

**An Examination into the Presence or Absence of a Northern Fur Seal  
Rookery at DfSj-23A and DfSi-4**

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**A Thesis submitted to the Faculty of Graduate Studies of**

**The University of Manitoba**

**In partial fulfillment of the degree of**

**Master of Arts**

**Department of Anthropology**

**University of Manitoba**

**2015**

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**University of Manitoba****Abstract****An Examination into the Presence or Absence of a Northern Fur Seal Rookery at DfSj-23A and DfSi-4****Tegan McGreevy**

This thesis builds a demographic profile of the Northern Fur Seal (NFS) population being consumed at DfSi-4 and DfSj-23 to determine if a NFS rookery existed within close proximity to both sites. A demographic profile of the death assemblages found at each site was built using visual identification, a non-linear growth curve algorithm developed by Michael Etnier (2002) and ancient DNA analysis. This study uses the demographic profile to evaluate the existence of a NFS rookery within the Barkley Sound area. Ultimately the existence of a rookery depends on demonstrating the existence of four age categories: fetal/newborn, juvenile, adult and adult male. Results indicate that a rookery likely existed near DfSj-24A, but there is much less certainty for DfSi-4. Further inquiry is now possible into the economic and ecological relationships that existed between the Toquaht and the NFS within the Barkley Sound area.

## Acknowledgements

There are many people I'd like to thank for providing me with invaluable support and assistance throughout the development of my thesis. Foremost I would like to thank my supervisor, Dr. Gregory Monks, for never giving up on me and for fighting for me. Next I would like to thank my committee members, Dr. Derek Johnson and Dr. Rick Riewe for all their efforts and patience.

I would also like to thank: Dr. Michael Kapp and Jessica Thomas for all their hard work on the DNA analysis, Dr. Michael Etnier for always being willing to answer my questions, Dr. Julia Gamble for helping me figure out SPSS and Dr. Christina Fawcett for proofreading and editing my thesis.

Lastly I'd like to thank my little brother, Calem Kenward for helping me understand the science behind DNA analysis, my parents: Merelene Austin and Gary Kenward for never letting me forget that I had not finished my thesis, my sisters Briean and Reilly Kenward for listening to me talk about nothing but Northern Fur Seals, the McGreevy/Fawcett clan for cheering me on and lastly my husband, Philip McGreevy for being my biggest fan, my greatest cheerleader and greatest supporter.

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## **Chapter One - Introduction**

*Callorhinus ursinus*, or Northern Fur Seal (NFS) remains are found abundantly within archaeological sites along the west coast. However, currently the only known NFS rookeries exist within the Pribilof Islands in the Bering Sea. The abundance of NFS remains and the known preference of NFS for breeding on offshore islands within higher latitudes in the pelagic zone (Burton et al. 2001:108) makes researchers speculate that NFS populations once established rookeries along the western coast of Canada and the United States.

This thesis will determine if a NFS rookery existed within close proximity of two Toquaht sites located in the Barkley Sound area of Vancouver Island, British Columbia: DfSj-23A and DfSi-4. This study will build a demographic profile of the death assemblages found at each site using visual identification, a non-linear growth curve algorithm developed by Michael Etnier (2002) and ancient DNA analysis. This demographic profile is used to evaluate the existence of a NFS rookery within the Barkley Sound area. Alternatively, if there is no rookery, NFS hunting could have been occurring at a haul-out site at sea during migration.

The different profiles that emerge provide information on the living NFS population hunted by the Toquaht. If the Toquaht were hunting from a rookery, the death assemblages would contain: adult males, adult females, juveniles, newborn and fetal remains. If the Toquaht were hunting NFS from haul-out sites or as they migrated north to the Pribilof Islands, certain age groups, specifically newborn and late-term fetal, should be missing from the death assemblage.

### **Optimal Foraging: Targeted Hunting**

Selective hunting and optimal foraging are key principles that will influence the demographic profile of the death assemblages from DfSj-23A and DfSi-4. The prey choice model predicts that as the availability of large-bodied taxa decline, predation on smaller-bodied and lower ranked taxa increase (Stephans and Krebs 1986). Lech, Betts and Maschner (2011) argue that many factors come into play when selecting prey. Larger bodied members, like the large adult male NFS, must be butchered immediately to allow for easier transport, storage and consumption (Lech, Betts and Maschner 2011, Lyman 1987, 1991, Rapson 1990). Larger prey can be more dangerous to hunt and requires expending more energy for more gain. Smaller prey, like adult female and juvenile NFS, are less dangerous, but they provide less return. Smaller prey is easier to transport and can be transported whole for processing, storage and consumption (Lech, Betts and Maschner 2011, Lyman 1987,1991, Rapson 1990). Smaller animals provide less return, but their reduced risk can make them a more optimal prey.

