# ANCESTRAL AFFINITIES OF PACIFIC NORTHWEST NATIVE AMERICANS

**By Gary Morris © 1981, 1986, 1992, 2004, 2010, 2013, 2020 EMAIL (2020) garymorris93@gmail.com**

**<http://freepages.rootsweb.com/~lopezislandhistory/history/other/Ancestral Affinities Pacific Northwest Americans.pdf>**

## INTRODUCTION

Relationships based on cranial measurements were examined for the area in the Pacific Northwest from the Columbia River to Alaska. This study examined not only population means, but each individual within a population. Several methods were employed. The results suggests three major physical types in the area: (1) Salish (descent from the Northern Native American Branch), (2) Locarno Beach descent from an Early Southern Native American Group, likely from an early Columbia River group (related to other Early Southern Native Americans, including Kennewick Man), and (3) the Fraser River Old Cordilleran, a group of the Northern Branch of the Early Asian West America people who inhabited much of west America, the oldest forms found in Central California.

(1) The dominant Northwest physical type descended about 7,000 and 13,000 years ago from the **NORTHERN NATIVE AMERICANS (NNA)**, which includes Salish, Na Dene, Wakashan, Penutian, Eskimo, and probably Algonquian. Penutian early on occupied the upper Columbia River (and more recently the lower Columbia). The Salish were in the Upper Fraser River Canyon by 7500 years ago, and expanded out 4500 to 2500 years ago.

The ancestral NNA may have been formed by a combination of two groups, one very likely SNA, and the other likely the Chukchi of NE Siberia. These groups, with a combination of the SNA/Paleo Eskimo, point directly at the Native North American groups (Salish, Wakashan, Na Dene, and Penutian).

(2) The second major group is the Locarno Beach type, a group of the Pacific Northwest branch of the **SOUTHERN NATIVE AMERICANS**, which includes Kennewick Man, SE Washington, Buhl, Idaho, Early San Juan Islands, and the earliest Queen Charlotte Island skeletal material. The Locarno Beach occupied the Gulf of Georgia and adjacent mainland some 2500 to 3500 (or 5000+) years ago, and faded out with the arrival of the Salish. Locarno Beach were closely related/descent from the "EARLY SAN JUAN" physical type, were early on the Columbia River and then spread up the west Cascades thousands of years ago (Puget Sound Olcott Phase, and N Olympics 10,000-4,000 years ago), and up into the Straits and to the Queen Charlotte Islands before 3500 years ago. There are clear indications the Locarno Beach/San Juan type descend into the historic Chemakum isolate Olympic group, but this cannot be proven.

(3) The oldest group in the Pacific Northwest were the **Early Asian Pacific Northwest group**, a part of the (Early Asian) West Americans, found in SE Oregon, Utah, and the Fraser River. The Early Asian Pacific Northwest group includes the earliest on the Fraser River, known as the Fraser River Old Cordilleran (found at the Glenrose Cannery Site). They are descent from an Eastern Oregon band. There is a hint that they possibly might have persisted within the Coquitlam Indians, found just east of Vancouver. Their physical type is separate from Native Americans (Northern and Southern), an (Early Asian) form descent apparently from a group in NE Asia perhaps 20,000 years ago. Likely Native Americans originated as a 50-50 cross about 20,000-30,000 years ago, between Ancient North Eurasians (most Europeans descend from this same group), and probably a similar West America or Central California Early Asian form.

**SOUTHERN NATIVE AMERICANS**: About 23,000 years ago, Native Americans split off from their ancestral North Asian ancestors (50-50 mix Ancient North Eurasian, and probably an (Early Asian) form). About 15,500 years ago, in Beringia, the Southern Native Americans branched off from the Northern Native Americans, and entered the Central Continent between 15,000 and 13,000 years ago. There is good indication that an early split occurred within SNA, one branch going to the east, then south about 13,000 years ago (New Foundland, SE US, Mexico and on into

South America), and the other group eventually further split into a Northern Plains group (ancestral Sioux) and Pacific Northwest group, and soon into the Southwest.

**In the Pacific Northwest we have several main groupings of Northern Native American Populations**: Salish, Wakashan (Kwakiutl and Nootka), Penutian (Yakima, Chinook, Oregon, and California), NaDene (Haida, Tlingit and Athapaskan), and the likely Southern Native American, Chemakum. Most findings suggest that Salish, Wakashan, Penutian, and NaDene were late comers to America (beyond the Arctic), spreading south between 11,000 and 7,000 years ago, along with the Algonquian, they are known as the Northern Native Americans.

By 10,000 years ago a group of **Early Asian Americans** migrated from the south, probably from the Great Basin (SE Oregon), and settled on the Upper Fraser River (Millikin Phase). By 7,000 BC they had occupied the Fraser River Delta, and survived until about 1,000 BC when the Salish began inhabiting their territory, either assimilating their genes into the Salish, or adopting the tribe as a sub tribe of their own.

Historically the percentage of this type concentrates along the Fraser River and apparently along the Skagit River also. It may be that the historic Coquitlam band are the remnant survivors of the Fraser Delta (Early Asian). The Coquitlam were slaves of the Kwantlen (Fraser Delta Halkomelem Salish), and that a whole tribe were slaves to another, is almost unheard of anywhere in Salish territory. As tradition goes, the Coquitlam band possessed no land, and during a great winter famine the Coquitlam people sold themselves into slavery to the more numerous and prosperous Kwantlen Tribe.

# PHYSICAL TYPE CLASSIFICATION

**With our present knowledge of cranial variation, it is possible to classify Pacific Northwest populations into several main physical types:**

## NATIVE AMERICAN - NORTHERN BRANCH:

The Northern Native American branch is distinct from the Southern Native Americans. The ancestral population was probably similar to the Southern type, and with admixture 14,000-10,000 years ago with ancestral Chukchi, the result was a distinct Pacific Northwest group of the Northern Native American.

### WAKASHAN:

The ancestral Wakashan were of the "Koskimo" Type, historically found purest within the Koskimo of NW Vancouver Island. The Koskimo village were claimed to be the "Chiefs of Chiefs", and thus must have retained the "royalty" of the Kwakiutl.

The Wakashan may have inhabited the British Columbia Coastline for 9,700 years (as evidenced from Namu). They were part of a much larger Maritime Oriented Coastal group, linking culturally and physically with the Eskimo and Aleut. Thus, it would seem likely that Wakashan originated by sea, migrating south from Alaska to the BC Coast, about 10,000 years ago. The Nootka migrated to Western Vancouver Island probably about 3,000 BC (or as late as 1,000 BC).

Cranial Data shows a strong core element within the Kwakiutl (Koskimo and Fort Rupert). A SNA (e.g.- Locarno Beach) element shows up in NE Vancouver Island (Bella Bella and 25% Nimkish), and also half of the Nootka.

### SALISH:

The Salish settled on the Upper Fraser River Canyon by 5,500 BC (Nesikep Tradition), to the Lower Fraser River Canyon by 4,300 BC (Eayem Phase), and began spreading outward by 2,500 to 1,500 BC. It was not until about 550 BC that they took over the Fraser River Delta, and outward into the San Juan Islands and southward.

### PENUTIAN:

The Penutian were likely in Eastern Washington by 10,000 years ago, and may represent the Okanagan and Indian Dan Phases before 3,500 BC. The early Marmes crania (SE Washington) from about 10,000

years ago, even with the very little data available, when compared to all other data in the United States, surprisingly fit closest to Paleo Penutian.

At present (2020) it appears that along the early Columbia River were two groups: the Southern Native Americans (SNA), represented by Kennewick Man, and early Penutian represented by the early Marmes skeletons. The SNA probably occupied most of the lower Columbia, and probably between 4,000 and 7,000 years ago migrated up west of the Cascades. However the data supports that probably between 4,000 and 7,000 years ago a distinct group was formed along the lower Columbia, by a combination of the early Penutian (about 2/3 to 3/4) and SNA (about 1/3 to 1/4). Later, in the past few thousand years, the Chinook became a combination of this later mixed group, and a remnant "mostly pure" Penutian very likely similar to the early Marmes fossils. This combination resulted in historic Chinook Penutian.

### NA DENE:

### ESKIMO:

# NATIVE AMERICAN-SOUTHERN BRANCH

### EARLY SAN JUAN

The basal levels of the San Juan Islands had very high and narrow skulls (originally found at Argyle Lagoon, San Juan Island, and later found at Hidden Inlet, Lopez Island). It is possible that this type may be ancestral to the historic Chemakum of the Northern Olympic Peninsula, Washington State, but at present it is difficult to say who the Chemakum actually are.

The cranial data suggests the EARLY SAN JUAN type to be distinct from all Pacific Northwest Indians. It is very likely that they descend from the first inhabitants of the Lower Columbia River perhaps earlier than 10,000 years ago to about 4 thousand years ago, with other groups migrating up into Western Washington perhaps 8 to 10 thousand years ago, and along the coast up many thousands of years ago. The Early San Juan were closely related to the Locarno Beach people of the Gulf Islands and adjacent mainland 5000-3000 years ago.

Early excavations of the Lower Columbia River describe the earliest inhabitants had very high and narrow skulls, closely matching the description of the Early San Juan Group. It is very likely that a remaining portion of this lower Columbia River group combined with early Penutian (See above). The San Juan/Locarno Beach also fit closely, 8,000-13,000 years ago, with the Early Pacific Northwest Branch of the southern Native Americans, which includes the Kennewick Man, SE Washington.

### CHEMAKUM:

At present, it seems likely that the Chemakum are descent from remnant San Juan/Locarno Beach people.

The Chemakum occupied the Northern Olympic Peninsula by 1,000 BC, and then were probably confined to the Hoko River area between 600 BC and 150 BC. About 150 BC is the estimated time that the Chemakum split into two groups, the Quileute along the Olympic Coast, and the Chemakum on the NE Olympic Peninsula, near Port Townsend. It is the Chemakum who became extinct over 100 years ago, but the Quileute are a growing band.

It is likely that the Chemakum have inhabited the Northern Olympic Peninsula since at least 8,500 years ago (Manis Mastodon site). Paleo Chemakum probably includes all the prehistoric populations of the Northern Olympic Peninsula and the Old Cordilleran Component in Northern Puget Sound (Olcott Phase) about 4,000 to 8,000 years ago.

### LOCARNO BEACH TYPE

The Locarno Beach type were apparently derived from ancestral San Juan, and even earlier, Lower Columbia populations.

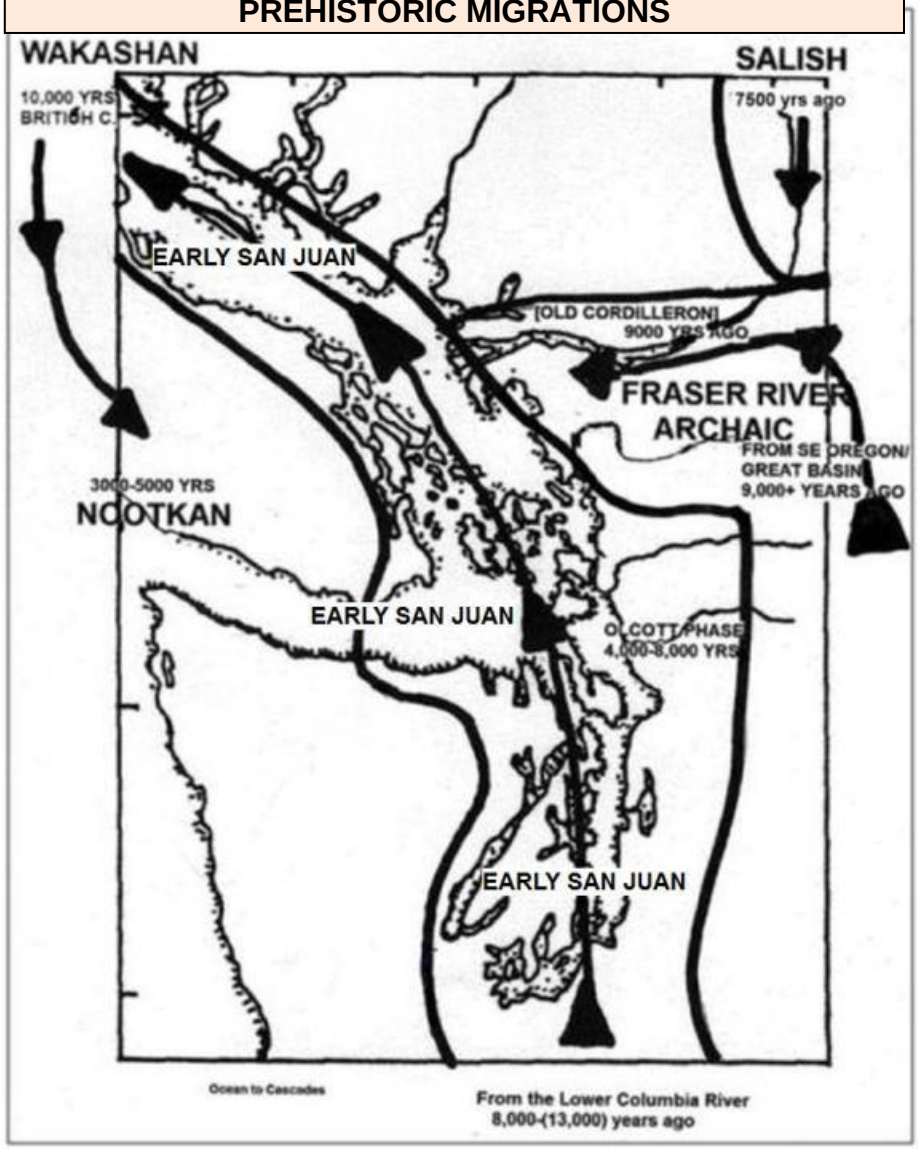
### QUEEN CHARLOTTE ISLANDS 3000 YEARS AGO (BLUE JACKET SITE)

