



Bioarchaeology

Reconstruction of life activity and subsistence in people of the prehistoric Okhotsk culture, northern Japan

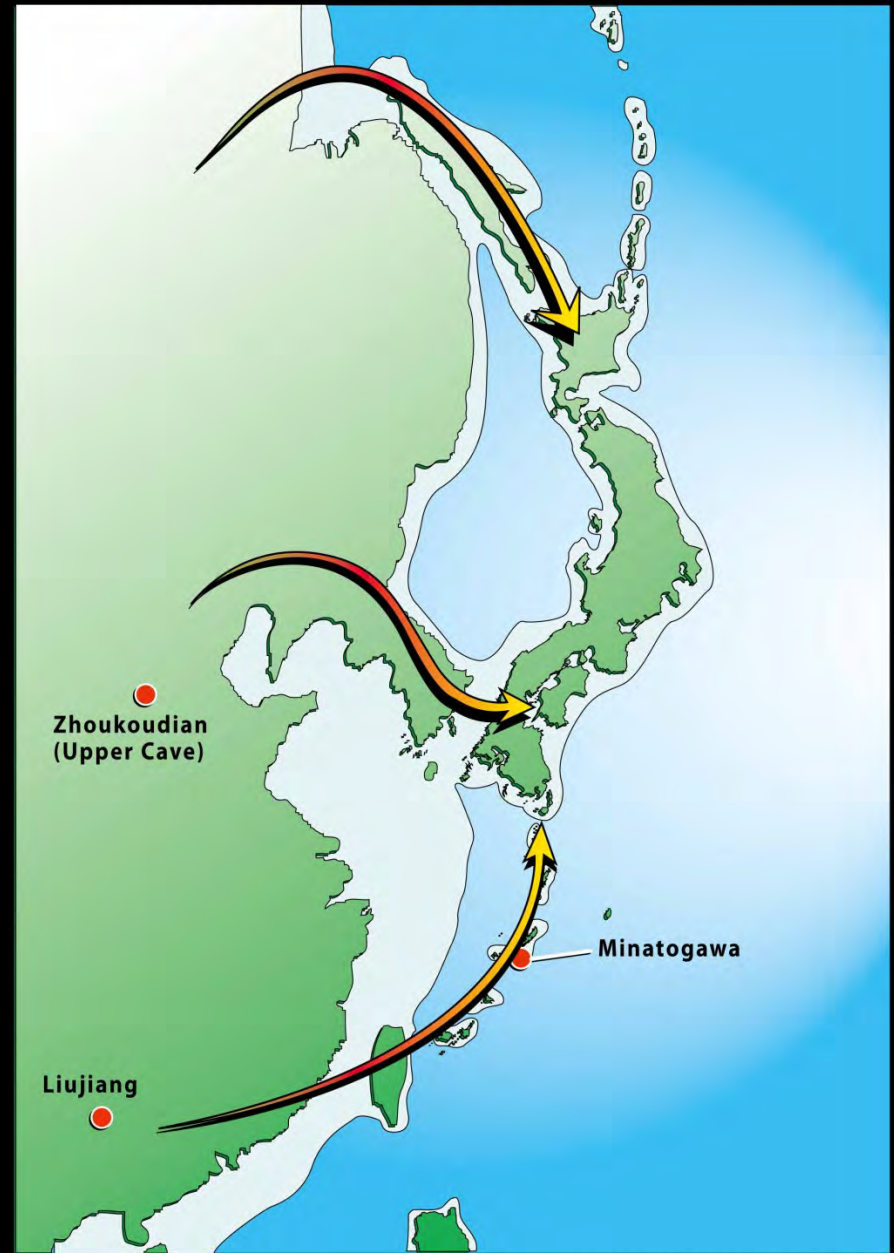
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Graduate School of Medicine,
University of the Ryukyus, Okinawa, Japan**



The first and second main cultural waves from Northeast Asia were Paleolithic microblade industries (15,000 to 12,000 BP) and Mesolithic blade arrowhead cultures (10,000 BP), although no human remains associated with this cultural tradition have been recovered.

Three Possible Routes of Human Migration during the Upper Paleolithic Time



Map of Japan 20,000 Years Ago



From the 5th to 12th century A.D., the prehistoric Okhotsk culture was distributed about Sakhalin, the Okhotsk Sea coast of Hokkaido and the Kurile Islands.



Sea-mammal hunting



Fishing

- The people of the Okhotsk culture are believed to have developed a considerable maritime infrastructure and their cultural remains were different from those of the native peoples in Hokkaido.

Research History



- Modern investigations into the Okhotsk began when Professor Shogoro Tsuboi of the University of Tokyo excavated some bone artifacts from the Susuya shell mound in Sakhalin in 1907.
- Professor Kenji Kiyono of Kyoto University recovered several human skeletal remains at the same shell mound in 1924.

Yuzhno-Sakhalinsk



Susuya Shell Mound



Kato Yamaura



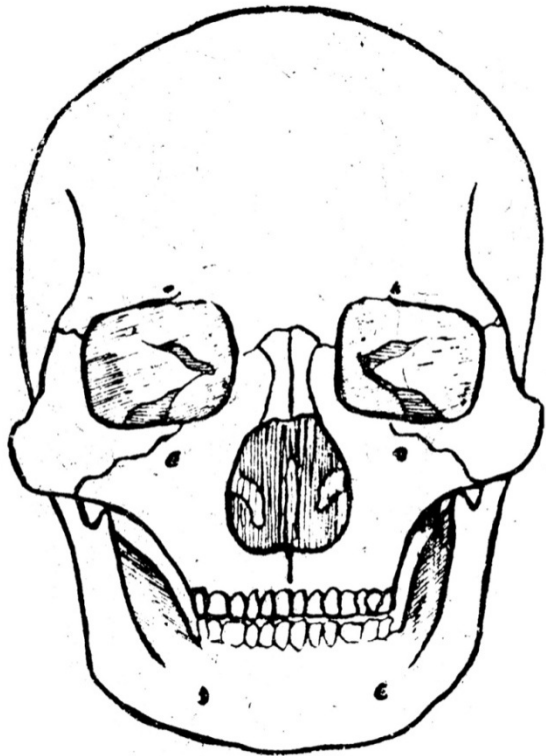
Moyoro Shell Mound



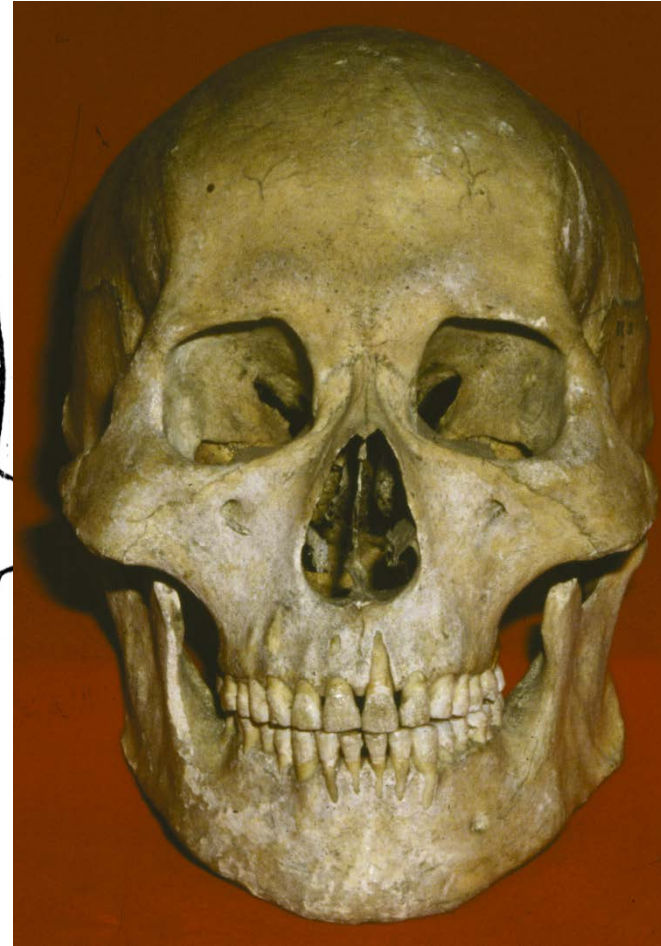
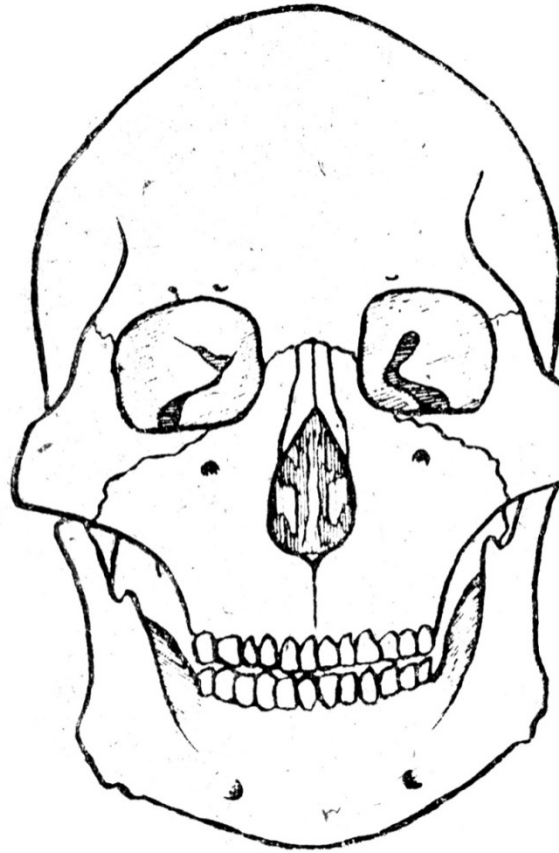
Moyoro Shell Mound

- After World War II, many human skeletal remains were recovered at the Moyoro shell mound, Abashiri, Hokkaido.
- Kodama (1947, 1948) pointed out that the markedly high, broad and flat face of the Okhotsk people contrasted well with the low and prominent face of the Ainu in Hokkaido.

Ainu



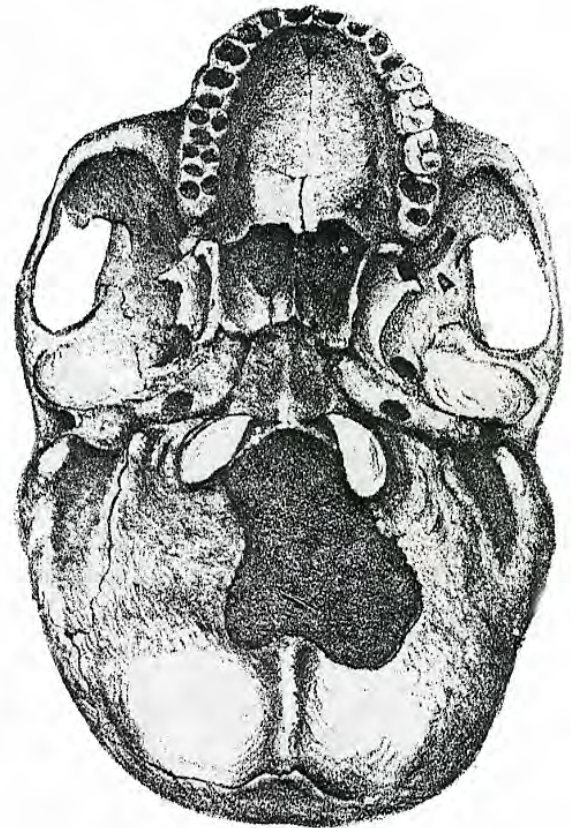
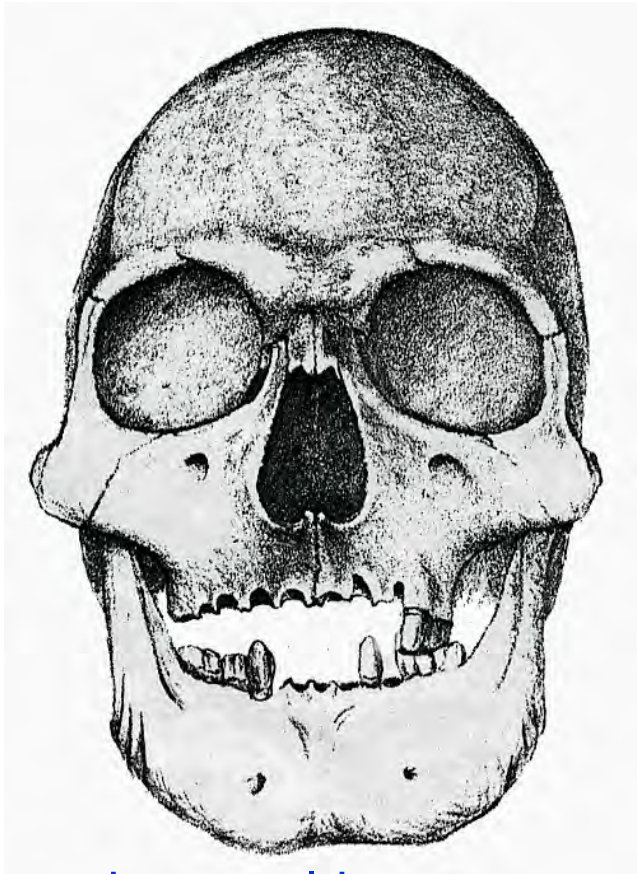
Okhotsk



First study on the Ainu skull

George Busk: Description of an Aino skull.

Transaction of Ethnological Society, N.S. Vol. V, March, 1867.



... Aino cranium would seem to present no very marked distinctive characters from those of the European ... it also differs not only from the European, but from all other types of skull ...

Okhotsk people

- The Okhotsk people has features typical of the so-called Northern Mongoloids; for instances, generally large size, high face, flat nasal bones, large maxillae and zygomatic bones.
- Hence, the Okhotsk people differ markedly in morphology from the Ainu.

Epi-Jomon

Okhotsk



Recent Excavations



Menashidomari Site



An adult male skull was excavated
in 1987.



Only a half of the facial skeleton
was preserved.



Utoro, Shari, Shiretoko



Utoro-Jinjayama Site



We had excavated this site from
1990 to 2008.



Many human skeletons were recovered.