Frank Bayham (1979) argues that optimal foraging is determined by two critical factors: body size and availability in the environment. Bayman (1979) continues to say that if an animal is abundant, all animals of a lower rank should be excluded from the diet. So what are the determinants for higher rank versus lower rank animals? As Smith (1974) points out, subtler factors like the biological potential of a species, ease of capture and seasonal changes in density levels can influence selective hunting. For example, the easier access to: younger bachelor adult males who congregate on the periphery of the rookery and the breeding female NFS who stay at the rookery longer than males to wean their young would make smaller NFS like juveniles, females and newborns a higher ranked prey compared to a fully grown adult male NFS who is much more hostile and doesn't stay around as long (Gifford-Gonzalez et al. 2005:22-23).

Prey choice, or selective hunting, ultimately can lead to an "exploitation depression" of local populations (Charnov et al 1976) or a "microhabitat depression" in which a prey group relocates. Lyman (2003) suggests that human predators were aware of the effects of harvesting certain age categories and how this could lead to a depression in a resource. Lyman (2003) further suggests that after thousands of years of hunting these populations, human predators would target certain age groups within a resource population to conserve the resource over time and allow an equilibrium to form between predator and prey. In his case study, Lyman (2003) argues humans targeted adult males because their size would mean more meat. However, it could be argued that non-breeding adult or juvenile males would make a better target as they are less aggressive than breeding adult males and females. Whichever group was being targeted, it would be most important that no one age-category would be targeted to consciously prevent

microhabitat depression and to strategically plan and limit NFS hunting to maintain the health of the rookery (Gifford-Gonzalez et al. 2005, Newsome et al. 2007 Etnier 2002).

### **Historical Ecology: The Importance of NFS in the Toquaht Economy**

Many archaeologists argue that sea mammals acted as a social development catalyst for the Nuu-chan-nulth and were as important as salmon acquisition elsewhere on the coast (Dewhirst 1980:344; Matson and Coupland 1994:272-274). The ethnographic accounts of John Jewitt indicate the hunting of whales was primarily a prestige activity and was rarely successful (Drucker 1951:49). Drucker (1951:49) quickly points out, in response to Jewitt, that whaling was a practice that could provide enough food, oil and resources for months in areas where there were no salmon streams on which to depend. Given the unreliable nature of whaling and its role as a prestige activity, it is reasonable to assume that whaling played a more symbolic role that reinforced the power of the elite system (Monks et al. 2001; Monks 2005; Drucker 1951:49-51). As such other resources, like hunting seals or other sea mammals, could have played a longer-term subsistence role in the Toquaht economy (Etnier 2002; Newsome et al. 2007). NFS hunting would be particularly accessible to hunters as they congregate seasonally to breed and there is a reduced risk, compared to whales, that makes them an economically viable prey species.

The resource variability of the Northwest Coast contributed to the Nuu-chan-nulth's development of complex social systems. Among foraging groups, like the Nuu-chan-nulth, a dietary reliance that shifts according to ecological factors allows for a surplus of food that is available year-round. Barton (2008) argues that in a landscape with

resource variability, foragers will collect a resource until it drops below the average encounter rate seen within the landscape. Therefore social mechanisms would have to develop to control the exploitation of a resource. Ames (1981:789) argues that social ranking acted as a system to monitor the distribution and maintenance of resources in response to the pressures of variables like population and the environment. Archaeological records have demonstrated that sustained interactions over millennia are possible between NFS and humans given proper maintenance (Gifford-Gonzalez et al. 2005, Newsome et al. 2007; Etnier 2002).

Among the Toquaht, a social ranking system and ownership of productive resource locations served as a mechanism to limit access to any one resource and to further sustain long term hunting practices. This ability to monitor and control harvest effects would have been imperative because, when threatened, NFS have been known to abandon their rookeries.

The relationship between the Toquaht and NFS is an important and complex one. As Monks (2005:170) states, the relationship between humans and sea mammals is not a “deterministic relationship”; instead it is based around a “dynamic mutual interrelationship”. NFS have the potential to provide the Toquaht with food, tools, oil, skins and other resources. As much as the Toquaht needed the resources NFS could provide, the Toquaht also held a responsibility to protect them. As Peterson and Bartholomew (1967) have demonstrated, repeated human disturbance to a rookery or haul-out location will result in abandonment. Currently, there is no known NFS rookery in the Barkley Sound Area. However, there is archaeological evidence that suggests that a NFS rookery may have existed within the Barkley Sound Area in the past.

### **The Research: A Case Towards a Rookery**

Faunal remains of NFS have been identified throughout deposits found at DfSi-4 and DfSj-23. However, very little is known about how NFS were hunted. Drucker (1951:13,16-17) maintains the Nootka hunters would “interce[pt] the fur seal herds [during their] annual migration”. Drucker is referring to the sealer-schooner trade of the 1880’s, when fur-sealing became a major occupation for Nootka hunters. Both Drucker (1951:46) and Singh (1966:21) maintain that NFS did not become important until historic times. The archaeological record countermands Drucker (1951) and Singh (1966) because NFS is found in deposits at DfSi-4 and DfSj-23 that predate the historic period. McMillan (1999:139-141) questions the validity of Drucker (1951) and Singh’s (1966) ethnographic accounts and argues that to better understand the cultural history of the Toquaht, we need to turn to the archaeological record.