# EARLY ASIAN WEST AMERICAN PACIFIC NW BRANCH

## FRASER RIVER (EARLY ASIAN) ("OLD CORDILLERAN")

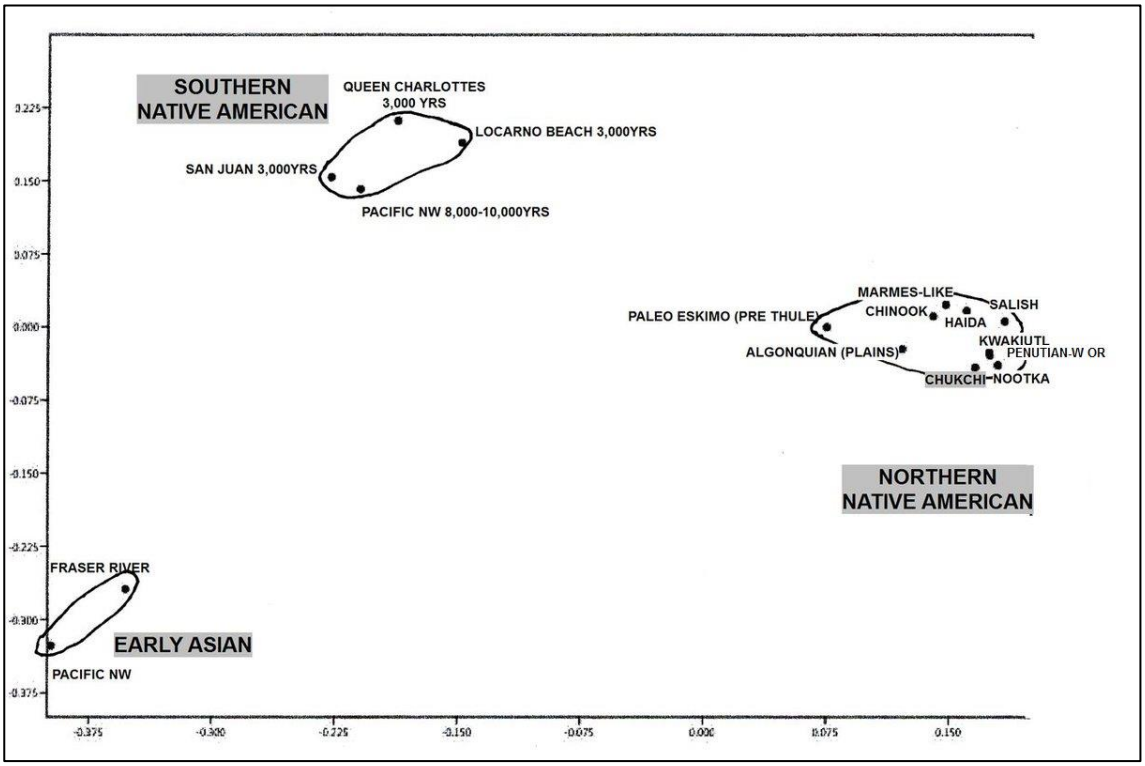
This type is found at the Glenrose Cannery at the Fraser Delta over 3,000 years ago. The Glenrose Cannery people are the most distinctive of any Pacific Northwest grouping, and one of the more distinctive in the Americas and much of the recent (past 3,000 years) world. They very likely represent either an Early Asian Type, early Sapiens mixed with the Denisovan but not distinctly descent directly from the Denisovan, but a branch of them. Denisovan is a of a branch of man, not clearly Sapiens (but may someday be included), who inhabited much of Asia before early Sapiens. Early Asian here refers to the Earliest East Asians that are either earliest (70,000 to 3,000 years ago), or most distinct of Asians, probably representing admixture of the first modern (Sapiens) Asians with the Denisovan. Modern man (Sapiens) (mostly for the Northern Hemisphere) would be those who migrated out of the Middle East some 70,000 to 50,000 years ago. There are three known populations of the Denisovans (Central Asia, East Asia, and New Guinea/Australia).

**WESTERN WASHINGTON / SW BRITISH COLUMBIA PREHISTORIC MIGRATIONS**



## PACIFIC NORTHWEST GROUPS
## MULTIDIMENSIONAL SCALING PLOT

The groups in the Northwest include most of the **Northern Native American** groups: Paleo Eskimo, Na Dene, Wakashan, Salish, Penutian, and Algonquian. The **EARLY ASIAN (American Archaic)** includes the Fraser River Old Cordilleran, a part of the Northwest Branch of the West American Archaic. The **Southern Native American** includes the Early San Juan and related Locarno Beach people, likely descent from the Lower Columbia River Early Americans, a branch of the Early Pacific Northwest Group, which includes Kennewick Man. By 3000 years ago they had migrated up into the Queen Charlotte Islands, but may have died out after 3000 years ago. The Southern Native American Group branched off from the Northern Native American group about 15,500 years ago (from Paleo DNA), and includes much of Eastern North American, the South West, and South America.






**There is more to life than what you can see, feel, hear, taste, or smell (what science can explain). That life is connected to our soul/spirit.**

# B:
# ANCESTRAL AFFINITIES OF NATIVE AMERICANS

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**<http://freepages.rootsweb.com/~lopezislandhistory/history/other/Straits%20Salish%20Prehistory.pdf>**

## INTRODUCTION

Relationships based on cranial measurements were examined originally for the Pacific Northwest, and then extended into the rest of America, and on into Asia. This study examined not only population means, but each individual within a population. Several methods were employed. The results suggests two major physical types in America, with two major groups in Asia:

**HOMO SAPIENS(LATER) AND BASAL EURASIAN**. About 50,000-70,000 years ago in the Middle East, ancestral Ancient Early Sapiens (mixed with a small portion of Neanderthal) spread out across Europe, Asia, and the South Pacific (like Australia). Just before that, a population NOT mixed with Neanderthal (called Basal Eurasian) travelled into North Asia, and were known as the Ancient North Eurasians. They are ancestral to most every Native American, and also most all Europeans (about 4000-5000 years ago with the spread of the Indo-European language).

**DENISOVAN**. Denisovan branched off some 350,000 years ago from the earliest Neanderthals. They spread out into Asia, and we don't know a whole lot about them. With the spread of early Sapiens (mixed with Neanderthal) into Asia, they confronted, and mixed with the Denisovan. Denisovan is comprised of many groups, what we know now, is D0 in Central Asia, D1 in the greater Australia region, and D2 in China/Mongolia and thereabouts. It is not exactly known whether some of the crania we have already seen are pure Denisovan, but most say they are mostly mixed with the early Sapiens (as early as 70,000 years ago). The Continental Asian groups most distant/distinct are found in the Western Mongolia area (5,000-9,000 years ago).

## NATIVE AMERICAN

Native American is ancestral to almost every Native American. They began as a group some 23,000 years ago in Siberia (similar to SNA rather than NNA), when they branched off from their Asian ancestor. Native American is composed of about 50% Ancient North Eurasian, and about 50% Early Asian (Ancient Sapiens mixed with the Early Asian Denisovan). These populations are so far back, that it is difficult to know for certain how this all works out. By subtracting the Native American from Ancient Sapiens and ANE, the resulting population fits closely with the Early Asian, such as: Early Pacific Northwest or 1/2 Pre Jomon (note: other 1/2 like W China Ancient). By averaging Ancient Homo Sapiens(or ANE) and the Archaic groups, the closest fit is again Early Pacific NW (DIST), then 1/2 Pre Jomon. So, 23,000 years ago it was probably the ANE mixing with the Early Asian group that also entered America, perhaps the Pacific NW type (DIST). It may possibly be that in NE Asia some 25,000 years ago was a single group ancestral to the (1/2) Pre Jomon and also those Early Asian in America.

This group soon travelled into Beringia (greater Alaska), and branched into two groups some 15,500 years ago, with the Southern Native American migrating south, and at least by 13,000 years ago had spread into the Northern Plains of America, clear down into South America. The remaining Northern Native American [Eskimo, Algonquian, Wakashan, Penutian, Na Dene, and Salish] spread south between 11,000 and 8,000 years ago.

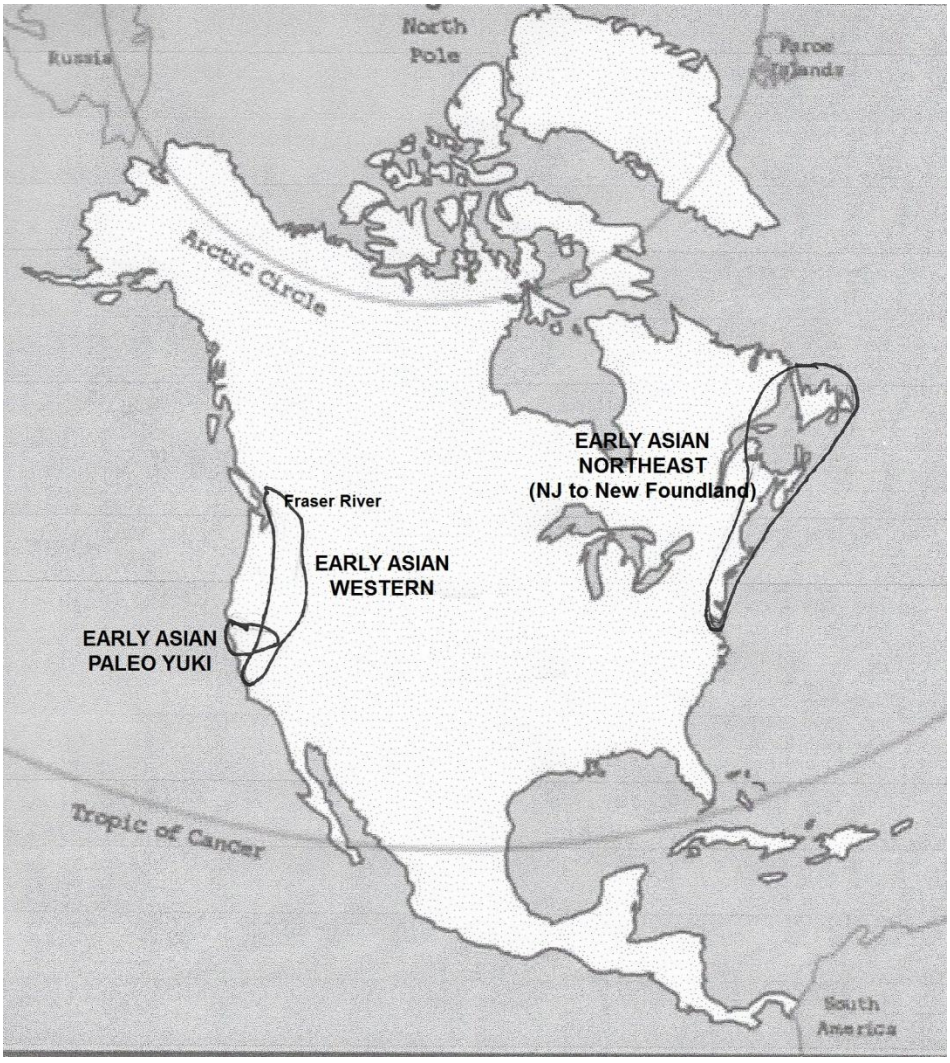
1) **NORTHERN NATIVE AMERICAN** was probably one group from about 15,500 years ago till about 10,000-13,000 years ago. The Algonquian and Penutian probably spread south first. Penutian were in Eastern Washington by 9,500 years ago (Marmes crania, although fragmentary, surprisingly group with

Paleo Penutian). The Northern Native American (NNA) was probably of the SNA physical type till about 13,000-10,000 years ago when they interbred with ancestral Chukchi, which formed the NNA, distinct from the SNA.

2) **SOUTHERN NATIVE AMERICAN**. It appears very likely that early on, perhaps 10,000-13,000 years ago, SNA had split into two groups, Western/Central and Eastern/Southern. The Western/Central groups include the North Plains (ancestral Sioux), the Pacific Northwest (like Kennewick Man, and into California). The Eastern includes New Foundland, Florida, Mexico and South America. The Ancestral SNA was somewhat similar to 10,000 years ago SNA, and not like NNA, which had Chukchi admixture some 13,000-10,000 years ago (see NNA).

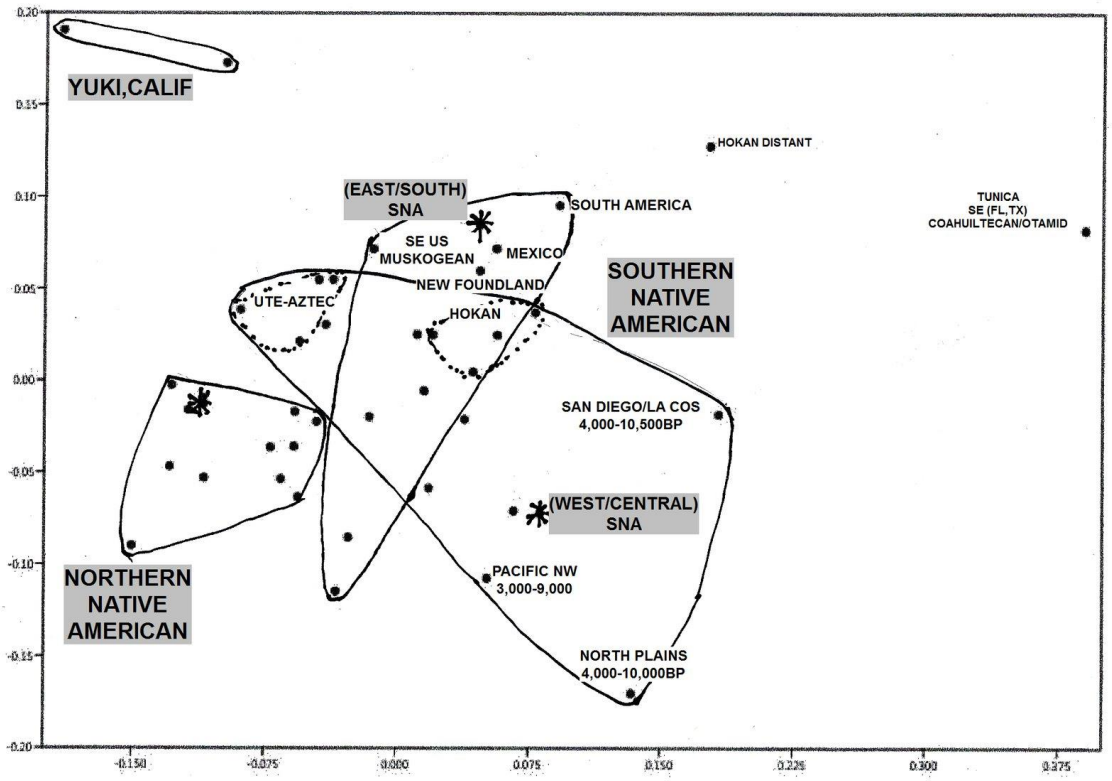
# EARLY ASIAN

3) **EARLY ASIAN**. Here refers to groups of individuals displaying an older East Asian (mainland, or SE islands) physical type, probably closer related to the Denisovan than most modern populations. A very old population surviving to just a few thousand years ago in Central California (mixed, later known as the Yuki Native Americans), and also another group in the Pacific Northwest and into California (Early Asian Western). The earliest form of Early Asian in America is represented by the Early Asian in NE America (New Jersey to New Foundland), and also the Paleo Yuki.