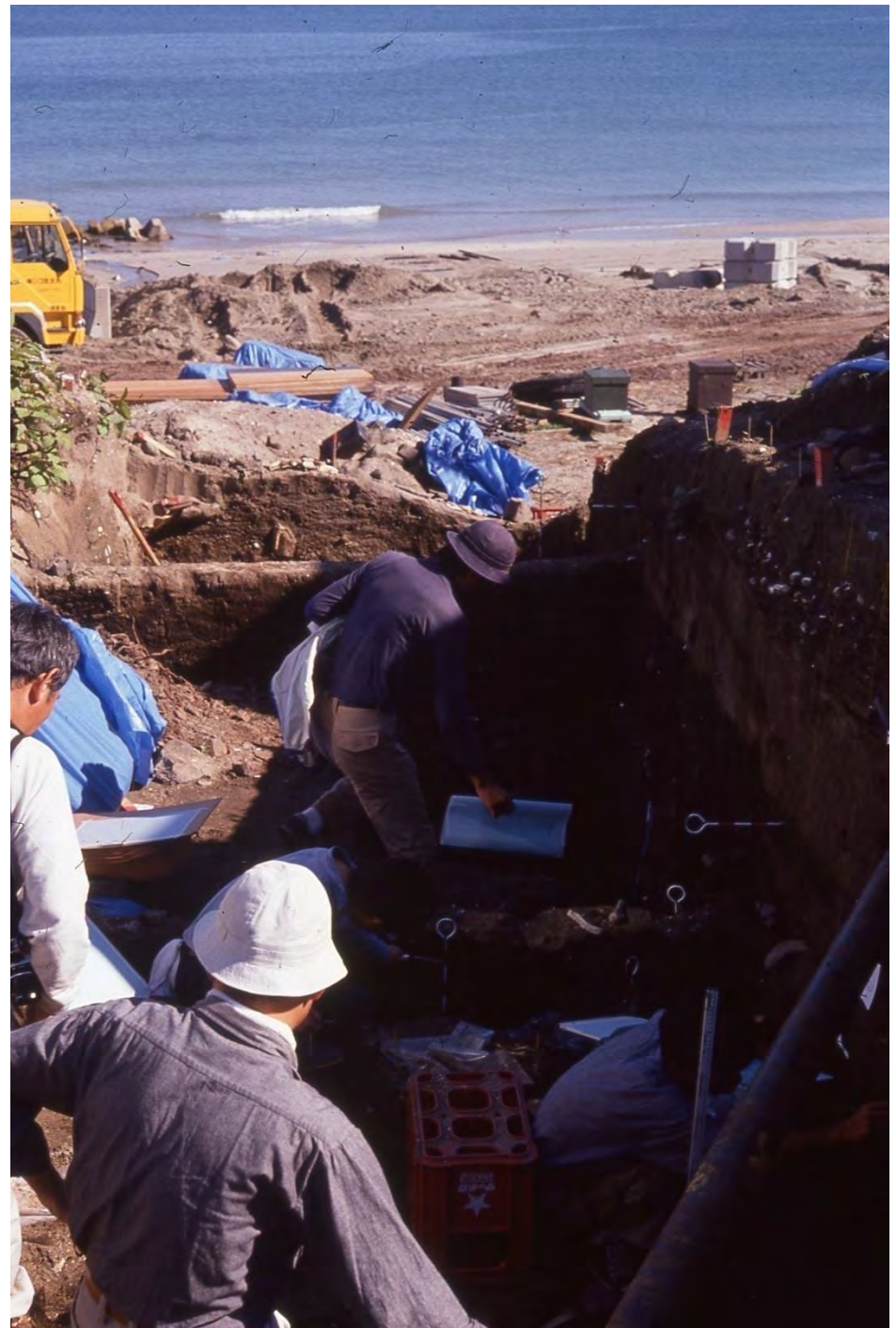
Rebun Island, Hamanaka Site



From 1990 to 1995, Excavation.



In 1990,
many
immature
skeletons
were
recovered.



Eight skeletal remains were recovered from one area.



Perinatal baby (New born or Stillbirth)



Infant

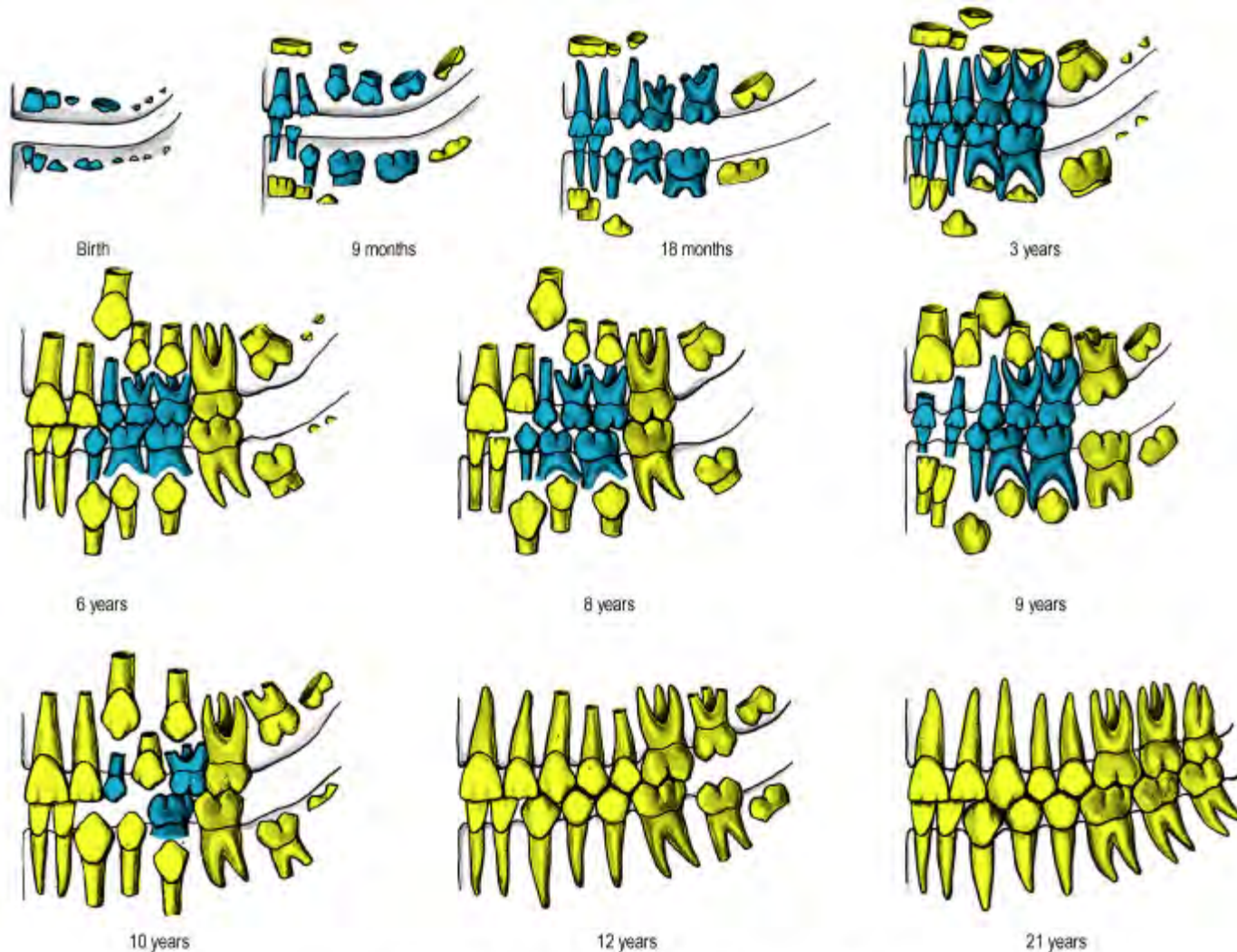


Child



Age-at-death estimation

- Age estimation is fairly accurate for subadults.



Birth



3 years



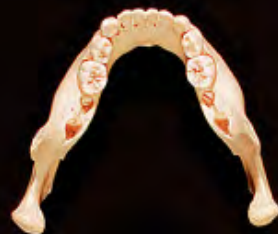
6 years



Adult



Edentulous
old age



From 1991 to 1993, seven human skeletons were excavated.





Adult female skeleton of Towada phase (550—650 years AD)



Severe dental wear had caused apical periodontitis around the left lower first molar, secondarily resulting in tooth fracture.



Adult male skeleton



Partial skeleton



'92 7.27

Abnormally large deposits of dental calculus, especially on the right upper 2nd and 3rd molars



During 1994 to 1997, the National Museum of Japanese History, Chiba, executed the research excavation at the Hamanaka 2 site.



Adult male skeleton (R1)



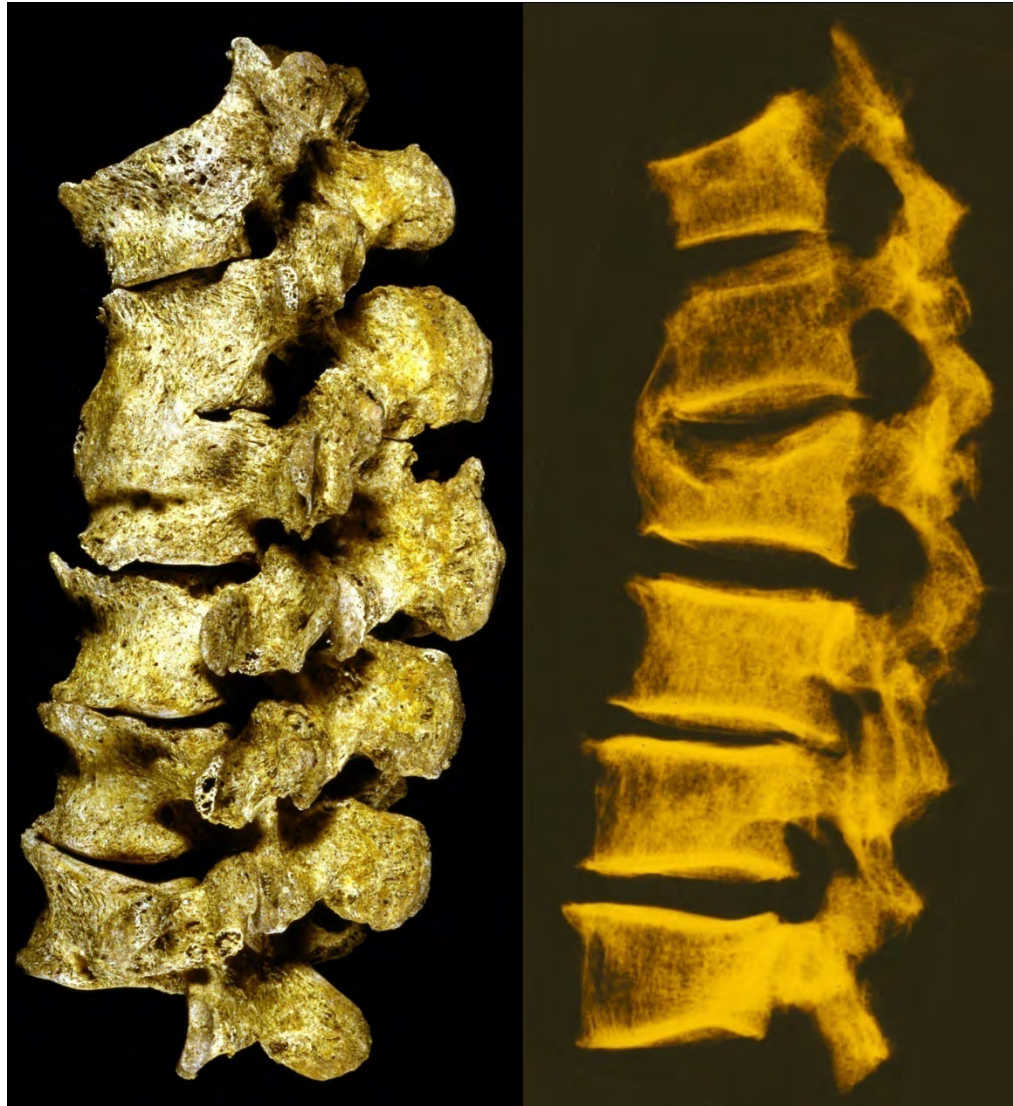
Adult male skeleton (R1)



Severe dental wear had caused apical periodontitis and radicular cyst.



Compression fractures affected the 12th thoracic and 2nd lumbar vertebrae.



Adult female skeleton (R2)



Infant (R3)



Life history of the Okhotsk people

Dr. Tomohito Nagaoka

Nagaoka T, Ishida H, Shimoda Y, Sunagawa M, Amano T, Ono H, Hirata K.
Estimation of skeletal adult age distribution of Okhotsk people in northern Japan.
Anthropological Science, 120: 103-113, DOI: 10.1537/ase.1107311, 2012.



Purposes

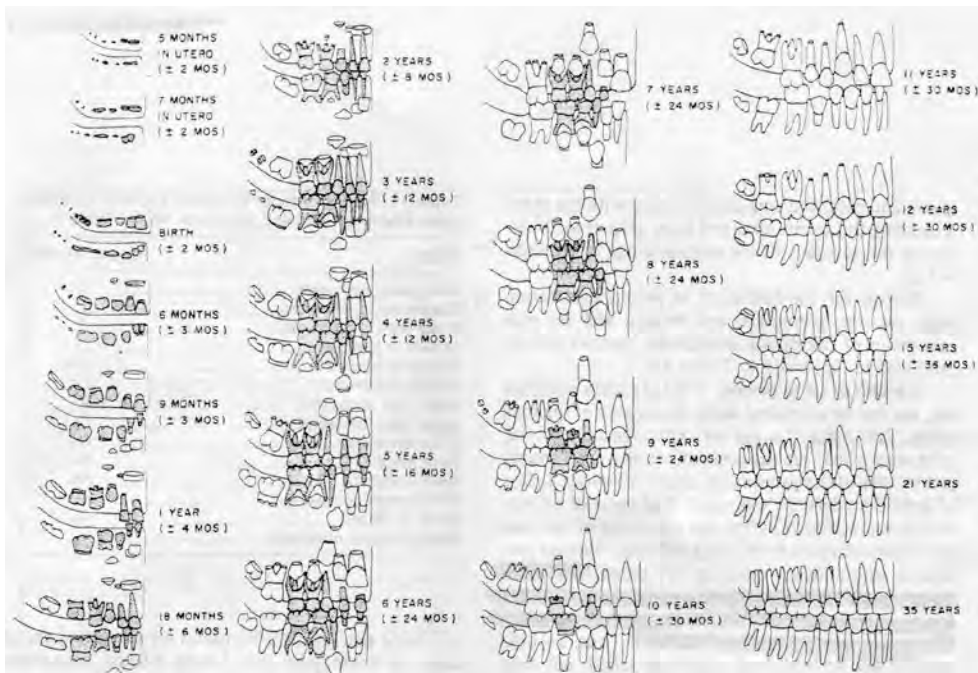
- The purpose of this study is to reconstruct adult age distributions using the Bayesian approach for auricular surfaces.
- The target of this study is the human skeletal remains associated with the Okhotsk culture.

Problems in paleodemography

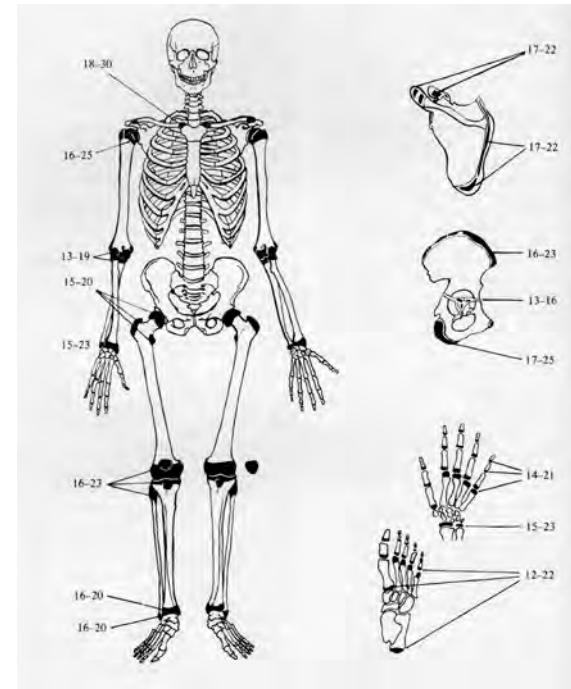
- Infant under-representation
- Difficulties of age estimation in particular for elderly individuals
- It is unknown whether the skeletal population represents the real demographic structure.

Difficulties in age-at-death estimation

- Age estimation is fairly accurate for subadults, but not for adults (Bocquet-Appel and Bacro, 1997; Milner et al., 2000; Murray and Murray, 1991).



