

Osteobiography of an Ancient Nuu-chah-nulth Wool Dog:
Investigating the Life and Death of a Domestic Dog from Tseshaht Territory in Barkley Sound

by

Katie Dierks
Bachelor of Arts, University of Victoria, 2020

An Essay Submitted in Partial Fulfillment
of the Requirements of the

HONOURS PROGRAM

in the Department of Anthropology

© Katie Dierks, 2020
University of Victoria

All rights reserved. This thesis may not be reproduced in whole or in part, by photocopy or other means, without the permission of the author.

Abstract

The domestication of dogs is a global phenomenon that holds specific cultural importance to Indigenous peoples along the Northwest Coast. The woolly dog, a precontact breed of Indigenous dog that was valued for its fur to use in making blankets, lived within Indigenous communities on the coast of British Columbia and Washington for thousands of years. Although these dogs no longer exist as a living breed, information about wool dogs is retained in ethnohistorical records and archaeological deposits. This research focuses on one wool dog burial excavated from the Tseshah village of *Kakmakimilh* in Barkley Sound, western Vancouver Island. This research is part of the *Kakmakimilh* Archaeological Project, a collaborative project among Tseshah First Nation, the Department of Anthropology at the University of Victoria, Pacific Rim National Park Reserve, and the Bamfield Marine Sciences Centre. Preliminary analysis of the skeletal remains show visible femoral asymmetry and morphological features diagnostic of osteoarthritis in the dog's knee. This research involves an in-depth zooarchaeological analysis of the remains to gain perspective on this dog's health and treatment in life and death at *Kakmakimilh*. This research provides cultural information about Indigenous dogs in conjunction with zooarchaeological results to gain deeper insight on how precontact wool dogs were kept and cared for within Tseshah communities and other Nuu-chah-nulth communities on the west coast of Vancouver Island.

Keywords: Archaeology, Tseshah First Nation, *Canis familiaris*, Wool dog, Nuu-chah-nulth, Barkley Sound, Historical ecology

Supervisory Committee: Lisa Mitchell, Iain McKechnie, Denis St. Claire

Table of Contents

Abstract	2
Table of Contents	3
List of Tables and Figures.....	4
Introduction.....	5
Background	6
<i>TSESHAHT FIRST NATION</i>	6
<i>INDIGENOUS DOGS IN BRITISH COLUMBIA</i>	7
<i>TSESHAHT ARCHAEOLOGY</i>	8
<i>DOG BURIAL</i>	9
Methods.....	10
Results.....	13
<i>TYPE</i>	13
<i>SIZE & STATURE</i>	13
<i>SEX & AGE</i>	15
<i>DENTITION</i>	15
<i>TRAUMA AND SKELETAL ANOMALIES</i>	16
Discussion.....	17
<i>NUU-CHAH-NULTH WOOL DOGS</i>	17
<i>PATHOLOGY</i>	18
<i>DIET</i>	22
<i>BURIAL</i>	24
<i>SIGNIFICANCE OF DOGS</i>	26
Conclusion	29
Acknowledgements.....	31
Tables and Figures	32
References.....	51

List of Tables and Figures

TABLE 1. CRANIAL MEASUREMENTS OF DOG FROM BURIAL BASED ON VON DEN DRIESCH (1976).....	32
TABLE 2. MANDIBULAR MEASUREMENTS OF DOG FROM BURIAL BASED ON VON DEN DRIESCH (1976).....	33
TABLE 3. POST-CRANIAL MEASURES OF DOG FROM BURIAL BASED ON VON DEN DRIESCH (1976).....	34
TABLE 4. OSTEOMETRIC RANGES OF DOG TYPES 1 & TYPE 2 AS PRESENTED IN CROCKFORD (1997, 105) ALONGSIDE MEASURE OF THE <i>KAKMAKIMILH</i> DOG FROM BURIAL. MEASUREMENTS ARE BASED FROM VON DEN DRIESCH (1976).	37
TABLE 5. BODY MASS CALCULATIONS FROM CRANIUM DIMENSIONS FOR <i>CANIS</i> SPP. IN LOSEY ET AL. (2015).....	38
TABLE 6. BODY MASS CALCULATIONS FROM MANDIBULAR DIMENSIONS FOR <i>CANIS</i> SPP. IN LOSEY ET AL. (2015).	39
TABLE 7. BODY MASS CALCULATIONS FROM LIMB DIMENSIONS FOR ADULT DOGS IN LOSEY ET AL. (2017).	40
FIGURE 1. MAP OF SHOWING NUU-CHAH-NULTH TERRITORIES ON VANCOUVER ISLAND, B.C. (McKECHNIE 2020).....	41
FIGURE 2. ARTIST’S RECONSTRUCTION OF A “VILLAGE DOG”, CROCKFORD’S TYPE 2 DOG (CROCKFORD 1997).....	42
FIGURE 3. ARTIST’S RECONSTRUCTION OF A “WOOL DOG”, CROCKFORD’S TYPE 1 DOG (CROCKFORD 1997).	42
FIGURE 4. “A WOMAN WEAVING A BLANKET” SONGHEES/ SAANICH TERRITORIES (KANE 1849-1856).....	43
FIGURE 5. MAP OF <i>KAKMAKIMILH</i> IN THE BROKEN GROUP ISLANDS, BARKLEY SOUND ON WESTERN VANCOUVER ISLAND, B.C. (McKECHNIE, 2020).	43
FIGURE 6. DOG CRANIUM EXCAVATED FROM BURIAL IN 2017 (IMAGE: McKECHNIE 2017).....	44
FIGURE 7. PLAN VIEW OF IN-SITU DOG REMAINS DURING 2018 EXCAVATION OF BURIAL.....	44
FIGURE 8. CRANIAL MEASURES OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 34) TYPE 1 & TYPE 2 SCATTERPLOT.	45
FIGURE 9. CRANIAL MEASURES #12 VS. #23 OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 34) TYPE 1 & TYPE 2 FIGURE 4-11 SCATTERPLOT.	45
FIGURE 10. RIGHT MANDIBLE MEASURES #1 VS. #18 OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 45) TYPE 1 & TYPE 2 FIGURE 5-5 SCATTERPLOT.	45
FIGURE 11. RIGHT MANDIBLE MEASURES #4 VS. #19 OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 45) TYPE 1 & TYPE 2 FIGURE 5-7 SCATTERPLOT.	45
FIGURE 12. RIGHT MANDIBLE MEASURES #1 VS. #14 OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 45) TYPE 1 & TYPE 2 FIGURE 5-8 SCATTERPLOT.	45
FIGURE 13. RIGHT HUMERUS GL VS. DP MEASURES OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 56) TYPE 1 & TYPE 2 FIGURE 6-3 SCATTERPLOT.	45
FIGURE 14. RIGHT HUMERUS GL VS. BD MEASURES OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 56) TYPE 1 & TYPE 2 FIGURE 6-4 SCATTERPLOT.	46
FIGURE 16. MEAN RADIAL GL VS. BD MEASURES OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 57) TYPE 1 & TYPE 2 FIGURE 6-6 SCATTERPLOT.....	46
FIGURE 17. MEAN FEMORAL GL VS. BP MEASURES OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 64) TYPE 1 & TYPE 2 FIGURE 7-3 SCATTERPLOT.	46
FIGURE 18. MEAN FEMORAL GL VS. BD MEASURES OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 65) TYPE 1 & TYPE 2 FIGURE 7-4 SCATTERPLOT.	46
FIGURE 19. LEFT TIBIA GL VS. BP MEASURES OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 65) TYPE 1 & TYPE 2 FIGURE 7-5 SCATTERPLOT.....	46
FIGURE 20. LEFT TIBIA GL VS. BD MEASURES OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 65) TYPE 1 & TYPE 2 FIGURE 7-6 SCATTERPLOT.....	47
FIGURE 21. CERVICAL VERTEBRA 2 LCDE VS. BFC D MEASURES OF DOG REMAINS PLOTTED ONTO CROCKFORD’S (1997, 74) TYPE 1 & TYPE 2 FIGURE 8-2 SCATTERPLOT.....	47
FIGURE 22. CAUDAL VIEW OF 6 TH LEFT RIB SHOWING NODULE.....	47
FIGURE 23. MEDIAL VIEW OF THE LEFT SCAPULA SHOWING PERIOSTEAL BONE DEPOSITION.	48
FIGURE 24. CRANIAL VIEW OF DOG FEMURS. NOTE ASYMMETRY BETWEEN LEFT AND RIGHT FEMURS AT PROXIMAL HEADS AND DISTAL ENDS.	49
FIGURE 25. CAUDAL VIEW OF THE DISTAL FEMORA SHOWING THE INTERCONDYLAR OSTEOPHYTE ON THE RIGHT FEMUR.	50
FIGURE 26. CRANIAL VIEW OF THE DISTAL FEMORA SHOWING EBURNATION ON THE PATELLAR GROOVE OF THE RIGHT FEMUR..	50

Introduction

Indigenous peoples along the Northwest Coast have kept domesticated dogs in communities for thousands of years. Knowledge of precontact Indigenous dogs, especially the selectively bred wool dog, is retained within ethnographic records and within archaeological sites. The breed known as the wool dog was recognized for their thick coat of fur and the economic uses this provided to communities. Limited archaeological research has been devoted to understanding the social value and or the treatment of these dogs within Nuu-chah-nulth communities.

Wool dog remains have been encountered in several coastal British Columbia archaeological sites, but those in the territories of Nuu-chah-nulth First Nations on the west coast of Vancouver Island have received limited research attention. One dog burial excavated from ancient shell midden deposits from Tseshah territory in Barkley Sound, B.C. offers potential insight on how these dogs were treated and the relationships they had with Nuu-chah-nulth peoples prior to European contact. This research focuses on this dog excavated from the Tseshah village site of *Kakmakimilh* to answer the following questions: (a) How can the zooarchaeological remains from this dog burial indicate its health and treatment in life and death at the Tseshah village of *Kakmakimilh*? (b) How can cultural information about Indigenous dogs be used in conjunction with interpretations made about this particular dog's skeletal remains and burial context to suggest the cultural value of these dogs and their relationship with people in Indigenous communities throughout the Northwest Coast?

To answer these questions, an integrative approach was used to draw on methods rooted in the disciplines of archaeology and cultural anthropology. Zooarchaeological methods of analysis will be used to develop osteobiographical interpretations about how this dog lived and died at *Kakmakimilh*. Ethnographic information and Tseshah oral histories will be reviewed alongside

archaeological results to present a holistic view on precontact lifeways and cultural perspectives on dogs. This research aims to gain deeper insight on how precontact wool dogs were kept and cared for within Tseshahst communities and other Nuu-chah-nulth communities on the west coast of Vancouver Island.

Background

Tseshahst First Nation

Tseshahst First Nation (*Ts'ishaa7ath*) is one of fourteen Nuu-chah-nulth First Nations on the west coast of Vancouver Island (McMillan and St. Claire 2005, 7; Tseshahst First Nation 2020) (Figure 1). The *hahuulhi*, or territory, of Tseshahst encompasses the Broken Group Islands, central Barkley Sound, Alberni Inlet, and majority of the Somass River in Alberni Valley (McMillan and St. Claire 2005, 22; Tseshahst First Nation 2020). The various exposed and sheltered shorelines of the Broken Group Islands provide a bounty of shellfish, fish, and sea mammal resources (McMillan and St. Claire 2005; McKechnie 2015). Tseshahst society and economy has always been based around the coastal and marine resources within the *hahuulhi* (McMillan and St. Claire 2005).

In the late 18th century, European contact in the territory resulted in significant changes to Tseshahst society and economy (McMillan and St. Claire 2005, 15). Introduced disease and warfare caused a huge loss in population. Reserves were assigned to Tseshahst in the late 19th century and communities moved from their ancestral villages on the islands to the Alberni Valley.

Today the Broken Group Islands are a part of Pacific Rim Nation Park Reserve (PRNPR), but Tseshahst Nation continues to assert jurisdiction over their *hahuulhi*. Tseshahst and PRNPR have a Cooperative Management Board to oversee the Broken Group Islands in partnership (Parks

Canada 2019). Tseshah, PRNPR, Bamfield Marine Sciences Centre, and the University of Victoria have collaborative agreement for archaeological research projects that add insight and knowledge of the deep history of Tseshah in Barkley Sound (Tseshah First Nation 2020; Tseshah First Nation et al. 2017).

Indigenous Dogs in British Columbia

Ethnographic accounts and archaeological remains have demonstrated domestic dogs (*Canis familiaris*) of many varieties have living alongside Indigenous populations in North America for thousands of years (Crockford 1997). Crockford (1997) defines two types of precontact dog on the Northwest Coast: the small “wool dog” (Type 1) and the larger “village dog” (Type 2). The village dog has been described as a medium-sized dog resembling the features of a coyote (Crockford 1997, 2; Allen 1920, 470) (Figure 2). The smaller, long-haired wool dog was selectively bred by communities for their thick fur which was shorn off and used to make textiles (Smith 1840, 134-5) (Figure 3). Wool dogs were frequently mentioned in early European accounts on the coast. The earliest account of this dog is described in Captain Vancouver’s 1792 encounter in Coast Salish territories in Puget Sound (Allen 1920, 469). As cited by Allen (1920, 469-470), Vancouver described these dogs and their use as he observed:

“[They] resembled those of Pomerania, though in general somewhat larger. They were all shorn as close to the skin as sheep are in England; and so compact were their fleeces, that large portions could be lifted up by a corner without causing any separation. They were composed of a mixture of a coarse kind of wool, with very fine long hair, capable of being spun into yarn.”

