the same in the raven as it is in the mammals.



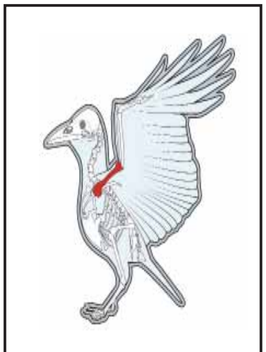
The Kuril Biocomplexity Project: www.kbp.org

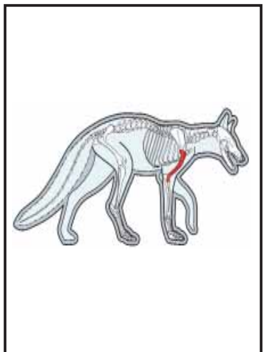
External Structure:

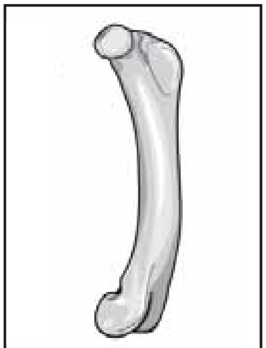
Because the structural requirements of a limb used for flight are so different from the structural requirements of a limb used for running, it is probably not surprising that bird humeri differ from mammal humeri in their external structure.

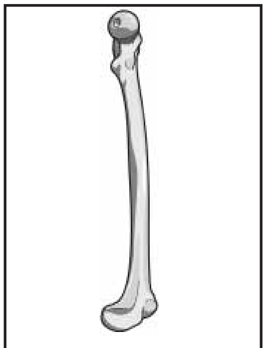
The biggest differences can be seen in the "head" of the humerus—the portion of the bone that fits into the shoulder joint. The head of a bird humerus tends to be broadly flared and a bit flattened, and is often noticeably hollow. In contrast, the heads of mammal humeri tend to be rounded and smooth, approximating a "ball - and - socket" joint (but see more on this with the femur), and are constructed of solid bone.

The femur provides a slightly different story. The legs of birds are used in much the same way as the legs of mammals—for supporting their body weight while walking. Consequently, the structural requirements are fairly similar, and the external structure of bird femora is not all that different from mammal femora (Figure xx). Both have a well-developed ball-and-socket joint that fits into the hip; both tend to be relatively straight-shafted; and both have a pair of surfaces at the knee joint that articulate with the shin bone.


Raven Humerus


Red Fox Humerus


Cormorant Femur


Human Femur

Internal Structure:

Now lets see what the bones look like on the inside. Find the longitudinally sectioned goose humerus and coyote humerus and examine them closely. As you can see, the main portion of the shaft of the goose humerus is thin-walled and hollow. The ends of the bones are filled with delicate struts of bone—these add structural support to the bone. Now look at the sectioned humerus from the coyote. Although the cortical bone is generally thicker than it is in the goose humerus, **the bone is hollow**. Furthermore, although the structure is a bit different, the ends of the coyote humerus are also filled with delicate struts of bone.

Special cases, and why it's difficult to generalize:

Turn now to the femora. There are subtle differences in the thickness of the cortical bone and the degree to which the ends are filled with bone struts. But both the goose femur and the coyote femur are hollow in the mid-shaft of the bone.

The patterns we've looked at so far are generalizations—they hold true for most species in most cases. Now let's look at some special cases where the general pattern doesn't hold.

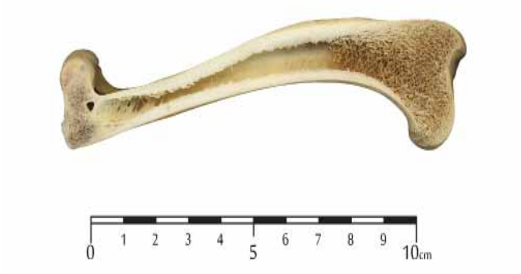
- diving birds: cormorants, puffins, penguins (extreme)
- flightless birds: emu, ostrich
- swimming mammals: seals, sea lions, fur seals, cetaceans (extreme)

For instance, birds that spend a substantial part of their lives diving under water in search of food often have developed skeletal features to make this easier. Lightweight, hollow bones are not advantageous to a diving bird. Consequently, natural selection has resulted in the evolution of bones that are relatively dense, and may actually be filled with oil or other fluids.