Given the geographic distribution of the NFS population, the Toquaht could have hunted them according to three different scenarios. The first scenario demands the presence of a rookery within the Toquaht territory, however an abandoned rookery has not yet been identified there. In this first scenario there would be a large number of NFS with a more variable distribution of age and sex within the NFS death assemblages. This scenario means that adult male, adult female, juvenile and fetal/newborn elements would all be represented in the death assemblage. The presence of adult females and newborns/fetal NFS elements in the death assemblage are crucial to demonstrating existence of a NFS rookery (Etnier 2002, Friedman 1976; Gifford-Gonzalez 2005, Lyman 1988, 1991, McMillan and St. Claire 2005).

The second scenario would have seen NFS being harvested at haul-out sites. A haul-out site is a site where NFS gather on land, between periods of foraging activity, without the intention of breeding. These sites are often occupied by juveniles, who are too young to breed. However, haul out sites are often within close proximity of a rookery. These sites are often close to prime feeding locations and provide adequate protection against predators. NFS are creatures of habit and maintain a strong attachment to their land sites (Gentry 1998:10-11).

In the third scenario, NFS would have been hunted through open water hunting practices during the NFS mid-March migration up the northwest coast to the Pribilof islands (McKechnie and Wigen 2011:134,158). In this scenario the majority of the NFS faunal assemblage would be young juveniles or female as those two groups tended to stay closer to land and within range of canoes.

This research builds a demographic profile to determine if a rookery existed within close proximity to DfSj-23A and DfSi-4. In particular this project looks for four age categories to be present within the death assemblages to demonstrate the presence of a NFS rookery: adult, adult male, juvenile and fetal/newborn (Etnier 2002, Friedman 1976; Gifford-Gonzalez 2005, Lyman 1988, 1991, McMillan and St. Claire 2005).

NFS pups begin to show physical maturation around thirteen months (Baker et al 1970:10-12; Naughton 2012: 426). Therefore, the designation of juvenile is considered to be any elements Etnier's (2002) algorithms estimate to be between 1 to 4 years old. Newborns are classified as any elements that Etnier's (2002) algorithms estimate that less than 1 year of age, and fetal remains are any remains that are estimated to be less than 0

years of age. Very little sexual dimorphism exists during the fetal, newborn and juvenile age periods, so it will not be possible to determine if the elements were male or female.

For the purpose of this study adult and adult male remains are considered to be any element from an individual of sociological maturity for females, or sexual maturity for males. There is a difference between sociological and sexual maturity for both male and female NFS. Sexual maturity is the age when puberty begins and NFS are physically capable of reproducing. Sociological maturity is the age at which NFS actually begin reproducing. Sexual maturity for adult males occurs around four or five years old (Gentry 1998), but sociological maturity occurs around seven or eight years old (Etnier 2002). For adult females, sexual maturity occurs around two years old, but sociological maturity does not tend to occur until four years (Gentry 1998; Scheffer and Wilke 1953; York 1983, 1987; York and Scheffer 1997). Preliminary studies, conducted by Versaggi (1981), suggest that epiphyseal fusion begins post-sociological maturity. Therefore, to verify the presence of adult remains requires an examination of the fused elements included in the samples from DfSj-23A and DfSi-4. Any remains which Etnier's (2002) algorithms estimate are over four years of age fall into the category of adult or adult male. Element size and development assists in helping identify between male and female; however it is often difficult to fully distinguish between a young male and a fully-grown female element. As a result young male and female are grouped into one category, adult. As NFS reach 4 years of age, males become significantly larger making it easier distinguish between male and female. This distinguishable size difference allows for an independent category for adult male.

## **Summary and Direction**

Carole Crumley (1994) argues the study of past ecosystems can give great insight into the relationship between cultural agency and the forces of nature. An examination of the NFS death assemblages at DfSi-4 and DfSj-23 allow further exploration into questions of the relationship between the Toquaht and NFS. The presence of a NFS rookery at DfSi-4 and DfSj-23, if demonstrated, will have important implications for Toquaht livelihood, cultural history, economy and social structure.

This thesis will consist of three parts. The first part provides background to the study, discussing the Toquaht, NFS and the known relationship between the two. The second part describes the methodology used to investigate the death assemblage and present the data. The last section analyzes and interprets the finding from the data, ultimately exploring the first question in understanding the relationship between the Toquaht and NFS: was there a NFS rookery within close proximity to DfSi-4 and DfSj-23 or were NFS being hunted from haul-out sites or during migration?

## Chapter Two - Background

The Nuuchahnulth represents a coalition of approximately twenty local groups from the Wakashan socio-linguistic family (Harkin 1998:317; Matson and Coupland 1995:272). The southern Wakashan socio-linguistic family is represented by through three different dialects on Vancouver Island (McMillan 1999, Arima and Dewhirst 1990). The Nuuchahnulth represents the northern and central branches of the three language groups, which exist as a series of “integrating dialects” (McMillan 1999:6). The Ditidaht and Makah represent the southern branches of the Wakashan socio-linguistic family (Fig. 2-1). Despite any linguistic differences between the three dialects, the groups consider themselves to be a single population, distinct from their Kwakwaka, Salish and Quileute neighbours (McMillan 1999:6-10).