Yarn made from wool dog hair was often mixed with other materials like mountain goat hair and plant fibres and was woven into blankets in Coast Salish communities (Allen 1920, 471) (Figure 4). Early 19th century seamen observed that wool dogs in Makah villages were kept on

isolated islands to prevent them from interbreeding with village dogs and losing their pure fur quality (Barsh et al. 2006, 2).

With the arrival of Europeans on the coast, the use of European blankets for trade meant these dogs were utilized and managed increasingly less until they eventually disappeared as a distinct breed (Allen 1920, 471). Today, wool dogs are the focus of research using existing information in ethnographic and historical literature, as well as wool dog skeletal remains recovered from archaeological sites.

Tseshah ***Archaeology***

There are at least seventy-three shell middens at ancient Tseshah settlement sites in the Broken Group archipelago (McKechnie 2015). The earliest known Tseshah site in Barkley Sound has been dated as early as 5,000 years ago (McMillan and St. Claire 2005). Decades of archaeological work has been carried out throughout Tseshah territory to learn more about the deep history of Tseshah on their *hahuulhi*. Previous Tseshah archaeological projects have involved excavating sites located on the Tseshah Reserve of Hiikwis (Equis), Benson Island, Clarke Island, Jaques Island, and presently Keith Island. Dogs are commonly found in Tseshah archaeological deposits, and several dog burials have been excavated in Barkley Sound (e.g., McMillan and St. Claire 1992; McMillan and St. Claire 2005).

The *Kakmakimilh* Archaeological Project is a five-year collaborative project among Tseshah First Nation, the Department of Anthropology at the University of Victoria, Pacific Rim National Park Reserve, and the Bamfield Marine Sciences Centre. This project enables archaeologists and community members to research Tseshah history in Barkley Sound (Tseshah First Nation et al. 2017). *Kakmakimilh* on Keith Island is one of many ancient village sites in the Broken Group archipelago (Figure 5). This site is located within one of nine reserves in Tseshah territory.

Archaeological excavations have been carried out annually at *Kakmakimilh* through the UVic Archaeology Field School since 2017 (McKechnie, St. Claire, and Salmen-Hartley 2019).

Dog Burial

The remains of a domestic dog (*Canis familiaris*) were initially uncovered in the first year of the *Kakmakimilh* Project in 2017. Located at an initial depth of 14cm below ground surface in excavation unit 306T8, the skeleton was loosely articulated in shell midden. The anatomical positioning of the skeletal elements indicated it was a purposeful burial. The remains were very well preserved, with some fragmentation as a result of taphonomic processes. The remains presented the nearly complete remains of a single individual. Other *Canis familiaris* bones were recovered from this unit, but these were highly dispersed and fragmentary. The remains of this dog were systematically excavated during the 2017, 2018, and 2019 summer field seasons. Charcoal associated with the burial dates to approximately 670-550 calibrated years before present¹. This indicates that this individual would have died ca. AD 1300, almost five centuries prior to European contact on the west coast of Vancouver Island (McMillan and St. Claire 2005).

Previous research on this burial includes the 2017, 2018, and 2019 field school student reports presenting zooarchaeological analyses on the bones recovered during each year of excavation (Dierks 2018; Henry 2017; Krakov 2018). In 2018, Dylan Hillis conducted a research project involving stable isotope analysis on the dog to understand its diet and human resource use at *Kakmakimilh* in the past (Hillis 2018). Preliminary analysis of the remains in 2018 noted visible asymmetry between the left and right femurs of the dog (Dierks 2018). The distal end of the right

¹ Radiocarbon calibration estimates represent years before present where present is AD 1950.

femur presented signs of degradation and remodelling, raising questions as to whether this dog could have suffered joint disease during life. This zooarchaeological research paper addresses these questions to understand the paleopathology and life experience of this Tseshaht wool dog.

Methods

Excavation of the dog remains was conducted by undergraduate students of the UVic Archaeology Field School in Barkley Sound over three separate field seasons. The remains were first uncovered in 2017 when the unit was a 1x2m unit and the anterior end of dog was excavated while the posterior end extended beyond the limits of the unit (Figure 6). In 2018 and 2019, the posterior end of the dog was excavated once the unit was expanded to a 2x2m size (Figure 7). Trowels were used to excavate the shell midden and expose the burial. The feature was pedestaled, and brushes were used to gently remove the matrix from around the bones. During each year of excavation, the remains were mapped and recorded in detail, and the bones were carefully bagged separate from other fauna. All skeletal remains were moved to the Bamfield Marine Science Centre where field school students conducted preliminary osteometric analyses (Dierks 2018; Henry 2017; Krakov 2019).

This research project involves an in-depth osteometric analysis of the dog remains from this burial. Osteometric data was obtained directly from the skeletal remains. Caliper measurements were taken in accordance with the standards and measurements defined by von den Driesch (1976). A visual examination of the remains was conducted to identify skeletal abnormalities. The results were analyzed based on six categories: dog type, size, stature, sex, age, dentition, trauma, and skeletal anomalies.

To determine dog type, the element measurements were compared with osteometric ranges of dog Types 1 & Type 2 presented by Crockford in her analysis of Indigenous dogs from Coast Salish and Makah territories (1997, 105). To present the size relationship between the *Kakmakimilh* dog and Type 1 & Type 2 dogs, the element measures were superimposed onto Crockford's (1997) cranial, mandibular, forelimb, hindlimb, and vertebral measure scatterplots. The average of the left and right-side measures were plotted where both elements could be measured. When only one side could be measured, the single measure was plotted. The scatterplots present measures from the dog from *Kakmakimilh* as a red square, amongst the Type 1 triangles and Type 2 crosses (Figures 8-21).

The size and stature of the dog was calculated using different equations to estimate the live body mass, shoulder height, and body length. Body mass estimates were calculated from the dog's cranial and mandibular measurements using linear regression equations for *Canis* spp.: $\text{Log}(y) = \alpha + \beta \log(x)$ presented in Losey et al. (2015). This process involved using the Microsoft excel \log_{10} function and inputting element measurements as the x-value. The result was multiplied by the coefficient (β), the constant (α) was subtracted, and the number was multiplied by 10. To simplify, " $=10^{(\text{Log}10(x)*(\beta)+ (\alpha))}$ " was input into Excel to calculate the y-value, the live body mass in kilograms.

Body mass estimates were also calculated from limb element measurements using linear regression equations presented in Losey et al. (2017): $\text{LN}(y) = a + b \text{LN}(x)$. Losey's coefficient (β) and constant (α) values were used from his adult dog only statistics (ibid., 184). For these calculations, measurements from von den Driesch (1976) were used, in addition to two measurements developed by Losey to measure the femoral head depth (Hdt) and breadth (Hbr) (Losey et al. 2017, 181). Similar to the previous equation, limb element measurements were

entered as the x-value. The following function was input into Microsoft Excel:

$$=EXP(LN(x)*(\beta)+(\alpha).$$

Live shoulder height estimates were calculated from the greatest length (GL) measurements of limb bones following Harcourt (1974). Length measurements for the left humerus, right tibia, and both ulnas were not obtained due to fragmentation. As a result, these estimates were based on calculations of right forelimb and the left hindlimb measures only. The following is Harcourt's (1974) equations for calculating shoulder height (cm) using the combined length measurements of two elements on the same side:

$$\text{Humerus + Radius: } (1.65 \times \text{GL}) - 4.32$$

$$\text{Femur + Tibia: } (1.52 \times \text{GL}) - 2.47$$

As was done in Crockford's analysis (1997, 89) analysis, Clark's (1995) regression equation was used to estimate live body length from the total pelvic length (PL) or greatest length (GL) of the pelvis:

$$\text{Body Length(cm)} = 0.47 \times \text{GL [PL(mm)]} - 15.7$$

These size and stature estimates were compared to the average shoulder height and body length estimates of Type 1 dogs and Type 2 dogs from Crockford's (1997) research.

Paleopathological research on the dog remains involved a visual examination of the bones to locate and assess bones presenting signs of disease or injury. Previous paleopathological research on ancient dogs and veterinary research articles on modern dog pathology were reviewed to determine the type of pathologies present in the bones based on diagnostic features.

Available ethnographic, oral historical, and early historical records about precontact dogs in Nuu-chah-nulth territories and elsewhere on the coast were reviewed. Cultural information in these sources that mention the wool dog appearance, purpose, value, and interactions with people

was used in tandem with zooarchaeological data to interpret how these dogs may have been treated in Tseshah communities.

Results

The osteometric data collected from the remains were tabulated and are presented in Tables 1-4. Measures that were unattainable due to fragmentation or the absence of an element were left blank. The cranial and mandibular measurements are presented in Tables 1 and 2. Post cranial measures were taken on all limb bones, both scapulae, both innominates, and the first two cervical vertebrae (Table 3). Elements not measured due to time constraint included ribs, metapodials, and remaining vertebrae.

Type

Cranial, mandibular, and post-cranial element measurements were compared with the osteometric size ranges of Type 1 and Type 2 dogs presented by Crockford (1997, 105). The dog from *Kakmakimilh* fits within the size range of a Type 1 dog (Table 4). This dog appears to be at the higher end of the Type 1 range and occasionally measures straddled the Type1/Type2 boundary. Overall, these results indicate this dog was wool dog.

Size & Stature

Body mass estimates calculated using Losey et al. (2015) produced a mean estimated body mass of 16.38 kg from cranial measures and 16.80 kg for mandibular measures, which averaged to 16.6 kg (Table 5 & 6). Estimates calculated from post-cranial limb measurements using

Losey's (2017) methods produced a body mass of 15.5 kg (Table 7). Averaging all measurement results, this dog is estimated to have a body mass of 16.1 kg.

Live shoulder height calculations combining the GL of the right humerus and radius were 47.4 cm and the combined GL of the left femur and tibia was 46.7 cm. These results averaged to a mean height of 47.1 cm. Crockford's average shoulder height calculations for Type 1 dogs were 44cm and 53cm for Type 2 dogs (Crockford 1997, 89). This dog falls slightly above the average shoulder height of the Type 1 dog.

The live body length was calculated as 49.3 cm. This dog is of "average" proportion, with its body length only a couple centimeters greater than its shoulder height (Crockford 1997, 89).

Crockford suggests similarities in sizes between Northwest Coast dogs and the size types presented by Colton (1970) through his osteometric analysis of Indigenous dogs from the U.S. southwest (Crockford 1997, 90). In his research, Colton (1970) describes two relative sizes of dog: large and small sizes. Small dogs are attributed to having a cranium length < 165 mm, humerus length < 140 mm, and femur length <160 mm, and defines large dogs as having element measures greater than these small dog limits (Colton 1970; Crockford 1997, 90).

The dog from *Kakmakimilh* exceeds all three of Colton's small dog size range (175 mm cranial length, 148.4 mm humerus length and 156.5 mm mean femur length), but is on the low end of the large dog range. In comparison to Crockford's ranges for dog types, this dog's cranium length exceeds the range of Type 1 dogs by 2 mm, but fits within the ranges for the humerus (<151 mm) and femur (<164 mm). This dog can be arbitrarily considered "medium-sized," measuring on the higher limits of the wool dog range.

Sex & Age

The *Kakmakimilh* dog was determined to be male, based on the presence of a baculum and a prominent sagittal crest (Bartelle et al. 2010). Tooth wear was not examined extensively, so this factor was excluded from the age determination process. Based on the observation of epiphyseal fusion and full eruption of adult teeth, this dog was an adult of at least eighteen months of age at the time of death (Bartelle et al. 2010; Crockford 1997).

Dentition

Examination of the dog's teeth show signs of dental anomalies. The dental formula (upper/lower) for adult dogs is presented in Crockford's (2009) practical guide on dog burials:

$$\begin{array}{c} 3. 1. 4. 2 \\ 3. 1. 4. 3 \end{array}$$

All teeth on the upper left and right tooth rows were anatomically present. The first premolar (PM1) on both left and right mandibles were congenitally absent. The third molar (M3) on the lower left side was also congenitally absent.

The congenital absence of lower PM1 is a common dental anomaly in North American Indigenous dogs (Crockford 1997). Crockford noted that 81.5% of her sample of Coast Salish and Makah dog mandibles were congenitally missing PM1 (Crockford 1997, 38). She also found that PM1 and M3 were missing from the right mandibles of two individuals from the sample (38). The dog from *Kakmakimilh* presented the same anomaly in its right mandible.