Likewise, marine mammals like pinnipeds (seals and sea lions and fur seals) spend a substantial part of their lives in the water. The structural demands this puts on the skeleton are very different than if they were full-time terrestrial species, and this shows up in the internal bone structure. In pinnipeds, the entire shaft of the humerus and the femur is filled with spongy cancellous bone.

Goose Humerus

Coyote Humerus



Seal Humerus

Name: ______________________________

Excercise #1

Identifing Species

Introduction:

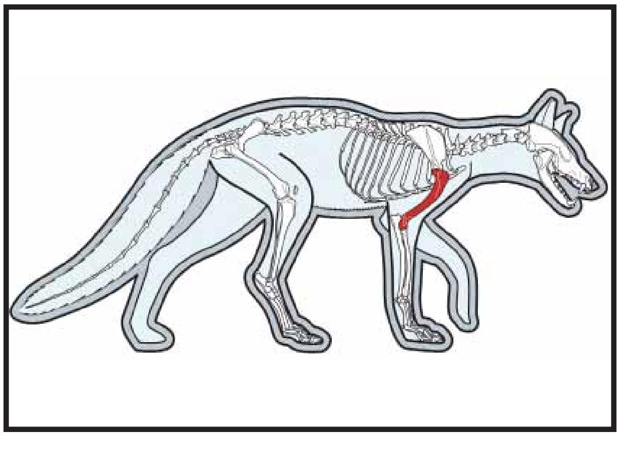
It may seem like an obvious first step, but one of the most common questions zooarchaeologists are asked by non-zooarchaeologists is: "Is this bone?" In fact, there are a lot of sticks and stones that do a great job of impersonating a bone. And, truthfully, bones, especially fragments of bone, can also sometimes look like sticks or stones.

But suppose you have something that you know is definitely a bone. The next step in a zooarchaeological analysis is to identify which particular bone, or fragment of a bone is represented in the sample.

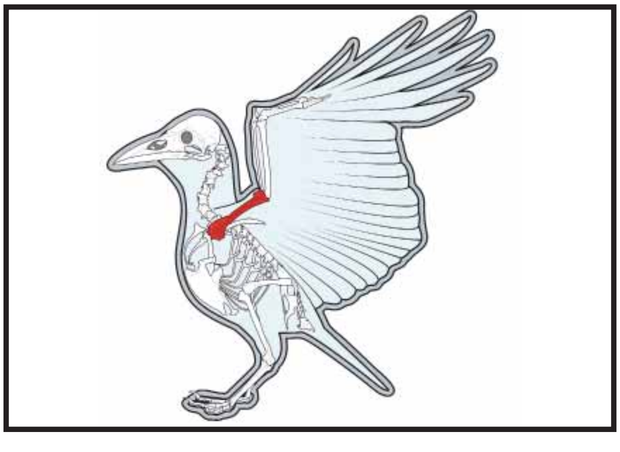
Finally, the zooarchaeologist has to determine what species of animal the bone sample has come from. Sometimes zooarchaeologists can determine even more from a bone, such as how old the animal was when it died, and whether it was a male or female (see "Age and Growth" sub-module for more information).

Each of these steps in the bone identification process requires that you know a lot about skeletal anatomy—a knowledge base that takes years and years of training and experience to accumulate.

You and your classmates will probably only be utilizing this Burke Box for a couple of weeks, and will probably only spend one or two class periods with the Zooarchaeology Module. That will probably not give you enough time to gain a full familiarity with skeletal anatomy. That is why this zooarchaeology sub-module—Identifying Species—will only focus on one skeletal element, the humerus (or upper arm bone).



Diagrammatic skeleton of a fox. The bone shaded black is the humerus.



Diagrammatic skeleton of a raven. The bone shaded black is the humerus.

Name: ______________________________

Excercise #1

Identifing Species

For the species identification, zooarchaeologists rely on the fact that animals that are closely related to each other tend to have similar-looking skeletons. Animals that are not closely related tend to have different-looking skeletons. The degree of difference or similarity usually scales with how closely related two species are.

The Artifacts Module discusses the fact that there are multiple ways to organize, or classify, artifacts. This flexibility allows researchers to analyze the artifacts in various ways depending on the research question they are interested in answering.

Zooarchaeologists already have a single, unifying organization structure in which to analyze the bones, teeth, and shells they find—the Linnaean Hierarchy. The Linnaean Hierarchy is named for Carl Linnaeus, the scientist from Sweden who formalized the system in 1735. This system organizes all the worlds' organisms into a hierarchical system that reflects the evolutionary history of those organisms—that is, how closely related they are.