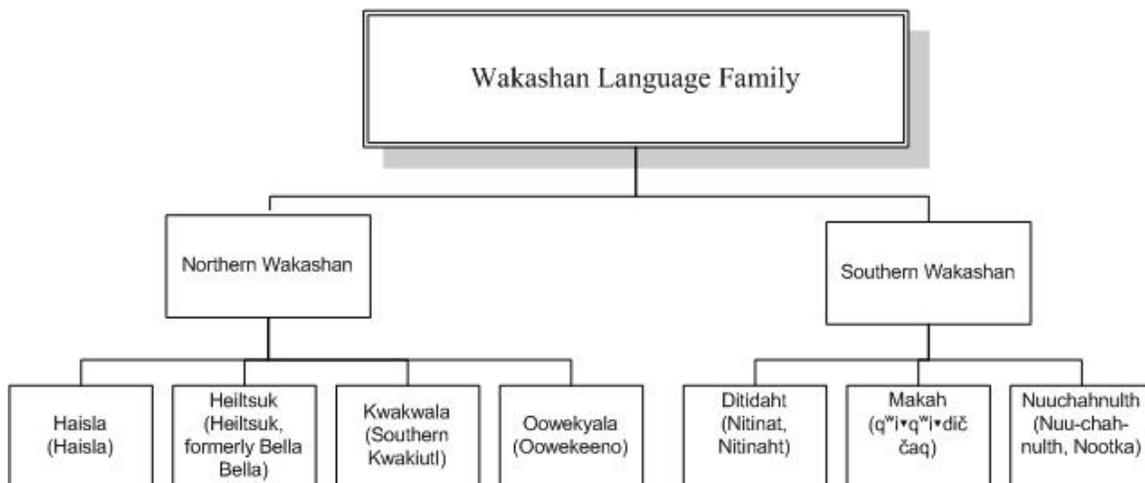
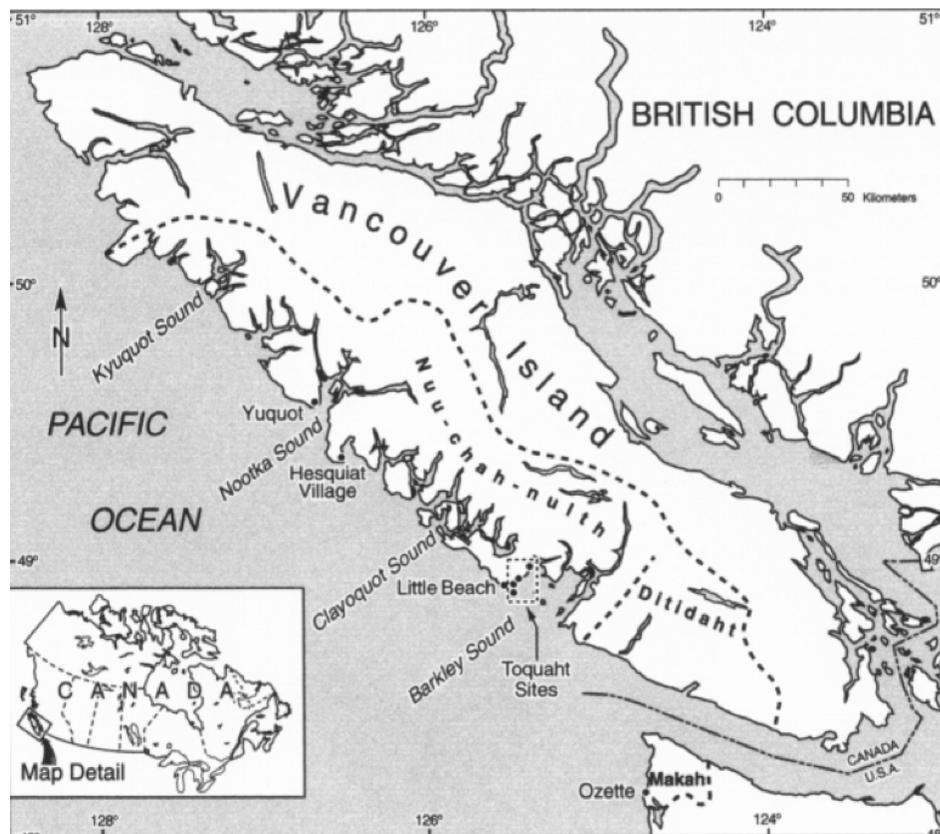


Fig. 2-1 Wakashan Language Family Tree (Barrett 2010)

Large inlets and sounds along the coast provided a natural setting which subdivided the sociolinguistic groups into eleven smaller sociopolitical groupings, including the Toquaht. (Harkin 1998:318, Arima and Dewhirst 1990:39, Arima et al 1991:55, Drucker 1951). These smaller socio-political groupings gave birth to complex political and cultural systems that made up the basic social and economic structure of the Nuu-chan-nulth community.

### **Nuu-chan-nulth: Geography and Environment**

The northern and central Nuu-chan-nulth traditional territory, defined as separate from the Dididaht and Makah territory, runs for 300 km along the west coast of Vancouver Island, from Cape Cook to Barkley sound (Map 2-2).