Crockford suggests that tooth anomalies indicate that prehistoric dogs around the world may have regional dental patterns (Crockford 1997, 38). Further examination of teeth from other dogs recovered in Barkley Sound and elsewhere in Nuuchahnulth territories could provide insight on these regional similarities.

Trauma and Skeletal Anomalies

Visual assessment of the skeletal remains located some signs on injury and pathology in the bones. Left rib #6 presents a nodule, which may be from a healed fracture (Fig. 22). There were no injuries visible in adjacent ribs on the right side. The fractured rib showed only minor deformation, and suggests impact was applied in a small area directly to the rib (Binois et al. 2013, 41). The cause of this injury is unclear; it could be the result of a kick to the side or blunt force from an attack. Regardless of the cause, the dog survived injury long enough for the bone to heal (Binois et al. 2013; Bartelle et al. 2010). Bartelle and colleagues (2010, 2728) found a similar nodule on the 6th left rib of a dog from San Nicolas Island (in southern California), which was determined using radiograph to be the result of a healed fracture occurring at least four months prior to the dog's death.

In the Susan Crockford's (2019) analysis of the Keith Island fauna, she catalogued abnormalities in two of the dog's caudal vertebrae. She notes that the "largest one is misshapen and the smallest looks like it has a healed break," suggesting the dog suffered an injury to its tail during life (Crockford 2019).

Examination of the dog remains from *Kakmakimilh* also located pathological morphologies on the left scapula and right femur. Some of these features are symptomatic of degenerative joint disease such as osteoarthritis, which would have affected the dog in life.

The cause of death of the dog was not determined through this research. This individual may have died from old age, disease, or injury. Reporting in 2017 by another student noted cut marks on the right scapula and sagittal crest of this dog (Henry 2017). This could be the result of death-inducing sacrifice or post-mortem skinning. Further research on the remains is needed to determine the cause of death and nature of these cut marks.

Discussion

The analyses of archaeological, paleopathological, and ethnographic data provide several avenues for interpreting the significance and social value that wool dogs held within Tseshaht communities and in other Nuuchahnulth territories.

Nuuchahnulth Wool Dogs

The Nuuchahnulth word for dog is “7iniitl”, which likely refers to both wool dog and village dog types (Powell 1991). Non-indigenous names used for wool dogs in early ethnographic literature include the Nootka Dog (Smith 1840, 134) and the Clallam-Indian Dog (Allen 1920, 469; Zimmerman 2011, 16).

Drucker (1951) writes that Nuuchahnulth communities in the central and northern portion of western Vancouver Island (north of Barkley Sound) did not keep wool dogs and that dog wool was not used in spinning (94, 109). Other sources suggest otherwise and provide examples of wool dogs living in various Nuuchahnulth communities (Allen 1920; Smith 1840; Turner et al. 1983, 66). With this in mind, Drucker’s general descriptions of dogs may refer to the village dog type.

Written descriptions of Nuuchahnulth wool dogs have described them as being large- or medium-sized with pointed ears and thick coats of white, brown, or black-colored fur (Allen 1920, 469; Smith 1840, 134). Zimmerman (2011, 17) notes ethnographic information which indicates differences in the size of wool dogs in Nuuchahnulth territories compared to those on the east coast of Vancouver Island in Coast Salish territories:

“While Kane (1859:210) and Anderson (1951 in Crisp 1956:39) both recall seeing small wool dogs near Victoria, Smith’s (Smith 1840:134) source told him of a large-sized wool dog from the village of Nootka on the west coast of Vancouver Island (Allen 1920:470).”

Size estimates calculated from the *Kakmakimilh* dog remains demonstrate this was an above-average sized wool dog (Figures 8-21) and is comparatively larger than the average for wool dogs from Coast Salish and Makah territories presented in Crockford (1997). It can be suggested that the wool dogs on Vancouver Island may have had regional size differences whereby wool dogs in Nuu-chah-nulth territories were larger than those within Coast Salish territories.

Hamilton Smith (1840) notes that “Nootka dogs” were valued for their dense coats of fine fur (Smith 1840, 134-5). Nuu-chah-nulth wool dog hair was shorn off and woven into high-value blankets (Smith 1840, 134; Allen 1920, 469-471). Turner and colleagues note that wool dog hair was often spun with yellow cedar bark in Nitinaht communities (Turner et al. 1983, 66). Zimmerman (2011, 16) cites Gunther (1927) as suggesting these dogs were kept by “tribes on the coast who did not hunt the mountain goat.” Considering there are no mountain goats in Nuu-chah-nulth territories or anywhere else on Vancouver Island during the Holocene (Nagorsen and Keddie 2000), it would have been beneficial for these communities to have large dogs that could provide more wool for textiles.

Pathology

Paleopathology is the study of diseases in the past through human and non-human archaeological remains (Binois et al. 2015). Paleopathology studies involving zooarchaeological remains provide information on past human society and activity in response to animal disease (Binois et al. 2015; Oliver et al. 2015). Joint disease (osteoarthropathy) is a well-researched area of animal paleopathology (Oliver et al. 2015). Harcourt’s (1967) analysis of osteoarthritis in Romano-British dog remains was the first paleopathological research on joint disease in domestic animals (Oliver et al. 2015, ii). Other studies focused on domestic dogs use an osteobiographical approach to examining injury and pathology to understand the treatment of

ancient dogs during life and after death (Bartelle et al. 2010; Binois et al. 2013; Tourigny et al. 2016). Paleopathological features preserved in bone can provide insight on human-animal relationships in the past (Oliver et al. 2015, i).

The skeletal remains of the dog from *Kakmakimilh* presented degenerative features on the scapula and right femur including new bone deposition, porosity, osteophytosis, and left and right femoral length disparities (Zampetti et al. 2016). These features are telling of osteoarthritis in this dog's left shoulder and right knee. Osteoarthritis is a degenerative joint disease that causes the "erosion of the cartilage in those parts of the articular surface where the highest load bearing occurs" (Oliver et al. 2015, iv). Zampetti and colleagues (2016) describe this pathological process of osteoarthritis: "The progress of the disease is characterized by three main phases: 1) breakdown of articular cartilage, which may result in bone contact with a consequent abrasion of the subchondral bone, 2) reactive bone formation (sclerosis)" (683). Osteoarthritis is caused by a number of factors including aging, infection, trauma, or by physical burdening of the joint (Oliver et al. 2015, iii). Despite the cause of osteoarthritis, the morphological changes that degenerative osteoarthritis has on the bones are the same (Oliver et al. 2015, iv).

The left scapula presented two pathological features: marginal lipping at the glenoid fossa and periosteal bone deposition on the neck of the scapula (Figure 23). Marginal lipping at the glenoid fossa is indicative of degenerative joint disease (Zampetti et al. 2016, 686). The glenoid fossa is the articular cavity where the humerus connects to the scapula at the shoulder joint. Lipping is the result of new bone formation along the margin of the shoulder joint (686).

Periosteum present on the costal surface of the neck of the scapula is also new bone deposition (Tourigny et al. 2016). The cause in the *Kakmakimilh* dog was not determined, but

further examination of the remains may indicate if this is the result of disease, injury, or infection (Tourigny et al. 2016).

The distal right femur presents porosity on the trochlear groove that makes the natural concave surface of the groove where the patella (kneecap) sits absent (Binois et al. 2013, 43) (Figure 26). A deformity like this is generally characteristic of patellar luxation, the dislocation of the patella (43). This displacement in the kneecap and the muscle connecting it to the femur and tibia changes the way muscle guides it across the joint of the femur (44). As this is a key weight bearing joint, it causes the eventual remodelling of the femoral groove gradually, producing porous bone (Binois et al. 2013, 43).

Patella luxation also creates changes in the condyles of the femur. Osteophytosis, the development of osteophytes, has developed between the condyles of the distal right femur of the dog from *Kakmakimilh* (Figure 25). Binois (2013) and colleagues identify a similar case of patellar luxation in the dog from Guimps, France to be the result of traumatic dislocation (44). Patellar luxations are congenital in toy and dwarf breeds of dogs (Binois et al. 2013, 44). Binois et al. note that medium-sized dogs are the least likely to have congenital dislocations (44). Considering the medium size of the *Kakmakimilh* dog, the cause of this dislocation was most likely from trauma. Furthermore, the right femur is 5mm longer than the left femur; differences in length femoral could be a congenital disorder in small dog breeds, or by traumatic dislocations (Bartelle et al. 2010, 2728) (Figure 24).

Pathologies such as these have been observed in dogs from archaeological contexts elsewhere in the world. An ancient dog skeleton from Guimps, France displays the same distal femoral morphology determined to have been caused by trauma (Binois et al 2013). The remodeling of porous bone on the distal femur of this dog shows close similarity to the dog from *Kakmakimilh*.

Tourigny and colleagues (2016) examined an indigenous dog from Ontario, Canada that had marginal lipping on the glenoid fossa of the left scapula and osteophyte development indicative of degenerative joint disease (821). In addition, Bartelle et al.'s (2010) research on a dog burial from San Nicolas Island, California shows similar features of injury on the femur, scapula, and rib. Bartelle and colleagues (2010) also found joint issues and rib injuries that may have been related and from the same injury time (Bartelle et al. 2010, 2728). They also observed that the right femur was shorter than the left (2728) The difference in length between femurs and the formation of osteophytes at locations where muscle attaches to bone are indicative of increased pressure during locomotion (2728). Mechanical stress would have been put on the right hindlimb to compensate for the injury on the left front limb while moving (2728).

Changes in bone morphology and structure are not always symptomatic of pain and mobility challenges, but some interpretations about the locomotion of the *Kakmakimilh* dog can be made when compared with dogs with similar afflictions. Patellar luxation causes significant instability and lameness of the joint and limb (Binois et al. 2013, 45). This would have caused a limp that would have impaired the dog's movement and was less useful if used as a work animal (45).

One aspect that helps us understand the level of care the *Kakmakimilh* dog received from people is the longevity of the dog's life and whether it was abused. This dog had at least one event of injury during its lifetime to fracture the 6th rib, fracture the caudal vertebra, and dislocate its right patella. These injuries may have been caused by mistreatment, but this is not always the case. Although this dog experienced physical trauma during life, it's worthy to note that it recovered from its injuries.

Comparison can be drawn from Bartelle and colleague's (2010) analysis on the dog from San Nicolas Island in California, whereby the healed injuries visible in the bones indicate the dog

lived for at least four months following the injury (2728). Furthermore, they indicate that the nature of the injury and asymmetry in the bone suggest this dog was cared for by people during these months of healing (Bartelle et al. 2010, 2732).

Similarities in the types of injuries and healing morphology indicate that the *Kakmakimilh* dog likely also healed for a few months following its injuries and required the care of people during that time. If the periosteal bone formation on the scapula is the result of a long-lasting affliction, this means that it lived long enough for that to develop on the bone. This indicates that the dog lived long enough to develop these skeletal changes, suggesting it may have been cared for through injury. This suggests that the longevity of the dog's life was valued to a certain degree.

Diet

The diet of this dog can provide further insight on its treatment during life. Indigenous dogs in villages on the coast may have scavenged on food scraps of human discard or they may have been deliberately fed by people (Cannon et al. 1999; Hillis, 2018; Vellanoweth et al. 2008). No specific ethnographic examples describe the diet of wool dogs in Nuu-chah-nulth territories, but sources on Coast Salish wool dogs describe they were fed specific diets to maintain the high quality of their coats (Zimmerman 2014, 18). Rather than scavenging for scraps, Coast Salish wool dogs were fed a diet including fish and elk to keep the dog's coat shiny and maintain fibre quality. (Barsh et al. 2006, 9)

Wool dogs likely received a different diet in comparison to village dogs whose coat quality was not valued. Drucker (1951, 109) notes that dogs scavenged "scraps" and "offal" around villages. Drucker also mentions that dogs were constrained from eating during times of food restriction such as the first run of salmon (ibid.). He mentions that "half-starved dogs" would

hang around cooking places looking for food (Drucker 1951, 91). Dogs were not necessarily purposefully starved. Drucker also notes some dogs may have been better fed than others; he writes that a chief at Kyuquot named his dogs “yuxnic, tcatsnał, La'qeqstł (‘mouth always greasy’ [ie., from eating fat meat])” (Drucker 1951, 259).

Prior isotopic research on the diet of the *Kakmakimilh* dog determined that it was fed a marine-based diet consisting predominantly of herring and anchovy (Hillis 2018). Tseshaht diets were largely marine-based as much of the food consumed by Tseshaht people consisted of fish, sea mammals, and shellfish. Herring and anchovy were an important and abundant food source to Tseshaht, as supported by the zooarchaeological record at *Kakmakimilh* (Hillis 2018, 15). The provisioning of schooling forage fish to wool dogs demonstrates a pattern of purposeful feeding.

The *Kakmakimilh* dog may have been fed a diet mainly of fish because of the benefits fish provide in maintaining a good coat. Ememe and Ememe (2017) chapter on nutritional foods for companion animals explain that “oily fishes such as herring, salmon, salmon, sardines, mackerel, and anchovies are rich in omega-3 fatty acids,” making them beneficial to dogs’ health (312). Foods containing Omega-3 fatty acids are good for maintaining shiny coats in dogs (Ememe and Ememe 2017, 309).