Here is the hierarchy, with an example we will use throughout this module:

1. **Kingdom** → Animalia
2. **Phylum** → Vertebrata
3. **Class** → Mammalia
4. **Order** → Carnivora
5. **Family** → Canidae
6. **Genus** → Canis
7. **Species** → Canis familiaris, domestic dog

Look at the following table to see how all of this relates to skeletons.

Order	Family	Genus	Species	Common Name
Carnivora	Canidae	Canis	Canis familiaris	domestic dog
Carnivora	Canidae	Canis	Canis latrans	coyot
Carnivora	Canidae	Vulpes	Vulpes vulpes	red fox
Carnivora	Procyonidae	Procyon	Procyon lotor	raccoon
Carnivora	Phocidae	Phoca	Phoca vitulina	harbor seal
Carnivora	Otariidae	Callorhinus	callorhinus ursinis	northern fur seal
Artiodactyla	Cervidae	Odocoileus	Odocoileus virginianus	white-tailed deer
Artiodactyla	Cervidae	Odocoileus	Rangifer tarandus	black-tailed deer
Artiodactyla	Cervidae	Rangifer		caribou

Name: ______________________________

Excercise #1
Identifing Species

For instance, foxes and dogs are very closely related members in the Family Canidae. Not surprisingly, their skeletons look very similar. Likewise, white-tailed deer and black-tailed deer are closely-related species within the same Genus (Odocoileus), and have very similar-looking skeletons. Bones from the other species in the Order Carnivora listed in the table are more similar to each other than they are to bones from species in the Order Artiodactyla. Finally, bones from various species of mammals are more similar to each other than they are to bones from various species of other Classes, such as birds (Class AVES—see the "Identifying Class" sub-module).

Zooarchaeologists use this basic pattern, years of training, and lots and lots of reference skeletons (complete skeletons of known identity), to help them identify archaeological samples.

The exercises in this module will focus on only one skeletal element: the humerus, or upper arm bone (shaded black in the diagrams of the skeletons). You will learn the basics of how zooarchaeologists identify what species a bone comes from, using species that either are found in the Kuril Islands, or are closely related to species that are found in the Kuril Islands (as well as in Washington State).

List of species used in this sub-module:

herring gull (*Larus argentatus*)
common murre (*Uria aalge*)
double-crested cormorant (*Phalacrocorax auritus*)
snow goose (*Chen caerulescens*)

fur seal (*Callorhinus ursinus*)
harbor seal (*Phoca vitulina*)
deer (*Odocoileus virginianus*)
fox (*Vulpes vulpes*)

Lets start with some terminology for different parts, or landmarks, of the bones. These are the anatomical parts that help zooarchaeologists be consistent in the ways they describe bones from various species, as well as specific identification characters, or features, that can be used to distinguish different species from each other. (See figue on next page)

Name: ______________________________

Excercise #1

Identifing Species

Step 1:

Start with reference bones. Use either the set of mammals bones or the set of bird bones. Choose one bone and sketch (or trace) the outline of the bone. Using the slide from the slideshow, label at least four of these characters/landmarks.

Name: ______________________________

Excercise #1

Identifing Species

Step 2:

Using the landmarks identified in the drawings, describe how each of the three reference bones in the set you have selected (either mammals or birds) is different from each other. Some important aspects of the landmarks may be their size or shape.

Name: ______________________________

Excercise #1

Identifing Species

Step 3:

Now, identify the fragmentary bones in the "Unknowns" bagusing the reference collections. Remember that size and shape are the two characters that are most helpful in identifying a species. All of the species illustrated here (4 bird species, 4 mammal species) are represented (by fragments). But there are also bones from a species not represented here.

Record the appropriate species for each specimen in the table (see next page). Each species will be represented by one or more fragments of bone. If you think a bone specimen is not a good match to any of the species in your list, mark it as "unknown."

Examine the "unknown" bone/s closely. Which of the four reference species does it most resemble? (Hint: Remember that closely-related species typically have bones that look similar to one another).