# EARLY NATIVE AMERICANS
# MULTI-DIMENSIONAL SCALING PLOT

**This chart mostly separates out the Native Americans, the Northern Native Americans clearly separate from the Southern, and also the two suspected groups of Southern Native Americans (East/North and the West/Central). Yuki is separate from these groups. There are also other groups to be worked on, mostly small population isolates that don't fit in closely.**

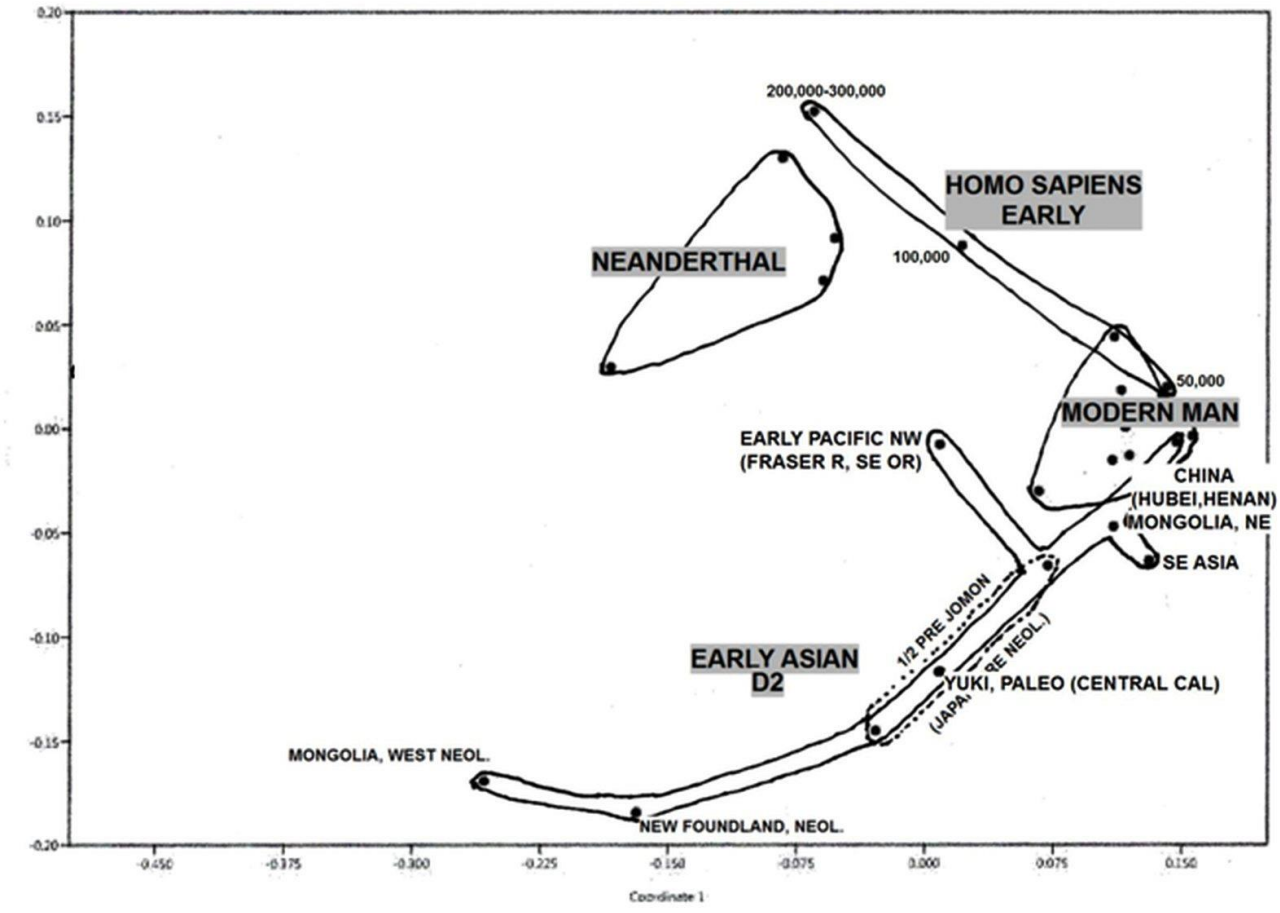


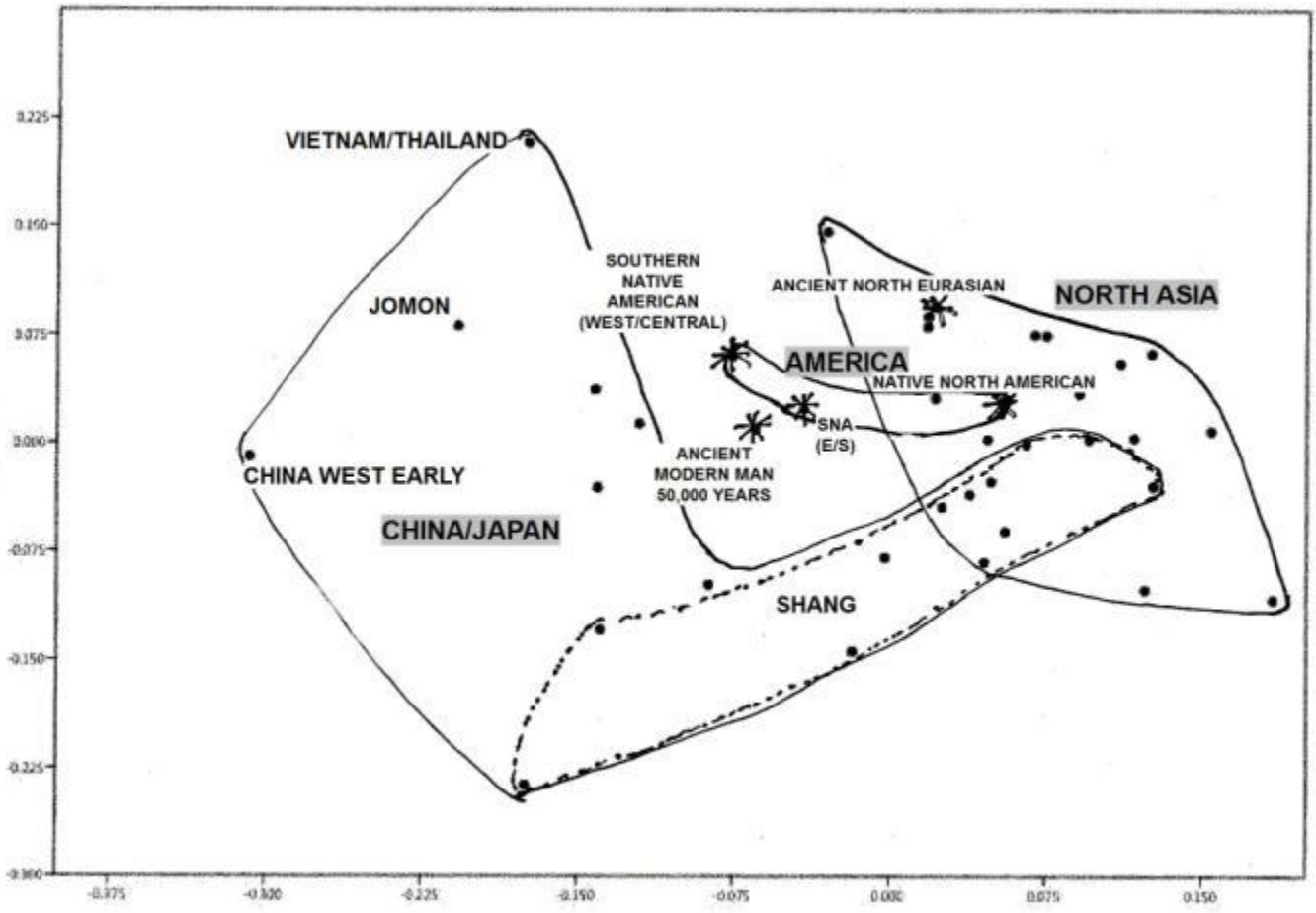
# EARLY MODERN MAN

**EARLY MODERN MAN CHART: NEANDERTHAL: 400,000 to 40,000 years ago. HOMO SAPIENS (Early Modern Man) 250,000 to 100,000 years ago. EARLY HOMO SAPIENS (ANCIENT MODERN MAN) (out of Middle East 50,000 to 70,000 years ago), 50,000 to 10,000 years ago, Europe, Asia, Australia, North America. EARLY ASIAN (probably close to Denisovan) 70,000 to 3,000 years ago (including type found in North America). FRASER DELTA, CANADA, as found at Glenrose Cannery, 9,000 to 3,000 years ago (likely derived from SE Oregon 10,000 years ago).**

# CRANIAL RELATIONSHIPS OF ANCIENT MAN

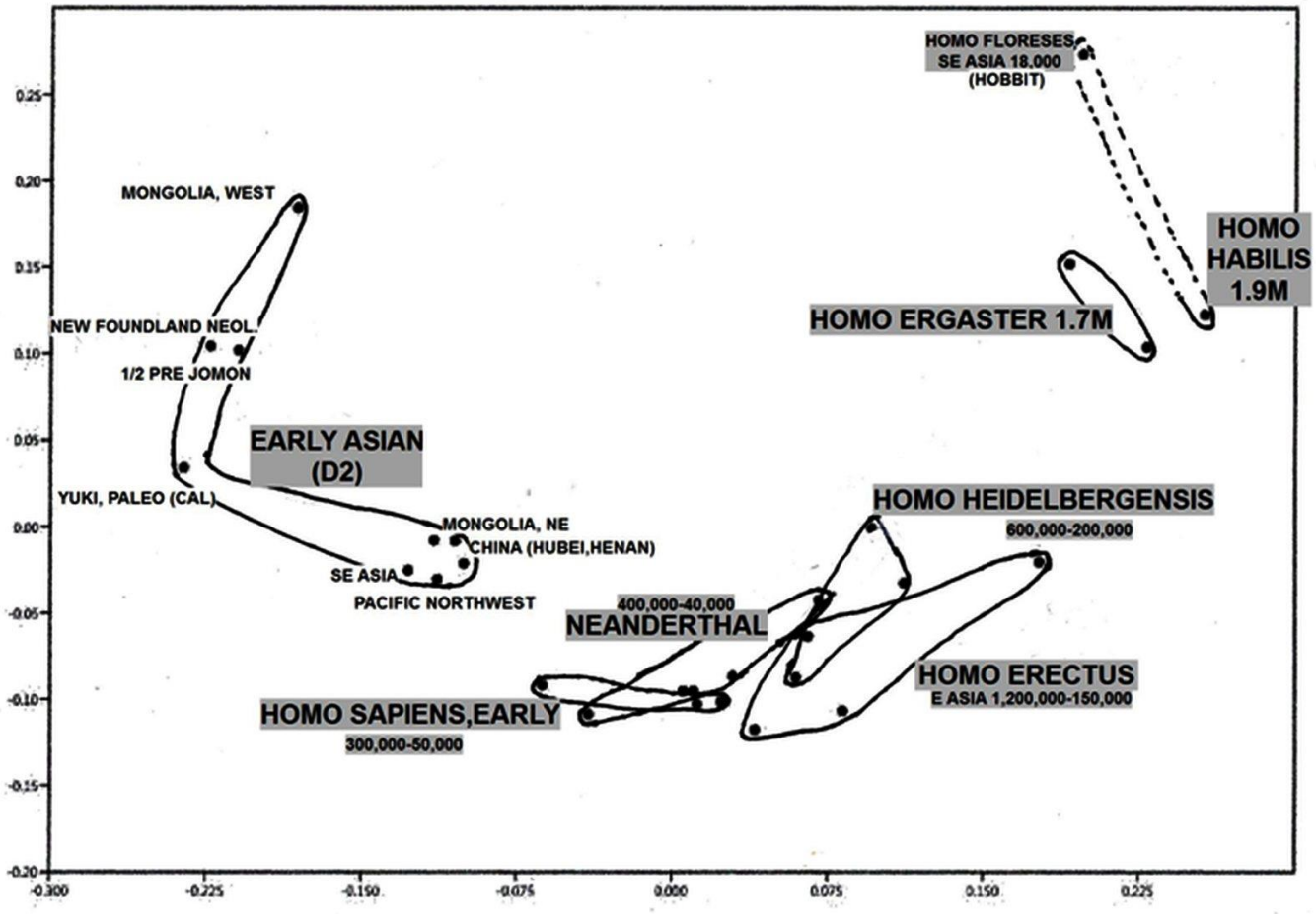
**This Multidimensional Scaling Plot of EARLY MAN to 400,000 years. The Early Northwest American includes the Fraser River Glenrose Cannery individuals and also Eastern Oregon and early Utah as well. The Paleo Yuki inhabited at least Central California from the Bay region into the Sacramento area (historically, they are well mixed, and live on the Coast north of San Francisco).**




VIETNAM/THAILAND
JOMON
SOUTHERN NATIVE AMERICAN (WEST/CENTRAL)
ANCIENT NORTH EURASIAN
NORTH ASIA
AMERICA
NATIVE NORTH AMERICAN
SNA (E/S)
ANCIENT MODERN MAN 50,000 YEARS
CHINA WEST EARLY
CHINA/JAPAN
SHANG

# EARLY MAN (PAST 2 MILLION YEARS) MULTIDIMENSIONAL SCALING PLOT

**This chart shows how the Early Asian fit in, and clearly mixed with Denisovan. Homo Floresis (Hobbit Man) of 18,000 years ago are akin to Homo Habilis.**



# EARLY ASIAN (DENISOVAN D2) PHYSICAL APPEARANCE

We don't know what the original Denisovan looked like, there are no known fossils, but through regression, using the least mixed individuals, it is possible to identify their distinguishable characteristics. The most unique appearance about them was their very broad head (XCB,XFB,STB), moderately wide face (ZYB,EKB) high headed (BBH), short Basion Prosthion/Nasion (Basion probably more forward) (BPL,BNL).

The following compares the Denisovan-like (Early Asian) with Ancient Homo Sapiens (50,000 years ago) (left column), and with the Neanderthal (300-400K years ago) (right columns). The number is the size adjusted measurement difference divided by the average world coefficient of variation for that variable.

1 (or -1) will fit about 67% of the population with another. 2 (-2) will fit about 95% of the populations together. 3 (-3) will fit about 3/1,000 of the populations together. So, it is clearly evident that Denisovan is extremely divergent, especially in their broad head.