Map 2-2 – Nuu-chan-nulth territory on the West Coast of Vancouver Island (Monks et al 2001) (used without permission)

The east side of the Nuu-chan-nulth territory borders the Vancouver Island Ranges. Loosely translated, Nuu-chan-nulth means “all along the mountains” (McMillan 1999:6). The western side of the Nuu-chan-nulth territory is bordered by an open water coastline, broken up by a series of inlets to provide cover.

Traditionally the Nuu-chan-nulth considered their country to represent two distinct, but equally important environments: the “kla’a” or “outside” and the “hilsts” or “inside” (Arima and Dewhirst 1990:393, Dewhirst 1980:9). The outside refers to the outer coastal and inlet area and the inside refers to the inner river and inlet environment.

The outside is a rocky outer coast directly exposed to the open Pacific water. The coast is broken up by sheltered islands and inlets, which are an extension of an undersea shelf that extends offshore from the coast for about three miles. The underwater shelf supports rich tidal, pelagic and demersal food resources (Dewhirst 1980:9-10). Along the outer coastline and inlet mouths sits a low plain, just under 500 feet elevation. The plain extends between three to seven miles wide and houses a few lakes and rivers that hold a number of significant salmon runs. There is limited shelter for long term habitation along the outside. The best habitation sites lie within the sounds and mouths of inlets. These sounds and inlets provide protection from the open waters and easy access to the rich resources of the outside (Dewhirst 1980: 9-10, Arima and Dewhirst 1990:393-394).

The inside refers to the inlets and streams that penetrate deeper into the island. The inside inlets can range from a few hundred yards to 40 miles across and can rise from sea level to between 2000 to 4000 feet. The inside environment has fewer resources, but its few rivers and streams are home to rich yearly salmon runs. However these inside rivers and streams do not hold the same amount nor the same species of salmon that the

West Coast mainland is so famous for (Donald and Mitchell 1994). The inside is also home to larger land mammals and edible plants which played an important part in the Nuu-chan-nulth diet (Arima and Dewhirst 1990:393-394, Dewhirst 1980:9-11).

### **Nuu-chah-nulth: Social Organization**

Drucker (1951:220) best describes the Nuu-chan-nulth “political unit” as “a local group centering around a family of chiefs who owned territorial rights, houses and other privileges”. Each group would identify itself either by the place or fishing-ground to which it belonged or by the chief or tradition it hailed from. Each family would own a territory over time. The family members would share ceremonial and ritual property based upon their own rank within the family.

Five major groups have been identified within Barkley Sound: Toquaht (T’ukw’aa7ath), Ucluelet (Yuulhuu7ilh7ath), Tseshaht (Ts’ishaa7ath), Huu-ay-aht (Huu7ii7ath) and Uchucklesaht (Huuchukwtlis7ath). These five local groups were broken down into families or subgroups called *ushtakimilh*. *Ushtakimilh* represented sects, lineages, or houses of descent that made up the larger local groups (McMillan 1999:14, Boas 1891). McMillan and St. Claire (1993:23) have comprised a list of 17 different lines of descent which have been identified today as the Toquaht group. Each *ushtakimilh* would share a house together in the winter. It was believed among each *ushtakimilh* that they all descended from a common ancestor. Kenyon (1980:84) describes it best:

“The (Nuu-chan-nulth) local group was conceived of as an idealized family, expanded over time, which owns a distinct territory and shared a common ceremonial and ritual property. Members of this family were ranked on the basis of primogeniture and it was the highest

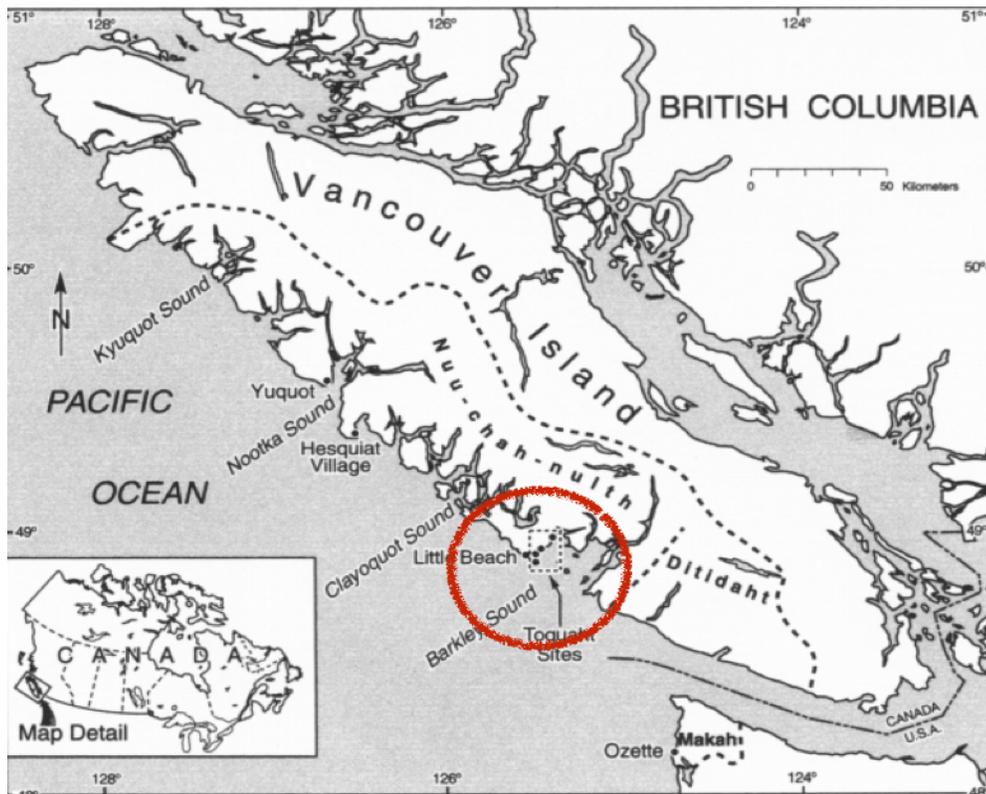
ranking member who was regarded as the owner of the group's property".