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Name: ______________________________

Excercise #1

Identifing Species

Specimen number	Species		Specimen number	Species
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KBP Burke 0135			KBP Burke 0155	
KBP Burke 0136			KBP Burke 0156	
KBP Burke 0137			KBP Burke 0157	
KBP Burke 0138			KBP Burke 0158	
KBP Burke 0139			KBP Burke 0159	
KBP Burke 0140			KBP Burke 0160	
KBP Burke 0141			KBP Burke 0161	
KBP Burke 0142			KBP Burke 0162	
KBP Burke 0143			KBP Burke 0163	
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KBP Burke 0145			KBP Burke 0165	
KBP Burke 0146			KBP Burke 0166	
KBP Burke 0147			KBP Burke 0167	
KBP Burke 0148			KBP Burke 0168	
KBP Burke 0149			KBP Burke 0169	
KBP Burke 0150			KBP Burke 0170	
KBP Burke 0151			KBP Burke 0171	
KBP Burke 0152			KBP Burke 0172	
KBP Burke 0153			KBP Burke 0173	

Possible species: Cormorant, Gull, Mallard, Murre, Deer, Fox, Fur seal, Harbor seal, Unknown.
The unknown "challenging" bone should be the coyote (in bold).

Name: ______________________________

Excercise #1

Identifing Species

Additional Explorations

All of the bone sketches in this module were developed from three-dimensional digital images created by the Virtual Zooarchaeology of the Arctic Project (VZAP). These images are stored as portable document files, otherwise known as PDFs, and can be viewed on most computers. Each of the illustration files is included on the DVD in the Burke Box. Once the files are opened and activated, you can view the illustrated bone from any angle by simply dragging the mouse/cursor.

To view the three-dimensional illustrations, double-click on the PDF file you are interested in.

Single-click on the image to “activate” the 3D capabilities.

Click and hold the mouse, and then rotate the bone by “dragging” it in any direction.

Name: ______________________________

Excercise #2

Age and Growth

Step 1:

Using reference bones included in this section and the illustrations as a guide, separate the diaphysis (long bone shafts) into two piles, one for humeri and one for femora.

Step 2:

Using the illustrations **AND** the sorted bones, determine which of the loose end caps (unfused epiphyses) belong with the humeri and which belong with the femora.

Step 3:

Using the broad categories in the table below, how many bones of each age are in your sample of humeri? How many bones of each age are in your sample of femora? You do not need to count the reference bones in your totals. You can ignore the fact that the bones may be from different species. However, if an unfused epiphysis definitely fits onto a diaphysis, count the matched pair as ONE bone.

	Humerus	**Femur**
Juvenile (no fused epiphyses)		
Sub-adult (only one epiphysis fused)		
Adult (all epiphyses fully fused)		

Step 4:

Using the information about the age when different epiphyses fuse in different species of animals (see laminated handout), determine as precisely as possible the age-at-death for the samples listed below. (D = distal; P = proximal):

species	**bone**	**state of fusion**	**Age Estimate**
dog	humerus	D unfused; P unfused	**answer:**
red fox	femur	D unfused; P fused	**answer:**
deer	femur	D fused; P fused	**answer:**
harbor seal	femur	D unfused; P unfused	**answer:**
male fur seal	humerus	D fused: P unfused	**answer:**
female fur seal	humerus	D fused; P unfused	**answer:**
fur seal, sex unknown	humerus	D unfused; P unfused	**answer:**

Name: ______________________________

Excercise #2

Age and Growth

Step 5:

Coyotes are intermediate in size between dogs and red foxes. Assuming that their growth patterns are also intermediate between dogs and red foxes, fill in the following table with your predictions of the age of fusion for the humerus and femur.

species	Proximal Humerus	Distal Humerus	Proximal Femur	Distal Femur
dog	10 months	5-8 months	6-9 months	6-8 months
coyote	**ans:**	**ans:**	**ans:**	**ans:**
red fox	17 weeks	16 weeks	26 weeks	28 weeks

Name: ______________________________

Excercise #3
Quantification

Using the set of bones for the Quantification exercise answer the following questions:

Question 1:
Keeping in mind that this exercise includes only two skeletal elements (humerus and femur), outline the steps you would take to determine what the MNI (minimum number of individuals) is for the sample.

Now follow these steps to answer the following:

Question 2:
What is the MNI for this sample, and what was it based on?

Question 3:
Suppose that all of the skeletal elements in your sample came from different individuals. What is the maximum number of individuals that could be represented in your sample?

Question 4:
What is the NISP of the sample, and how does that relate to your answer to Question 3?