## EARLY ASIAN (CENTRAL ASIA)

| Denisovan D2 vs Early Homo Sapiens | | DENISOVAN D2 vs Neanderthal (350K) | |
|---|---|---|---|
| XCB | 8.14 | XCB | 8.12 |
| XFB | 8.08 | XFB | 6.02 |
| BBH | 5.52 | STB | 4.64 |
| STB | 4.82 | BPL | -4.01 |
| BPL | -3.51 | BBH | 2.24 |
| EKB | -2.76 | EKB | -2.15 |
| BNL | -2.60 | MAL | -2.14 |
| ZYB | 2.04 | BNL | -1.35 |
| ZMB | 1.67 | ZYB | 1.25 |
| GOL | 0.96 | OBB | -1.05 |
| NLH | -0.92 | OBH | 1.03 |
| OBB | -0.90 | ZMB | 0.73 |
| MAB | -0.82 | GOL | 0.59 |
| NLB | -0.80 | NPH | -0.43 |
| OBH | 0.43 | NLH | -0.42 |
| NPH | -0.33 | MAB | 0.29 |

**The Denisovan D1 population from the greater Australia region might have been mostly bred out early, unlike Denisovan D2 (where there were probably individuals 5,000-10,000 years ago that were >1/2 Denisovan). From the data available it does appear that they did have a longer, shorter, and much broader head (using, time adjusted data to 40,000, compared to Ancient Sapiens 50,000BP) (data probably from <1/2 Denisovan): (FRK 7.73, PAK 3.89, XCB 3.09, BNL -2.70, AUB 2.69, FRC -2.53, ASB 2.18, BBH -1.79, ZMB 1.54). Similarly, when compared to Neanderthal they had longer Frontal and Parietal bones, short cranial height, and a broader head, along with a shorter Basion to Prosthion and Nasion Length (FRK 8.26, PAK 7.49, BPL -6.62, BNL -5.72, FMB -3.53, EKB -3.15, NPH -2.74, PAC 2.30, FRC -1.53, XCB 1.50, XFB -1.47, BBH -1.31).**

# EARLY AMERICAN TRIBAL RELATIONSHIPS

## TIME SEQUENCE (estimated)

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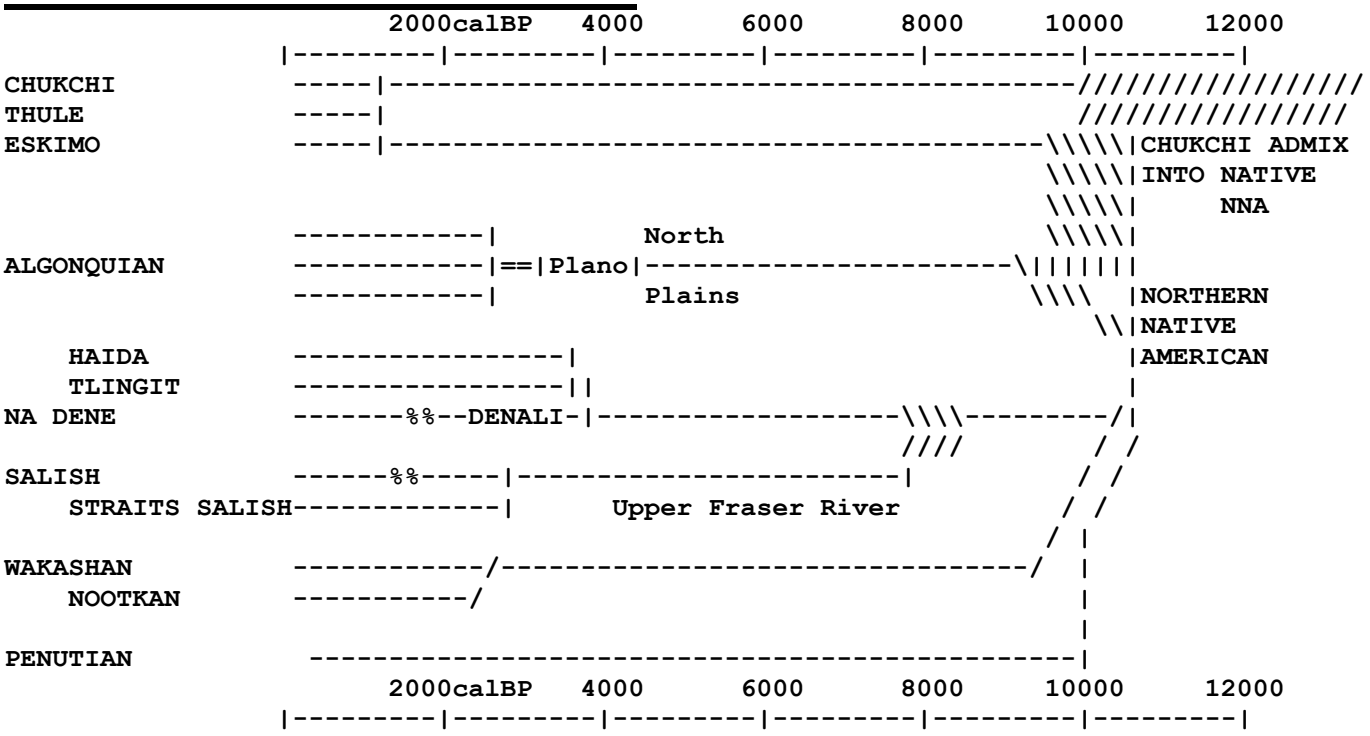
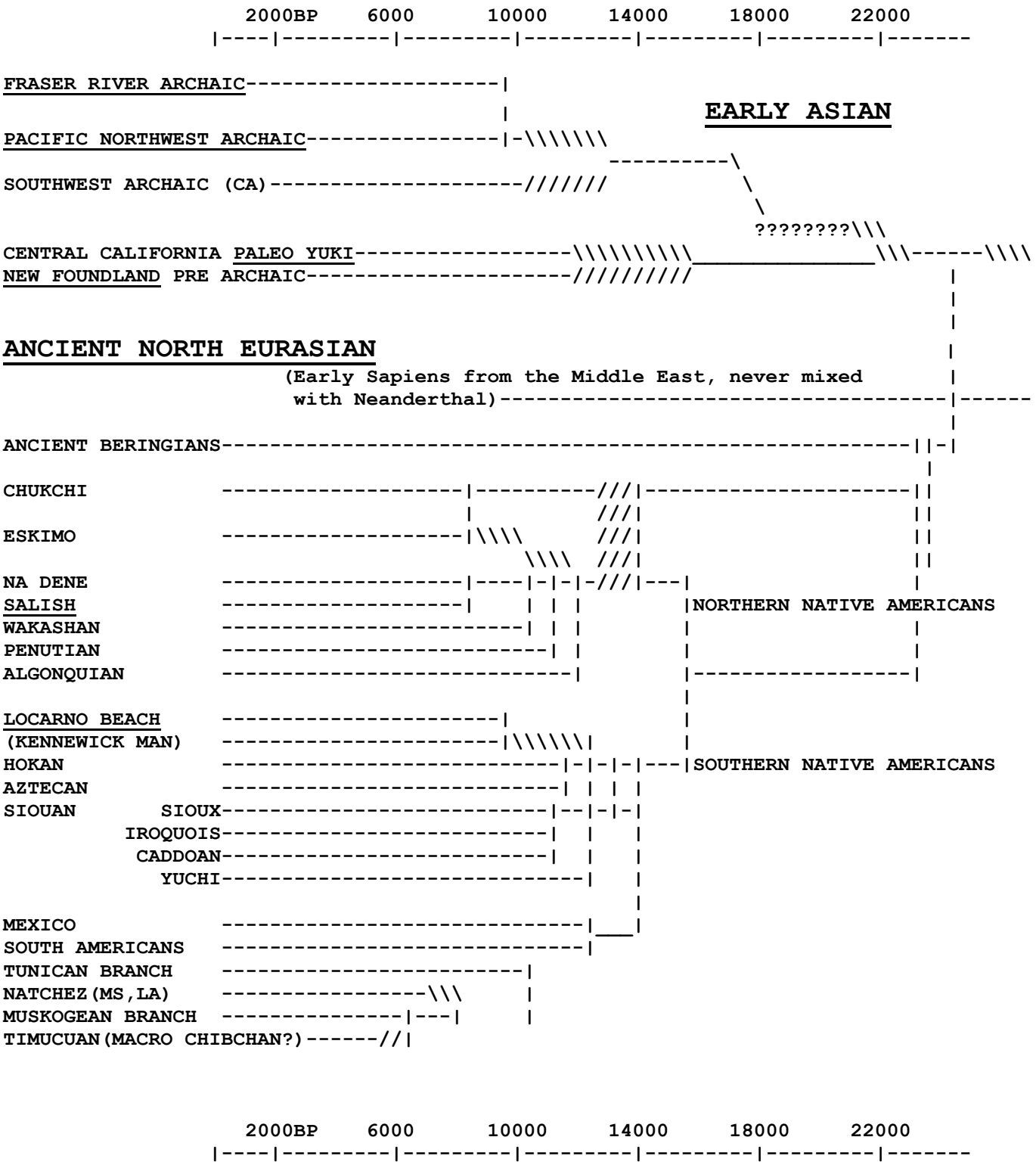
# NATIVE NORTH AMERICAN



# AMERICAN GROUPS

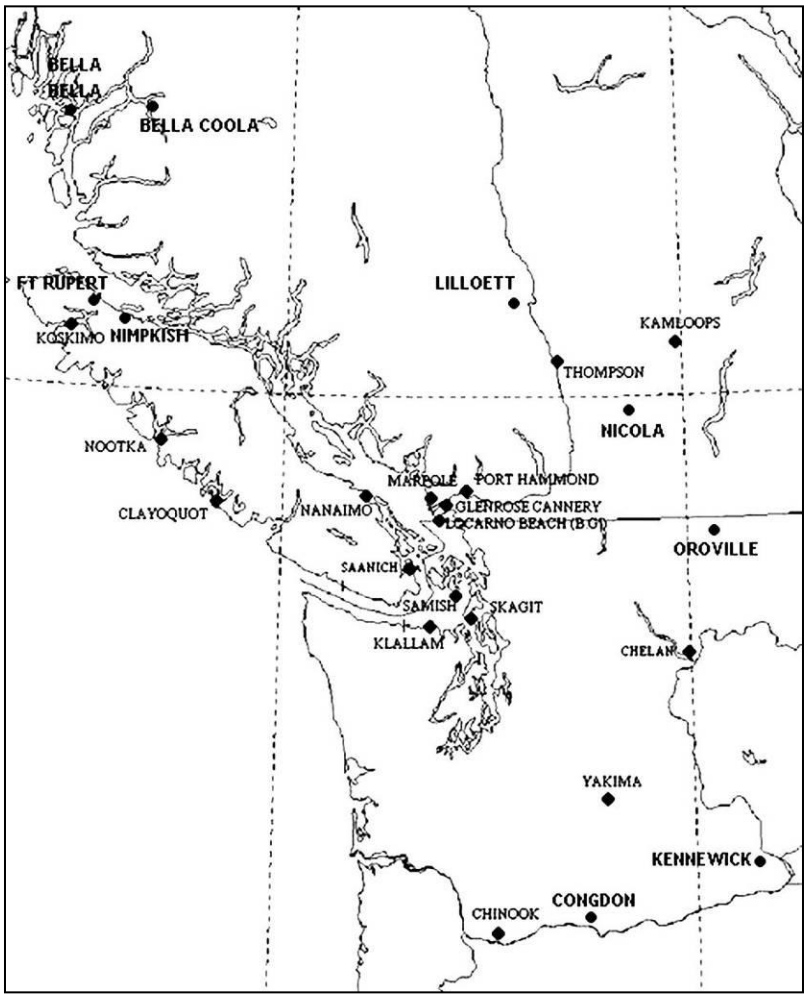


# METHODS

## MATERIAL

**Using a cranial database of over 13,000 individuals, and about 1,000 populations from around the world. Up to 100 measurements on numerous individuals, over 50 measurements on a few thousand individuals, and 8-20 measurements on a few thousand individuals. Data from several dozen sources.**

**MAP OF LOCATIONS OF GROUPS USED**




## DATA ADJUSTMENTS:

**The ideal correlation method is using a large size population, and one where every individual has no missing data. This is not possible in analyzing all sorts of various populations and archaeological sites. In order to correct for this, there are several variables which help, none are ideal, and it is debatable whether using such methods is a good idea, but I have found that, in general, data adjustments help out considerable in improving a population/individual for comparison.**

**POPULATION SIZE: The reduction of the Correlation gives a very good idea of what population size to use for comparisons. For each individual population (or measurement), a formula can be used, where 2 individuals increases the correlation (or reduces the COV)**

**by 25%, 4=50%, 8=80%, 15=85%, 20=90%, 40=95%, 100=98%, 400=99.5% (for a population using 35 measurements; when using Howells data of 82 measurements, 2 individuals increases the correlation by 50%, 3=67%, 4=75%, 5=80%, 10=90%, 25=98%). The formula for each correlation population size (with 35 measurements) (or individual measurements) matches observed: 1-((n+n)/((n*n)). The error in this is the standard deviation of the correlation (average is +-34% for individuals, 2=25%, 3=20%,4=17%,5=15%, 10=13%, 15=12%, 20=10%).**

**NUMBER OF MEASUREMENTS TO USE: It depends on which measurements are used, some, using only a dozen measurements show a similar correlation using up to 20 measurements. For now, the more the better -- needs further investigation.**

**SEXUAL DIMORPHISM -- A worldwide average of dimorphism was used, created using size adjusted individuals within populations (with divergent individuals/groups separated out), to extract the best shape, rather than size. Using Howell's data (largest world database) it is possible to take any individual around the world and determine if they are male or female with an average of 79% accuracy. The other ~20% is not necessarily random, but varies mostly from population to population, some populations skewed female, some skewed male, with the largest deviations in the nasal area. The average World Sexual Dimorphism (average of Africa, Europe, Asia, S Oceana, and Americas) is 95.5% (female of male), with a standard deviation average of .9%, suggesting that most world populations have a similar dimorphism. (STDEV of 43 populations of 50 or more individuals is 1.8%).**

**Using Howells data on population means, by including females, to double the size of the population to analyze, the error is only about 1.5% (1 individual=0, 50 individuals=100%). So for 2 males, to include 2 females, total 4, the correlation is increased to about 50-75%.**

**SIZE ADJUSTED GEOMETRIC MEAN -- When creating a population mean from several individuals, but there is data missing here and there for each individual, this can distort the actual population mean. To correct for error in averaging the population with different sizes, the individuals were size adjusted, and creates a population more representative of shape. This method incorporates about 20 measurements of length, width and height. (using W.W. Howells' abbreviations): Length [GOL, BNL, BPL, FOL, MAL, OCK {Occipital Arc}], Breadth [XCB, NLB, MAB, OBB, DKB, ZMB, FMB, EKB, FOB], and Height [BBH, NPH, NLH, OBH, FRK {Frontal Arc}, PAK {Parietal Arc}. It is hoped to be able to improve adjustments for each weighted measurement, and thus increase the correctness of the size adjustment.**

**Variation in size in a "related" population averages about 4-10%, leaving shape variation at 90-96%. Size adjusting the population for obtaining a standard deviation/coefficient of variation increases the resolution of accuracy in comparing one individual/group to another by about 5%, which helps.**