The diet of this dog may also present therapeutic intervention of people through feeding (Binois et al. 2015). If this dog had arthritic limbs that limited its mobility, it may not have been able to forage for its own food and needed to be fed by people to survive (MacKinnon 2010, 304). Veterinary research on dogs has shown that the consumption of fish oil omega-3 fatty acids has beneficial effects to dogs with osteoarthritis (Roush et al. 2010). A controlled diet of fish would have helped aid osteoarthritis in its joints, which may suggest care was taken to maintain the dog’s health.

Burial

The dog's intentional burial offers insight on how it was treated after death by people at *Kakmakimilh*. The remains were determined to be purposefully buried based on the articulation and anatomical positioning of skeletal elements, otherwise the bones would have been damaged or dispersed by scavengers if left exposed on the midden. The remains of the dog were positioned in a roughly north-south orientation, with the head facing south. The positioning of the remains has the limbs tucked underneath the body (Henry 2017). Associated with the burial were several intact paired clamshell valves as well as a hammerstone located directly underneath the left humerus. One large butter clam was nested in the ribcage of the dog. These paired clamshells located in the dog's ribcage suggest they were purposefully placed into the burial rather than an accidental occurrence.

Post-mortem treatment is important in understanding how dogs are valued by people in life. Discussing archaeological contexts in the Salish Sea, Marino (2015, 49) explains that dog burials on the Northwest Coast support the idea that the dogs may have acquired personhood in life through social interactions and received treatment in death similar to that of humans (cf. Morey 2006). Discussing Indigenous dogs more generally, Morey notes that dog burials have the capacity to demonstrate social relationships between humans and dogs as these dogs are treated in death much as humans are (2006, 170). Although the dog from *Kakmakimilh* is not known to be associated with a human burial, the fact that this dog was buried in of itself demonstrates its importance apart from being "analogs of humans" (Marino 2015, 9).

Prior archaeological research in Barkley Sound has uncovered dog burials and wool dog remains from Tseshaht and other Nuuchahnulth Nation sites. Half the *Canis familiaris* remains excavated at the ancestral Tseshaht village site of *Ts'ishaa* were the size of wool dogs when

compared with Crockford's Type 1 ranges (Frederick and Crockford 2005, 179). Two partial dog skeletons excavated at the *Ts'ishaa* back terrace were likely deliberate burials (McMillan and St. Claire 2005, 102). These mid-Holocene dogs were located at the earliest dated portion of the site, which means Tseshah kept dogs there as early as 5,000 years ago (McMillan and St. Claire 2005, 102). These dog burials were associated with human burial cairns that were encountered but not excavated (Frederick and Crockford 2005, 178). McMillan and St. Claire note that deliberate dog burials indicate "these animal's status as pets" (2005, 102).

During the Toquaht Archaeological Project (1991-1996), excavations at the Toquaht site of *T'ukw'aa* in western Barkley Sound uncovered an articulated dog skeleton buried with numerous large whale bones (McMillan and St. Claire 1992). Whaling was the most prestigious activity among the Nuu-chah-nulth and was only practiced by individuals of high status (Cote 2010; McMillan 2015; Monks et al. 2001). Considering the high economic, cultural and spiritual significance that whaling held within Nuu-chah-nulth societies, the association of whale bones with this burial suggests this dog or its owner held high social value and status within in the community (McMillan and St. Claire 2005; *ibid.* 2015; *ibid.* 2001). Furthermore, this association indicates the cultural importance of dogs among the Nuu-chah-nulth.

The burial context of the dog at *Kakmakimilh* demonstrates the cultural importance of this dog as reflected through its treatment after death. The incorporation of the paired clamshells within the burial suggests the shells were placed at the ribcage with some care. The placement of these shells may have been symbolic or it may have contained something that has since decomposed.

When considered alongside the burial practices encountered at *Ts'ishaa* and the whale bones associated with the dog at *T'ukw'aa*, dog burials in Barkley Sound present symbolic

associations. As a result, the dog burial at *Kakmakimilh* reflects the relationship Tseshaht had with wool dogs and the broader cultural importance of dogs to Nuu-chah-nulth.

Significance of Dogs

Ethnographic information offers valuable insight on the archaeological and pathological interpretations of the *Kakmakimilh* dog burial. Cultural information about the presence of dogs in community life and their representation in oral traditions provide insight on the cultural attitudes towards dogs and demonstrates their value within Nuu-chah-nulth culture and societies.

Ethnographic information describing dogs as pet animals provides information on how these dogs were treated in Nuu-chah-nulth communities (Drucker 1951, 109). Drucker (1951) notes that dogs were given names which were usually attributed to the status of its owner (109). He explains that dogs belonging to chiefs had “high-sounding names” while dogs of other men had casual names (Ibid., 109). Pet dogs may have been treated as companion animals and have had kinship-like relationships with its owner, which can be understood through the dog’s feeding, longevity of life, and burial.

The presence of dogs in Tseshaht ceremony is useful in understanding the position and roles they held within cultural practices. The Dog-Eating Ceremony is part of the Wolf-Ritual which was an important winter ritual by numerous Indigenous groups on the Northwest Coast, including the Nuu-chah-nulth (Sapir and Swadesh 1955; Sapir 1911). This ceremony involved the ceremonial consumption of dog meat, a practice which Drucker (1951, 61) noted as being taboo among Nuu-chah-nulth. Ethnographic information about this ceremony indicates that the act of cutting open and consuming dog flesh was seen as repulsive and frightening to community observers (Sapir and Swadesh 1955, 104). Eating dog flesh is one act that a dancer is compelled to do when the wolf spirit enters their body (Sapir 1911).

The oral historical accounts of the “Dog Children story” demonstrates the close relationship between humans and dogs within Nuu-chah-nulth culture and history with versions specific to Tseshaht territory. The story describes the intercourse between humans and dogs and the birth of supernatural dog offspring (Sapir and Swadesh 1939, 54-63). The original story spoken in Nuu-chah-nulth and later translated by Sapir and Swadesh (1939, 55-63) was summarized by Kelsey MacLean (2012, 44-46) as presented below:

While the Tseshaht were living at Hiikwis, a young woman was approached by a man who promised to marry her, and she had his children (Sapir and Swadesh 1939: 55). It turned out that he was actually a dog, and her children were dogs as well. Disgraced, her father moved himself and the entire village, leaving her and her children abandoned (Sapir and Swadesh 1939:55). The girl’s uncle returned to build her a house, and promised that he would always return to bring her and her children food (Sapir and Swadesh 1939:55). For four days the woman was digging clams when she heard singing. As she returned home, she realized it was her children singing, but as soon as she came inside they would stop (Sapir and Swadesh 1939:55). When this happened four more times, the woman decided she wanted to catch them singing, as this was strange for dog-children (Sapir and Swadesh 1939:57). To do so, she set up her digging stick on the beach with her clothes on it, and crept stealthily back to the house. As she got closer, she could hear that they were singing a lullaby, and saw that they were now human. The young woman surprised them, stole their robes and threw them on the fire so that they couldn’t transform back into dogs.

The woman was overjoyed to have human children, who grew up quickly into young men. She made bows so they could hunt, and rope and hook-lines so they could fish. One of the boys caught a whale with his little hook, because he had supernatural powers (Sapir and Swadesh 1939:59). The young men started skinning the whale, and one of them formed the whale into a bird. He threw it into the air four times and it was transformed into a real bird. Then, he taught the bird to talk and had it deliver a piece of whale blubber to the woman’s family who had abandoned her (Sapir and Swadesh 1939:59, 61).

The bird found her mother and told her that the young woman had a drift whale. The girl’s uncle went to see her to find out how she got the whale. Upon seeing the boys instead of dogs, the girl was able to convince him to gather his things and move back there with her. He set out the next morning but before he left he told the tribe that the girl they had abandoned had a drift whale. The tribe was excited, and decided to all move back as well. The girl’s uncle arrived first, and when the girl saw the others coming she sent her boys to the beach to bathe (Sapir and Swadesh 1939:63). As the canoes neared, the boys called up a storm, which capsized the canoes and drowned the people, who were transformed into rocks. The sons had chosen to take revenge on those who had

abandoned the girl because of her dog children. Only the girl and her uncle lived, and “then the boys disappeared, they went off to another land” (Sapir and Swadesh 1939:63).

This story was shared by community informant Big Fred in October 1913 and took place at ‘Fair-beach’ (ibid. 1939, 55). This location is *Uukwatis*, which has been translated to ‘very pretty beach’ and ‘pleasant beach’ as well (St. Claire 1991, 133-134). *Uukwatis* village on Sechart Channel in Barkley Sound is within *Nash’as7ath* territory. The story originally came from the *Nash’as7ath* Nation which amalgamated with the Tseshah in the late 1700s (McMillan and St. Claire 2005, 17).

There are multiple versions of the Dog Children story among other Nuuchahnulth Nations which occur north of Barkley Sound. Some of these include a version recorded by Bouchard and Kennedy (1990) and Boas (2002 [1894]) which present differences in location and the number of dog children. Bouchard and Kennedy (1990, 87) note a version of this story occurred in the territory of the Hesquiaht First Nation at “ikisxa” in Hesquiat Harbour. This story has also been stated to have occurred at “hii7atu” in Tofino (Bouchard and Kennedy 1990, 513). Bouchard and Kennedy (1990, 87) describe ten puppies born while number of puppies in the Sapir and Swadesh (1939) version is not provided. An unpublished version specific to *Nash’as7ath* (a group who amalgamated with Tseshah in the 1700s) in the Broken Group Islands describes the physical appearance of the children as matching the physical appearance of wool dogs (St. Claire personal communication April 14, 2020). The occurrence of this story across Nuuchahnulth territories and the supernatural role of dogs demonstrates the broader cultural importance and potential significance of the wool dog burial at Kakmakimilh and is worthy of further research.

Conclusion

This research project used an integrative approach of both archaeological data and ethnographic and ethnohistorical information to provide a holistic perspective on dogs within Tseshaht culture and history with a focus on a single dog burial from an archaeological site in the Broken Group Islands. Ethnographic knowledge about Nuu-chah-nulth wool dogs was combined with zooarchaeological methods to contribute towards further understanding of Tseshaht culture and more broadly, the significance of dog-human relationships among First Nations communities on the B.C. coast.

Osteometric analysis of the dog remains recovered from the Tseshaht village site of *Kakmakimilh* determined this dog as a large-sized wool dog. Size and stature data from this individual animal compared with ethnohistorical accounts of wool dogs on the British Columbia coast (Allen 1920; Smith 1840) suggest that Nuu-chah-nulth wool dogs may have been of larger size from those in the Coast Salish region (Crockford 1997).

Paleopathological analysis on the remains determined this dog suffered from degenerative osteoarthritis in the right knee and left shoulder. A healed fracture in the 6th right rib and a trauma-inflicted patellar luxation determined that this dog suffered from injury during its life. Although it is possible the injury was inflicted through abuse or conflict with other dogs, the dog's survival with limited mobility, its purposeful feeding, and its burial after death suggest it was cared for by people.

The ethnographic information adds perspective that wool dogs had a social and cultural value with Tseshaht people. These dogs were viewed as companions and had kinship-like relationships with people as seen in their treatment in life and death through care in illness, diet, and burial.

Future research can build on the paleopathological analysis to include radiography, professional veterinary advice, ancient DNA analysis, or other disease signatures to expand current understanding of the pathologies present within this dog. Further osteometric and paleopathological analyses on dog remains from other Tseshaht archaeological sites may offer additional insight on past dog-human relationships in Tseshaht society.

As has been observed elsewhere on the Northwest coast, the care in ill-health, feeding, and burial suggests that this wool dog had a strong social bond with the people at *Kakmakimilh* (Bartelle 2010, 2732). This research provides information about the relationships that Nuu-chah-nulth communities had with dogs to contribute to the body of knowledge about Tseshaht culture and their relationships with animals.

Acknowledgements

This research was supported through *Kakmakimilh* Archaeological Project, a collaborative project between Tseshaht First Nation, UVic's Department of Anthropology, Pacific Rim National Park Reserve, & the Bamfield Marine Sciences Centre. Field work took place in Tseshaht territory and preliminary analysis took place in Huu-ay-aht territory at the Bamfield Marine Sciences Centre through the UVic Archaeology Field School. Osteometric analysis took place on the territories of the Lekwungen peoples and the Songhees, Esquimalt, and WSÁNEĆ peoples at the University of Victoria.

I would like to give my sincerest thanks to project co-directors Dr. Iain McKechnie and Denis St. Claire who made this project possible and provided endless knowledge and support over the last couple years. Thank you very much to Drs. Lisa Mitchell and Iain McKechnie guiding this project as my Honours co-supervisors.

Thank you to the University of Victoria for awarding me with the Jamie Cassels Undergraduate Research Award (JCURA) that provided financial support during Fall 2019/Spring 2020, and to the Department of Anthropology and Iain McKechnie for supporting my NSERC USRA program in Summer 2019.