Name: ______________________________

Excercise #3

Quantification - Continued

Question 5:

What is the MNI for femora. Is it the same as for humeri? Why or why not? Which MNI would you use to represent the number of animals at the site?

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Name: ____________________________

Analyzing Data

Part 1

The following set of exercises is based on realistic data for three archaeological sites in the Kuril Islands.

Step 1 (optional). Using the spreadsheet of raw data, tally the total number of specimens identified for each species (NISP), from each stratum, for each of the three archaeological sites. Put your totals in the appropriate boxes on the table "Bone ID NISP blank table" (data for Simushir, Stratum 1, are already provided).

PAY CAREFUL ATTENTION TO INFORMATION PROVIDED IN THE "COMMENTS" COLUMN OF THE DATA TABLE.

Step 2. Using either your results from Step 1, or the provided data table ("Bone ID NISP data"), answer the following questions:

1. Are there significant changes through time in the number of albatross that were harvested at Rasshua?

2. Do you think the changes in albatross use at Simushir are significant?

3. Is it safe to conclude that the people living on Ushishir did not own dogs? Why or why not?

4. List at least two hypotheses that could explain the increase in sea otters at Rasshua. Be sure to examine the dates of occupation (see "Stratigraphic dates" table in the spreadsheet).

Name: ______________________________

Analyzing Data

Part 1

Step 3 (optional). Using the spreadsheet of raw data, tally the minimum number of individuals (MNI) represented by the sample of bones for each species FOR ONE STRATUM from only ONE SITE (data for Simushir, Stratum 1, are already provided). Use information about the skeletal element that is represented, any age or sex information that is recorded, as well as information in the "Comments" column of the spreadsheet. Enter your MNI data in the appropriate boxes in the table "Bone ID MNI blank table," including what you based your calculations on (for instance, in Stratum 1 at Simushir, the MNI of salmon is 1 based on the presence of either bone, while the MNI of albatross is based on the presence of a single humerus).

Step 4. Using either your results from Steps 1 & 3, or the provided data tables ("Bone ID NISP data" and "Bone ID MNI data"), answer the following questions:

1. When the data are quantified using MNI instead of NISP, do you come to a different conclusion about the trend in albatross use at Rasshua? Why or why not?

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2. When the data are quantified using MNI instead of NISP, do you come to a different conclusion about the trend in albatross use at Simushir? Why or why not?

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Step 5. Imagine that you have lost the stratigraphic information from the deepest part of your excavations at Rasshua (Stratum 3 and Stratum 5). You still have the data table of identifications, but now you must recalculate the NISPs and the MNIs with these two strata combined. Fill out the table "Combined Strata Blank" and answer these questions:

1. How do the NISPs change relative to the original, un-combined strata?

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2. Do the MNIs change in the same way? Why or why not?

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Name: ______________________________

Analyzing Data

Part 2

Now you'll have the opportunity to explore real data from your own state! (requires internet access). You'll have an opportunity to explore the actual Kurils data in "**Analyzing Data, Part 3"**.

Archaeological and paleontological data are typically available to the public, especially if the project is funded through a federal agency like the National Science Foundation. Although the standard approach scientists use to make their data available is to publish their results in scientific and popular journals, the internet is an increasingly popular outlet for making data broadly available.

One of the most comprehensive on-line databases is called the "Neotoma Paleoecological Database." The database is named after a curious rodent called a pack rat (scientific name *Neotoma*), which has a habit of collecting scraps of vegetation and storing them in large piles in caves. These piles accumulate and in the right conditions can preserve for tens of thousands of years. Paleoecologists study the vegetation in these pack rat "middens" to understand how climate has changed through time.

The Neotoma database is an on-line archive of a wide range of paleoecological data, including pollen studies and mollusk studies, as well as paleontological and archaeological bone data.

To access this on-line database, open the URL for the "Neotoma Paleoecological Database" (using the web browser of your choice): **http://www.neotomadb.org**

You should see a screen that looks something like this (it changes occasionally, so don't be alarmed if it doesn't look exactly like this):

Use your mouse to move the cursor over the word "DATA" at the top left of the screen. When the line of words appears that reads "Overview Contribute Data Tilia FAQ Explore Data etc..." move the cursor to the word "Explore Data" and click on that to open the link.