**Variables (Howells Abbreviation) of correlation to average Geometric Mean.**

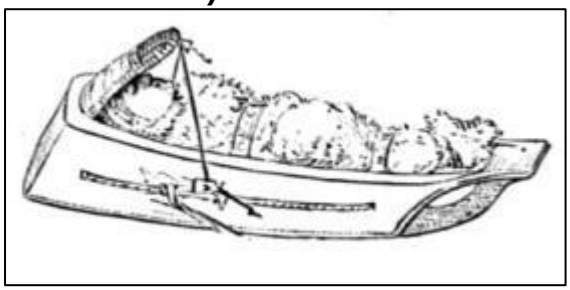
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BNL | 0.71 | ZOR | 0.59 | FRC | 0.52 | BAR | 0.42 | SIS | 0.35 | PAC | 0.24 |
| BBH | 0.68 | NAS | 0.58 | PRR | 0.49 | ZMR | 0.42 | DKS | 0.35 | OCC | 0.24 |
| FMB | 0.67 | JUB | 0.58 | MAB | 0.48 | IML | 0.42 | NLB | 0.34 | SSS | 0.23 |
| DKR | 0.67 | SSR | 0.58 | OBH | 0.47 | VRR | 0.41 | WMH | 0.33 | PAF | 0.22 |
| NAR | 0.66 | XFB | 0.55 | AVR | 0.46 | WNB | 0.40 | ASB | 0.32 | OCF | 0.22 |
| BRR | 0.63 | NLH | 0.54 | FOL | 0.45 | SOS | 0.39 | ZMB | 0.26 | NDS | 0.16 |
| WCB | 0.63 | ZYB | 0.53 | NPH | 0.45 | OSR | 0.38 | BPL | 0.26 | MLS | 0.12 |
| MDH | 0.61 | NOL | 0.52 | XCB | 0.44 | FMR | 0.36 | LAR | 0.25 | GLS | 0.11 |
| EKB | 0.61 | GOL | 0.52 | DKB | 0.44 | STB | 0.36 | MDB | 0.25 | FRS | 0.11 |

**AUB 0.60 XML 0.52 EKR 0.44 OBB 0.36 FRF 0.24 PAS 0.08**

## CRANIAL DEFORMATION IN PACIFIC NORTHWEST INDIANS

**Pacific Northwest Indians used to confine infant's heads in a carrier that deformed the head. Three types of deformation were practiced: Koskimo (within the Wakashan), Chinook (Penutian), and Cowichan (Salish). The distortion of the cranial vault is not a genetic trait and cannot be used to determine an individual's interrelationship.**

**Cranial deformation in the Chinook and Cowichan was produced by applying a board attached to a cradleboard, causing the head to be compressed as in a vise, with the result that both the frontal and occipital regions become flattened, and the parietal expand in a sideward direction (known as Anteroposterior or Fronto-Occipital Compression). Koskimo deformation was caused by winding bandages, or pads and bandages, over the frontal region and under the occiput and completely encircling the brain-case, causing a rounded contour (known as Conical deformation).**



CHINOOK CRADLEBOARD BINDING THE HEAD OF THE INFANT

**The below chart shows average deformed skulls compared to undeformed (equivalent) skulls This was estimated by using regression on the percentage of each individual deformation within a population. Several analysis were run to figure this out: comparing the measurements on the vault which correlated to deformation, giving a first approximation; second using these estimates for a second analysis and regression estimates; several more figurations and regressions to complete estimations of regression on each individual. Below gives the estimates for 100% deformed and 100% undeformed. These estimates were used to adjust each individual to their undeformed equivalent, and a population average (and groupings) of the adjustments gives very good results for further analysis.**

**Column 1 is Howells abbreviation of measurements. Columns 3, 4, and 5 are Chinook, Salish, Koskimo 100% deformed minus the undeformed, then divided by the average American Standard Deviation adjusted the given population (resulting in a deformed COEFFICIENT OF VARIATION). The second column is the average of column 3,4,5. Column 6, 7, and 8 are the percent difference between Deformed and Undeformed. The COV gives a much more accurate representation of deformation than the percentage difference.**

| | AVERAGE\|\| | DEFORM-UNDEF/STAND DEV\|\| | | | | DEFORMED/UNDEFORMED | | | Description |
|---|---|---|---|---|---|---|---|---|---|
| | | CHIN | SAL | KOSK | | CHIN | SAL | KOSK | |
| GOL | 2.97 | -2.66 | -2.72 | 3.53 | \|\|\|\| | -7.36 | -7.52 | 8.34 | Cranial Length |
| XCB | 3.86 | 5.42 | 3.85 | -2.33 | \|\|\|\| | 15.24 | 11.32 | -8.37 | Cranial Breadth |
| BBH | 1.64 | -3.05 | -1.75 | -0.11 | \|\|\|\| | -11.29 | -6.17 | -0.38 | Cranial Height |
| FRC | 1.40 | -0.91 | -1.58 | 1.72 | \|\|\|\| | -3.43 | -6.13 | 5.92 | Frontal Chord |
| PAC | 2.72 | -3.82 | -2.96 | 1.37 | \|\|\|\| | -22.35 | -16.48 | 6.15 | Parietal Chord |
| OCC | 1.57 | -0.38 | -1.77 | 2.57 | \|\|\|\| | -1.94 | -9.78 | 11.43 | Occipital Chord |
| FRK | 1.64 | -1.58 | -1.60 | 1.73 | \|\|\|\| | -7.46 | -7.58 | 7.06 | Frontal Arc |
| PAK | 2.12 | -2.77 | -2.70 | 0.88 | \|\|\|\| | -17.50 | -16.99 | 4.51 | Parietal Arc |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OCK | 1.49 | -1.12 | -1.71 | 1.66 | \|\|\|\| | -6.38 | -10.09 | 8.16 | Occipital Arc |
| XFB | 1.53 | 2.18 | 1.98 | -0.42 | \|\|\|\| | 7.51 | 6.88 | -1.58 | Frontal Br Max |
| WFB | 0.64 | 1.24 | 0.67 | -0.02 | \|\|\|\| | 5.99 | 3.33 | -0.11 | Frontal Br Min |
| CCV | 0.53 | -0.96 | 0.52 | 0.10 | \|\|\|\| | -6.62 | 3.23 | 0.64 | Cranial Circumf |
| CRC | 0.43 | 0.53 | 0.18 | 0.59 | \|\|\|\| | 1.76 | 0.60 | 1.94 | Cranial Capacity |
| | | | | | \|\|\|\| | | | | |
| ZYB | 2.19 | 1.67 | 2.65 | -2.27 | \|\|\|\| | 4.72 | 7.31 | -7.22 | Bizygomatic Br |
| FMB | 1.04 | .40 | 1.18 | -0.53 | \|\|\|\| | 3.30 | 2.80 | -1.32 | Upper Facial Br |
| EKB | 1.77 | 2.52 | 1.85 | -0.95 | \|\|\|\| | 5.92 | 4.41 | -2.42 | Biorbital Br |
| ZMB | 0.86 | 0.10 | 1.33 | -1.14 | \|\|\|\| | 0.40 | 5.03 | -4.75 | Mid Facial Br |
| BNL | 0.80 | -1.75 | 0.33 | 0.33 | \|\|\|\| | -5.67 | 1.00 | 0.99 | Basion Nasion Len |
| BPL | 0.53 | -0.43 | 0.86 | -0.31 | \|\|\|\| | -1.78 | 3.38 | -1.30 | Basion ProsthionL |
| OBH | 0.66 | 1.21 | 0.45 | 0.33 | \|\|\|\| | 5.65 | 2.18 | 1.60 | Orbit Height |
| OBB | 0.74 | 0.99 | 0.84 | -0.41 | \|\|\|\| | 3.28 | 2.79 | -1.43 | Orbit Breadth |
| DKB | 1.20 | 2.10 | 1.40 | 0.10 | \|\|\|\| | 16.13 | 11.34 | 0.86 | Interorbital Br |
| NPH | 0.73 | 1.24 | 0.96 | 0.00 | \|\|\|\| | 5.85 | 4.59 | 0.00 | Upper Facial Ht |
| NLH | 0.42 | 0.77 | 0.50 | 0.00 | \|\|\|\| | 3.52 | 2.29 | 0.00 | Nasal Height |
| NLB | 0.73 | -1.10 | 0.70 | -0.38 | \|\|\|\| | -7.76 | 4.40 | -2.55 | Nasal Breadth |
| WNB | 0.48 | 0.45 | 0.72 | -0.26 | \|\|\|\| | 9.09 | 13.64 | -6.04 | Simotic Chord |
| | | | | | \|\|\|\| | | | | |
| PAL | 0.51 | -0.52 | 0.66 | -0.34 | \|\|\|\| | -3.70 | 4.37 | -2.39 | Palate length |
| PAB | 1.04 | -1.12 | 1.61 | -0.40 | \|\|\|\| | -5.78 | 7.29 | -1.98 | Palate Breadth |
| MAL | 0.35 | -0.33 | 0.37 | -0.36 | \|\|\|\| | -1.68 | 1.82 | -1.88 | Ext Palate Length |
| MAB | 0.76 | -0.99 | 0.73 | -0.55 | \|\|\|\| | -4.60 | 3.11 | -2.49 | Ext Palate Br |
| FOL | 0.26 | 0.10 | -0.05 | -0.65 | \|\|\|\| | 0.58 | -0.29 | -4.02 | Foramen Magnun L |
| FOB | 0.64 | 0.84 | 0.70 | -0.39 | \|\|\|\| | 5.45 | 4.58 | -2.74 | Foramen Magnun Br |

**AGE ADJUSTMENT -- With present analysis, it is not possible to get good estimates of age from just cranial data, excepting for children (and it is possible to get a good estimate of an adult equivalent from a young child crania). Further analysis is required.**

**CORRELATION METHOD- Each individual or population is compared to each other: the sum of all measurements, each measurement minus compared individual/population measurement and squared, divided by variance, all divided by the number of measurements.**

**Variance is computed from the average Coefficient of variation of size adjusted populations (e.g.- worldwide average) (standard computation of the Coefficient of Variation is from a population mean, unadjusted, which incorporates variation due to size and shape, whereas by using shape only, the resolution and accuracy of comparing individuals to others is increased, slightly).**

**The two individuals - populations are also adjusted for the number of individuals being compared (which, I believe, needs some improvement for extremely small populations less than about 5 individuals): (Count p1+count p2)/(1+(Count p1*count p2)).**

**This correlation method is a simplified method of Mahalanobis, and does not use several of his features.**

**The numerical correlations are then plotted using mostly Multi Dimensional Scaling, and to a lesser degree, Principal Coordinate Analysis. Also used is a combination of Coefficient of racial likeness, Principal Component Analysis (to identify the spread, and outliers of a population), and cluster analysis, as well as about a dozen other comparisons, including Mahalanobis (where there was no missing data). Through these combinations,**

**it was possible to further identify possible outlier individuals not visible in just using populations means.**

# CRANIAL DATA
# SAMISH AREA

| GROUP | Hidden Inlet | | | | | | | Watmough Bay | | | | | Argyle | | Glenrose Cannery | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SW Lopez Island | | | | | | | SE Lopez Island | | | | | Lagoon | | Fraser Delta | | |
| ID | 1 | 2 | 3 | 4 | 7 | 5 | 6 | E | C | A | D | B | 1 | 19 | 6 | 9 | 5 |
| SEX | F | M | M | M | M | F? | F | F? | F | F? | M? | M | | M? | M | M | F |
| AGE | 40 | Mat | 12 | Adt | Mat | (Adt) | Mat | | | Ad/Ma | Adt | Adt | | YngAd | Adt | Adt | Adt |
| DATE | 3000 | 3000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1500 | 1500 | 1500 | 1500 | 1500 | 3000 | 3000 | 3000 | 2300 | 3000 |
| NOTES | CI | | Lambd | Def | | | | | | 100- | 115- | 130- | | | | | |
| | 67.0 | | Def | | | | | | | 115Cm | 125Cm | 150Cm | | | | | |
| SOURCE | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | (1=Morris; 2=Carlson 1950) | | | | |
| GOL | | 199 | 180 | 177 | | | | 160 | 157 | 163 | | 169 | 184 | | 182 | 169 | 185 |
| BNL | | 102 | 102 | 105 | | | | 92 | | | | 100 | 104 | | 107 | 92 | 112 |
| BBH | | 140 | 137 | 137 | | | | 133 | 120 | 119 | | 136 | 151 | | 136 | 124 | 132 |
| XCB | | 132 | 128 | 143 | | | | 150 | 141 | 135 | | 151 | 116 | | 135 | 132 | 140 |
| ZYB | | | 143 | | | | | 135 | 126 | 138 | 136 | 138 | | | 124 | 124 | 128 |
| ASB | | | | | | | | | | | | | | | 102 | 100 | 107 |
| BPL | | | 101 | | | | | 100 | 106 | | | 108 | 102 | | | 107 | 115 |
| NPH | | | 71 | | | | | 68 | 71 | 66 | 68 | 69 | 83 | 50 | | 41 | 59 |
| NLH | | | 52 | | | | | 53 | 51 | 50 | 53 | 49 | 59 | | | 46 | 49 |
| NLB | | | 24 | | | | | 26 | 26 | 22 | 24 | 26 | 26 | | | 22 | 24 |
| MAB | | | 58 | | | | | 60 | 62 | 64 | 65 | 63 | 58 | | | | |
| OBH | | 39 | 38 | | | | | 35 | 35 | 35 | 33 | 33 | 36 | 35 | | 36 | 33 |
| OBB | | | 40 | | | | | 39 | 39 | 37 | 35 | 39 | 41 | 38 | 37 | 36 | 39 |
| DKB | | | 22 | | | | | | | | | | | | 19 | 20 | 23 |
| WNB | | | | | | | | | | | | | | | 10 | 15 | 8 |
| ZMB | | | | | | | | | | | | | | | | 80 | 96 |
| FRC | | | | | | | | | | | | | | | 112 | 104 | 109 |
| PAC | | | | | | | | | | | | | | | 101 | 97 | 111 |
| OCC | | | | | | | | | | | | | | | 94 | 92 | 93 |
| FOL | | | | | | | | | | | | | | | 32 | 35 | 32 |
| WFB | | | | | | | | | | | | | | 115 | 101 | 105 | 93 |
| CRC | | | | | | | | | | | | | | | 490 | 473 | 480 |
| FOB | | | | | | | | | | | | | | | 23 | 25 | 24 |
| MAL | | | | | | | | | | | | | 56 | | | | |
| PAL | | | | | | | | | | | | | | | | 43 | 53 |
| PAB | | | | | | | | | | | | | | | | 35 | 40 |
| MaxBiParBr | | | | | | | | | | | | | | | 130 | 127 | 135 |
| FRK | | | | | | | | 111 | 111 | 115 | | 131 | | 114 | 128 | 120 | 126 |
| PAK | | | | | | | | | | 118 | | 121 | | | 116 | 117 | 113 |
| OCK | | | | | | | | | | | | | | | 120 | 120 | 120 |
| CNB | | | | | | | 132 | | | | | | | | | | |
| GNB | | | | | | | 112 | | | | | | | | | | |
| RMB | | | | | 40 | 36 | 39 | | | | | | | | | | |
| RMH | | | | | 58 | 54 | 54 | | | | | | | | | | |
| SYH | | | | | 36 | | 33 | | | | | | | | | | |