Thank you to everyone who provided additional time and support to this my research efforts: Helen Kurki, Marla MacKinnon, and Ran Donaldson.

Tables and Figures

Table 1. Cranial measurements of dog from burial based on von den Driesch (1976).

Measurement Code	Side	Measurement (mm)
1	-	175.0
2	-	165.0
3	-	155.0
4	-	48.5
5	-	106.2
6	-	-
7	-	87.9
8	-	84.1
9	-	101.6
10	-	68.0
11	-	-
12	-	69.4
13	-	87.8
13a	-	86.8
14	-	24.0
14a	-	24.0
15	L	60.7
15	R	60.8
16	L	14.9
16	R	16.2
17	L	48.2
17	R	47.7
18 (L)	L	16.8
18 (B)	L	7.2
18 (L)	R	19.6
18 (B)	R	7.3
19	-	-

Measurement Code	Side	Measurement (mm)
20	-	-
21	-	-
22	L	21.4
22	R	22.7
23	-	65.4
24	-	64.7
25	-	34.7
26	-	47.3
27	-	18.8
28	-	14.7
29	-	52.6
30	-	103.8
31	-	37.7
32	-	56.4
33	-	38.2
34	-	60.2
35	-	34.3
36	-	37.0
37	L	28.5
37	R	28.3
38	-	60.0
39	-	54.6
40	-	39.5
41	L	38.5
41	R	38.3
42	-	-

Table 2. Mandibular measurements of dog from burial based on von den Driesch (1976).

Measurement Code	Side	Measurement (mm)
1	L	-
2	L	-
3	L	-
4	L	110.0
5	L	104.8
6	L	111.1
7	L	68.1
8	L	-
9	L	58.0
10	L	28.3
11	L	-
12	L	30.6
13(L)	L	21.0
13(B)	L	8.4
14	L	20.3
15(L)	L	8.3
15(B)	L	6.4
16	L	-
17	L	12.3
18	L	51.3
19	L	22.9
20	L	18.9
21	L	38.5

Measurement Code	Side	Measurement (mm)
1	R	127.1
2	R	127.9
3	R	121.3
4	R	110.6
5	R	104.3
6	R	105.2
7	R	70.4
8	R	-
9	R	61.8
10	R	33.5
11	R	-
12	R	30.7
13(L)	R	21.0
13(B)	R	8.2
14	R	21.0
15(L)	R	-
15(B)	R	-
16	R	-
17	R	12.3
18	R	51.5
19	R	23.7
20	R	-
21	R	38.3

Table 3. Post-cranial measures of dog from burial based on von den Driesch (1976).

Element	Side	Measurement Code	Measurement (mm)
Femur	L	GL	154.0
Femur	L	Bd	29.2
Femur	L	Bp	34.6
Femur	L	SD	12.3
Femur	L	DC	17.9
Femur	R	GL	159.0
Femur	R	Bd	31.9
Femur	R	Bp	32.8
Femur	R	SD	12.8
Femur	R	DC	16.3
Tibia	L	GL	155.0
Tibia	L	Bd	21.0
Tibia	L	Bp	33.4
Tibia	L	SD	12.0
Tibia	R	GL	-
Tibia	R	Bd	21.3
Tibia	R	Bp	35.7
Tibia	R	SD	9.8
Humerus	L	GL	-
Humerus	L	Bd	29.1
Humerus	L	SD	13.0
Humerus	L	DP	-
Humerus	R	GL	148.4
Humerus	R	Bd	29.2
Humerus	R	SD	12.4
Humerus	R	DP	35.7
Radius	L	GL	143.4
Radius	L	Bd	23.2
Radius	L	Bp	17.0
Radius	L	SD	12.2

Table 3 (Continued).

Element	Side	Measurement Code	Measurement (mm)
Radius	R	GL	141.6
Radius	R	Bd	22.5
Radius	R	Bp	16.8
Radius	R	SD	11.9
Ulna	L	GL	-
Ulna	L	SDO	20.9
Ulna	L	BPC	15.8
Ulna	L	DPA	23.7
Ulna	R	GL	-
Ulna	R	SDO	20.7
Ulna	R	BPC	15.8
Ulna	R	DPA	23.7
Fibula	L	GL	-
Fibula	L	Bd	12.5
Fibula	L	BP	10.6
Fibula	R	GL	-
Fibula	R	Bd	11.2
Fibula	R	BP	10.9
Scapula	L	HS	-
Scapula	L	SLC	22.9
Scapula	L	GLP	28.6
Scapula	R	HS	-
Scapula	R	SLC	25.9
Scapula	R	GLP	31.8
Innominate	-	GL	138.2
Innominate	-	GBA (fused)	75.8
Innominate	-	GBTc (fused)	84.9
Innominate	-	SBI (fused)	59.3
Innominate	-	GBTi (fused)	88.0
Innominate	-	LFo	29.4
Innominate	-	LS	42.1

Table 3 (Continued).

Element	Side	Measurement Code	Measurement (mm)
Innominate	-	SH	15.6
Innominate	-	SC	-
Innominate	-	LA/LAR	21.8
Atlas	-	GL	38.0
Atlas	-	BFcd	29.0
Atlas	-	LAd	15.4
Atlas	-	BFcr	28.6
Atlas	-	GB	75.6
Axis	-	BFcd	18.0
Axis	-	BFcr	28.1
Axis	-	LAPa	-
Axis	-	LCDe	42.7
Axis	-	H	35.3
Axis	-	SBV	21.3
Axis	-	BPac	29.2
Sacrum	-	BFcr	17.0
Sacrum	-	GB	41.5
Sacrum	-	BPacr	-
Sacrum	-	PL	32.1
Sacrum	-	HFcr	10.6

Table 4. Osteometric ranges of dog Types 1 & Type 2 as presented in Crockford (1997, 105) alongside measure of the *Kakmakimilh* dog from burial. Measurements are based from von den Driesch (1976).

Cranial Measurements (mm)			
Measurement Code	Type 1 dog range	Type 2 dog range	This study
1	146-173	176-203	175
2	140-162	164-188	165
12	59-73	76-87	69.4
13	73-86	89-98	87.8
15B	76-85	90-99	85.9
23	56-60	64-71	65.4
34	56-58	65-69	60.2
Mandibular Measurements (mm)			
Measurement Code	Type 1 dog range	Type 2 dog range	This study
1	103-128	135-151	127.1
4	85-112	113-132	110.3
6	87-113	118-131	105.2
7	64-74	76-84	69.3
19	18-21	26-27	23.3
Post-cranial Measures (mm)			
Element (Code)	Type 1 dog range	Type 2 dog range	This study
Femur (GL)	142-164	167-182	156.5
Tibia (GL)	139-158	159-177	155
Humerus (GL)	137-151	153-179	148.4
Radius (GL)	123-141	145-156	142.5
Atlas (LAd)	12-14	15-17	15.4
Axis (LCDe)	37-44	45-57	42.7
Sacrum (PL)	30-32.5	33.5-38	32.1

Table 5. Body mass calculations from cranium dimensions for *Canis* spp. in Losey et al. (2015).

Measurement Code	Side	Element Measurement (X)	Coefficient (β)	Constant (α)	Body Mass (kg) (y)
1	-	175.0	3.14	-5.883	14.459
2	-	165.0	2.849	-5.177	13.823
3	-	155.0	2.837	-5.075	13.771
7	-	87.9	2.998	-4.629	15.815
8	-	84.1	2.275	-3.216	14.551
9	-	101.6	2.444	-3.723	15.200
13a	-	86.9	2.869	-4.416	13.983
15	L	60.7	2.379	-3.017	16.796
15	R	60.8	2.379	-3.017	16.861
16	L	14.9	2.528	-1.852	12.996
16	R	16.2	2.528	-1.852	16.056
17	L	48.2	1.687	-1.502	21.742
17	R	47.7	1.687	-1.502	21.362
18 (L)	L	16.8	2.269	-1.596	15.283
18 (B)	L	7.2	1.218	0.164	16.1521
18 (L)	R	19.6	2.269	-1.596	21.683
18 (B)	R	7.3	1.218	0.164	16.425
29	-	52.6	2.751	-3.418	20.722
30	-	103.8	2.918	-4.639	17.549
34	-	60.2	3.804	-5.677	12.376
Mean of Body Mass (kg):					16.380

Table 6. Body mass calculations from mandibular dimensions for *Canis* spp. in Losey et al. (2015).

Measurement Code	Side	Element Measurement (X)	Coefficient (β)	Constant (α)	Body Mass (kg) (y)
1	L	-	2.840	-4.859	-
2	L	-	2.710	-4.570	-
3	L	-	2.815	-4.750	-
4	L	110.0	2.607	-4.174	14.057
5	L	104.8	2.586	-4.075	14.114
6	L	111.1	2.484	-3.917	14.606
7	L	68.1	2.600	-3.658	12.828
8	L	-	2.695	-3.782	-
9	L	58.0	2.444	-3.206	12.700
11	L	-	2.487	-2.707	-
12	L	30.6	2.590	-2.726	13.243
13 (L)	L	21.0	2.218	-1.659	18.779
13 (B)	L	8.4	2.373	-0.944	17.754
14	L	20.3	2.113	-1.495	18.524
15 (L)	L	8.3	1.008	0.475	25.201
15 (B)	L	6.4	0.939	0.663	26.302
17	L	12.3	2.588	-1.412	25.625
18	L	51.3	2.301	-2.738	15.739
19	L	22.9	2.406	-2.020	17.855
20	L	18.9	2.538	-2.000	17.364
1	R	127.1	2.84	-4.859	13.084
2	R	127.9	2.71	-4.570	13.791
3	R	121.3	2.815	-4.750	13.063
4	R	110.6	2.607	-4.174	14.258
5	R	104.3	2.586	-4.075	13.940
6	R	105.2	2.484	-3.917	12.755
7	R	70.4	2.600	-3.658	13.985
8	R	-	2.695	-3.782	-
9	R	61.8	2.444	-3.206	14.831
11	R	-	2.487	-2.707	-
12	R	30.7	2.590	-2.726	13.356
13 (L)	R	21.0	2.218	-1.659	18.779
13 (B)	R	8.2	2.373	-0.944	16.767
14	R	21.0	2.113	-1.495	19.899
15 (L)	R	-	1.008	0.475	-
15 (B)	R	-	0.939	0.663	-
17	R	12.3	2.588	-1.412	25.625
18	R	51.5	2.301	-2.738	15.880
19	R	23.7	2.406	-2.020	19.392
20	R	-	2.538	-2.000	-
Mean of Body Mass (kg):					16.803

Table 7. Body mass calculations from limb dimensions for adult dogs in Losey et al. (2017).

Measurement Code	Side	Measurement Code	Element Measurement (X)	Coefficient (β)	Constant (α)	Body Mass (kg) (y)
Femur	L	Hbr	17.7	2.645	-4.777	16.836
Femur	L	Hdt	17.6	2.568	-4.585	16.115
Femur	L	GL	154.0	2.332	-9.000	15.582
Femur	L	Bd	29.2	2.682	-6.372	14.548
Femur	L	Bp	34.6	2.647	-6.677	14.933
Femur	R	Hbr	17.3	2.645	-4.777	15.849
Femur	R	Hdt	16.4	2.568	-4.585	13.442
Femur	R	GL	159	2.332	-9.000	16.788
Femur	R	Bd	31.9	2.682	-6.372	18.443
Femur	R	Bp	32.8	2.647	-6.677	12.963
Tibia	L	GL	155	2.041	-7.486	16.570
Tibia	L	Bd	21	2.79	-5.927	13.029
Tibia	L	Bp	33.4	2.766	-6.996	15.009
Tibia	R	GL	-	2.041	-7.486	-
Tibia	R	Bd	21.3	2.790	-5.927	13.555
Tibia	R	Bp	35.7	2.766	-6.996	18.044
Humerus	L	GL	-	2.358	-8.940	-
Humerus	L	Bd	29.1	2.551	-6.025	13.114
Humerus	L	DP	-	2.668	-6.957	-
Humerus	R	GL	148.4	2.358	-8.940	17.284
Humerus	R	Bd	29.2	2.551	-6.025	13.230
Humerus	R	DP	35.7	2.668	-6.957	13.216
Radius	L	GL	143.4	2.126	-7.698	17.443
Radius	L	Bd	23.2	2.735	-5.845	15.709
Radius	L	Bp	17	2.747	-5.056	15.284
Radius	R	GL	141.6	2.126	-7.698	16.980
Radius	R	Bd	22.5	2.735	-5.845	14.446
Radius	R	Bp	16.8	2.747	-5.056	14.795
Ulna	L	GL	-	2.035	-7.606	-
Ulna	L	BPC	15.8	2.122	-3.145	15.055
Ulna	L	DPA	23.7	2.357	-4.719	15.518
Ulna	R	GL	-	2.035	-7.606	-
Ulna	R	BPC	15.8	2.122	-3.145	15.055
Ulna	R	DPA	23.7	2.357	-4.719	15.518
Scapula	L	HS	-	2.665	-10.223	-
Scapula	L	SLC	22.9	2.341	-4.613	15.134
Scapula	R	HS	-	2.665	-10.223	-
Scapula	R	SLC	25.9	2.341	-4.613	20.189
Mean of Body Mass (kg):						15.471