Each *ushtakimilh* had its own permanent house within the winter village, with the head chief's, or direct descendent, being the largest. Other chiefs were assembled in a pattern or fixed ranking, which could be shifted through political alliances (McMillan 1999:15). The winter gatherings were often host to important social assemblies, like the potlatch. Potlatches were used to mark various rites of passage. *Ushtakimilh* would trade, intermarry and form social alliances at these gatherings to gain prestige. Often prestige and rank were tools to exert control over the lower houses (Drucker 1951:332, McMillan 1999:15). It was the head chief who would lay claim to all of these resources, but each *ushtakimilh* had access to its own set of resources as granted by the chief. Access and control of these resources was very strict. Often control over these resources would lead to warfare and conflict.

At times hostility, disagreement and ego would cause the families to fight, and violent conflict could erupt. It was very common for hostilities to be driven by the desire to appropriate the holdings of a neighbouring group (McMillan 1999:12-15, Drucker 1951:332-334). Swadesh (1948) argues that the motivation behind the fighting was territorial gain to improve the resource base; however, Drucker (1951:332) argues that conflict served as an "integrative function" because it "enforced the realization on united groups that they had to stand together for mutual protection". Donald and Mitchell (1994) identify that the same need to improve ones resource base that inspired warfare could have also inspire the Nuu-chan-nulth's complex social and cultural systems.

### The Toquaht: A Brief history

The Toquaht Nation is located along the north shore of Barkley Sound, including the mouth of the Ucluelet Inlet on Vancouver Island (Map 2-3). At its cultural peak, the Toquaht were a large and powerful society. Toquaht informants today maintain that the Toquaht were once the dominant group in the Western Barkley Sound area (McMillian and St. Claire 1993:25). St. Claire (1991:53,54) recounts that the Toquaht were the “original Barkley Sound group, from which all the others emerged”. St. Claire’s findings are consistent with the ethnographic record documented by Gilbert Malcolm Sproat (1868:19).



Map 2-3 Map of Vancouver Island Highlighting Toquaht Nation (Monks et al. 2001) (used without permission)

Oral tradition suggests that the Toquaht were considered the protectors of Ucluelet Inlet and dominated the Ucluelet groups (McMillian and St. Claire 1993: 24-26). This predominance of the Toquaht group is supported by archaeological features like the location of T'ukw'aa (DfSj-23) at the entrance of the Ucluelet Inlet and the accompanying fortress site (DfSj-23B). A drastic decline in the Toquaht population occurred in the 19<sup>th</sup> century due to disease and armed conflict. Today, a significant loss of traditional knowledge and reliable information exists because other groups have mostly absorbed what was left of the Toquaht (Arima et al 1991).

By the mid-to-late 19<sup>th</sup> century the Toquaht had become one of the smallest Barkley Sound groups. Blenkinsop (1874:32-33), an Indian Commissioner for the Canadian government, described the Toquaht in the late 19th century as “dwindling away from a once powerful tribe to scarcely a tenth of what they were fifty years since”. Little mention of the Toquaht appears in the ethnographic accounts of Sapir and Boas. Boas only briefly mentions DfSj-23 as a seasonal fishing location in his ethnographic accounts of the West Coast (McMillan 1999:66). When Peter O'Reilly laid out the reserve maps in 1882, he described DfSj-23 as nothing more than “a fishing station used only during the sealing season” (McMillian 1999:66). However as Ruyle (1973:608-609) points out, ethnographic accounts are to be viewed with some skepticism. Most ethnographies were written after contact, during a period of social and economic metamorphosis for the Toquaht. While many of these historical accounts work to accurately represent the groups they are portraying, they often fail to do so.

One thing all these accounts have in common is that by the 19<sup>th</sup> century, the Toquaht population, which had not disappeared through war, was under constant threat of extinction through exposure to dysentery, smallpox and measles epidemics. As a result, entire *ushtakimilhs* were killed off. Sproat (1868:104-105) describe the Toquaht in the 1860s as “the remnants of a large tribe, distinguished formally in war and for sage arts”. Blekinsop (1874:33) noted that by 1874 the Barkley Sound tribe consisted of only 47 men, women and children.