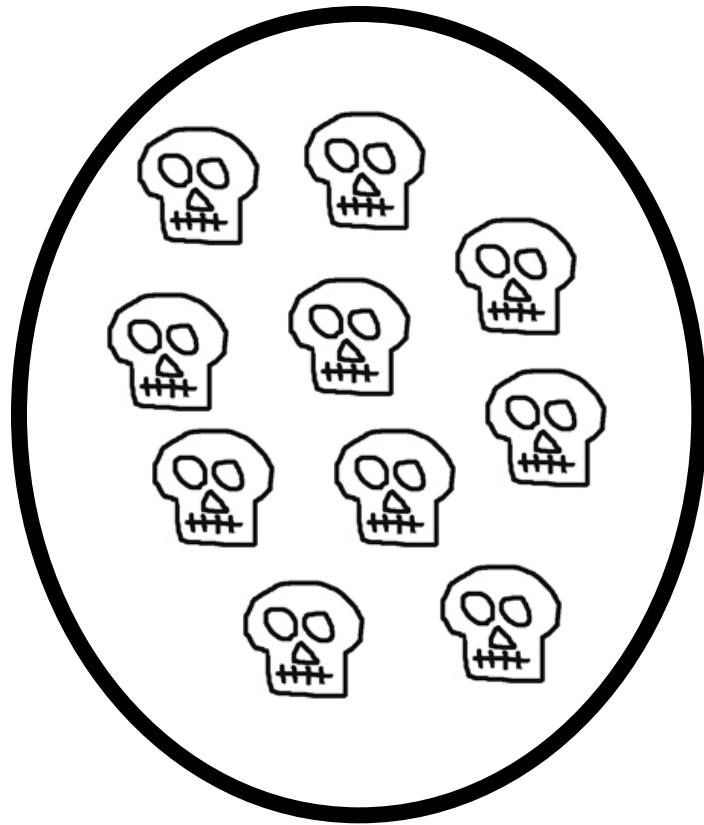
(Ubelaker, 1989)



(Brothwell, 1981)

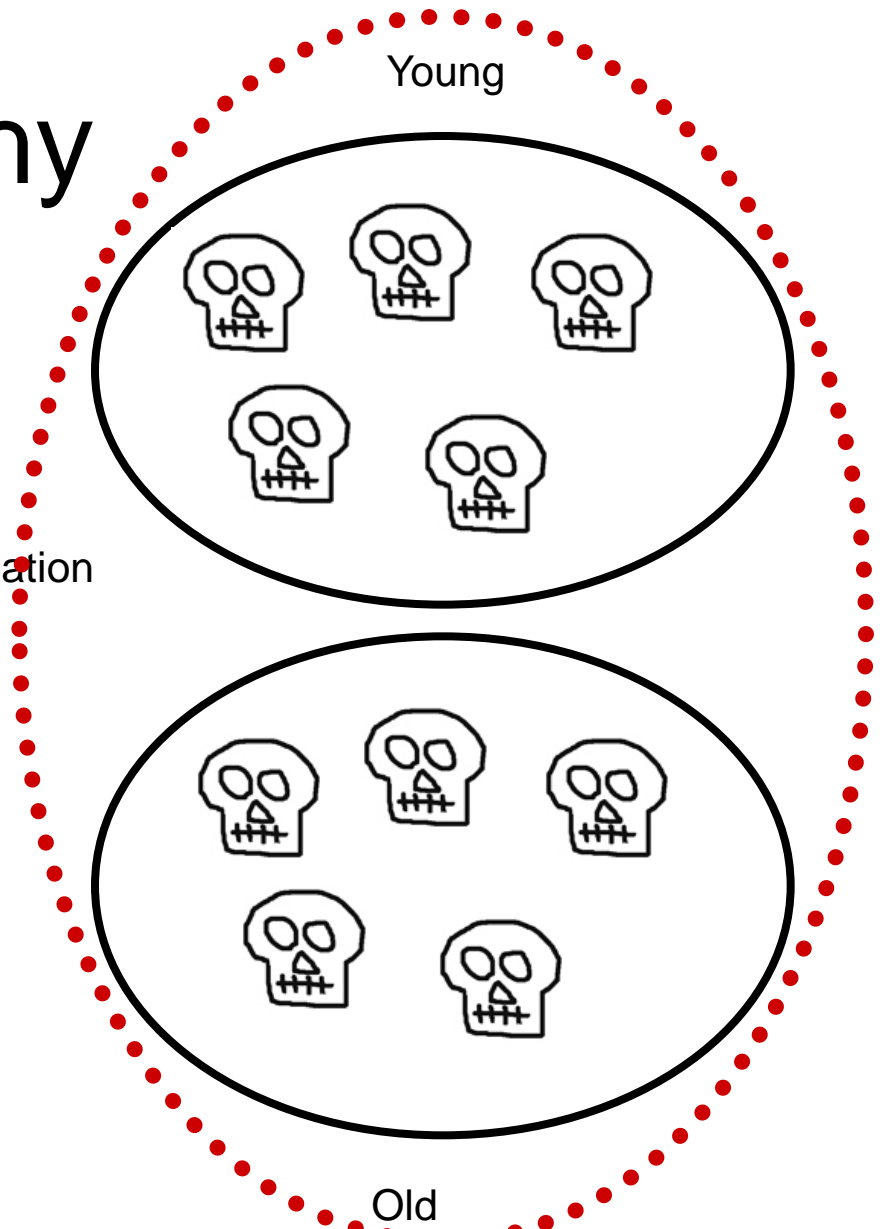
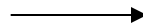


Paleodemography



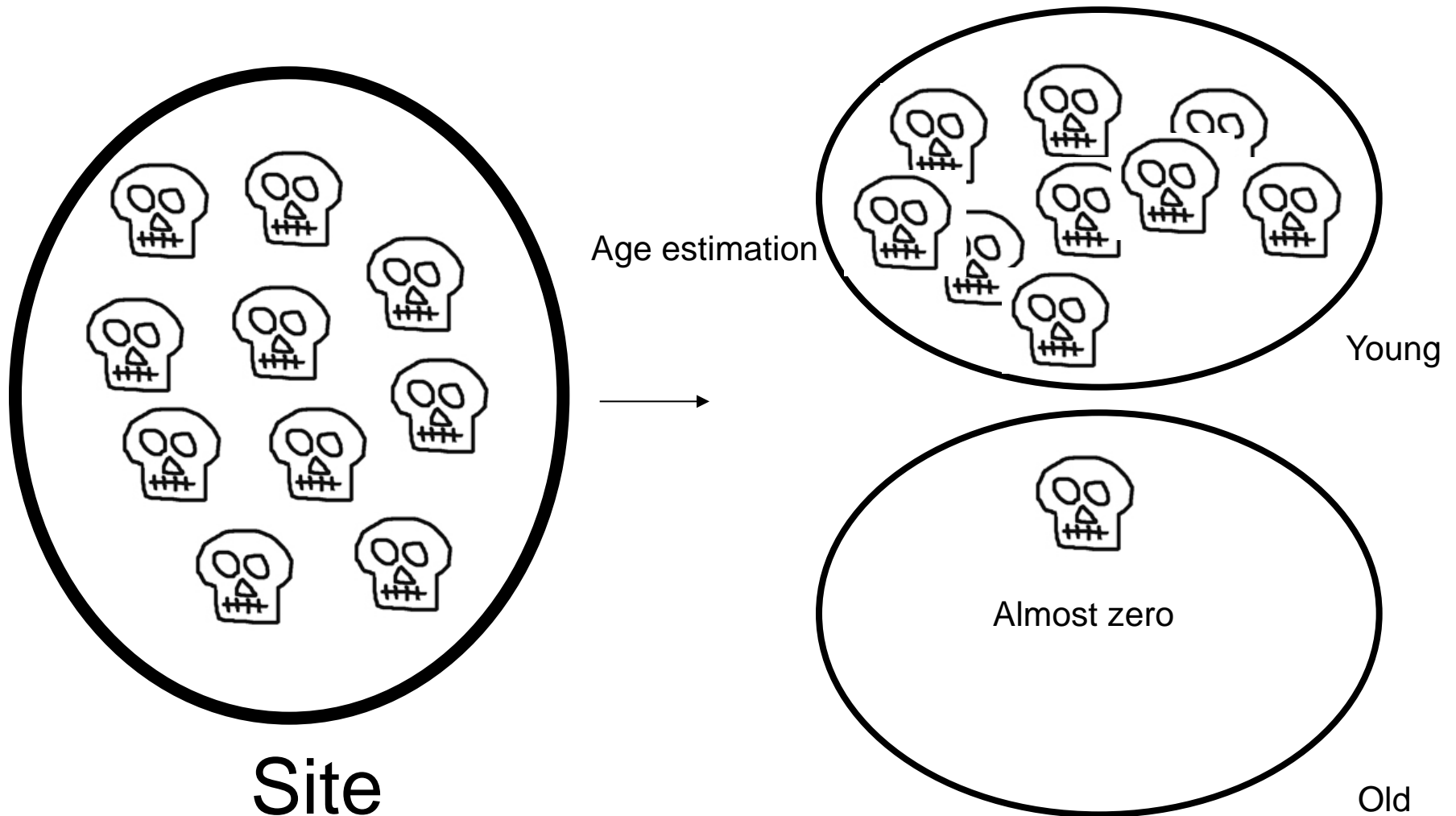
Site

Age estimation



Age structure of
skeletal population

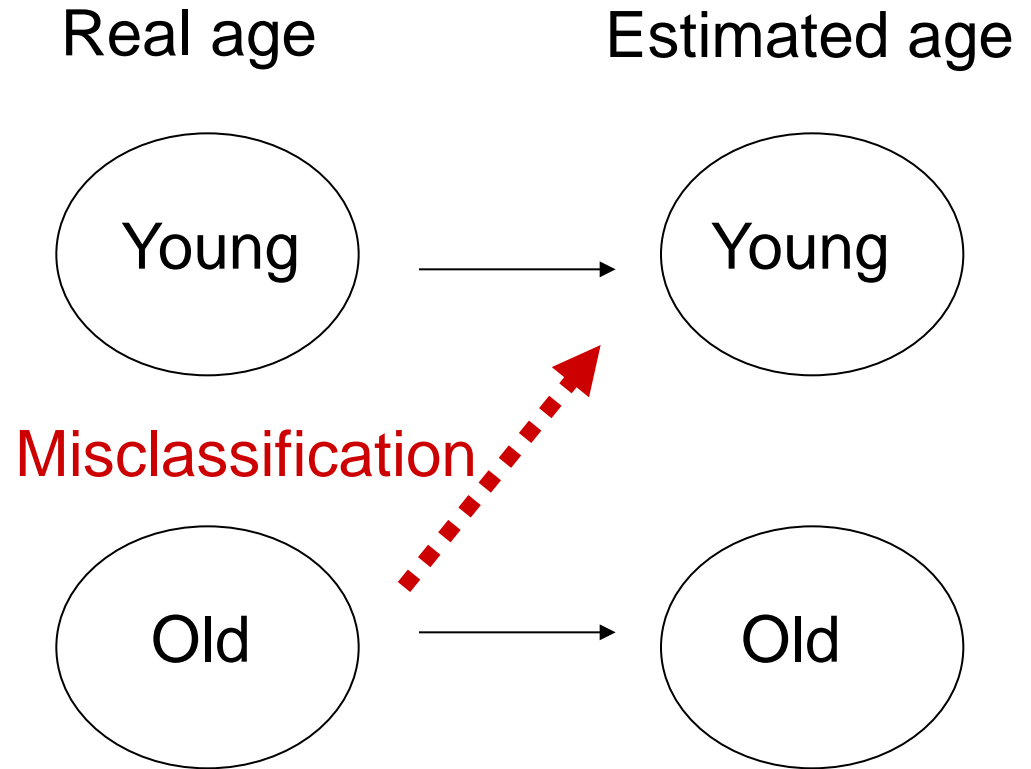
Previous estimation





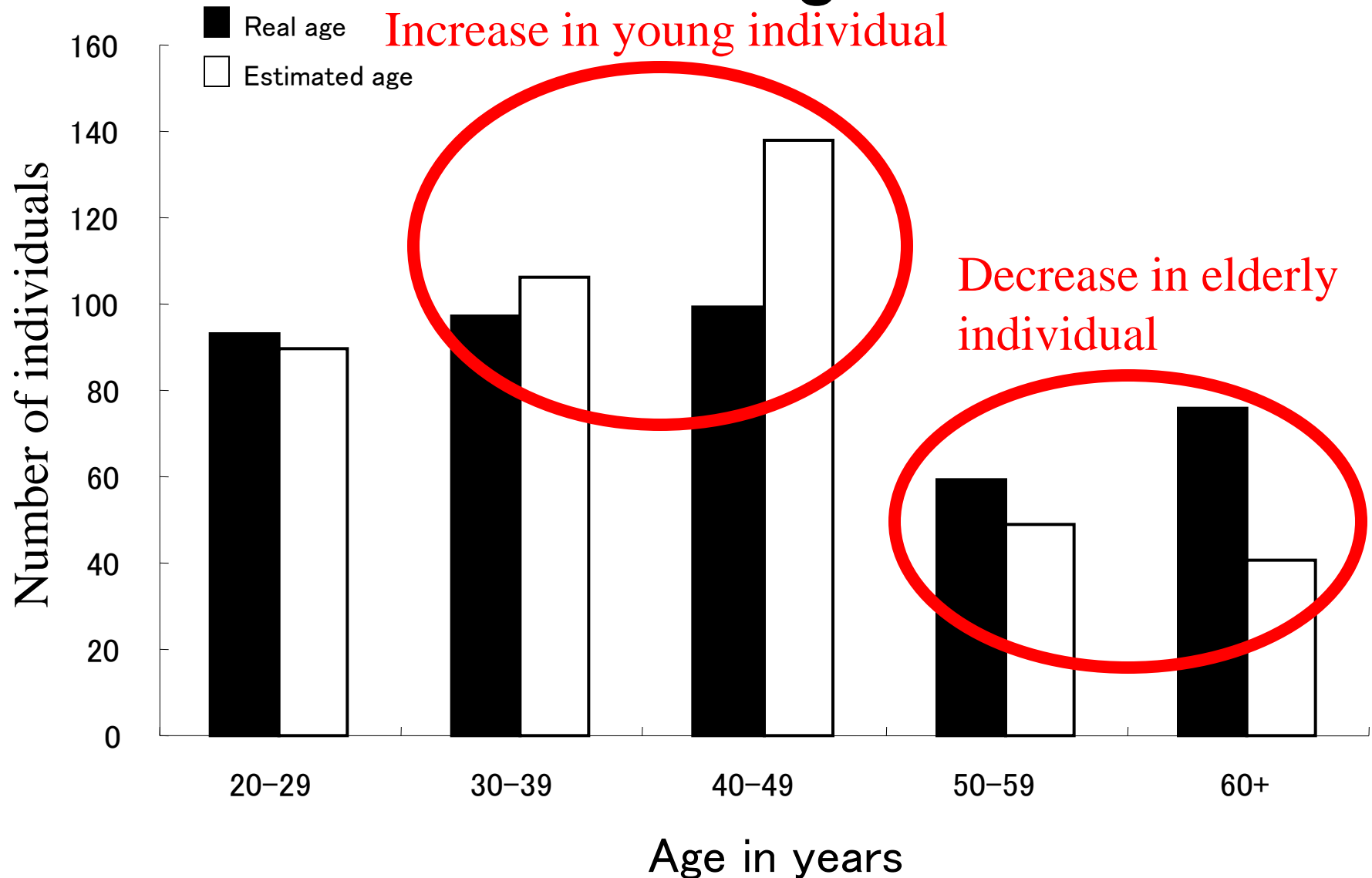
Problems of adult age estimation

- Young individual is easy to be estimated as young one, but old individual is difficult to be correctly classified.