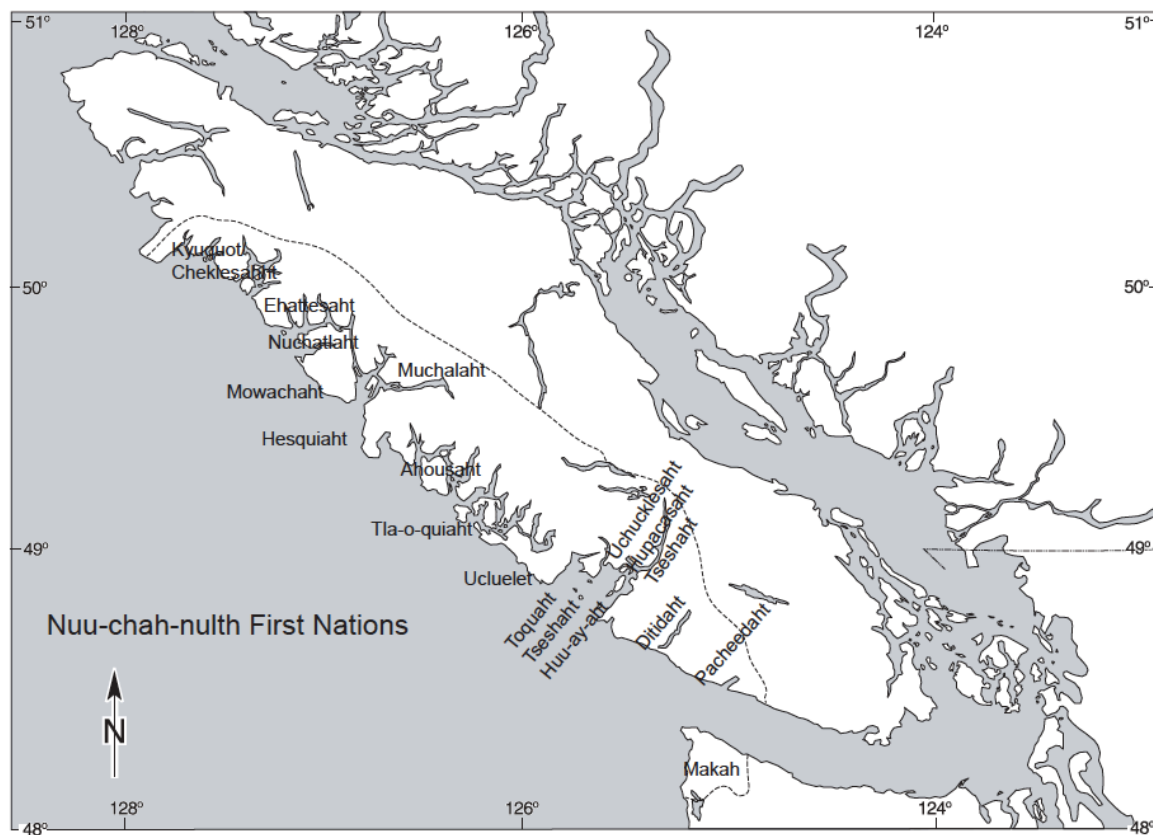


Figure 1. Map of showing Nuu-chah-nulth territories on western Vancouver Island as well as Makah in northwest Washington State. Map prepared by Iain McKechnie based on McMillan (1999).

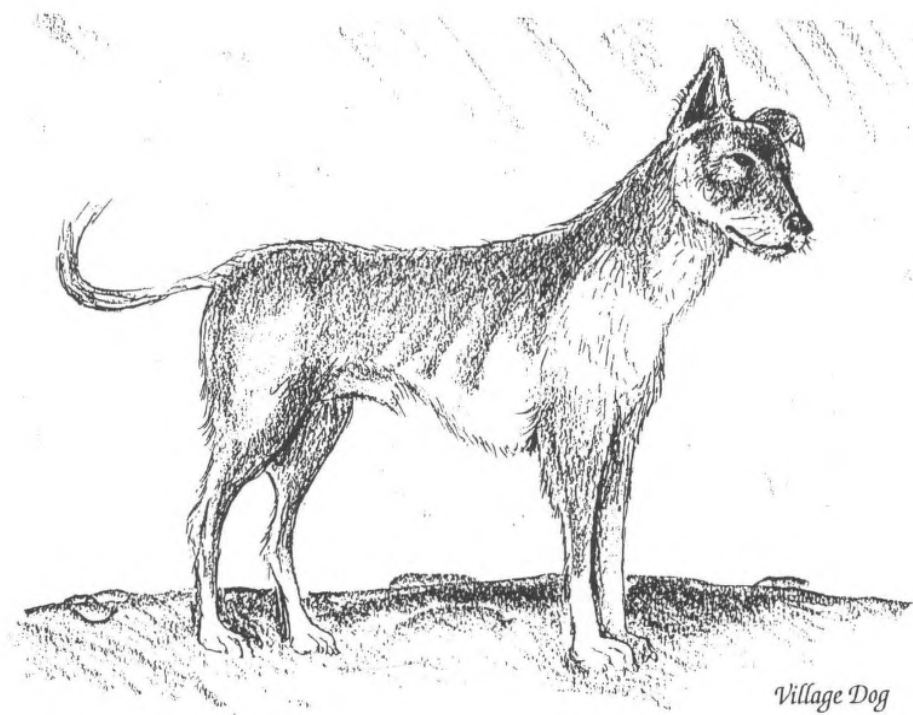


Figure 2. Artist's reconstruction of a "Village Dog", Crockford's Type 2 dog (Crockford 1997).



Figure 3. Artist's reconstruction of a "Wool Dog", Crockford's Type 1 dog (Crockford 1997).



Figure 4. "A Woman Weaving a Blanket" Songhees/ Saanich territories (Kane 1849-1856)

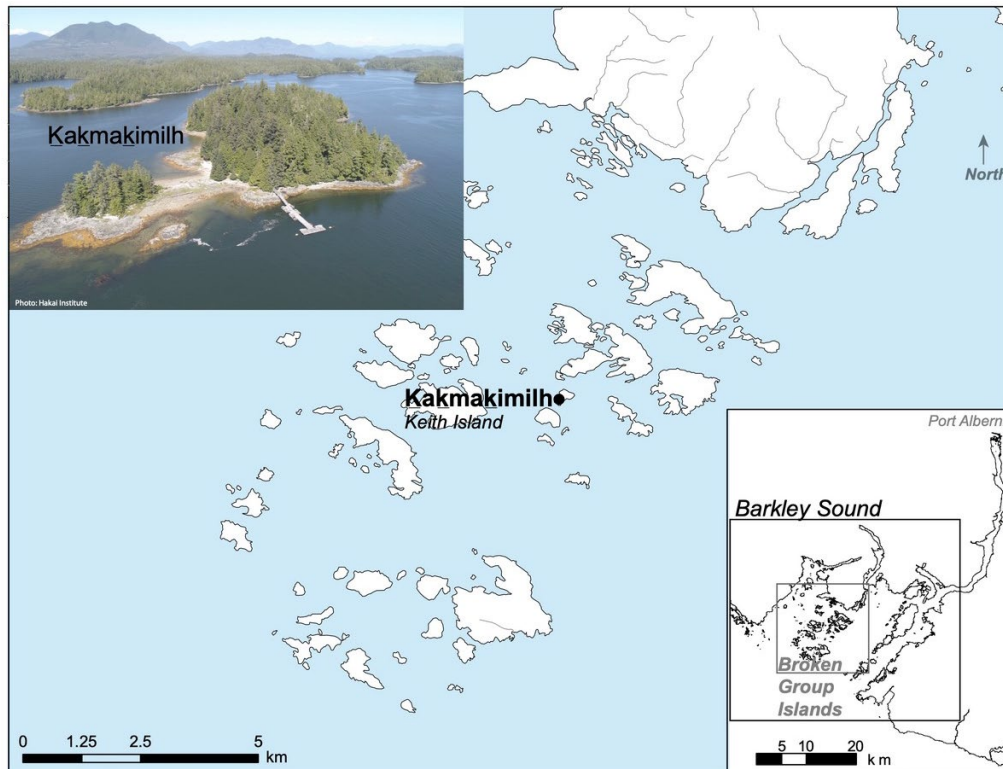


Figure 5. Map of *Kakmakimilh* in the Broken Group Islands, Barkley Sound on western Vancouver Island, B.C. (McKechnie, 2020).



Figure 6. Dog cranium excavated from burial in 2017 (Image: McKechnie 2017).



Figure 7. Plan view of in-situ dog remains during 2018 excavation of burial

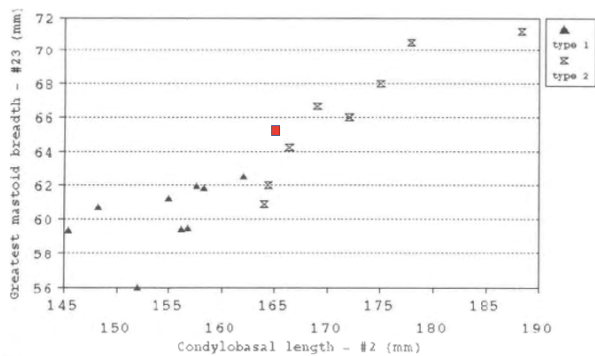


Figure 8. Cranial measures of dog remains plotted onto Crockford's (1997, 34) Type 1 & Type 2 Figure 4-10 scatterplot.

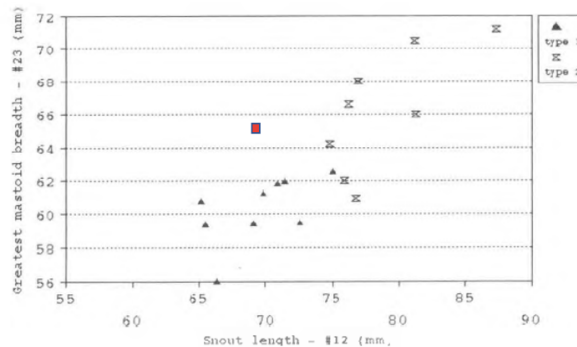


Figure 9. Cranial measures #12 vs. #23 of dog remains plotted onto Crockford's (1997, 34) Type 1 & Type 2 Figure 4-11 scatterplot.

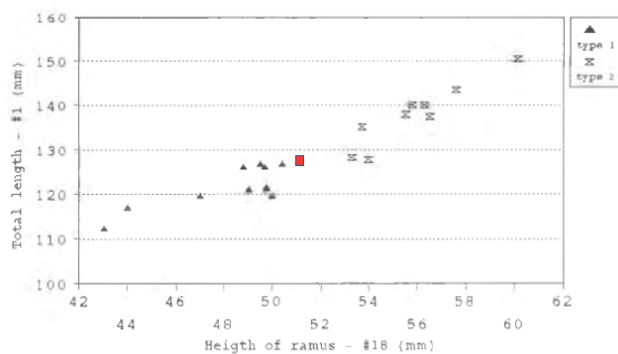


Figure 10. Right mandible measures #1 vs. #18 of dog remains plotted onto Crockford's (1997, 45) Type 1 & Type 2 Figure 5-5 scatterplot.

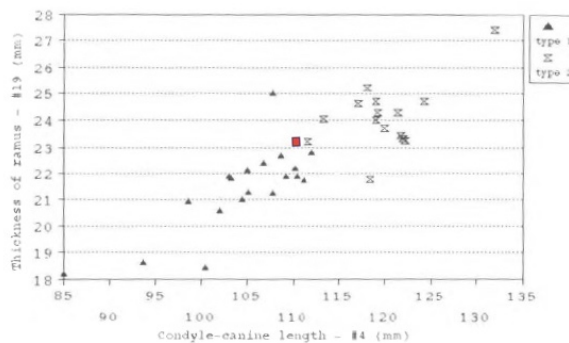


Figure 11. Right mandible measures #4 vs. #19 of dog remains plotted onto Crockford's (1997, 45) Type 1 & Type 2 Figure 5-7 scatterplot.

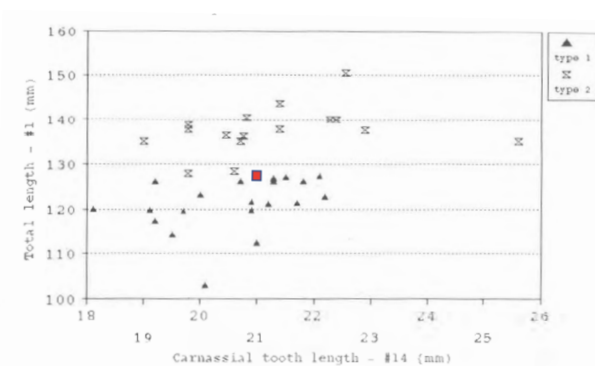


Figure 12. Right mandible measures #1 vs. #14 of dog remains plotted onto Crockford's (1997, 45) Type 1 & Type 2 Figure 5-8 scatterplot.