Finally, click on the map or the "Go to the Neotoma Explorer" link at the bottom of the page to launch the "EXPLORER" function of Neotoma.

Name: ______________________________

Analyzing Data

Part 2 - Continued

[You can by-pass all of this by simply loading the following URL. However, this also by-passes interesting and potentially important back-ground information about the Neotoma database]. **http://www.neotomadb.org/data/category/explorer**

VERY IMPORTANT NOTE ABOUT NEOTOMA MAPPING FUNCTION: You must specify if you want Neotoma to search only within the area of the map visible on your screen, or if you want to search globally [see "Geographic Coordinates" at bottom left of screen]. Either approach works fine, just be aware that the area visible on your screen might determine how complete your search is.

The first search you will perform will be to find all the paleontological and archaeological data that have been recorded for Clallam County, which lies at the extreme northwest corner of Washington State.

To do that, start typing "United States" in the "Place Name" section of the Search window on the left-hand side of the screen. A drop-down list will appear. You can either scroll down through the list, or you can continue typing "United States_Washington_Cl…." until the following appears:

Once you have "United States_Washington_Clallam" showing in the "Place Name "section, click the "SEARCH" button at the bottom left corner of the screen.

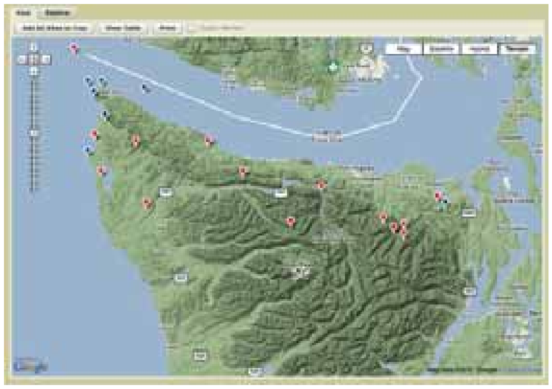
There are several ways to view the search results. Most immediately, you should see a map with several pin-flags showing the locations of sites with paleontological and archaeological data. Adjust the zoom level either by using

Name: ______________________________

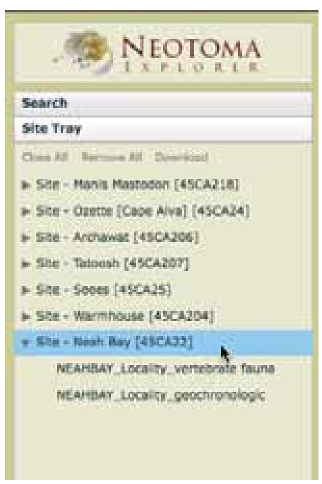
Analyzing Data

Part 2 - Continued

the slider on the left, or by double-clicking on the map (to re-center and zoom in). Blue pin flags represent archaeological/paleontological sites (there are 7 on the map), and red pin flags represent pollen sites (14 total, with some modern and some ancient).



You can also view the search results in table format by toggling the "View Map/View Table" button. To find data for a specific site, you need to load the site on the "Site Tray." To do this, either double-click on a pin-flag, or in the map view, click on the "Add All Sites To Tray" button.



To see what has been loaded onto the "Site Tray," click on the white bar at the bottom left corner of the screen (the white bar that says "Site Tray").

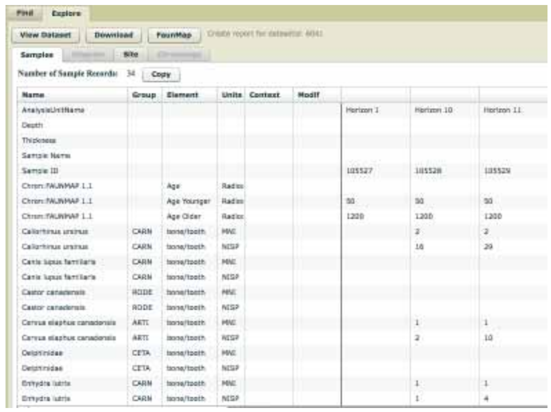
Now double-click on the site you are interested in. If it is a modern sample, the table entry will expand to show only one additional line of text, which will lead you to the data for that site (by double-clicking on the text). If the data are from an ancient site, the table entry will expand to show two additional lines: one for the data, and one for the geochronological information (i.e., the dating for that site).