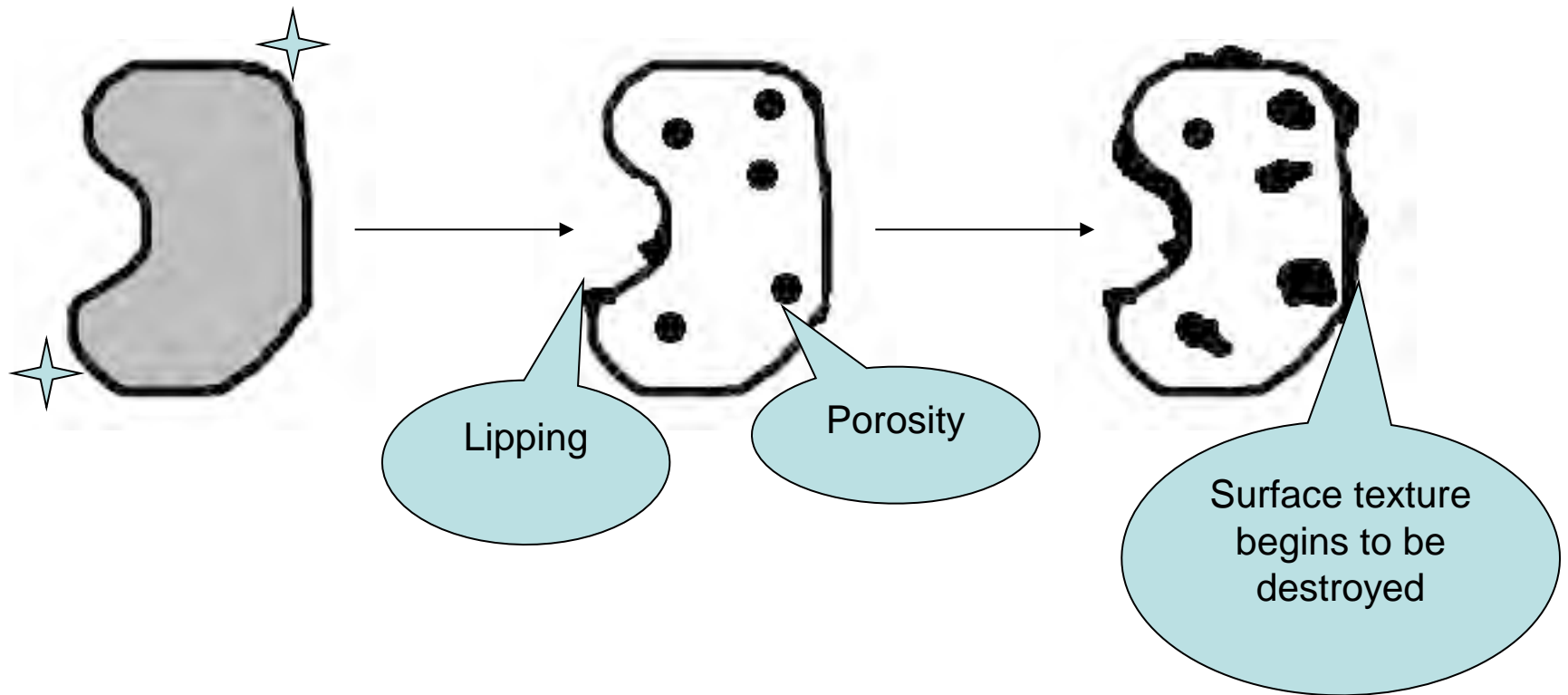




Problems of adult age estimation



Age-related changes in auricular surface of the ilium



Age-related changes in auricular surface of the ilium



Surface Texture

スコア2:50～90%がfinely granular, 他はcoarsely granularにかわる。Dense boneはない。

少しざらざら Coarse

滑らか Fine

Surface Texture

スコア4: Dense boneあり。50%に達しない。

ざらざら(密度0.5mm以下)
Coarse

ざらざら(密度0.5mm以上)
Dense

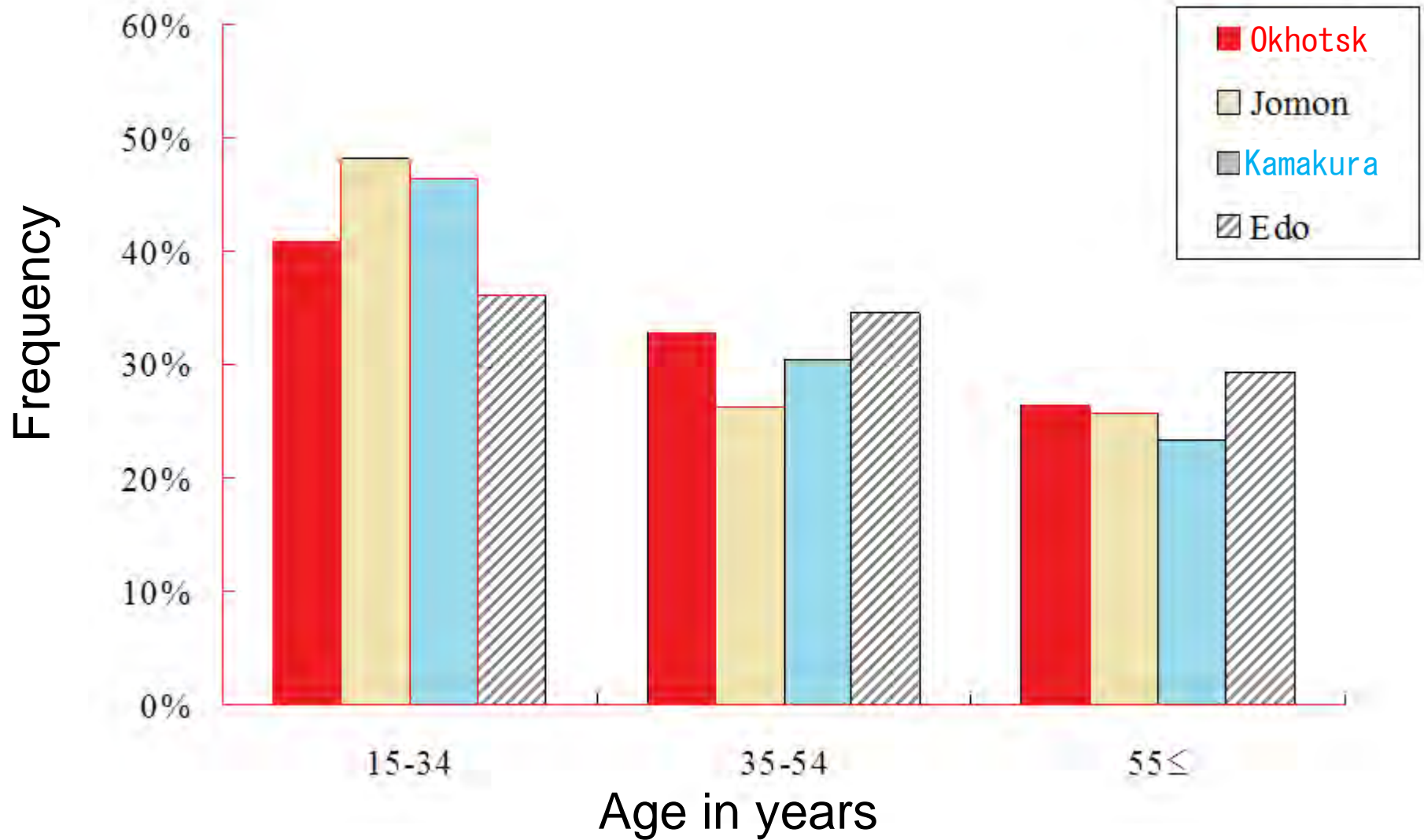
Surface Texture

スコア5: Dense boneあり。50%以上。

ざらざら(密度0.5mm以上)
Dense



Comparison among four samples



Demography of the Okhotsk people

- The age distributions of the Okhotsk had low proportions of young adults and high proportions of elderly adults.
- The results indicated 24.4-51.3% for the proportion of individuals above the age of 55 years.

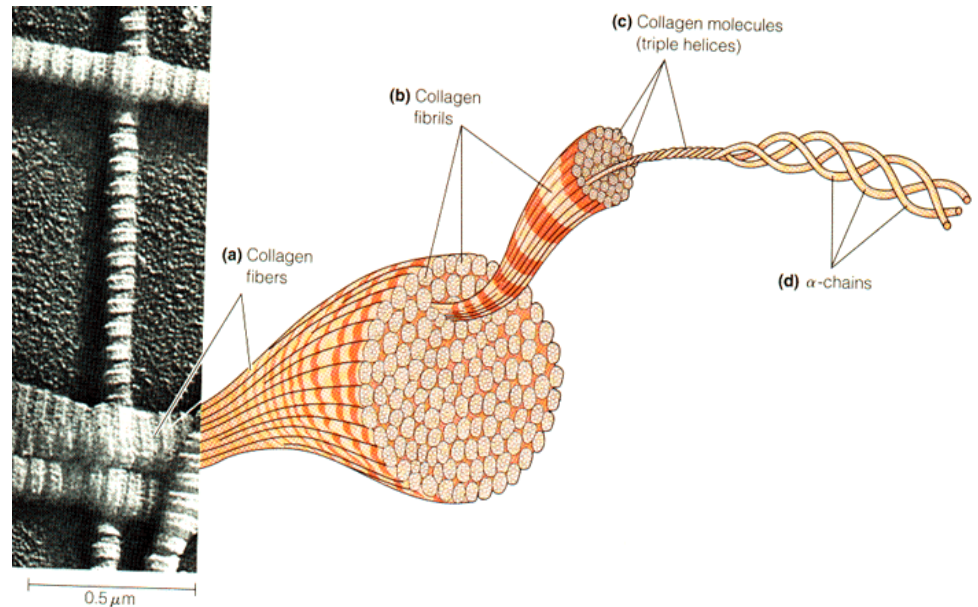
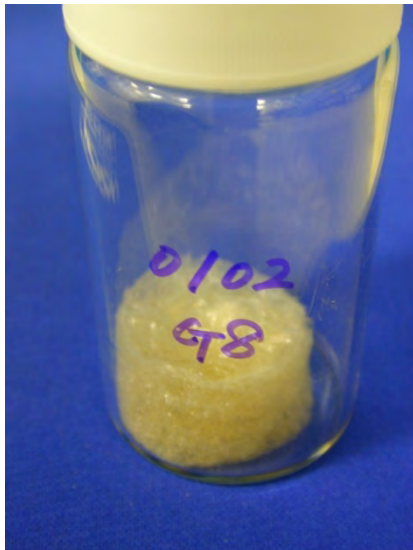
Prof. Minoru Yoneda

Dietary reconstruction of the Okhotsk Culture of Hokkaido, Japan, based on nitrogen isotopic composition of amino acids: implication for the correction of radiocarbon marine reservoir effects on human bones.



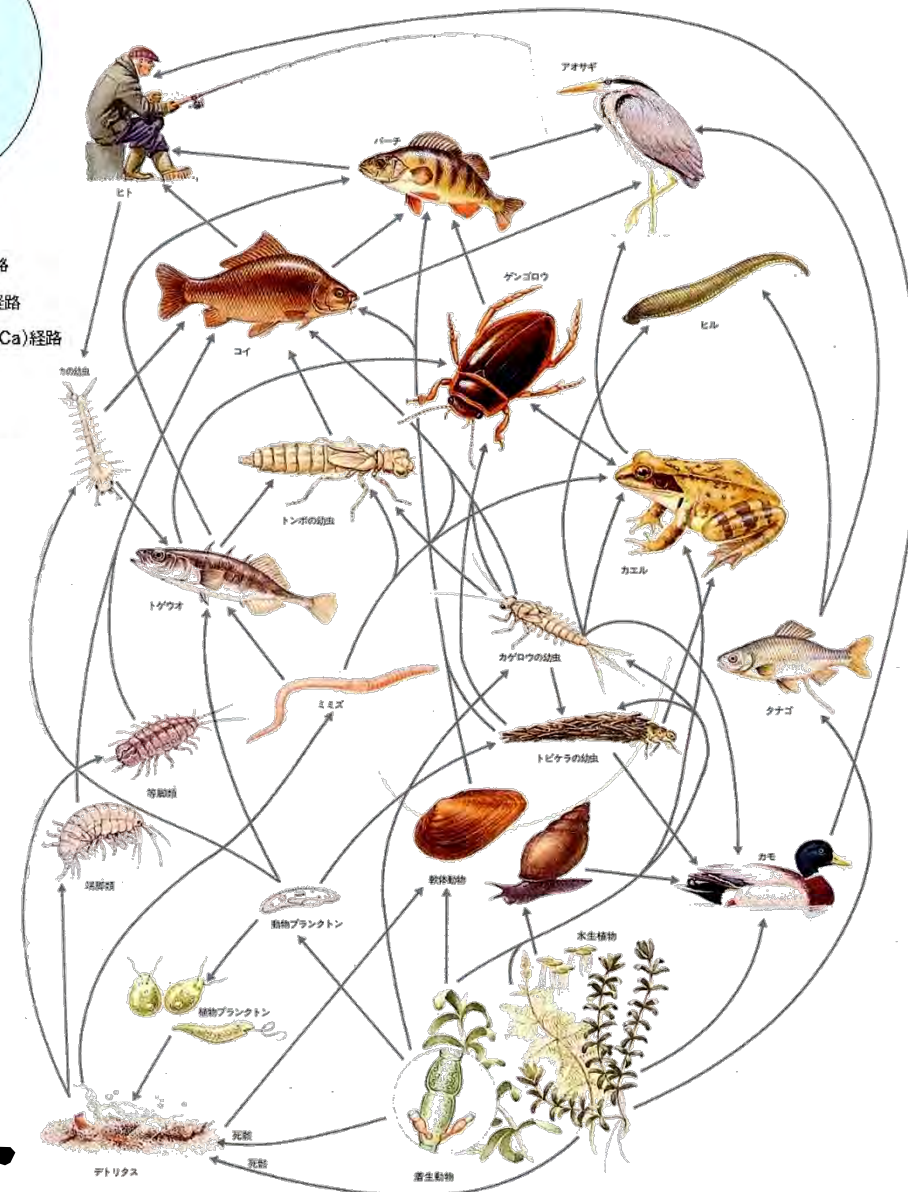
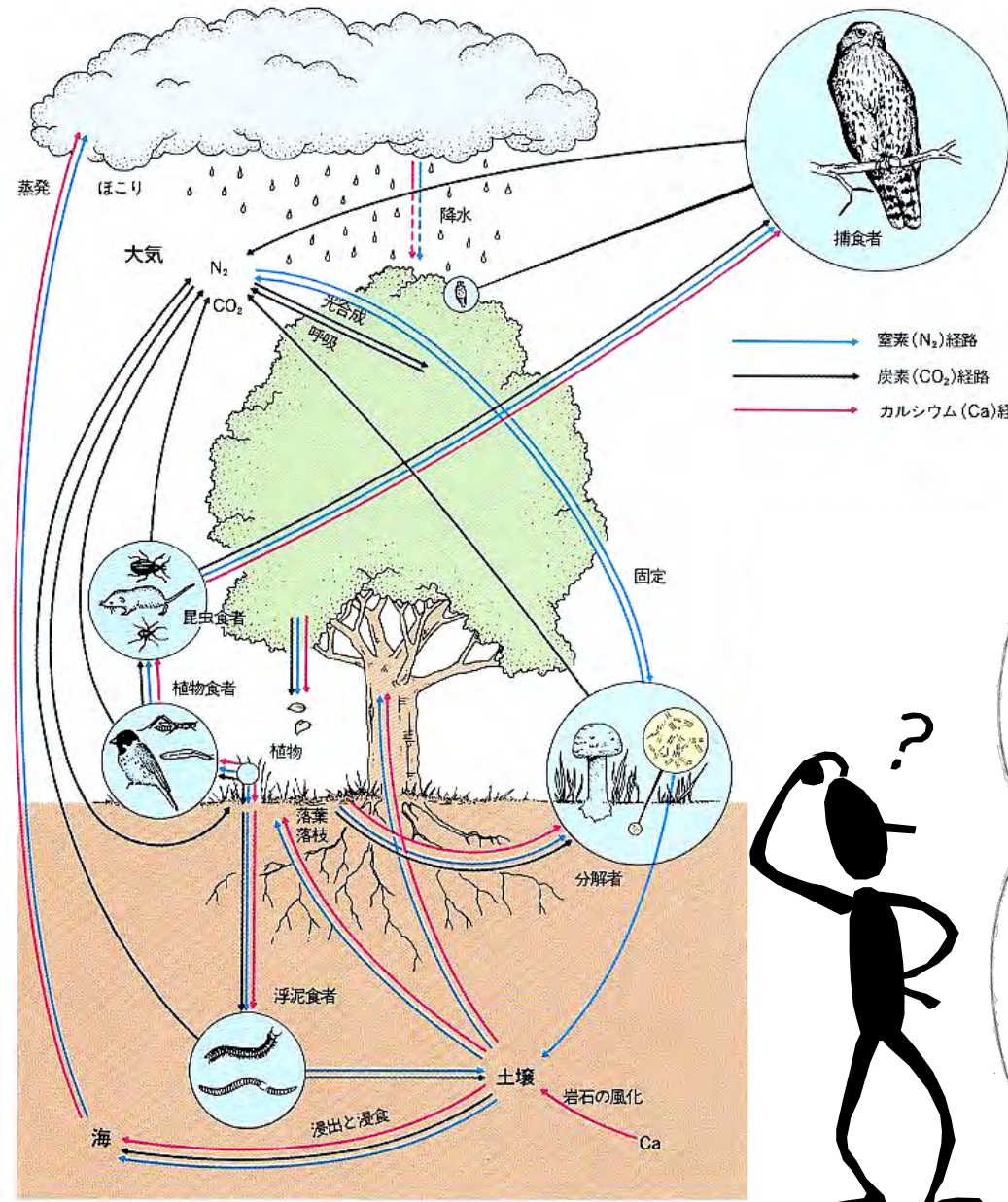
Stable Isotope Analysis

- The Okhotsk peoples had developed significant adaptation to the marine food sources and expand their habitat during a few hundred years along the coast of the Sea of Okhotsk (Amano, 2003; Hudson, 2004).
- The nature of subsistence of the Okhotsk culture was recently confirmed using stable isotope analysis (Naito et al., 2010).