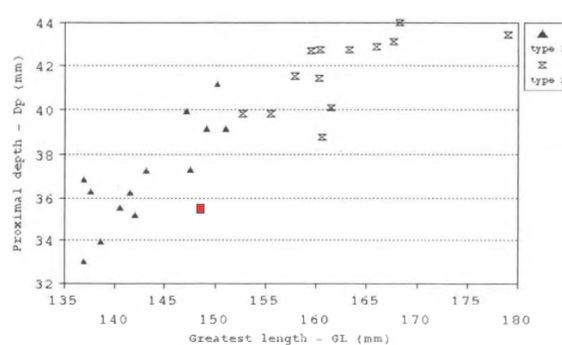


Figure 13. Right humerus GL vs. Dp measures of dog remains plotted onto Crockford's (1997, 56) Type 1 & Type 2 Figure 6-3 scatterplot.

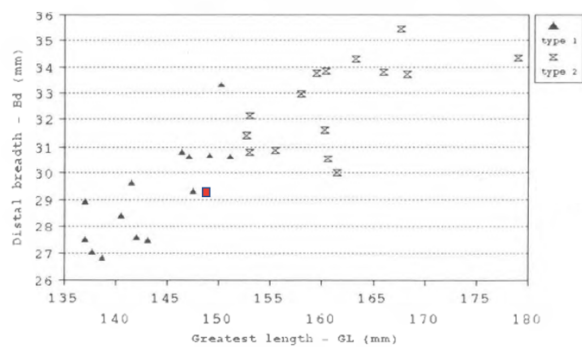


Figure 14. Right humerus GL vs. Bd measures of dog remains plotted onto Crockford's (1997, 56) Type 1 & Type 2 Figure 6-4 scatterplot.

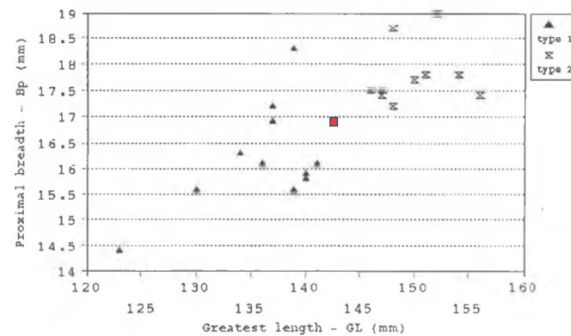


Figure 15. Mean radial GL vs. Bp measures of dog remains plotted onto Crockford's (1997, 57) Type 1 & Type 2 Figure 6-5 scatterplot.

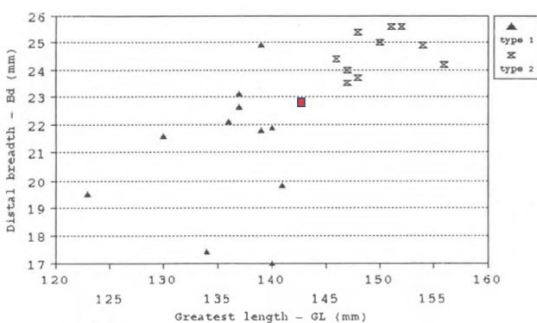


Figure 16. Mean radial GL vs. Bd measures of dog remains plotted onto Crockford's (1997, 57) Type 1 & Type 2 Figure 6-6 scatterplot.

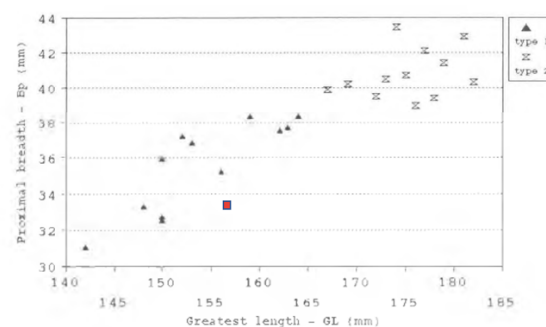


Figure 17. Mean femoral GL vs. Bp measures of dog remains plotted onto Crockford's (1997, 64) Type 1 & Type 2 Figure 7-3 scatterplot.

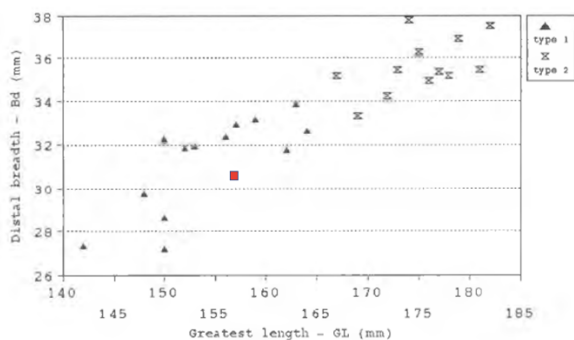


Figure 18. Mean femoral GL vs. Bd measures of dog remains plotted onto Crockford's (1997, 65) Type 1 & Type 2 Figure 7-4 scatterplot.

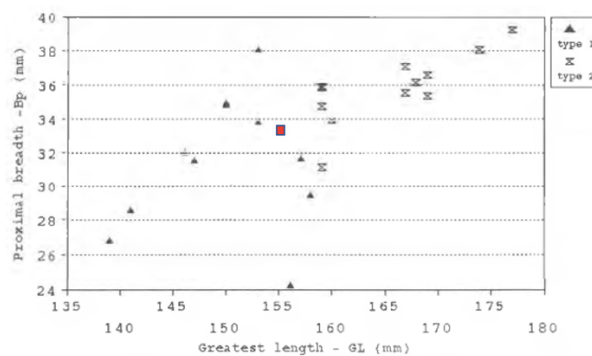


Figure 19. Left tibia GL vs. Bp measures of dog remains plotted onto Crockford's (1997, 65) Type 1 & Type 2 Figure 7-5 scatterplot.

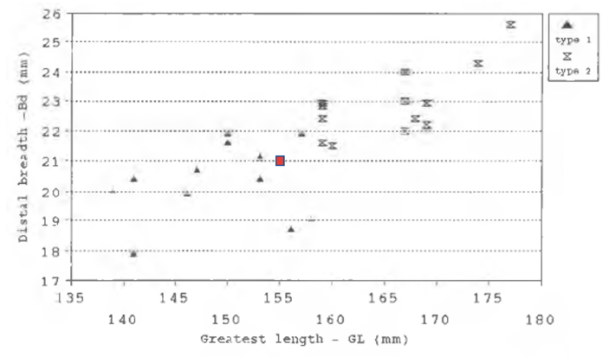


Figure 20. Left tibia GL vs. Bd measures of dog remains plotted onto Crockford's (1997, 65) Type 1 & Type 2 Figure 7-6 scatterplot.

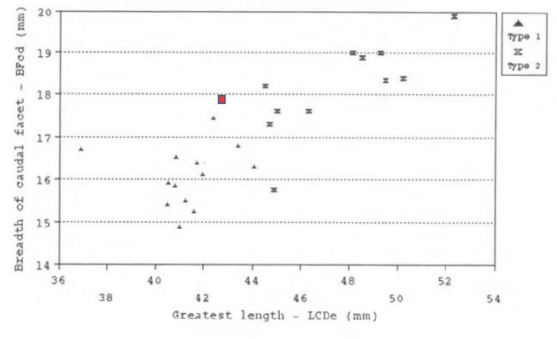


Figure 21. Cervical Vertebra 2 LCDe vs. BFcd measures of dog remains plotted onto Crockford's (1997, 74) Type 1 & Type 2 Figure 8-2 scatterplot.



Figure 22. Caudal view of 6th left rib showing nodule.

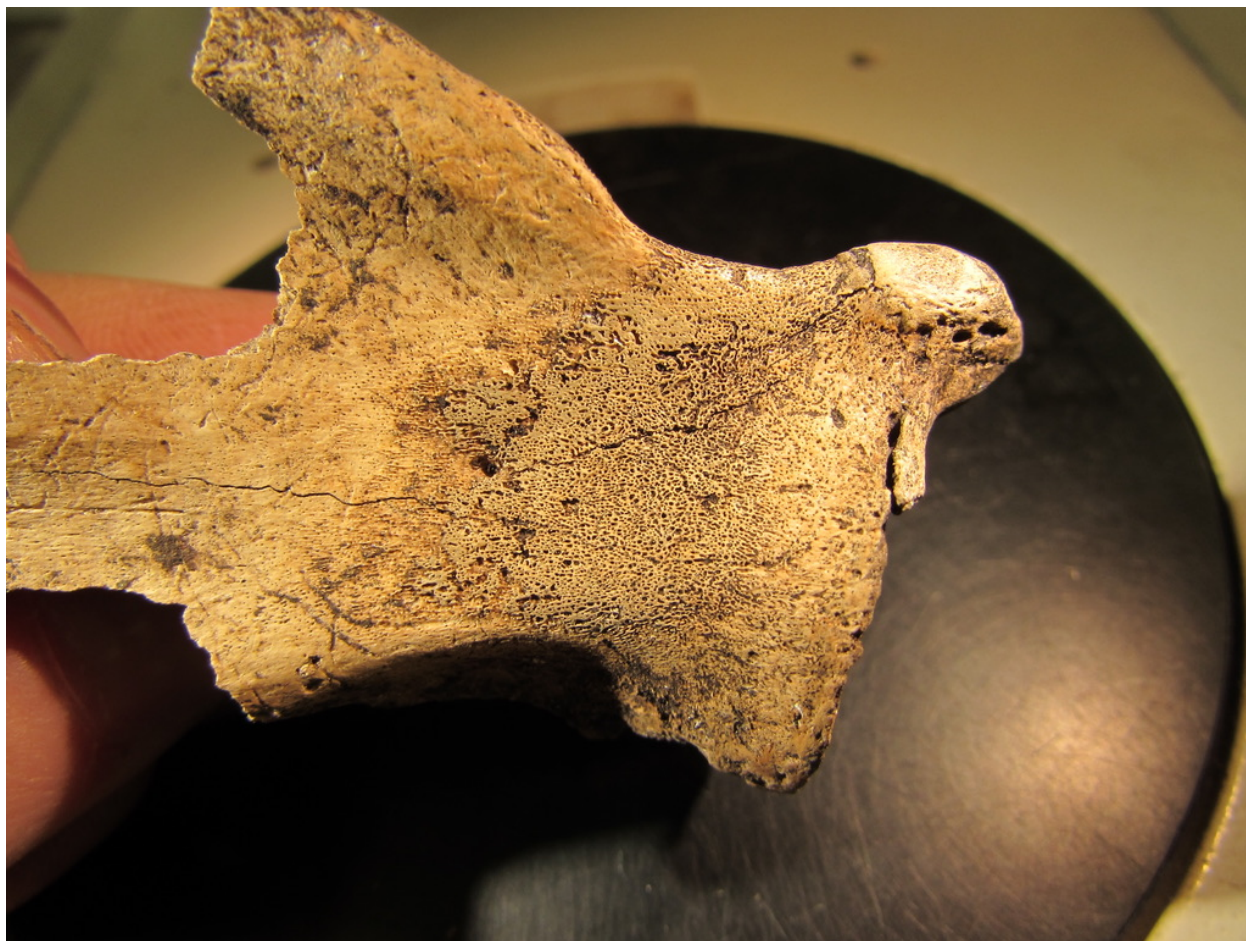


Figure 23. Medial view of the left scapula showing periosteal bone deposition.



Figure 24. Cranial view of dog femurs. Note asymmetry between left and right femurs at proximal heads and distal ends.



Figure 25. Caudal view of the distal femora showing the intercondylar osteophyte on the right femur.



Figure 26. Cranial view of the distal femora showing eburnation on the patellar groove of the right femur.