Recent ethnographic efforts have been made to record the oral history of Barkley Sound. Denis St. Claire has been working with Nuu-chan-nulth elders since 1975 to record the Barkley Sound history. Before the death of some key elders, St. Claire was able to record a considerable amount of data, including place names, site locations and traditional information (McMillan and St. Claire 1993:20-22; St. Claire 1991: 155-167).

### **The Toquaht Archaeological Project (TAP)**

In 1991 St. Claire redirected his efforts towards the Toquaht when he joined Alan McMillan on the Toquaht Archaeological Project (TAP). The TAP aimed to investigate, record and preserve Toquaht culture history through a combination of archaeological survey, excavation and ethnographic research (Monks, McMillan, St. Claire 2001:63; McMillan and St. Claire 1993:1-3; McMillan 1999:62).

The Toquaht Archaeological Project carried out excavations through the summers of 1991, 1992, 1994 and 1996 at a number of sites around Barkley Sound including DfSj-23 and DfSi-4. The excavations were all performed under the supervision of Alan

McMillan and Denis St. Claire and with the active cooperation of the Toquaht First Nation. Greg Monks supervised the collection and analysis of all faunal remains (McMillan and St. Claire 1993:3-4).

Extensive middens were found across both sites. Preliminary analysis of the middens contents indicate that fishing, whaling, the hunting of land and sea mammals, and the collection of clams all took place at DfSj-23 and DfSi-4.

### **The Toquaht: Traditional Territory**

Today the Toquaht area is restricted to Toquaht Bay, Mayne Bay and parts of the western shore of Barkley Sound (McMillan and St. Claire 1982:12). McMillan and St. Claire were able to determine through ethnographic research and archaeological survey that the traditional Toquaht territory includes all of Toquaht Bay, Pipestem Inlet, Mayne Bay and Macoah Passage. A prominent bluff, which sits just inside of Ucluelet Inlet, marks the territory boundary between the Toquaht and their neighbours, the Ucluelet. From the bluff, the traditional Toquaht territory moves south into the open water around the George Fraser Islands (McMillan and St. Claire 1993:1). Blenkinsop (1874:33) noted that the Ucluelet and the Toquaht shared the George Fraser Island area for whaling purposes. The eastern boundary of the traditional Toquaht territory is marked by Lyall Point. Lyall Point also serves as the boundary marker between the Toquaht and the Tseshaht. This eastern boundary was known to fluctuate at times, as there was much contention between the Toquaht and Tseshaht (St. Claire 1991: 55, 167).

Throughout the course of TAP, Alan McMillan and Denis St. Claire (1993:1-28) worked to record large villages that were inhabited by the Toquaht. McMillan and St. Claire (1993) were able to locate and identify approximately 51 sites within the traditional Toquaht area. Only three of the identified sites were determined to be large village sites that demonstrated an ancestral link to the Toquaht Nation (McMillan 1999:63-64). These three village sites are known as Ch'uumat'a (DfSi-4), Macoah (DfSi-5) and T'ukw'aa (DfSj-23). For the purposes of this thesis, DfSj-23A and DfSi-4 will serve as a focus because abundant *Callorhinus ursinus* remains were found at both sites.

### **DfSj-23: A Brief History**

DfSj-23 is the largest of the aforementioned three village sites located by the Toquaht Archaeological Project. The ethnographic accounts of Edward Sapir and Franz Boas (Alan McMillan 1999:66) note that, when the reserve was first established in 1882, the site was characterized by O'Reilly as a "fishing station [which is] only used during the sealing season". O'Reilly's assessment led the Royal Commission of Indian Affairs to list DfSj-23 as a "village site and fishing station" (McMillan 1999:66). However, the archaeological deposits of DfSj-23 suggest that the site held much more significance in its pre-contact days of occupation. C14 dates have indicated that the site was heavily occupied between 1150 BP to 640 BP (McMillan 1999:80-82). After 640 BP the site was reduced to occasional use and marked as a fishing station (McMillan and St. Claire 1993:3; McMillan 1999:67-69). The reclassification of site use after 640 BP has created much contention within ethnographic records and archeological assessments as to the role

DfSj-23 played within the Toquaht Nation's past.

The initial importance of DfSj-23 is reflected in the translation of Toquaht, "the people of T'ukw'aa" (McMillan 1999:66). T'ukw'aa translates as "narrow beach" (St. Claire 1991:55); hence, Toquaht becomes "the people of narrow beach". This translation links the site directly back to the Toquaht nation. Toquaht lore suggests that DfSj-23 served as a main village center for "the most highly ranked of those which made up the Toquaht" (Boas 1891:678-679).