Collagen in bone ← amino acid ← Protein in food

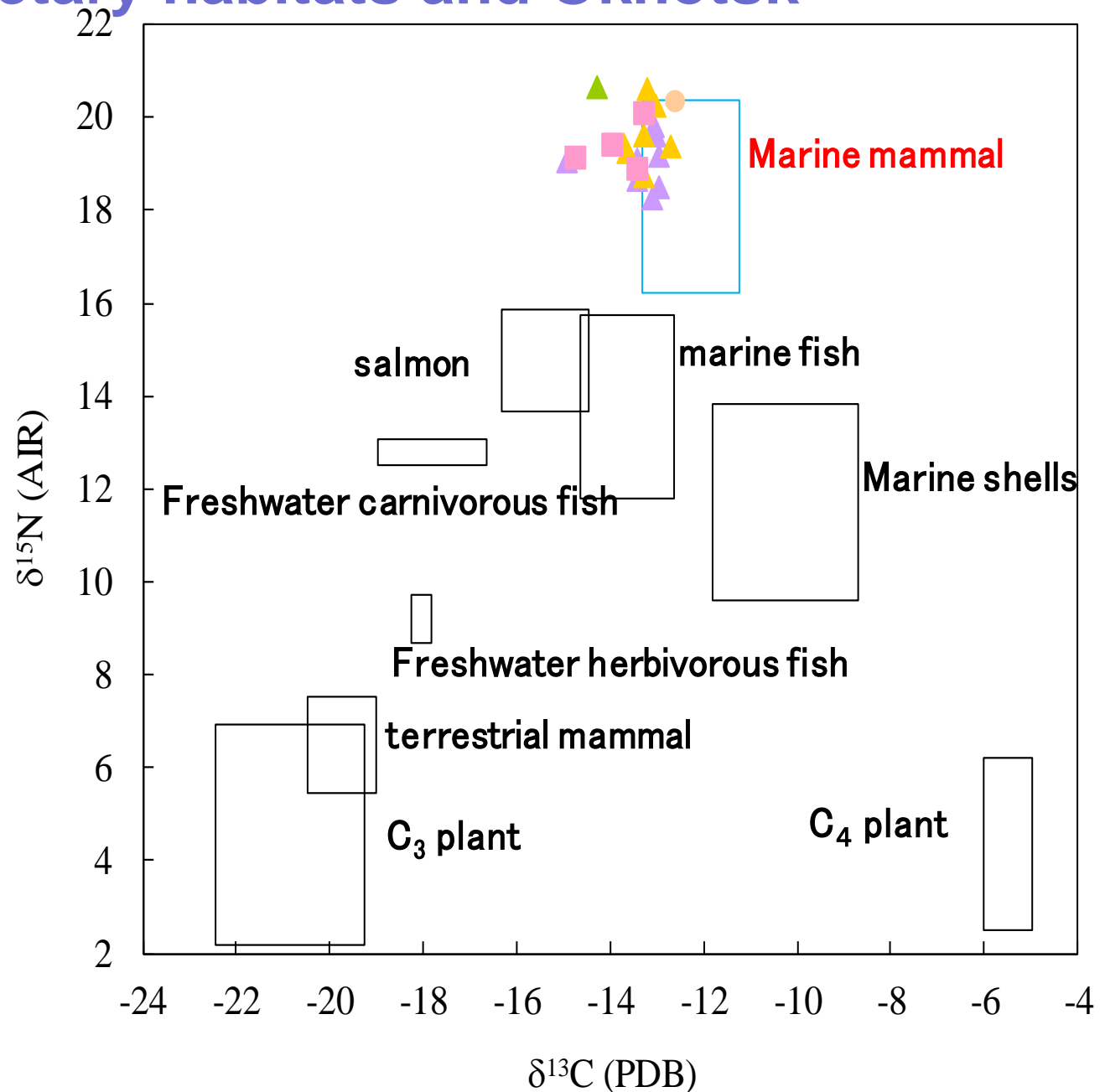
Food chain



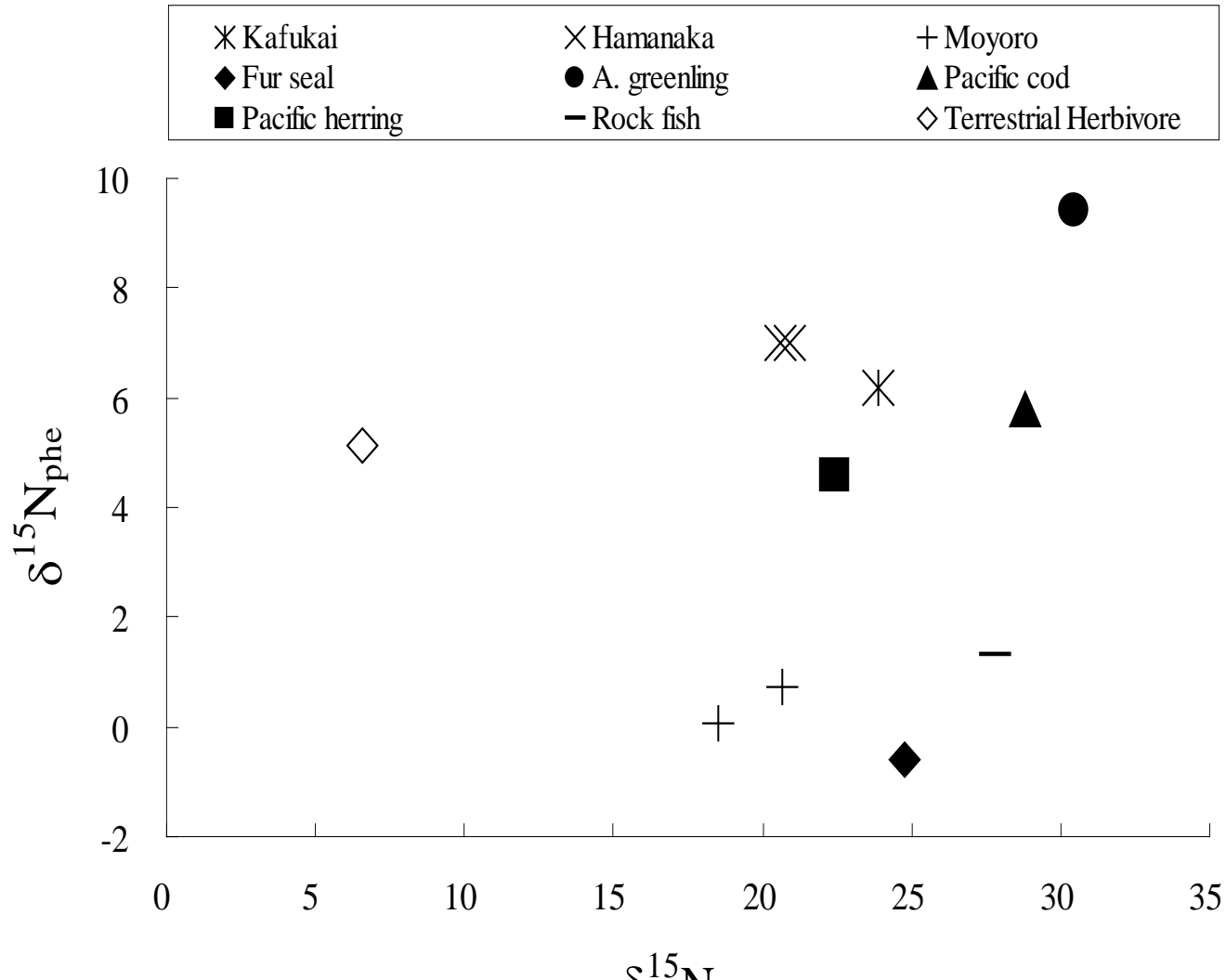
Human position in Eco-system ?

Dietary habitats and Okhotsk

- ◆ Hamanaka
- ▲ Tanetonnai
- Utorojinjayama
- ▲ Moyoro
- Shikotan

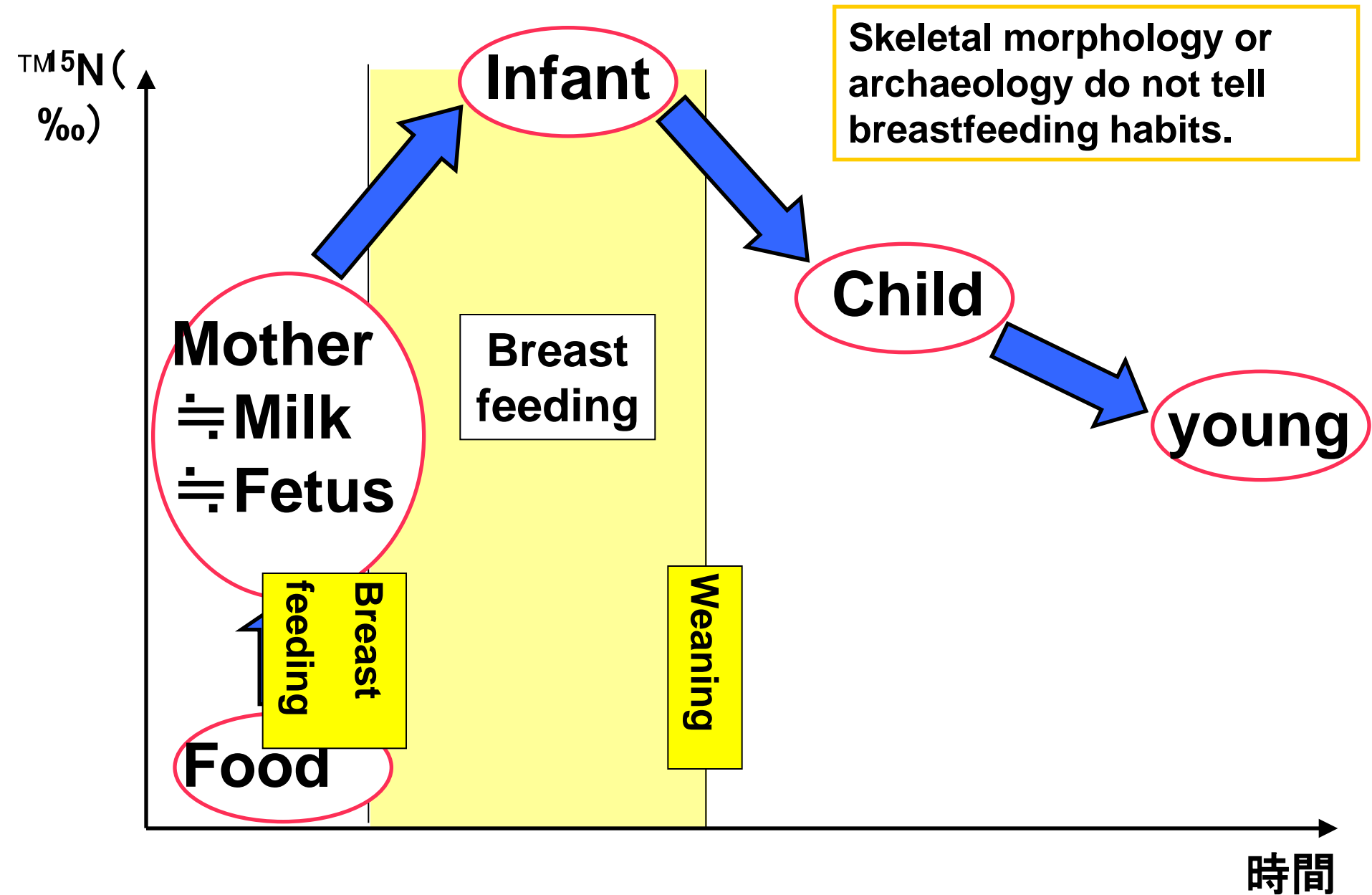


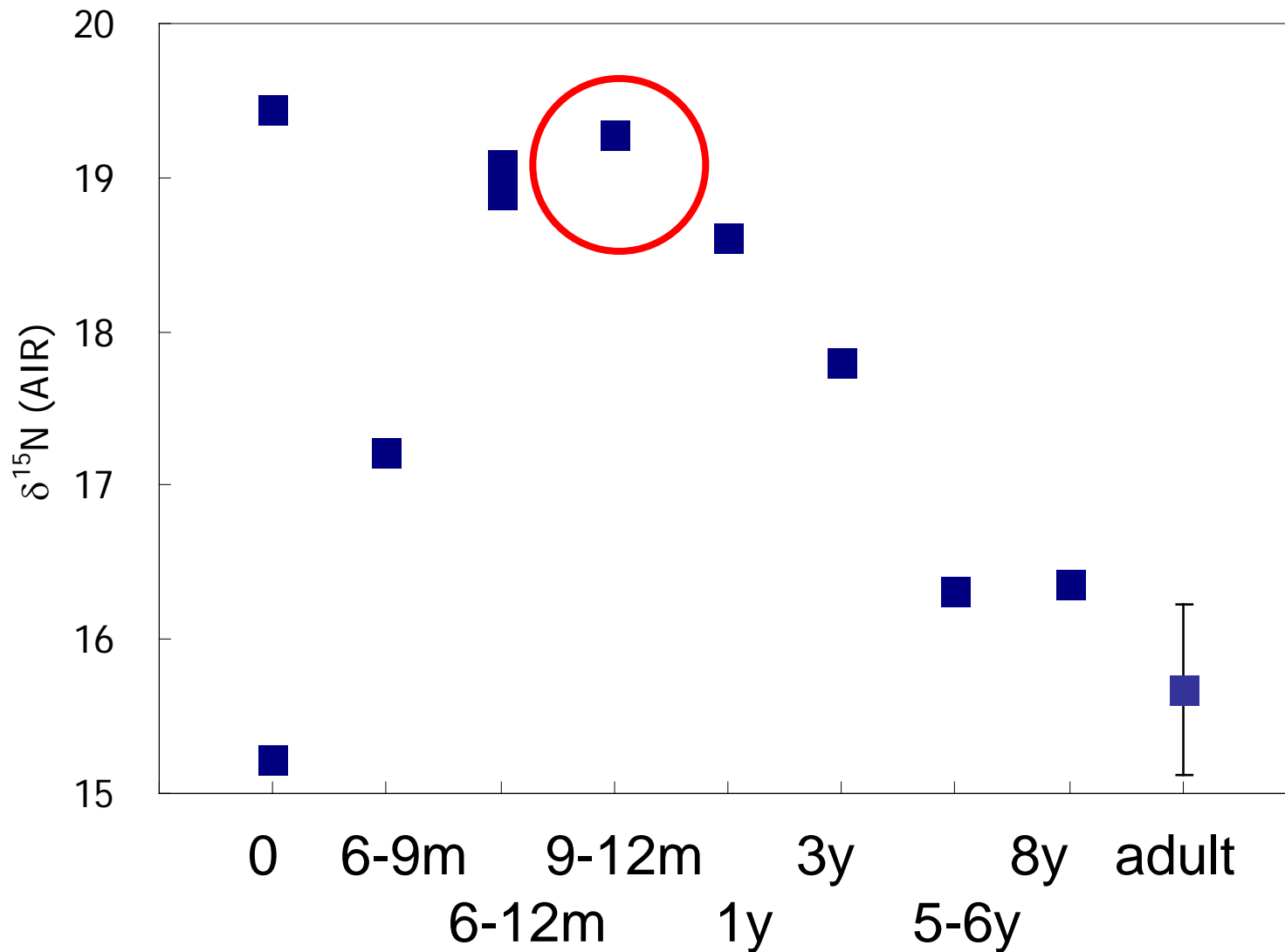
Nitrogen isotopic composition of their constituent amino acids suggests differences in fur seal contributions among northern Hokkaido (0-24% for Kafukai 1, 0-10% for Hamanaka 2) and eastern Hokkaido (78-80% for Moyoro) populations.