References

- Allen, Glover Morrill. (1920). Dogs of the American Aborigines: With Twelve Plates. *Harvard University Museum of Comparative Zoology Bulletin* 63(9):431-517.
- Barsh, Russel L., Joan Megan Jones, Wayne Suttles, L. M. Snyder, and E. A. Moore. (2006). "History, ethnography, and archaeology of the Coast Salish woolly-dog." *Dogs and People in Social, Working, Economic or Symbolic Interaction*. 9th ICAZ Conference, Durham. 1-11.
- Bartelle, Barney G., René L. Vellanoweth, Elizabeth S. Netherton, Nicholas W. Poister, William E. Kendig, Amira F. Ainis, Ryan J. Glenn, Johanna V. Marty, Lisa Thomas-Barnett, and Steven J. Schwartz. (2010). "Trauma and pathology of a buried dog from San Nicolas Island, California, USA." *Journal of Archaeological Science* 37(11): 2721-2734.
- Boas, Franz (2002 [1895]) *Indian myths and legends from the North Pacific Coast of America*. A translation of Franz Boas' 1895 edition of *Indianische Sagen von der Nord-Pacifischen Kuste Amerikas*, edited by R. Bouchard and D. Kennedy. Translated by D. Bertz. Talon Books, Vancouver.
- Binois, Annelise. (2015). "Excavating the history of ancient veterinary practices." *Veterinary Record* 176, 564-569. <https://veterinaryrecord.bmj.com/content/vetrec/176/22/564.full.pdf>
- Binois, Annelise, Christophe Wardius, Pierre Rio, Anne Bridault, and Christophe Petit. (2013). "A dog's life: multiple trauma and potential abuse in a medieval dog from Guimps (Charente, France)". *International Journal of Paleopathology* 3(1): 39-47.
- Bouchard, Randy, and Dorothy Kennedy. (1990). Clayoquot Sound Indian Land Use. Submitted to B.C. Indian Language Project Victoria report prepared for MacMillan Blodel Limited, Fletcher Challenge Canada, and the British Columbia Ministry of Forests.
- Cannon, Aubrey, Henry P. Schwarcz, and Martin Knyf. (1999). Marine-based subsistence trends and the stable isotope analysis of dog bones from Namu, British Columbia. *Journal of Archaeological Science*, 26(4): 399-407.
- Clark, Geoffrey R. (1995). "The Kuri in prehistory: a skeletal analysis of the extinct Maori dog." MA thesis, University of Otago, New Zealand.
- Colton, Harold S. (1970). "The aboriginal southwestern Indian dog." *American Antiquity* 35(2): 153-159.
- Cote, Charlotte. (2010). *Spirits of Our Whaling Ancestors: Revitalizing Makah and Nuuchah-nulth Traditions*. University of Washington Press, Seattle.
- Crockford, Susan J. (1997). *Osteometry of Makah and Coast Salish Dogs*. Archaeology Press, Simon Fraser University, Burnaby.

- Crockford, Susan J. (2009). *A Practical Guide to In Situ Dog Remains for the Field Archaeologist*. Pacific Identifications Inc., Victoria.
- Crockford, Susan J. (2019) Keith Island Vertebrate Fauna: Units 306T7 and 306T8: Analysis of Excavation Units and Column Sample Remains from 2017 and 2018. Report Prepared by Pacific Identifications Inc.
- Dierks, Katie. (2018). Analysis of Skeletal Remains from a Woolly Dog Burial on *Kakmakimilh*. A report submitted in partial fulfilment of the requirements of Historical Ecology and Coastal Archaeology at the Bamfield Marine Sciences Centre, Instructor: Iain McKechnie. Co-Director: Denis St. Claire.
- Drucker, Philip. (1951). "The Northern and Central Nootkan tribes." Bureau of American Ethnology Bulletin 144. *Smithsonian Institution, Washington D.C.*
- Ememe, Mary, and Chukwuma Ememe. (2017). "Benefits of super food and functional food for companion animals." In *Superfood and functional food: an overview of their processing and utilization*. InTech, London: 309-322. <http://dx.doi.org/10.5772/65946>
- Frederick, Gay, and Susan Crockford. (2005). Appendix D: Analysis of the Vertebrate Fauna from Ts'ishaa Village, DfSi-16, Benson Island, B.C. In A. D. McMillan and D. E. St. Claire, *Ts'ishaa: Archaeology and ethnography of a Nuu-chah-nulth origin site in Barkley Sound*, pp. 173–205. Archaeology Press, Simon Fraser University, Burnaby.
- Harcourt, R.A. (1967). "Osteoarthritis in a Romano-British dog." *Journal of Small Animal Practice* 8(9): 521-522.
- Harcourt, R. A. (1974). The dog in prehistoric and early historic Britain. *Journal of Archaeological Science*, 1(2): 151-175.
- Henry, Tanisha. (2017). Analysis of *Canis familiaris* Skeletal Remains Recovered from Traditional Tseshaht Territory on Keith Island. A report submitted in partial fulfilment of the requirements of Historical Ecology and Coastal Archaeology at the Bamfield Marine Sciences Centre, Instructor: Iain McKechnie. Co-Director: Denis St. Claire.
- Hillis, Dylan. (2018). "Stable Isotope Analysis of a Nuu-chah-nulth Wool Dog Provides Insight into Past Human Resource Use in Barkley Sound, British Columbia." Honours Thesis, Department of Geography, University of Victoria.
- Howay, Frederic W. (1918). The Dog's Hair Blankets of the Coast Salish. *The Washington Historical Quarterly* 9(2):83-92.
- Kane, Paul. (1849-1856). "A Woman Weaving a Blanket" Songhees/Saanich [Oil on canvas]. Royal Ontario Museum. <https://collections.rom.on.ca/objects/228434/a-woman-weaving-a-blanket-songheessaanich-central-coast>

- Krakov, Vlad. (2019). Analysis of a dog burial at *Kakmakimilh*, July 2019. A report submitted in partial fulfilment of the requirements of Historical Ecology and Coastal Archaeology at the Bamfield Marine Sciences Centre, Instructor: Iain McKechnie Co-Director: Denis St. Claire.
- Losey, Robert J., Benjamin Osipov, Rajitha Sivakumaran, Tatiana Nomokonova, Evgenii V. Kovychev, and Natalia G. Diatchina. (2015). "Estimating body mass in dogs and wolves using cranial and mandibular dimensions: application to Siberian canids." *International Journal of Osteoarchaeology*, 25(6): 946-959.
- Losey, Robert J., K. McLachlin, Tatiana Nomokonova, Katherine Latham, and Leslie Harrington. (2017). Body mass estimates in dogs and North American gray wolves using limb element dimensions. *International Journal of Osteoarchaeology*, 27(2): 180-191.
- Lupo, Karen D., and Joel C. Janetski. (1994). "Evidence of domesticated dogs and some related canids in the eastern Great Basin." *Journal of California and Great Basin Anthropology* 16(2): 199-220.
- MacKinnon, Michael. (2010). "'Sick as a dog': zooarchaeological evidence for pet dog health and welfare in the Roman World." *World Archaeology* 42: 290-309.
- MacLean, Kelsey. (2012). "An Analysis of the Flaked Stone Assemblage from the Hiikwis Site Complex, Barkley Sound, British Columbia." MA Thesis, University of Victoria.
- Marino, Matthew. 2015. "A Relational Perspective on Dogs and Their Burials from DGRV-006 Coastal Southwestern British Columbia." MA Thesis, Department of Anthropology Washington State University.
- McKechnie, Iain (2013). "An Archaeology of Food Settlement on the Northwest Coast." PhD dissertation, Department of Anthropology, University of British Columbia, Vancouver.
- McKechnie, Iain (2015) Indigenous Oral History and Settlement Archaeology in Barkley Sound, Western Vancouver Island. *BC Studies* (187):191–225.
- McKechnie, Iain, Denis St. Claire and Jacob Salmen-Hartley (2019) *Kakmakimilh* - (306T) - Keith Island 2017/2018 Archaeological Field Program Report, with contributions from Robert Gustas and Ian Sellers and appendices by the 2018 UVic Archaeology field school students. Report Submitted to Tseshah First Nation and Parks Canada March 7, 2019.
- McMillan, Alan D. (1999) *Since the Time of the Transformers: The Ancient Heritage of the Nuuchah-nulth, Ditidaht, and Makah*. Pacific Rim Archaeology Series. UBC Press, Vancouver.
- McMillan, Alan D. (2015). "Whales and Whalers in Nuuchah-nulth Archaeology." *BC Studies* (187): 229–261.
- McMillan, Alan D., and Denis E. St. Claire. (1992). Toquaht Archaeological project: Report on

- the 1992 field season. Report submitted to the B.C. Archaeology Branch and Toquaht First Nation.
- McMillan, Alan D., and Denis E. St. Claire. (2005). *Ts'ishaa: Archaeology and ethnography of a Nuu-chah-nulth origin site in Barkley Sound*. Archaeology Press, Simon Fraser University, Burnaby.
<http://archpress.lib.sfu.ca/index.php/archpress/catalog/view/70/40/1884-1>
- Monks, Gregory G., Alan D. McMillan, and Denis E. St. Claire. (2001). Nuu-Chah-Nulth whaling: archaeological insights into antiquity, species preferences, and cultural importance. *Arctic Anthropology* 38(1):60-81.
- Morey, Darcy F. (2006) "Burying key evidence: the social bond between dogs and people." *Journal of Archaeological Science* 33(2): 158-175.
- Nagorsen, David W. and Grant Keddie (2000) Late Pleistocene mountain goats (*Oreamnos americanus*) from Vancouver Island: biogeographic implications. *Journal of Mammalogy* 81(3):666–675.
- Oliver, Maciej Janeczek, Aleksander Chrószcz, and Nemanja Marković. (2015). "Joint diseases in animal paleopathology: veterinary approach." *Macedonian Veterinary Review* 38(1): 5-12.
- Parks Canada. (2019). "Pacific Rim National Park Reserve: Our First Nation Partners." <https://www.pc.gc.ca/en/pn-np/bc/pacificrim/plan/premieresnations-firstnations>
- Plomp, K. A., C. A. Roberts, and U. Strand Viðarsdóttir. (2013). "Morphological Characteristics of Healthy and Osteoarthritic Joint Surfaces in Archaeological Skeletons." *International Journal of Osteoarchaeology*, 25(4): 515-527.
- Powell, James V. (1991). "Our world, our ways: T'aat'aaqsapa cultural dictionary." Port Alberni, BC: Nuu-chah-nulth Tribal Council.
- Roush, James K., Chadwick E. Dodd, Dale A. Fritsch, Timothy A. Allen, Dennis E. Jewell, William D. Schoenherr, Daniel C. Richardson, Phillip S. Leventhal, and Kevin A. Hahn. (2010). "Multicenter veterinary practice assessment of the effects of omega-3 fatty acids on osteoarthritis in dogs." *Journal of the American Veterinary Medical Association* 236(1): 59-66.
- Sapir, Edward. (1911). "Some Aspects of Nootka Language and Culture." *American Anthropologist*, 13(1): 15-28.
- Sapir, Edward, and Morris Swadesh. (1939). *Nootka Texts: Tales and Ethnological Narratives, with Grammatical Notes and Lexical Materials*. Philadelphia: Linguistic Society of America.

- Sapir, Edward & Swadesh, M., (1955). *Native Accounts of Nootka Ethnography*. Bloomington: Indiana University, Research Center in Anthropology, Folklore, and Linguistics.
- Smith, Hamilton. (1840). The Natural History of Dogs: Canidae or Genus Canis of Authors, Vol. 2, In *The Naturalist's Library, Mammalia, Vol. X, Dogs*. Edinburgh.
- Sproat, Gilbert Malcolm, 1832-1913. (1868). *The Nootka: Scenes and studies of savage life*. London: Smith, Elder and co.
[https://babel.hathitrust.org/cgi/pt?id=uc1.\\$b282490&view=1up&seq=331](https://babel.hathitrust.org/cgi/pt?id=uc1.$b282490&view=1up&seq=331)
- St. Claire, Denis E. (2020). Personal communication, e-mail message, April 14, 2020.
- St. Claire, Denis E. (1991). "Barkley Sound Tribal Territories." In *Between Ports Alberni and Renfrew: Notes on West Coast Peoples*, edited by E. Y. Arima, D. E. St. Claire, L. Clamhouse, J. Edgar, C. Jones and J. Thomas, pp. 13–202. Mercury Series. vol. 121. Canadian Ethnology Service, Canadian Museum of Civilization, Ottawa.
- Tourigny, Eric, Richard Thomas, Eric Guiry, Richard Earp, Andrew Allen, Jaime L. Rothenburger, Dennis Lawler, and Marc Nussbaumer. (2016). "An osteobiography of a 19th-century dog from Toronto, Canada". *International Journal of Osteoarchaeology*, 26(5):818-829.
- Tseshah First Nation (2020). History. Retrieved from <https://tseshaht.com/history-culture/history/>
- Tseshah First Nation, Pacific Rim National Park Reserve, Bamfield Marine Sciences Centre, and UVic Faculty of Social Sciences – Department of Anthropology. (2017). Collaboration Plan, 2017-2022.
- Turner, Nancy J., John Thomas, Barry F. Carlson, and Robert Ogilvie. (1983). *Ethnobotany of the Nitinaht Indians of Vancouver Island*. Occasional Papers 24. Royal BC Museum, Victoria.
- Vellanoweth, René L., Barney G. Bartelle, Amira F. Ainis, Amanda C. Cannon, and Steven J. Schwartz. (2008). "A double dog burial from San Nicolas Island, California, USA: osteology, context, and significance." *Journal of Archaeological Science* 35(12): 3111-3123.
- von den Driesch, Angela. (1976). A Guide to the Measurement of Animal Bones from Archaeological Sites, vol. 1, Peabody Museum Bulletin, Cambridge, MA (1976).
- Zampetti, Stefania, Valentina Mariotti, Nico Radi, and Maria Giovanna Belcastro. (2016). "Variation of Skeletal Degenerative Joint Disease Features in an Identified Italian Modern Skeletal Collection." *American Journal of Physical Anthropology* 160: 683-693.

Zimmerman, Kasia. (2014). "Changing Ways, Constant Companions: The ancient DNA and local knowledge of Tla'amin dogs." MA Thesis, Department of Archaeology, Simon Fraser University.