**NOTE: Morris 1982 measured 1982 BY AUTHOR GARY J. MORRIS**

# CRANIAL MEASUREMENTS
# ASIAN/NORTH AMERICAN ANDPACIFIC NORTHWEST GROUPS

**(1991 Revised 2020)**

| | |
|---|---|
| **A** | **NEANDERTHAL - 350,000-400,000 YEARS** |
| **B** | **NEANDERTHAL - SW ASIA (IRAQ,ISRAEL) 60,000-120,000** |
| **C** | **NEANDERTHAL - EUROPE 40,000-120,000 YEARS** |
| **D** | **NEANDERTHAL - EUROPE 30,000-50,000 YEARS** |
| **E** | **DENISOVAN D2 - ESTIMATE (CLOSEST-regression from past 70,000yrs)** |
| **F** | **HOMO SAPIENS - 100,000-200,000 YEARS** |
| **G** | **HOMO SAPIENS - SW ASIA (MIDEAST) 95,000 YEARS** |
| **H** | **HOMO SAPIENS - ANCIENT 50,000 YEARS (ESTIMATE FROM WORLD REGRESSION)** |
| **I** | **EARLY ASIAN - ASIA-SE-AUSTRALIA (MIX)** |
| **J** | **EARLY ASIAN - ASIA-SE-AUSTRALIA (TO 40,000 BP)** |
| **K** | **EARLY ASIAN-CHINA-HUBEI/SHAANXI PROVINCES** |
| **L** | **EARLY ASIAN - ASIA-SE** |
| **M** | **EARLY ASIAN - ASIA-JAPAN (1/2 PRE JOMON)** |
| **N** | **EARLY ASIAN - ASIA-MONGOLIA,NE/HENAN/HUBEI/QINQHAI** |
| **O** | **EARLY ASIAN - ASIA-MONGOLIA,W WEST (****CLOSEST TO DENISOVAN*****)** |
| **P** | **EARLY ASIAN - NA-E-CANADA-NEW FOUNDLAND (Indiv regression)** |
| **Q** | **EARLY ASIAN - NA-SW-PALEO YUKI DISTANT** |
| **R** | **EARLY ASIAN - NA-NW-Fraser River 3000 Years (only 2 individuals)** |
| **S** | **EARLY ASIAN - NA-SW-CALIFORNIA ,CENTRAL (SAN FRAN TO SACRAMENTO)** |
| **T** | **EARLY ASIAN - NA-NW-PACIFIC NW/CAL,CENTRAL - Distant (PACIFIC NW)** |
| **U** | **EARLY ASIAN - NA-NW-WA/OR/UT** |
| **V** | **ASIA-N-ANCIENT NORTH EURASIAN** |
| **W** | **ASIA-N-ANCIENT-LENA RIVER 8000-5000BP (75%)** |
| **X** | **ASIA-N-PALEO BAIKAL NEOLITHIC (SIBERIAN)** |
| **Y** | **ASIA-N-MONGOLIAN (3000-200BP)** |
| **Z** | **ASIA-N-CHUKCHI** |
| **AA** | **ASIA-N-CHUKCHI-PALEO (INDIV REGRESSION-DISTANT)** |
| **AB** | **ASIA-N-SAKHALIN** |
| **AC** | **NA-NNA-E-ALGONQUIAN,PLAINS** |
| **AD** | **NA-NNA-N-CHUKCHI (ALASKA/ARCTIC)** |
| **AE** | **NA-NNA-N-ESKIMO,PALEO (PRE THULE)** |
| **AF** | **NA-NNA-N-ESKIMO,THULE (ALASKA,ARCTIC)** |
| **AG** | **NA-NNA-NW-NA DENE-HAIDA-MEDIAN** |
| **AH** | **NA-NW-NA DENE-ATHAPASCAN (YUKON/ALASKA)** |
| **AI** | **NA-SNA-NW-PENUTIAN,CHINOOK (SNA) - DISTANT REGRESSION** |
| **AJ** | **NA-NNA-NW-PENUTIAN,CHINOOK (NNA) - MODE** |
| **AK** | **NA-NW-OR-PENUTIAN-KLAMATH (OR/CA)** |
| **AL** | **NA-NW-OR-PENUTIAN-WEST OREGON** |
| **AM** | **NA-NW-OR/WA-COLUMBIA RIVER** |
| **AN** | **NA-NNA-NW-PENUTIAN, MARMES (9500BP) LIKE RECONSTRUCTED** |
| **AO** | **NA-SNA-NW-SALISH (SNA)-DISTANT REGRESSION** |
| **AP** | **NA-NNA-NW-SALISH-MODE** |
| **AQ** | **NA-NNA-NW-SALISH,INTERIOR** |
| **AR** | **NA-NNA-NW-SALISH,HALKOMELEM,PALEO (PORT HAMMOND,MARPOLE)** |
| **AS** | **NA-NNA-NW-SALISH,STRAITS** |
| **AT** | **NA-NNA-NW-WAKASHAN,KWAKIUTL MODE** |
| **AU** | **NA-NNA-NW-WAKASHAN,NOOTKA MEDIAN** |
| **AV** | **NA-SNA-NW-Kennewick,Buhl(ID),San Juan,Locarno Beach,Queen Charlotte 3000BP** |
| **AW** | **NA-SNA-NW-BC-Queen Charlotte Islands,Blue Jackets Site 3000BP** |
| **AX** | **NA-SNA-NW-WA-EARLY SAN JUAN (SAN JUAN ISLANDS)** |
| **AY** | **NA-SNA-NW-BC-LOCARNO BEACH 3000YRS** |
| **AZ** | **NA-SNA-NW-PACIFIC NW 8000-11000BP (ID,WA,UT)** |

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GOL | 196 | 193 | 196 | 194 | 183 | 200 | 196 | 190 | 197 | 192 | 182 | 195 | 199 | 183 | 194 | 195 | 190 |
| NOL | 192 | 197 | 195 | 192 | | 192 | 186 | 188 | 188 | | | | | | | | |
| BNL | 108 | 114 | 109 | 110 | 94 | 127 | 105 | 102 | 102 | 95 | | 108 | 104 | 103 | 98 | 101 | 103 |
| BBH | 128 | 133 | 130 | 134 | 135 | 129 | 127 | 135 | 135 | 129 | 142 | 145 | 148 | 137 | 132 | 143 | 147 |
| XCB | 150 | 150 | 145 | 145 | 156 | 148 | 145 | 140 | 144 | 148 | 144 | 147 | 157 | 144 | 163 | 157 | 150 |
| XFB | 114 | 122 | 113 | 120 | 130 | 118 | 119 | 116 | 122 | 114 | | 124 | 132 | 128 | 150 | | 119 |
| ZYB | 153 | 142 | 141 | | 135 | 138 | 143 | 138 | 143 | 135 | | | | | | 144 | 150 |
| AUB | 141 | 138 | 131 | | | 131 | 131 | 125 | 135 | 132 | | | | | | | 140 |
| ASB | 125 | 124 | 115 | 119 | | 118 | 120 | 110 | 117 | 117 | | | | | | 128 | 117 |
| BPL | 113 | 115 | 105 | 121 | 86 | 116 | 110 | 103 | 102 | 98 | | 102 | 99 | 97 | 94 | 86 | 95 |
| NPH | 83 | 87 | 70 | 78 | 63 | 73 | 73 | 68 | 69 | 65 | 77 | 68 | 67 | 77 | 65 | 71 | 70 |
| NLH | 57 | 61 | 56 | | 48 | 50 | 54 | 52 | 48 | 49 | 56 | 51 | 49 | 57 | 53 | 55 | 51 |
| JUB | 129 | 125 | 117 | | | 115 | 130 | 119 | | | | | | | | | |
| NLB | 32 | 33 | 32 | 28 | 25 | 30 | 32 | 27 | 30 | 29 | 27 | 26 | 27 | 26 | 26 | 24 | 27 |
| MAB | 77 | 74 | 74 | 57 | 65 | 71 | 71 | 67 | 71 | | | 67 | 66 | 64 | 66 | 59 | |
| MDH | 36 | 24 | 24 | 24 | | 28 | 29 | 31 | | | | | | | | | |
| MDB | | 11 | 14 | 9 | | 13 | 15 | 18 | | | | | | | | | |
| OBH | 31 | 37 | 36 | | 35 | 34 | 32 | 32 | 31 | 36 | 36 | 34 | | 36 | 36 | | |
| OBB | 43 | 42 | 42 | | 36 | 40 | 47 | 41 | 42 | 41 | 40 | 41 | 40 | 40 | 41 | | |
| DKB | 33 | 30 | 26 | 26 | | 29 | 24 | 24 | | | | 23 | 24 | 21 | 26 | | |
| NDS | 21 | 13 | 12 | | | 15 | 9 | 10 | | | | | | | | | |
| WNB | 13 | 16 | 14 | | | 9 | 7 | 8 | | | | | | | | | |
| ZMB | 113 | 111 | 99 | | 97 | 91 | 109 | 99 | 102 | 104 | 102 | 109 | 110 | 101 | 103 | | |
| SSS | 33 | 39 | 38 | | | 25 | 27 | 23 | | | | | | | | | |
| FMB | 122 | 115 | 106 | 113 | | 111 | 113 | 108 | 108 | 104 | | | | | | | |
| NAS | 21 | 23 | 25 | 22 | | 21 | 16 | 18 | | | | | | | | | |
| EKB | 113 | 116 | 107 | 107 | 93 | 112 | 112 | 102 | 108 | 100 | | 101 | 98 | 100 | 103 | | |
| WMH | 32 | 28 | 27 | | | 24 | 24 | 24 | | | | | | | | | |
| STB | 115 | 124 | 110 | 114 | 123 | 103 | 109 | 107 | 111 | | | | | | | 123 | 119 |
| FRC | 107 | 111 | 106 | 111 | | 118 | 113 | 114 | 113 | 105 | | | | | | | |
| PAC | 107 | 105 | 104 | 109 | | 119 | 118 | 117 | 124 | 118 | | | | | | | |
| OCC | 92 | 98 | 90 | 100 | | 97 | 92 | 98 | 98 | | | | | | | | |
| FOL | 41 | 43 | 43 | | | 40 | 39 | 39 | | | | | | | | 37 | |
| WFB | 110 | 107 | 103 | 102 | | 107 | 107 | 96 | 96 | 96 | | | | | | 94 | |
| CCV | 122 | 315 | 68 | 14 | 45 | 140 | 2 | | 139 | 41 | 53 | 81 | 345 | | | | |
| CRC | 551 | 503 | | | | | 539 | 525 | | | | | | | | | |
| FOB | 31 | | 33 | 27 | | | | 29 | | | | | | | | | |
| MAL | 66 | | | | 44 | 67 | 62 | 57 | 60 | | | 56 | 52 | 51 | 46 | 50 | |
| PAL | 51 | 52 | | 46 | | 55 | 63 | 53 | | | | | | | | 36 | |
| PAB | 43 | 54 | 43 | 38 | | | 46 | 41 | | | | | | | | 37 | |
| FRK | 119 | 121 | 117 | 125 | | 129 | 123 | 127 | 122 | 160 | | | | | | | |
| PAK | 111 | 120 | 110 | 111 | | 124 | 129 | 130 | 149 | 150 | | | | | | | |
| NAH | | 82 | 80 | 65 | | | | 70 | | | | | | | | | |
| GNB | | 99 | 82 | 87 | | | | 104 | 107 | | | | | | | | |
| RMB | | 31 | 31 | | | | | 35 | 31 | | | | | | | | |
| RMH | | 51 | 37 | 38 | | | | 61 | | | | | | | | | |
| SYH | | 27 | 18 | 28 | | | | 37 | 38 | | | | | | | 29 | |