Using Stable Isotope Analysis reconstructs Breastfeeding Practice in Prehistoric Hokkaido.





Hamanaka subadult

The weaning age is one of the most important determinants of the fertility, shorter breastfeeding duration suggests an increased fertility.

Degenerative Joint Changes



- Degenerative joint disease, or osteoarthritis, is a common disease characterized pathologically by damage to the articular cartilage and bone surface in synovial joints, associated with osteophyte formation at the joint margins.
- This condition affects not only the hands, hips and knees, but also the spine, and is strongly age-related, currently rising in frequency after 50 years old.



Degenerative changes of the spine in people from prehistoric Okhotsk culture and two ancient human groups from Kanto and Okinawa, Japan. Shimoda et al (2012) Anthropological Science, 120:1-21.

- The cervical spine of each sex had most osteophytes on the vertebral body.
- Moreover, severe osteophytes on the body of the lumbar vertebrae were more frequently seen in the Okhotsk males.
- Degenerative changes of the articular process of the Okhotsk series were most frequently seen in the lumbar vertebrae and least frequently seen in the cervical vertebrae.

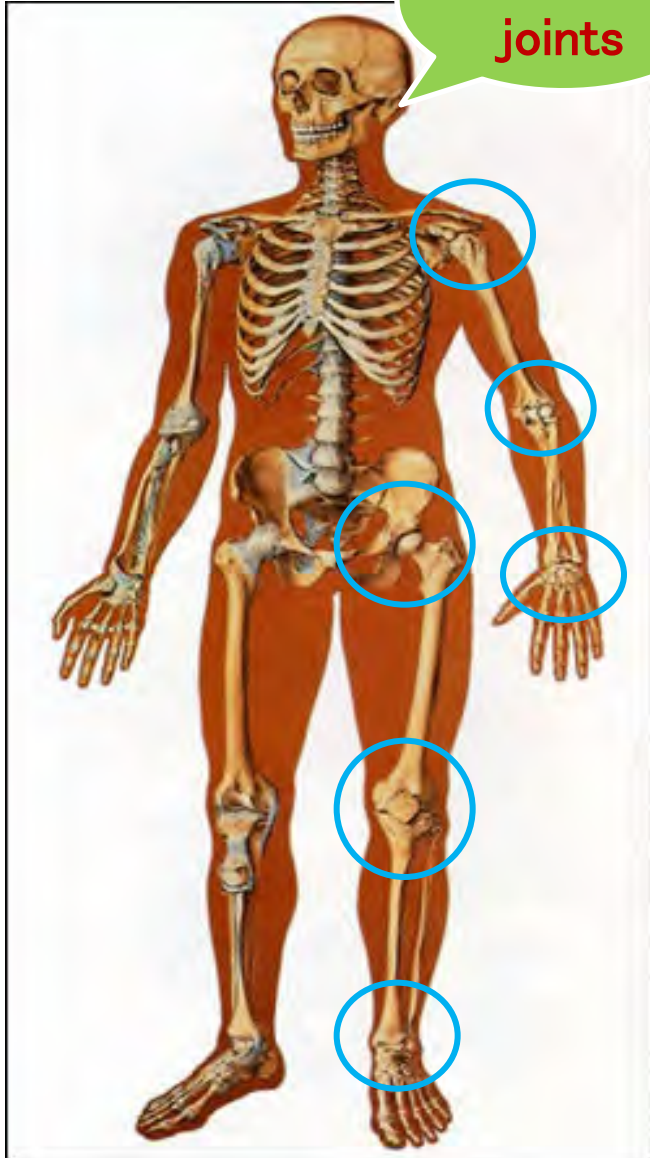




- The Okhotsk culture developed a considerable maritime infrastructure, the lifestyle required for sea-mammal hunting and fishing seems to have particularly affected the incidence of severe degenerative changes of the lumbar vertebrae.



6 major
joints



Scales of osteoarthritis (BRIDGE)

Scale 1 (微量)



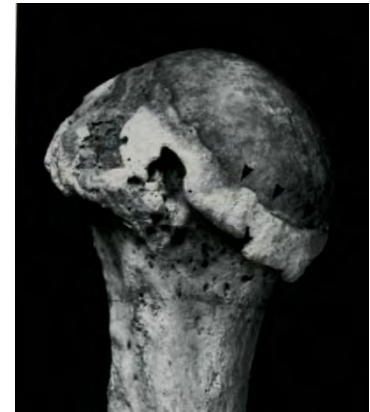
Scale 2 (軽度)



Scale 3 (中等度)



Scale 4 (重度)



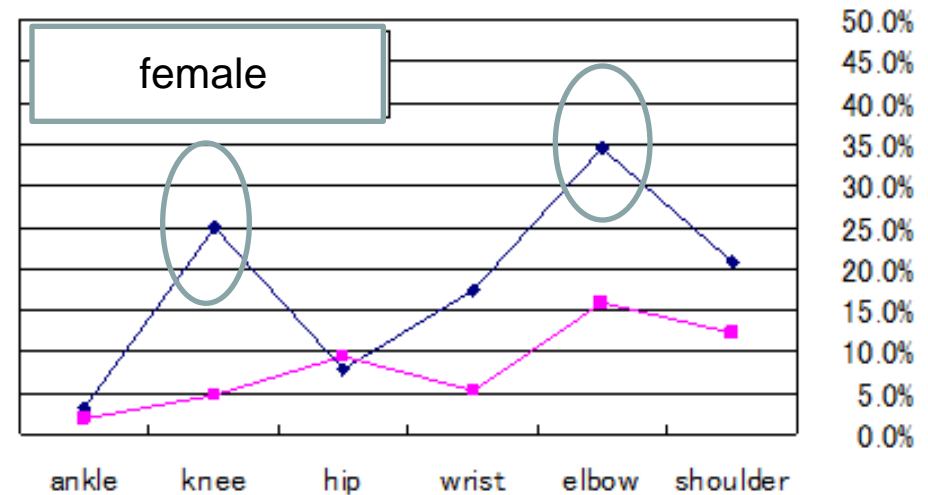
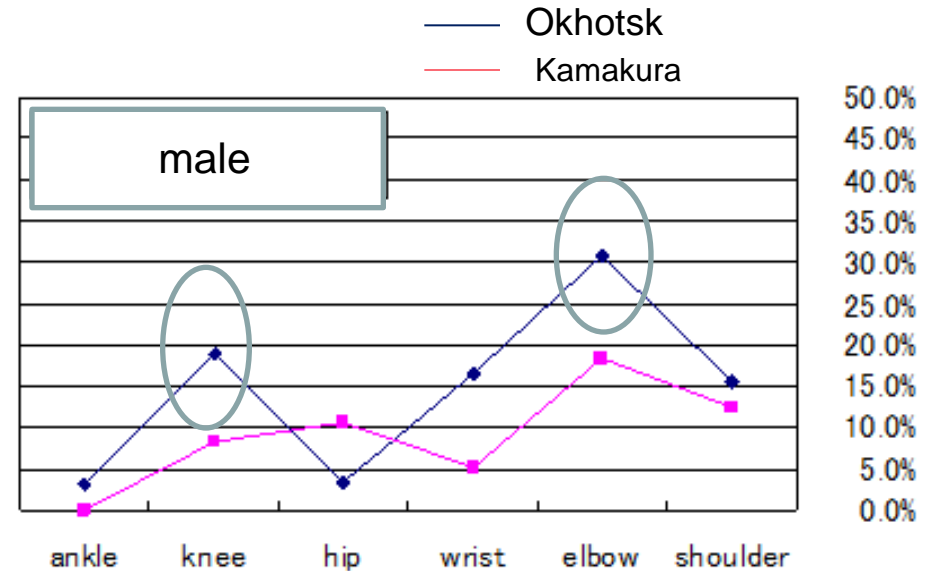
(Truamoto)



Ratio comparison of the appendicular severe osteoarthritis



elbow



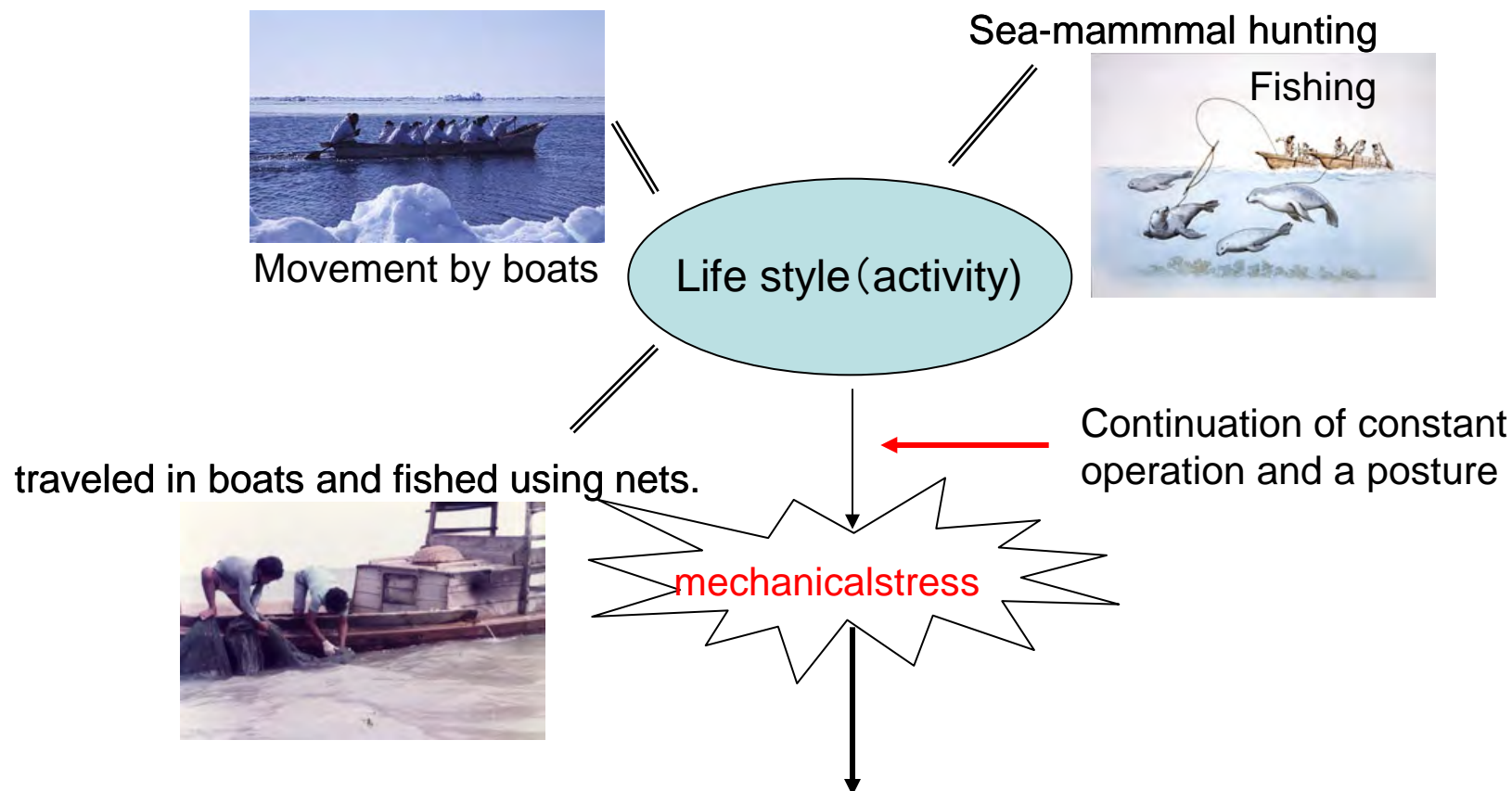
The Okhotsk sample showed high frequency by elbow and knee
(Sunagawa et al.,2007)

Less frequency of DJD in the shoulder joints did not indicate the circumduction.



People from Okhotsk culture

The Okhotsk culture developed considerable sea-mammal hunting, in both shallow and deep water.



Degenerative changes of the specific spine, elbow, and knee

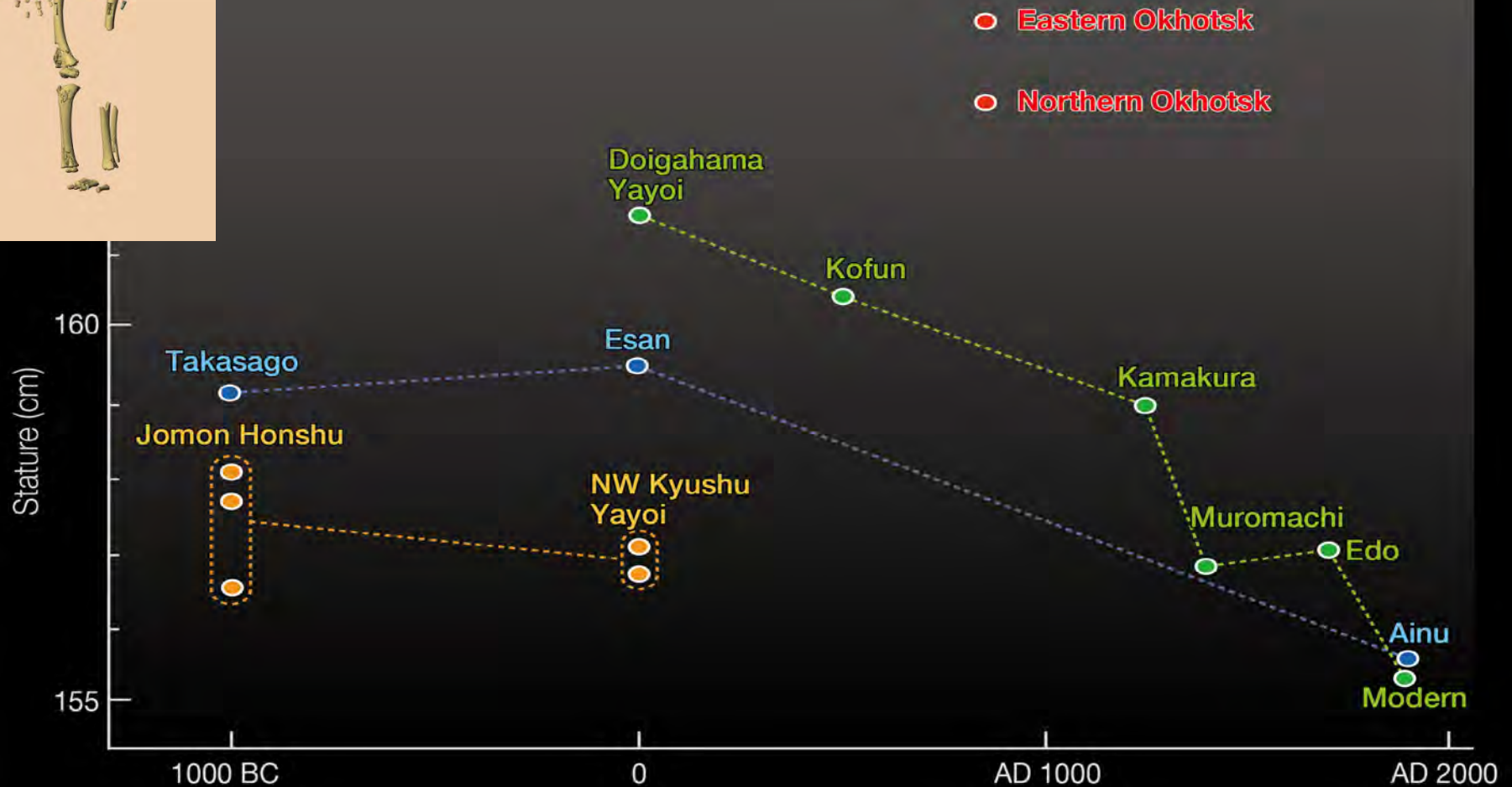
Metric characteristics of limb bones in the Okhotsk people

- The Okhotsk people had large limb bones.
- Stature (height) was high.