Name: ____________________

Analyzing Data

Part 2 - Continued

As an example, navigate to the data table for the archaeological site called "Neah Bay." It is represented by the blue pin flag out near the middle of the Strait of Juan de Fuca [this is not actually the true location of the site; the true location has been intentionally "blurred" to limit the amount of illegal and destructive looting of this sensitive archaeological site]. Double-click on the text that reads "NEAHBAY_Locality-vertebrate fauna" and you should see this table:



Name	Group	Element	Units	Context	Modif			
AnalysisUnitName						Horizon 1	Horizon 10	Horizon 11
Depth								
Thickness								
Sample Name								
Sample ID						105527	105528	105529
Chron:FAUNMAP 1.1		Age	Radio					
Chron:FAUNMAP 1.1		Age Younger	Radio			50	50	50
Chron:FAUNMAP 1.1		Age Older	Radio			1200	1200	1200
Callorhinus ursinus	CARN	bone/tooth	MNI				2	2
Callorhinus ursinus	CARN	bone/tooth	NISP				16	29
Canis lupus familiaris	CARN	bone/tooth	MNI					
Canis lupus familiaris	CARN	bone/tooth	NISP					
Castor canadensis	RODE	bone/tooth	MNI					
Castor canadensis	RODE	bone/tooth	NISP					
Cervus elaphus canadensis	ARTI	bone/tooth	MNI				1	1
Cervus elaphus canadensis	ARTI	bone/tooth	NISP				2	10
Delphinidae	CETA	bone/tooth	MNI					
Delphinidae	CETA	bone/tooth	NISP					
Enhydra lutris	CARN	bone/tooth	MNI				1	1
Enhydra lutris	CARN	bone/tooth	NISP				1	4

Adjust the column widths if you need to by dragging-and-dropping the edges of the column, or by double-clicking on a column boundary. Here are some of the key components of the data table for Neah Bay:

Date of deposits: Ranges from 2,000 radiocarbon years BP to 50 radiocarbon years BP.

Species represented: *Callorhinus ursinus* (northern fur seal), *Canis lupus familiaris* (domestic dog, entered here as a sub-species of wolf, *Canis lupus*), and so on.

Quantification Units used: Both MNI (minimum number of individuals) and NISP (number of identified specimens) were recorded for this particular collection of bones [see the "QUANTIFICATION" lesson if you need to review quantification methods]. Occasionally species are recorded in Neotoma only as present/absent, with a "1" indicating that at least one bone was identified from that stratum.

Using the Neah Bay data table answer these questions:

1. How many horizons, or strata, are represented by the data? ____________________

2. What is the total NISP for raccoons (*Procyon lotor*) for all horizons combined? ____________________

3. What is the total NISP for northern fur seals (*Callorhinus ursinus*) for all horizons combined? __________

4. What is the total MNI for northern fur seals (*Callorhinus ursinus*) for all horizons combined? __________

Name: ______________________________

Analyzing Data

Part 2 - Continued

OTHER SEARCHES

You can also narrow your search by other search terms.

Start by first clearing the previous search results (unless you want to combine two or more searches). To do this, click on the "Remove All" button at the top of the Search Tray. Then click on the white bar at the top left corner of the screen (the white bar that says "Search").

To search for data for different species, use the "Taxon Name" section of the Search window. To see a map of all the sites that have a particular species (black-tailed deer (*Odocoileus hemionus*) in this example) recorded in them, start typing "Odocoile..." and use the drop-down list to select black-tailed deer.

Using the same approach as you did for extracting data for the Neah Bay site, answer these questions [Remember that the "Geographic Coordinates" setting may affect your search results]:

1. How many total sites are recorded in North America that contain black-tailed deer bones? ______________

2. Describe the geographic distribution of the sites that contain black-tailed deer bones.

____
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____
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____
____

3. How many sites in Washington State contain black-tailed deer bones? ____________________________

Name: ______________________________

Analyzing Data

Part 3

All of the zooarchaeological data for the Kuril Islands sites have also been entered into the Neotoma database.

In order to see the map distribution of all the sites with faunal remains, enter “Russia_Sakhalin [Sakhalinskaya]” into the “Place Name” section of the Search window.

1. How many sites in the Kuril Islands are reported to have faunal remains? ______________________________

2. Based on information presented in the Settlement modules of the Kurils Burke Box, what is the total number of archaeological sites recorded?______________________________

3. Are the answers to Question 1 and Question 2 the same? Why do you think this is the case?

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