| | R | S | T | U | V | W | X | Y | Z | AA | AB | AC | AD | AE | AF | AG | AH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GOL | 188 | 175 | 198 | 192 | 190 | 191 | 177 | 184 | 183 | 180 | 181 | 180 | 182 | 184 | 183 | 183 | 185 |
| NOL | | | | | | | | 178 | | | | | | | | | |
| BNL | 112 | 99 | 117 | 104 | 102 | 100 | 97 | 101 | 101 | 101 | 105 | 102 | 101 | 104 | 103 | 104 | 104 |
| BBH | 137 | 118 | 140 | 139 | 130 | 128 | 124 | 131 | 135 | 137 | 135 | 132 | 134 | 134 | 136 | 138 | 138 |
| XCB | 135 | 138 | 144 | 138 | 142 | 144 | 144 | 150 | 142 | 141 | 147 | 142 | 138 | 141 | 138 | 142 | 139 |
| XFB | | | 119 | | | | 116 | 130 | | | | | | | | 116 | |
| ZYB | 131 | 125 | 139 | 135 | 140 | 140 | 134 | 143 | 140 | 135 | 144 | 141 | 138 | 135 | 139 | 142 | 139 |
| AUB | | 124 | 135 | | | | 129 | 132 | | | | | | | | | |
| ASB | 107 | | 112 | 107 | | | 111 | 113 | | | | 111 | 109 | 105 | 111 | | |
| BPL | 109 | | 108 | 105 | 101 | 104 | 96 | 97 | 102 | 100 | 105 | 98 | 97 | 102 | 98 | 104 | 103 |
| NPH | 61 | 68 | 62 | 62 | 69 | 70 | 73 | 76 | 78 | 76 | 76 | 70 | 76 | 73 | 73 | 75 | 78 |
| NLH | 51 | 47 | 52 | 48 | 52 | 52 | 53 | 56 | 55 | 53 | 54 | 54 | 55 | 53 | 54 | 50 | 55 |
| JUB | | | | | | | 118 | 120 | | | | | | | | | |
| NLB | 24 | 26 | 26 | 26 | 26 | 25 | 26 | 28 | 25 | 24 | 26 | 26 | 24 | 25 | 23 | 26 | 25 |
| MAB | | 65 | 56 | | 66 | 66 | 64 | 65 | 65 | 65 | 69 | 66 | 64 | 65 | 65 | 68 | 67 |
| MDH | | | 31 | | | | 31 | 28 | | | | | | | | | |
| MDB | | | | | | | 12 | 17 | | | | 12 | | | | | |
| OBH | 33 | | 34 | 32 | 34 | 34 | 34 | 36 | 37 | 36 | 35 | 34 | 38 | 35 | 37 | 36 | 36 |
| OBB | 39 | | 37 | 37 | 39 | 39 | 39 | 41 | 41 | 38 | 41 | 41 | 41 | 40 | 40 | 43 | 40 |
| DKB | 22 | | 22 | 22 | | | 20 | 24 | 24 | | 19 | 22 | 19 | 21 | 19 | 24 | |
| NDS | | | | | | | 8 | 9 | | | 10 | | | | | | |
| WNB | 9 | | 10 | 9 | | | 7 | 8 | 6 | | 6 | 8 | | | | 8 | |
| ZMB | 100 | | 100 | | | | 99 | 102 | 104 | | 105 | 102 | 103 | 97 | 102 | 104 | |
| SSS | | | | | | | 18 | 19 | | | 22 | 24 | | | | | |
| FMB | | 111 | 108 | | | | 99 | 105 | 111 | | | 101 | | | | 111 | |
| NAS | | | | | | | 14 | 14 | 16 | | | 19 | | | | | |
| EKB | | | | | | | 96 | 100 | 103 | | | | 99 | 95 | 99 | 104 | |
| WMH | | | 26 | | | | | 28 | | | | 24 | | | | | |
| STB | | | 121 | | | | | 117 | | | | | | | | | |
| FRC | 113 | | 118 | 114 | | | 108 | 112 | 114 | | 99 | 110 | 113 | 110 | 112 | 113 | |
| PAC | 108 | | 115 | 113 | | | 106 | 108 | 111 | | | 109 | 111 | 111 | 109 | 110 | |
| OCC | 94 | | 96 | 97 | | | 94 | 93 | 98 | | | 93 | 98 | 97 | 98 | 97 | |
| FOL | 33 | | 36 | 33 | | | 36 | 37 | 38 | | | | 37 | 40 | 38 | 36 | |
| WFB | | 91 | 99 | 102 | | | 93 | 95 | 96 | | 97 | 95 | | | | 94 | 97 |
| CCV | | | | | 1447 | | | 1578 | | | 1533 | | 1409 | 1476 | 1496 | 1415 | |
| CRC | | | | 493 | | | | | | | 527 | | | | | 518 | |
| FOB | | | | 24 | | | | 31 | | | 30 | 31 | | | | 30 | |
| MAL | | 52 | 55 | 58 | 57 | 60 | 53 | 51 | 56 | 57 | 57 | 55 | 54 | 56 | 54 | 56 | |
| PAL | | 48 | | | | | | | 56 | | 47 | | 50 | 50 | 51 | 48 | |
| PAB | | | | 42 | | | | | | | 41 | | | | | 44 | |
| FRK | | | | 130 | | | | | | | 125 | | | | | 129 | |
| PAK | | | | 117 | | | | | | | 118 | | | | | 124 | |
| NAH | | | | | 72 | 72 | | 79 | 81 | 78 | 79 | 69 | 79 | 76 | 76 | | |
| GNB | | 95 | 108 | | | | | | | | | | | | | 106 | |
| RMB | | 32 | | | | | | | | | | | | | | 39 | |
| RMH | | 61 | 71 | 75 | | | | | | | | | | | | 66 | |
| SYH | | 31 | 33 | 38 | | | | | | | | | 38 | 38 | 35 | 36 | |

| | AI | AJ | AK | AL | AM | AN | AO | AP | AQ | AR | AS | AT | AU | AV | AW | AX | AY | AZ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GOL | 178 | 175 | 177 | 177 | 175 | 180 | 173 | 175 | 174 | 173 | 177 | 180 | 178 | 190 | 193 | 189 | 188 | 187 |
| NOL | | | | | | | | | | | | | | 188 | | | | 188 |
| BNL | 101 | 102 | 99 | 103 | 102 | 101 | 96 | 101 | 101 | 100 | 101 | 102 | 99 | 107 | 109 | 106 | 106 | 110 |
| BBH | 139 | 139 | 134 | 135 | 137 | 137 | 140 | 134 | 130 | 135 | 132 | 133 | 129 | 144 | 148 | 143 | 141 | 141 |
| XCB | 140 | 141 | 141 | 144 | 140 | 145 | 153 | 143 | 137 | 142 | 143 | 141 | 138 | 142 | 142 | 137 | 142 | 144 |
| XFB | 117 | 118 | | 120 | 117 | 120 | 116 | 115 | 115 | 116 | 115 | 115 | 115 | 117 | | 118 | 119 | 108 |
| ZYB | 136 | 137 | 142 | 137 | 137 | 141 | 141 | 138 | 138 | 136 | 139 | 143 | 143 | 143 | | 142 | 141 | 144 |
| AUB | | | | 126 | | | | | | | | | | 131 | | | | 131 |
| ASB | | | | | | | | | | | | | | 113 | | | 112 | 113 |
| BPL | 98 | 102 | 93 | 102 | 102 | 101 | 98 | 100 | 100 | 102 | 104 | 102 | 102 | 105 | 104 | 103 | 104 | 111 |
| NPH | 70 | 71 | 72 | 70 | 71 | 70 | 70 | 72 | 70 | 73 | 71 | 77 | 72 | 74 | 76 | 76 | 73 | 71 |
| NLH | 51 | 53 | 51 | 52 | 52 | 50 | 51 | 52 | 51 | 51 | 52 | 54 | 53 | 54 | 55 | 54 | 54 | 52 |
| JUB | | | | | | | | | | | | | | 120 | | | | 120 |
| NLB | 26 | 25 | 25 | 24 | 25 | 24 | 24 | 24 | 24 | 23 | 25 | 24 | 25 | 25 | 25 | 25 | 25 | 25 |
| MAB | 67 | 68 | | 65 | 69 | 65 | 61 | 64 | 63 | 63 | 64 | 66 | 66 | 64 | 64 | 61 | 65 | 67 |
| MDH | | | | | | | | | | | | | | 32 | | | | 32 |
| MDB | | | | 17 | | | | | | | | | | 11 | | | | 11 |
| OBH | 36 | 35 | | 36 | 35 | 35 | 37 | 36 | 35 | 36 | 36 | 37 | 36 | 36 | 35 | 36 | 36 | 35 |
| OBB | 43 | 41 | | 43 | 41 | 42 | 41 | 42 | 40 | 42 | 42 | 42 | 41 | 40 | 41 | 41 | 39 | 41 |
| DKB | 20 | 20 | | | 20 | 22 | 22 | 22 | 22 | 22 | 24 | 24 | 23 | 22 | | 20 | 24 | 19 |
| NDS | | | | | | | | | | | | | | 10 | | | | 10 |
| WNB | 8 | 8 | | | 8 | 7 | 7 | 8 | 8 | 8 | 9 | 8 | 8 | 8 | | | 8 | 10 |
| ZMB | 103 | 100 | | | 101 | 98 | 96 | 98 | 97 | 96 | 96 | 101 | 100 | 101 | 102 | 99 | 101 | 99 |
| SSS | | | | | | | | | | | | | | 29 | | | | 29 |
| FMB | 106 | 105 | | 109 | 105 | 108 | | 106 | 105 | 105 | 104 | 108 | 106 | 104 | | 106 | | 103 |
| NAS | | | | | | | | | | | | | | 16 | | | | 16 |
| EKB | 100 | 96 | | 100 | 96 | 99 | 99 | 97 | 97 | 97 | 99 | 102 | 99 | 101 | | 110 | 97 | 102 |
| WMH | | | | | | | | | | | | | | 24 | | | | 24 |
| STB | | | | | | | | | | | | | | 96 | | | | 96 |
| FRC | 117 | 115 | 110 | | 115 | 115 | 120 | 112 | 108 | 111 | 113 | 112 | 111 | 119 | | 116 | 122 | 113 |
| PAC | 105 | 105 | | | 103 | 111 | 99 | 104 | 101 | 106 | 104 | 105 | 102 | 105 | | 108 | 101 | 111 |
| OCC | 104 | 100 | | | 101 | 97 | 100 | 97 | 94 | 96 | 99 | 95 | 94 | 109 | | 104 | 110 | 106 |
| FOL | 31 | 34 | | 35 | 34 | 35 | 31 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | | 35 | 34 | 38 |
| WFB | 91 | 93 | | 97 | 92 | 96 | 88 | 93 | 92 | 95 | 96 | 95 | 93 | 94 | 93 | 92 | 95 | 95 |
| CCV | 14351473 | | | | 14601468 | 1390 | 1381 | 1322 | 1359 | 1373 | 1387 | 1337 | 1572 | | | 1610 | | 1530 |
| CRC | 508 | 501 | | | 502 | 515 | 512 | 502 | 499 | 502 | 506 | 509 | 501 | 526 | | 523 | 521 | |
| FOB | 28 | 29 | | | 29 | 30 | 31 | 30 | 29 | 30 | 30 | 30 | 31 | 28 | | 30 | 28 | |
| MAL | 53 | 54 | | 55 | 54 | 54 | 52 | 54 | 53 | 55 | 56 | 56 | 56 | 54 | 55 | 54 | 54 | 55 |
| PAL | 47 | 47 | | 49 | 47 | 49 | 51 | 49 | 46 | 49 | 48 | 48 | 48 | 48 | 48 | 46 | 47 | |
| PAB | 42 | 44 | | 42 | 44 | 41 | 43 | 41 | 39 | 40 | 41 | 41 | 42 | 40 | 39 | 38 | 41 | |
| FRK | 129 | 127 | | | 127 | 130 | 126 | 124 | 121 | 123 | 125 | 124 | 123 | 134 | | 131 | 134 | 133 |
| PAK | 118 | 120 | | | 117 | 127 | 118 | 118 | 112 | 122 | 115 | 121 | 119 | 116 | | 120 | 113 | 118 |
| NAH | | | | 73 | | | | | | | | | | | | | | |
| GNB | | | | 103 | | 102 | | 105 | 106 | 103 | 105 | 114 | | 108 | 107 | 107 | 109 | |
| RMB | | | | 34 | | 37 | | 36 | 37 | 38 | 35 | 41 | | 39 | 39 | 40 | 39 | |
| RMH | | | | 64 | | 68 | | 61 | 61 | 62 | 62 | 60 | | 69 | 73 | 64 | 66 | |
| SYH | | | | 34 | | 37 | | 35 | 35 | 37 | 35 | 37 | | 38 | 39 | 38 | 37 | |

# CRANIEL MEASUREMENT GLOSSARY ABBREVIATIONS AND DESCRIPTIONS

| ABBR | BASIC DESCRIPTION | | DESCRIPTION |
|---|---|---|---|
| GOL | Maximum Cranial Length | g-op | Glabella (g) to opisthocranion (op) (straight line). |
| NOL | Occipital Length | n-op | Nasion (N)-Opishocranion Length. Median sagittal plane. |
| BNL | Cranial Base Length | ba-n | Basion (Ba) to Nasion (N) direct length |
| BBH | Basion Bregma Height | ba-b | Basion (anterior foramen m.(Ba) to Bregma (B) |
| XCB | Maximum Cranial Breadth | eu-eu | Eurion (eu) to eurion (eu). |
| XFB | Frontal Maximum Breadth | co-co | Coronal Suture to Coronal Suture. |
| ZYB | Bizygomatic Breadth | zy-zy | Zygion to zygion. Zygomatic arch Breadth |
| AUB | Biauricular Breadth | au-au | Auriculare to Auriculare. Min. exterior breadth zygomatic arches. |
| WCB | Minimum Cranial Breadth | | The breadth across the sphenoid at the base of the temporal fossa, at the infratemporal crests. |
| ASB | Biasterionic Breadth | ast-ast | Point where temporal, occipital and parietal meet |
| BPL | Basion-Prosthion Length | ba-pr | Basion (ba) to prosthion (pr), Direct Length |
| NPH | Nasion-Prosthion Height | n-pr | Nasion (n) to prosthion (pr).Superior/Upper Facial Height. NOTE: NPH averages 94.7% of Nasion Alveolare (M48) height. |
| NLH | Nasal Height | n-ns | Nasion (n) to nasospinale (ns) |
| JUB | Bijugal Breadth | | External breadth across the malars at the jugalia |
| NLB | Nasal Breadth | al-al | Alare (al) to alare (al) |
| MAB | Maxillo Alveolar Breadth | ect-ect | Ext Palatal Breadth. Ectomolare to ectomolare. At M2 (2nd Molar) |
| MDH | Mastoid Height (Height) | | Upper border of external auditory meatus to inferior tip mastoid process |
| MDB | Mastoid Breadth | ms-ms | Between the two incisura mastoidea (mastoids) |
| OBH | Orbit Height, Left | | Height between upper-lower orbit margins (norm-left orbit) |
| OBB | Orbit Breadth, Left | d-ec | Ectoconchion to dacryon. Oetteking la-ek (lacrimalia ectoconchion) is similar. |
| DKB | Interorbital Breadth | d-d | Breadth across nasal, dacryon-dacryon. Similar to Oetteking Posterior Interorbital breadth [la-la] (lacrimalia-lacrimalia). |
| NDS | Naso-Dacryal Subtense | | Deepest point profile nasal bones to interorbital breadth |
| WNB | Simotic Chord(Least Nasal Br) | | The minimum transverse breadth across the two nasal bones, or chord between the naso-maxillary sutures |
| SIS | Simotic Subtense | | Subtense from nasal bridge to simotic chord. |
| ZMB | Bimaxillary Breadth | zm-zm | Mid Facial Breadth. The breadth across the maxillae, from one zygomaxillare anterior to the other. |
| SSS | Zygomaxillary Subtense | | Projection from subspinale to bimaxillary breadth. |
| FMB | Bifrontal Br.(Up.Face B.) | fmt-fmt | Frontomolare temporale breadth. (Outer Orbital). (Not Howells FMB, WHICH IS:-- Howells (1973) frontomalare anterior (fma) to frontomalare anterior.) |
| NAS | Nasio-Frontal Subtense | | The subtense from nasion to the bifrontal breadth. |
| EKB | Biorbital Breadth | ec-ec | Ectoconchion (ec) to ectoconchion (ed)) |
| DKS | Dacryon Subtense | D-zm | Mean subtense from dacryon to biorbital zygomaxillare . (ant interorbital?? [mf-mf??] |
| IML | Malar Length, Inferior | | Zygomaxillare (zm) anterior to lowest point. |
| XML | Malar Length, Maximum | | Lower zygotemporal suture to zygoorbitale. |
| MLS | Malar Subtense | | Max subtense from the convexity of malar angle to max length of the bone, at level of zygomaticofacial foramen. |
| WMH | Cheek Height, Minimum | | Minimum distance from lower border of orbit to lower margin of maxilla (left side) |
| SOS | Supraorbital Projection | | Max projection of left supraorbital arch betw midline, in region of glabella or above, and frontal bone just anterior to the temporal line in its forward part, measured as a subtense to line defined. |
| GLS | Glabella Projection | | Subtense from nasion (n) to supraglabellare. |
| STB | Bistephanic Breadth | | Intersection coronal suture and inferior temporal |
| FRC | Nasion-Bregma Chord | n-b | FRONTAL CHORD. Direct length nasion to bregma. |
| FRS | Nasion-Bregma Subtense | | FRONTAL SUBTENSE. Max subtense, at highest point on convexity of frontal bone in midplane, to nasion-bregma chord. |
| FRF | Nasion-Subtense Fraction | | Fraction nasion to bregma. Distance along nasion-bregma chord, fr nasion, at which the nas-breg subtense falls. |
| PAC | Bregma-Lambda Chord | b-l | PARIETAL CHORD. Direct distance from bregma to lambda |
| PAS | Bregma-Lambda Subtense | | PARIETAL SUBTENSE. Max subtense, at highest point on convexity parietal bones in midplane,to bregma-lambda chord. |
| PAF | Bregma-Subtense Fraction | | Parietal fraction. Distance along bregma-lambda chord, fr bregma, at which the bregma-lambda subtense falls. |
| OCC | Lambda-Opisthion Chord | l-o | OCCIPITAL CHORD. Lambda Opisthion Chord |
| OCS | Occipital Subtense | | subtense lambda to opisthion. Max subtense, at most prominent point on basic contour of occipital bone in midplane. |
| OCF | Occipital Subtense-Fraction | | subtense lambda to opisthion. Distance along lambda-opisthion chord,fr lambda,at which the lambda-opisthion subtense falls. |
| FOL | Foramen Magnum Length | ba-o | Basion (ba) to opisthion (o) |
| NAR | Nasion Radius | | The perpendicular to the transmeatal axis trom nasion. |