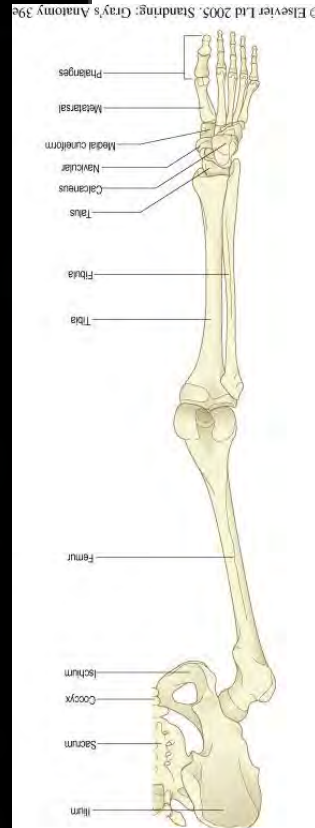
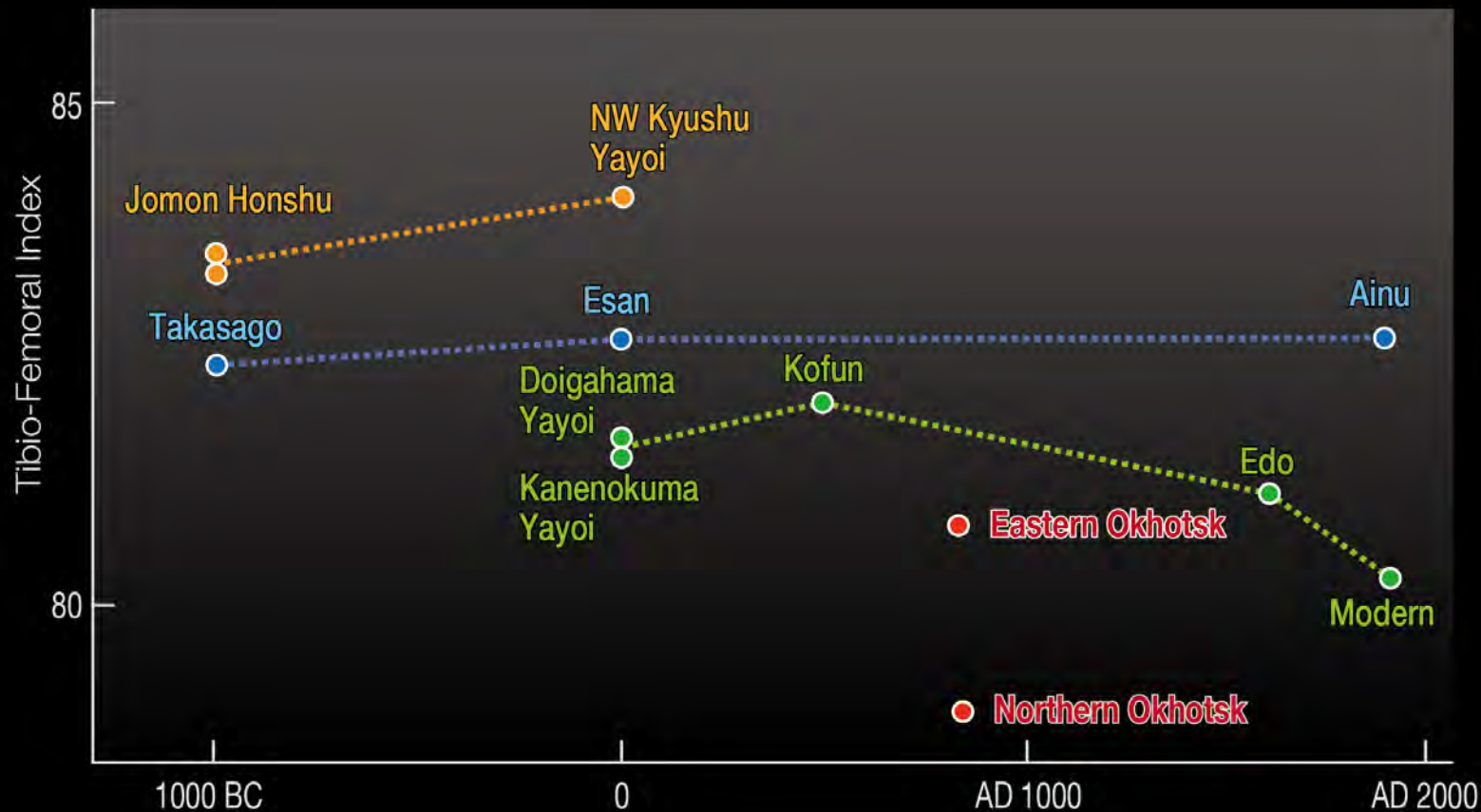
- Kudaka M, Fukase H, Kimura R, Hanihara T, Matsumura H, Saso A, Fukumine T, Ishida H. Metric characteristics of human limb bones in Asian and Japanese populations. Anthropological Science, DOI: 10.1537/ase.121125. 2013.

Secular changes of the height in Japan

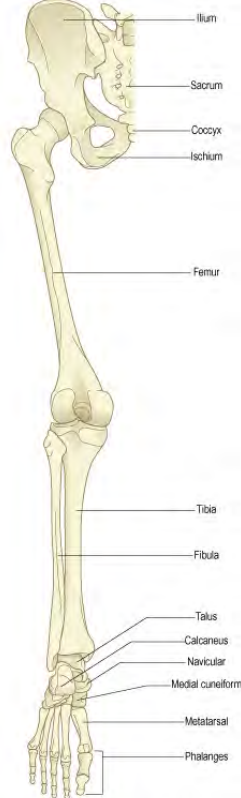


Tibio-femoral Index

Similar to the northeastern Asians, the Okhotsk people had much lower tibiofemoral index values than other Japanese populations



Mean annual temperature (%C)



© Elsevier Ltd 2005. Standing: Gray's Anatomy 39e

**northern
Okhotsk**

Neanderthal

Lapp

• 畿内日本人

• バイカル

**eastern
Okhotsk**

Belgian

Eskimo

• サハリンアイヌ

white

American white

S.African white

Yugoslav

• 北海道アイヌ

Mesolithic

Early modern

(Israel)

Early modern
(Europe)

S. African

Melanesian

Egyptian

African Amer

Pygmy

Bushman

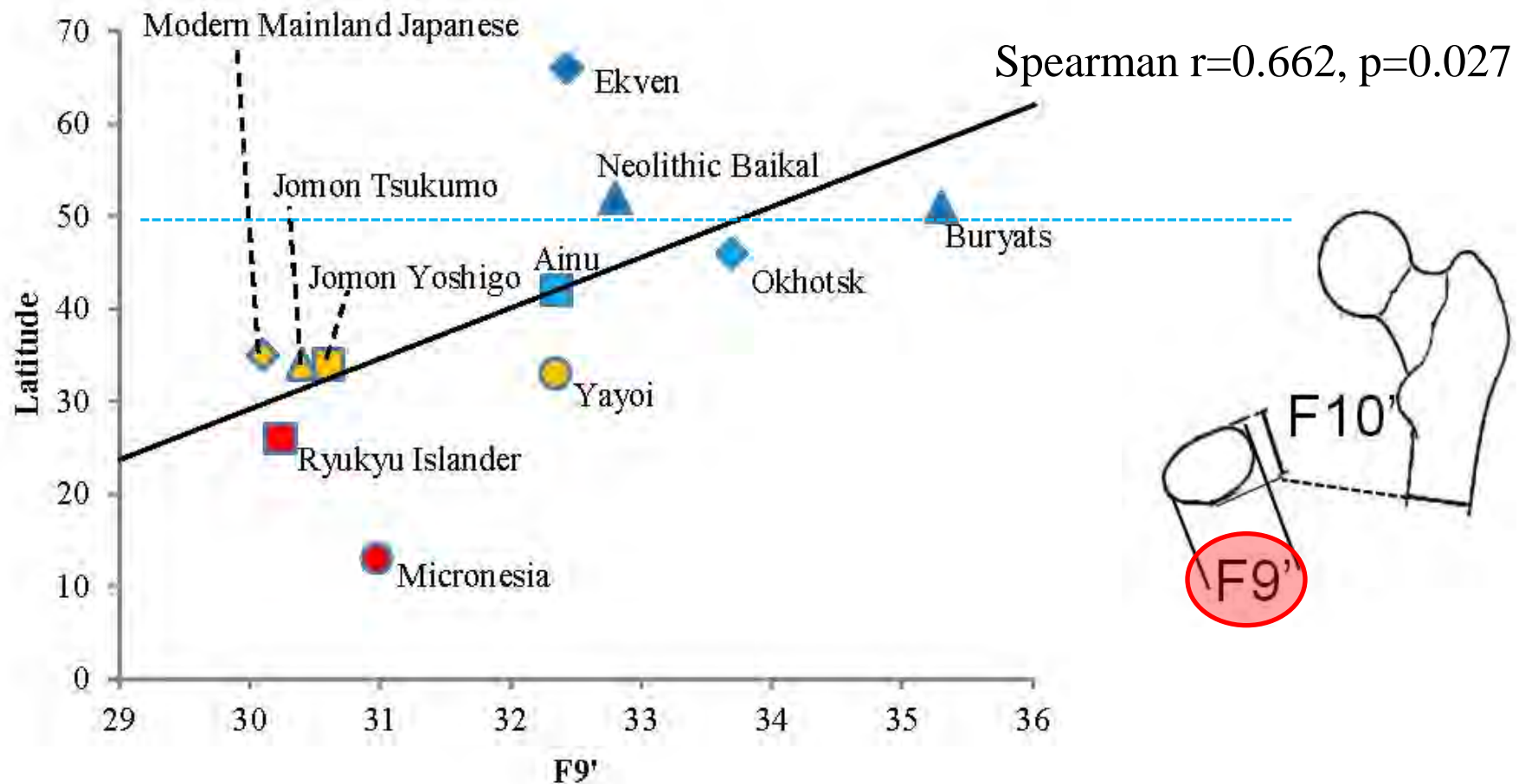
Arizona Indi

S. African black

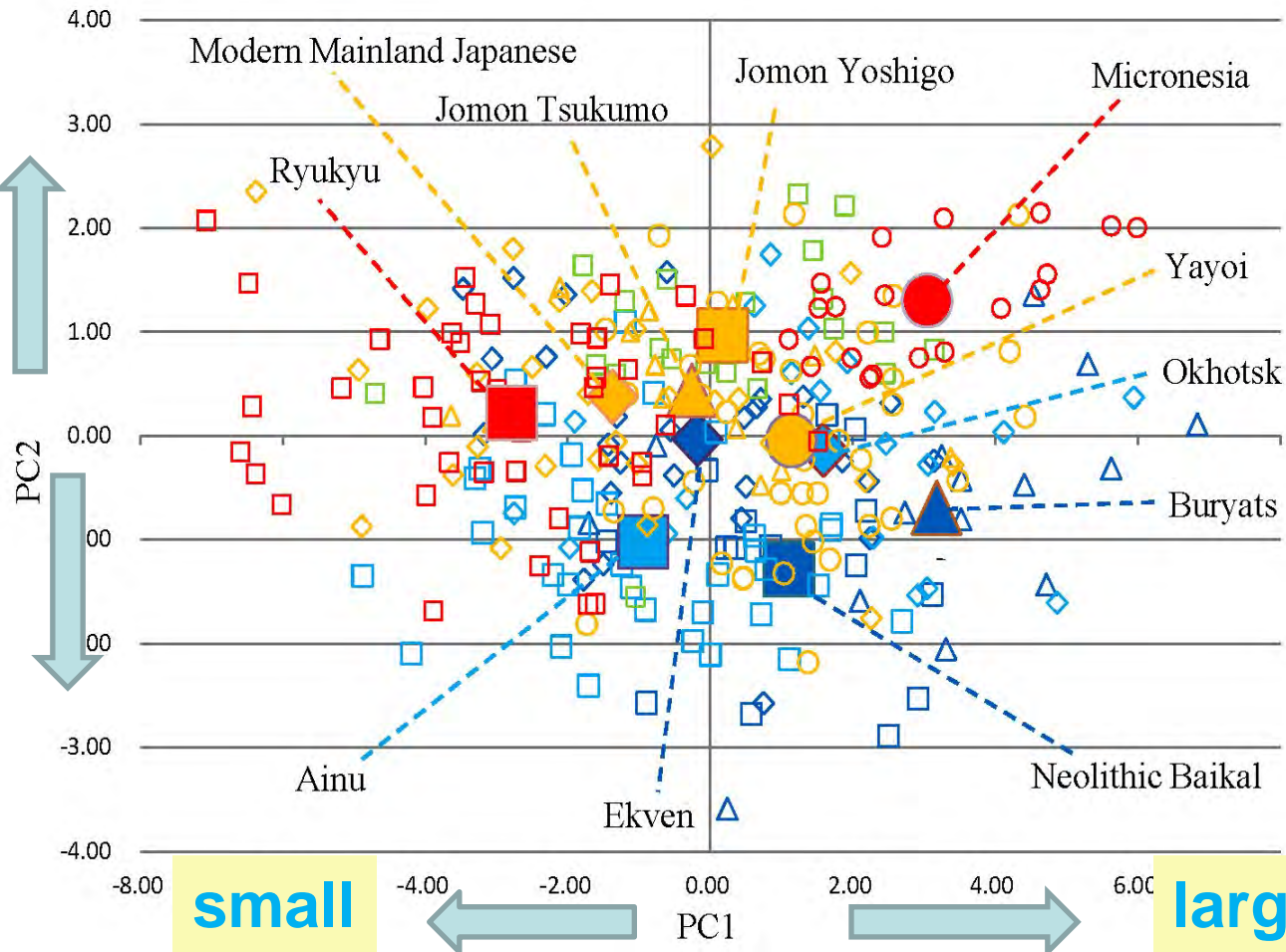
New Mexico Indian

Mean index of tibia/femur length (crural index)

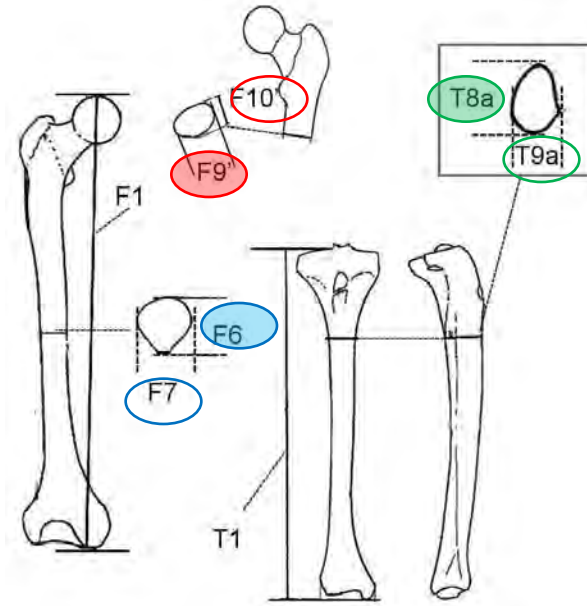
Correlation with latitude. Among the measurements, the significant correlation was observed in the maximum subtrochanteric diameter (F9')



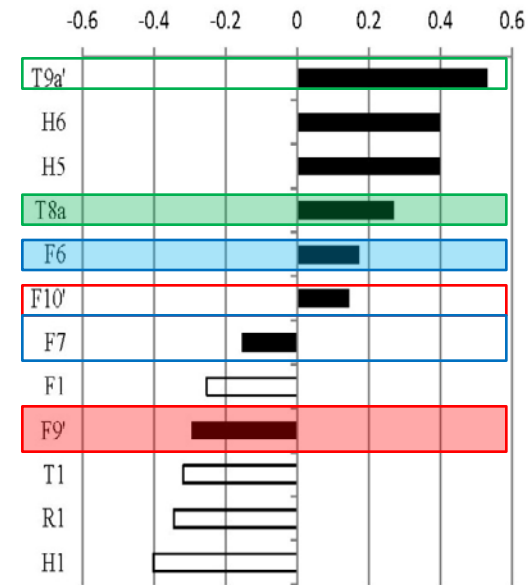
The 1st PC can be interpreted as a size component. The 2nd PC axis in the graph also shows that the northeastern samples with a comparatively long, thin, and flat shaft are roughly positioned around the lower area, while the southern samples are located at the upper area.