| | | | |
|---|---|---|---|
| SSR | Subspinale Radius | | The perpendicular to the transmeatal axis fr subspinale |
| PRR | Prosthion Radius | | The perpendicular to the transmeatal axis fr prosthion |
| DKR | Dacryon Radius | | Perpendicular to the transmeatal axis fr left dacryon |
| ZOR | Zygoorbit Radius | | Perpendicular to transmeatal axis fr left zygoorbitale. |
| FMR | Frontomalar Radius | | Perpendicular to transmeatal axis fr left frontomalare anterior. |
| EKR | Ectoconch Radius | | Perpendicular to transmeatal axis fr left ectoconchion |
| ZMR | Zygomailla Radius | | Perpendicular to transmeatal axis fr left zygomaxillare anterior. |
| AVR | M1 Alveolus Radius | | The perpendicular to the transmeatal axis from the most anterior point on the alveolus of the left first molar. |
| BRR | Bregma Radius | | |
| VRR | Vertex Radius | | Perpendicular to transmeatal axis fr most distant point on parietals (including bregma or lambda) |
| LAR | Lamba Radius | | |
| OSR | Opisthion Radius | | |
| BAR | Basion Radius | | |
| NAA | Nasion Angle | bas-pr | Of the tacial triangle, the angle at nasion, whose sides are basion-nasion and nasion-prosthion. |
| PRA | Prosthion Angle | bas-nas | Of the facial triangle, the angle at prosthion, whose sides are basion-prosthion and nasion-prosthion. |
| BAA | Basion Angle | nas-pr | Of the facial triangle, the angle at basion, whose sides are basion-nasion and basion-prosthion. |
| NBA | Nasion Angle | bas-br | The angle at nasion whose sides are basion-nasion and nasion bregma (the opposite side being basion-bregma). |
| BBA | Basion Angle | nas-br | Angle at basion whose sides are basion-nasion and basion bregma (the opposite side being nasion-bregma chord) |
| BRA | | | |
| SSA | Zygomaxillary Angle | | The angle at subspinale whose two sides reach from this point to zygomaxillare anterior left and right. |
| NFA | Nasio-Frontal Angle | | The angle at nasion whose two sides reach from this point to frontomalare, left and right. |
| DKA | Dacryal Angle | | Angle formed at dacryon by the orbital br from ectoconchion and subtense from ryon to biorbital br.; right and left angles |
| NDA | Naso-Dacryal Angle | | The angle formed at the midline of the nasal es, whose sides reach from this point to dan, left and right. |
| SIA | Simotic Angle | | Angle at midline of nasal bones, at narrowest point, whose sides reach the end points of the minimum br of nasal bones. |
| FRA | Frontal Angle | | Sagittal plane, angle underlying the curvature of frontal bone at its maximum height above the frontal chord |
| PAA | Parietal Angle | | In sagittal plane,angle underlying the curvature of parietal bones along sagittal suture,at maximum ht abv parietal chord. |
| OCA | Occipital Angle | | Sagittal plane, the angle underlying the curvature of occipital bone at max height above the occipital chord |
| RFA | | | |
| RPA | | | |
| ROA | | | |
| BSA | | | |
| SBA | | | |
| SLA | | | |
| TBA | | | |

| | | | |
|---|---|---|---|
| WFB | Minimum Frontal Breadth | ft-ft | Frontotemporale (ft) to frontotemporale (ft) (SOME: Post Orbital Breadth?) (MFB) |
| CCV | Cranial Capacity (Volume) | | Cubic centimeters in the cranial cavity. |
| CRC | Cranial Circumference | | Horizontal arc over glabella: circumferance over prominent part of glabella-projecting part posterior portion cranium. |
| FOB | Foramen Magnum Breadth | | Between lateral margins foramen magnum, greatest curvature |
| OAB | Anterior Interorbital Br. | mf-mf | The distance between the two maxillofrontalia (inner rims cut by the fronto-maxillary sutures) (Oetteking) |
| OMB | Orbit Breadth | mf-ek | Orbital breadth from the maxillofrontale. |
| MAL | Maxillo Alveolar Length | pr-alv | Prosthion to alveolon |
| PAL | Palatal Length | | Dist betw median point of line tangent to inner alveolar border of 2 mid incisors and median point |
| PAB | Palatal Breadth | | Distance from the inner alveolar border of the second molar to the corresponding point on the opposite side. of line tangent to 2 indentation in the posterior border of the palate. |
| BIPB | Max Biparietal Breadth | | |
| FRK | Frontal Arc (Nasion-Bregma) | | (FRONTAL SAGITTAL ARC) The curve of the frontal bone from the nasion to the bregma. Tape measure. |
| PAK | Parietal Arc(Bregma-Lambda) | | (PARIETAL SAGITTAL ARC) The curve of the parietal bone from the bregma to the lambda. Measuring tape. |
| OCK | Occipital Arc(Lambda-Opisth.) | | (OCCIPITAL SAGITTAL ARC) The arc from lambda to opisthion. Measuring tape. |
| NAH | Nasion Alveolare Height | | |

| | | | |
|---|---|---|---|
| NMA | Nasion Malar Angle | | |
| NFA2 | Nasio-Facial Angle(Rodriguez) | | |
| NXB | Nasalia, Maximum Breadth | | |
| AIB | Anterior Interorbital | MF-MF | |
| AUH | Auricular Height | | From porion to apex. Apex is point where a line perpendicular to Frankfurt Horizontal intersects midsagittal contour. |
| PBH | Porion Bregma Height | | From porion to bregma. Porion is the uppermost lateral point in the margin of the external auditory meatus. |
| | Mandible | | |
| CNB | Bicondylar Breadth (Cdl) | cdl-cdl | condylon laterale (cdl) to condylon laterale (cdl) |
| GNB | Bigonial Breadth (Gog) | go-go | Gonion to Gonion |
| RMB | Minimum Ramus Br.(Wrb) | | Minimum distance btwn ant/post borders of ascending ramus |
| RMH | Maximum Ramus Ht (Xrh) | | distance from hightest point on the condyle to gonion. |
| SYH | Chin Height (Gni) | id-gn | SYMPHYSIAL HEIGHT. Infradentale to gnathion |
| MNH | Mandibular Body Ht.(Hml) | | Alveolar process to inferior mandibular border at mental foramen |
| MNB | Mandibular Body Br.(Tml) | | Maximum breadth in region of mental foramen. Bimental Diameter. |
| MNL | Mandibular Length | | Anterior margin of chin to posterior border of mandibular Angle |
| MAN | Mandible Angle | | angle formed by inferior border of corpus and posterior border of ramus |
| RXB | Ascending Ramus Max Br. | | |
| CSL | Condylo- Symphyseal | | |
| CPB | Corpus Thickness | | |

# CORRELATION COEFFICIENTS AMONG PACIFIC NORTHWEST POPULATIONS

(revised 2005)

| | CCV | CRC | FRA | PAA | OCA | FOL | FOB | BPL | NPH | ZMB | OAB | OPB | OMB | OLB | OBH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CCV | --- | | | | | | | | | | | | | | |
| CRC | .30 | --- | | | | | | | | | | | | | |
| FRA | .24 | .35 | --- | | | | | | | | | | | | |
| PAA | .37 | .24 | .25 | --- | | | | | | | | | | | |
| OCA | -.02 | .22 | -.02 | -.41 | --- | | | | | | | | | | |
| FOL | .09 | .16 | .11 | .02 | -.18 | --- | | | | | | | | | |
| FOB | .07 | -.04 | .08 | .10 | -.09 | .30 | --- | | | | | | | | |
| BPL | -.20 | -.03 | .21 | -.06 | .07 | .04 | .02 | --- | | | | | | | |
| NPH | .01 | -.12 | .09 | .08 | -.16 | .03 | .06 | -.02 | --- | | | | | | |
| ZMB | .24 | -.02 | -.18 | -.01 | -.21 | -.02 | -.09 | .17 | .19 | --- | | | | | |
| OAB | -.05 | -.20 | -.45 | -.08 | -.09 | -.21 | -.14 | -.14 | -.04 | .07 | --- | | | | |
| OPB | -.07 | -.18 | -.39 | -.16 | -.13 | .02 | -.26 | -.20 | -.14 | .04 | .56 | --- | | | |
| OMB | -.08 | .31 | .07 | -.13 | .23 | .07 | .10 | .09 | .11 | -.01 | -.50 | -.22 | --- | | |
| OLB | -.15 | .28 | .14 | .02 | .20 | .08 | .13 | .25 | -.13 | -.07 | -.42 | -.33 | .81 | --- | |
| OBH | -.07 | .16 | .02 | -.07 | .03 | -.04 | -.02 | -.31 | .22 | .01 | -.24 | -.32 | .10 | .11 | --- |
| NSB | -.12 | -.04 | .01 | .02 | -.09 | -.02 | -.19 | -.14 | .14 | .18 | .05 | .09 | .06 | .03 | -.12 |
| NSH | .12 | .15 | -.07 | .01 | -.04 | .19 | -.12 | -.16 | .38 | .25 | -.09 | -.11 | -.11 | -.12 | .26 |
| NWB | -.18 | -.25 | -.07 | -.19 | -.10 | -.30 | -.13 | -.26 | -.27 | -.20 | .28 | .23 | -.28 | -.33 | -.17 |
| NXB | -.29 | -.47 | -.12 | -.28 | -.17 | -.33 | -.24 | -.02 | -.02 | .05 | .13 | .19 | -.20 | -.18 | -.11 |
| MAL | -.13 | -.18 | .11 | -.01 | -.09 | .15 | .02 | .54 | .11 | .00 | -.28 | -.15 | -.13 | -.12 | -.28 |
| MAB | -.12 | -.04 | -.03 | .02 | -.02 | .06 | -.12 | .17 | .16 | .20 | -.13 | -.05 | .05 | .00 | .09 |
| PAL | -.19 | -.16 | .04 | -.08 | -.04 | -.04 | -.14 | .35 | .05 | .00 | -.40 | -.15 | .01 | .04 | -.08 |
| PAB | -.29 | -.07 | -.08 | .01 | .06 | .03 | -.10 | .15 | .03 | .15 | .02 | -.13 | .09 | .14 | -.05 |
| CNB | -.02 | .32 | -.06 | .16 | -.19 | .01 | .25 | -.35 | .21 | .32 | .20 | .14 | -.19 | -.20 | .37 |
| GNB | -.16 | -.08 | -.30 | -.51 | .32 | -.08 | .05 | -.17 | .29 | .09 | -.20 | -.11 | .07 | -.03 | .27 |
| RMB | -.17 | .10 | -.32 | -.33 | .07 | -.04 | .00 | -.03 | .12 | -.01 | .02 | .04 | -.05 | .07 | .05 |
| RMH | .23 | .07 | .15 | .01 | .13 | .19 | .07 | .01 | .00 | -.23 | -.10 | -.15 | .21 | .15 | -.15 |
| SYH | .15 | -.02 | .14 | -.11 | .21 | -.08 | .12 | -.25 | .38 | -.21 | -.25 | -.23 | -.19 | -.13 | .06 |

| | NSB | NSH | NWB | NXB | MAL | MAB | PAL | PAB | CNB | GNB | RMB | RMH | SYH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSB | --- | | | | | | | | | | | | |
| NSH | -.04 | --- | | | | | | | | | | | |
| NWB | -.01 | -.18 | --- | | | | | | | | | | |
| NXB | .14 | -.31 | .17 | --- | | | | | | | | | |
| MAL | -.10 | -.13 | -.16 | .08 | --- | | | | | | | | |
| MAB | -.12 | .16 | -.17 | -.19 | .10 | --- | | | | | | | |
| PAL | -.04 | -.15 | -.16 | .25 | .61 | -.06 | --- | | | | | | |
| PAB | -.04 | .03 | -.07 | -.23 | .01 | .54 | -.12 | --- | | | | | |
| CNB | .26 | .19 | -.22 | -.56 | -.44 | -.13 | -.46 | .21 | --- | | | | |
| GNB | -.04 | .30 | -.12 | -.21 | -.37 | -.26 | -.22 | .06 | .15 | --- | | | |
| RMB | -.22 | .40 | -.01 | -.21 | -.15 | -.30 | -.05 | -.11 | .02 | .33 | --- | | |
| RMH | -.15 | -.14 | -.15 | -.07 | -.19 | .03 | -.16 | .08 | -.15 | -.07 | -.30 | --- | |
| SYH | -.34 | -.09 | .01 | .07 | .22 | -.18 | .07 | -.34 | -.26 | .03 | -.08 | -.04 | --- |

**NOTE: About 75-100 individuals used for the cranium, and about 30-50 for the jaw.**