PC-loading No.1(55.83%)

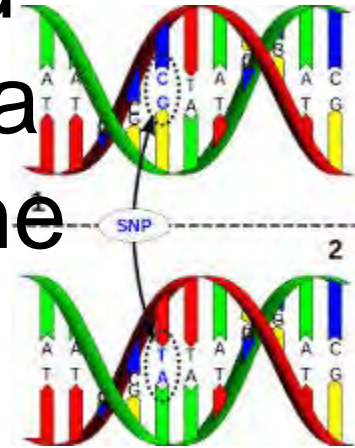


PC-loading No.2(10.64%)



APPENDIX-Okhotsk GENOME(??)

The history of human populations in the Japanese Archipelago inferred from genome-wide SNP data with a special reference to the Ainu and the Ryukyuan populations

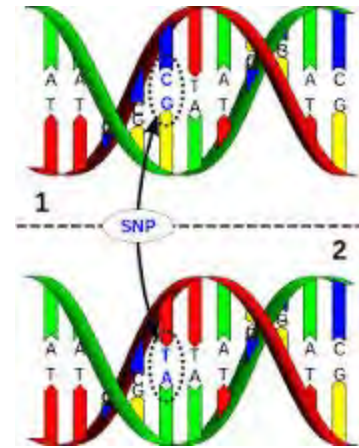
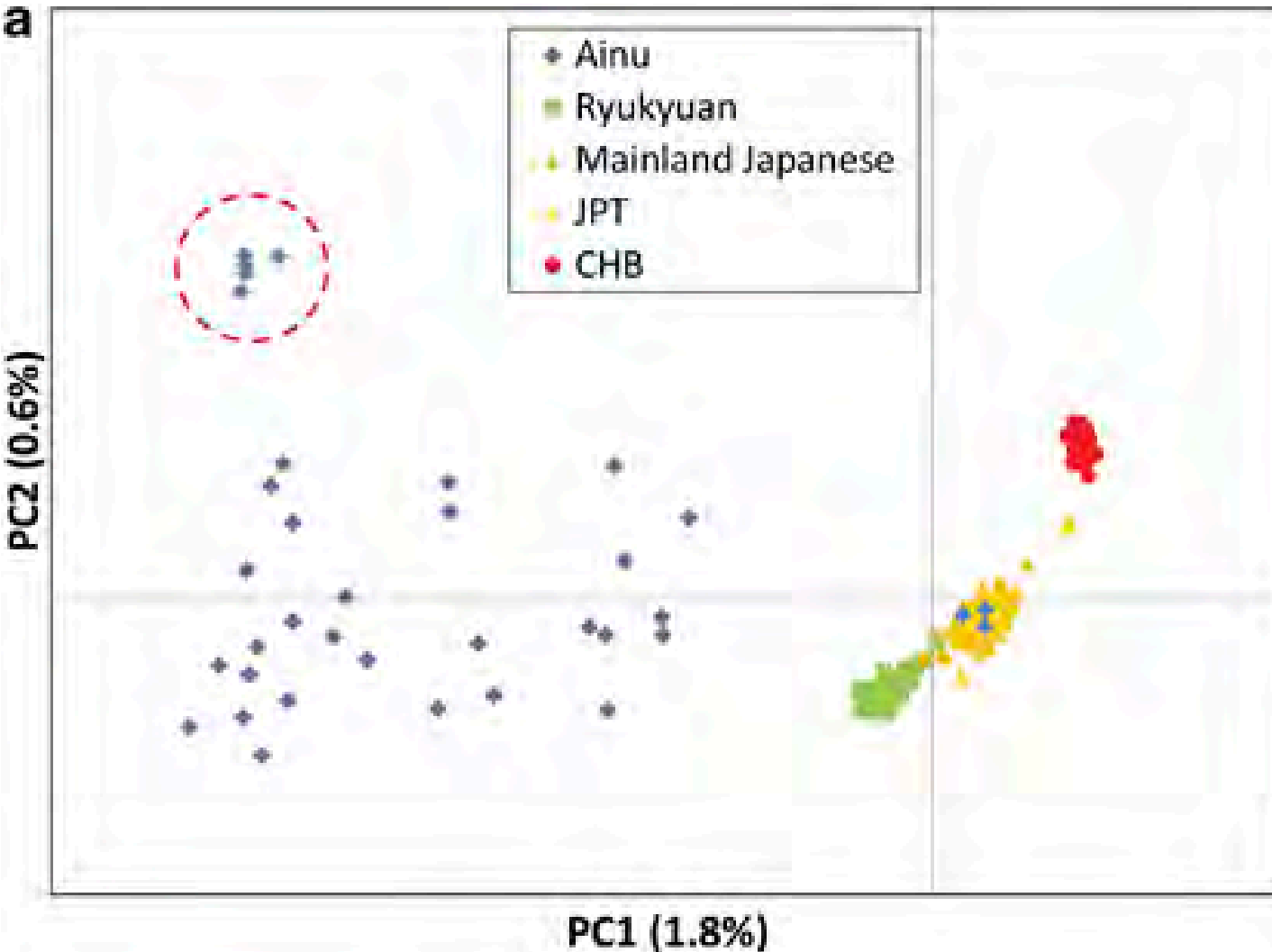


Japanese Archipelago Human Population Genetics Consortium

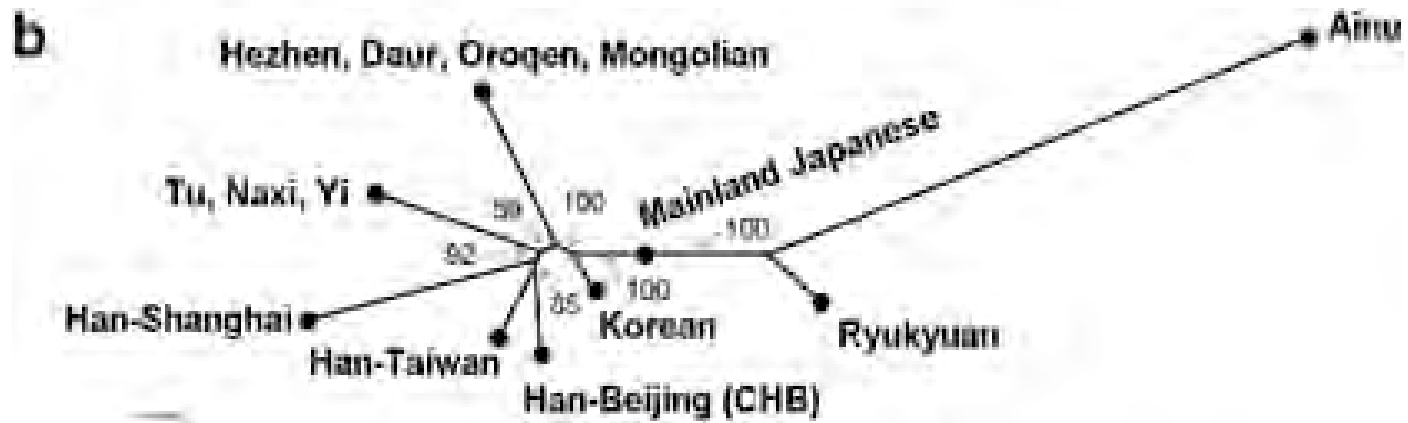
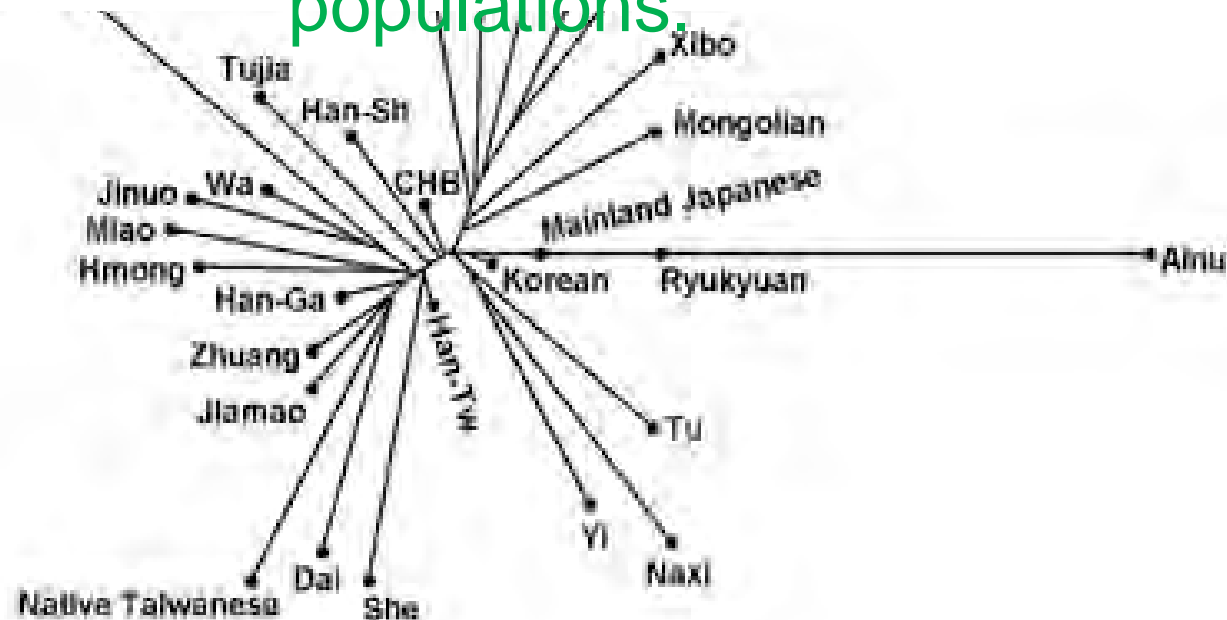
Journal of Human Genetics (2012) 57, 767-795.

They determined close to one million single-nucleotide polymorphisms (SNPs) for the Ainu and the Ryukyuan, and compared these with existing data sets.

The genetic similarity between the Ainu and the Ryukyuan, in spite of their large geographical distance with each other within the Japanese Archipelago. The other five Ainu individuals in a red circle constituted a distinct cluster.

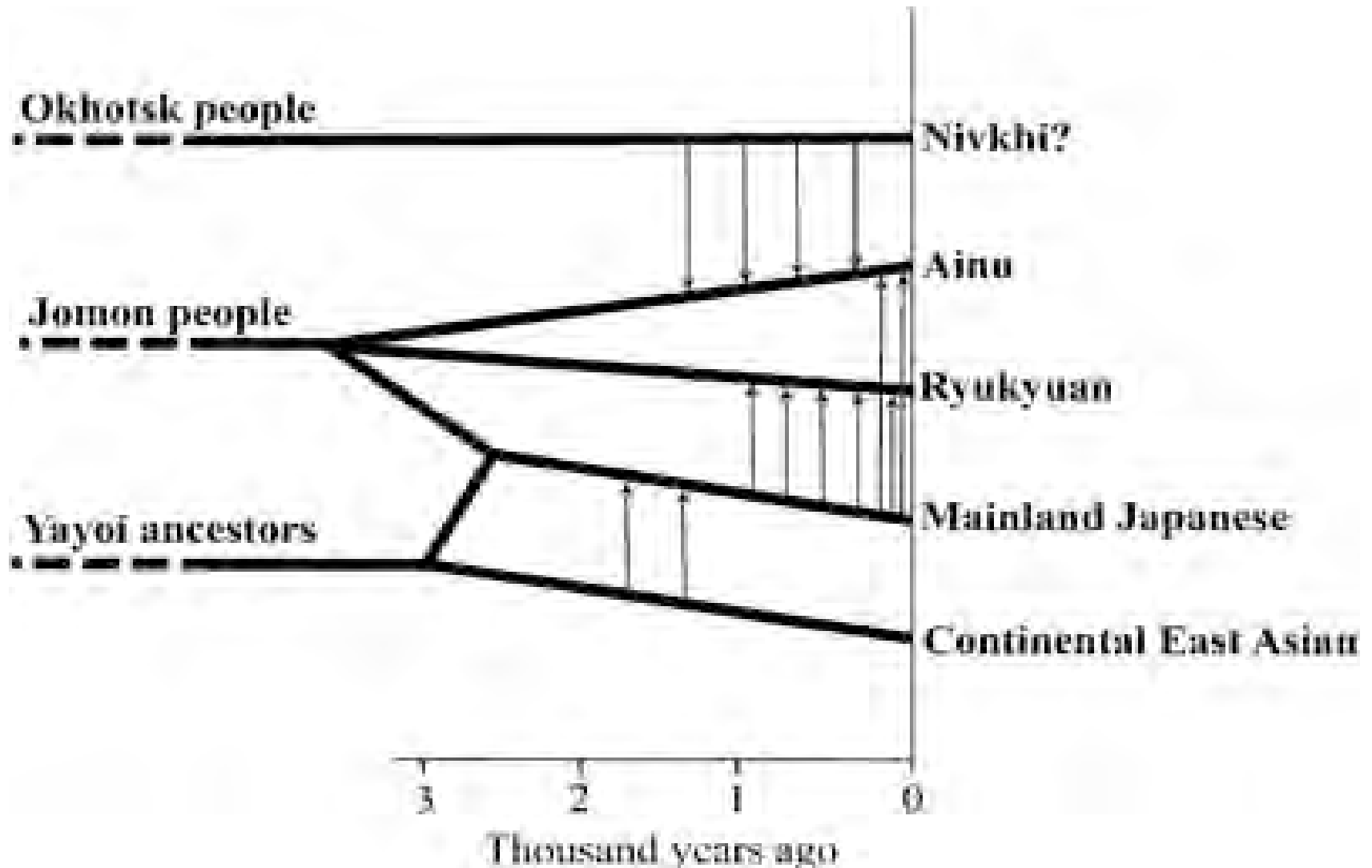


The Ainu and the Ryukyuan are tightly clustered with 100% bootstrap probability followed by the Mainland Japanese in the phylogenetic trees of East Eurasian populations.



Okhotsk Genome ??

A scenario of the evolutionary history of the human populations in the three regions of the Japanese Archipelago based on the results of this study and archeological evidences.



Many thanks to all my colleagues.