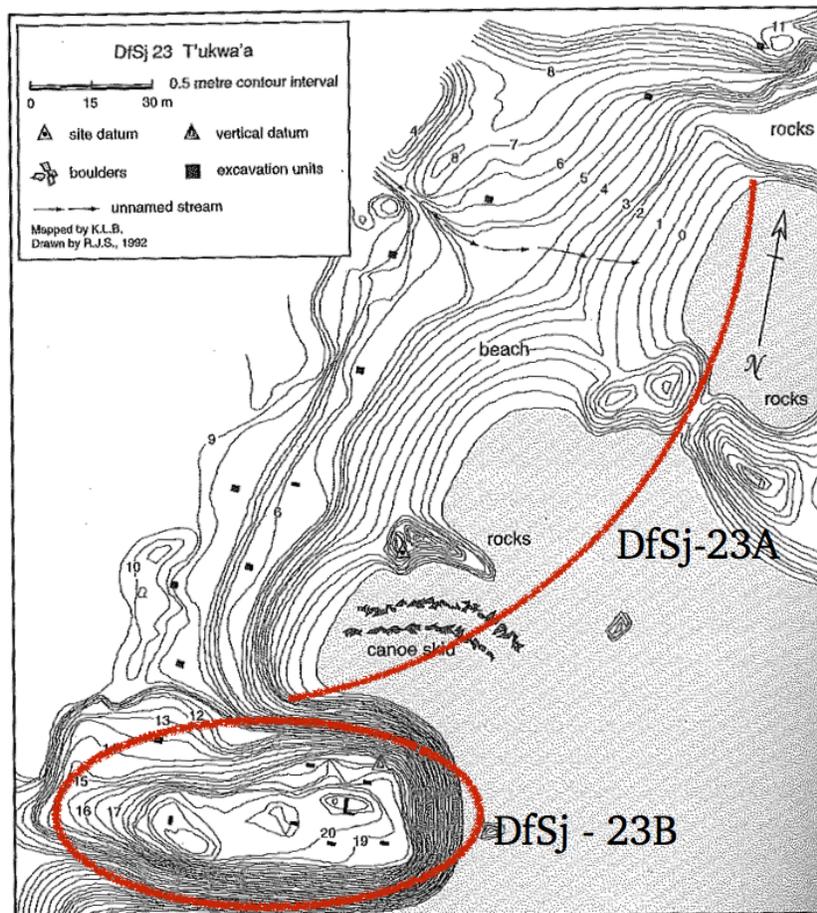
All ethnographic accounts agree that the Toquaht practiced seasonal movement between sites; yet, the ethnographic records regarding the activities that occurred at DfSj-23 are limited and contradictory. Blenkinsop (1874) originally described the site as a winter village. O'Reilly (1883) described the site as spring and summer fishing and sealing. O'Reilly's description is consistent with current known NFS breeding habits, leading one to believe there could have been a rookery within close proximity. Both Blenkinsop (1874) and O'Reilly (1883) mention that the site was used for growing potatoes. The growth of potatoes suggests that the site would have been inhabited during the planting season, in the spring, and the harvest season, in the late summer/early fall. As Europeans introduced potatoes, there is no way to tell from ethnographic records if a late summer/early fall occupation was maintained pre-contact.

A spring/late summer occupation would allow the Toquaht to take advantage of the fish and sea mammals that inhabited the neighbouring reefs and small islands adjacent to DfSj-23 or a possible adjacent rookery. A spring/late summer occupation would also attest to the site's reputation as the main Toquaht summer village (St. Claire 1991:155). While G.M. Sproat (1868:30) hints that a portion of the tribe maintained a camp close to

the ocean for year round access to its resources, Sproat's accounts are vague and open to much interpretation. Sproat's vagueness makes it difficult to determine where and to whom he was referring. If Sproat is referring to the Toquaht, this vagueness could imply a portion of the population occupied DfSj-23 year round.

### DfSj-23: Geography

DfSj-23 is located in a bay on the Northwest shore of Barkley Sound, at the opening of the Ucluelet inlet (Map 2-4).



Map 2-4 – Edited Contour Map of DfSj-23 (McMillan 1999:66)

The site can be broken into two parts. The first portion, DfSj-23B, is a large open area which sits at the far southern portion of the site atop a rocky bluff approximately 20 meters above the water. The only access point to the site is through a narrow passage from the village. Its relative inaccessibility makes DfSj-23B easy to defend. On top of the bluff sits an extensive shell midden with a basal date of 780 +/- 90 BP and several flat areas that suggest house locations (McMillan and St. Claire 1993:97). The physical features of this location, coupled with the significant archaeological remnants, have led to the conclusion that DfSj-23B most likely served as a defensive location, possibly with a palisade, for the Toquaht people during times of conflict. DfSj-23B's role as a palisade indicates that very little processing would have taken place at this site. As it is unlikely a fair representation of the local sea mammal population would be found at DfSj-23B, it is being excluded from this analysis.

The second portion of DfSj-23 runs along the peninsula to the north of DfSj-23B. Cultural deposits have been found for approximately 250 meters along the beach. The extent of these deposits suggests that the beach portion of the site, DfSj-23A, was once a very large and important village. DfSj-23A is divided in two by a small stream. Through excavation and survey, McMillan and St. Claire (1993:97) identified two distinct terraces to the south of the stream. The upper terrace ridges show the outline of what would have once been longhouses. To the north of the stream, McMillan and St. Claire (1993:97) note that the area appears to reside on a single level which sharply rises up a steep slope, creating a higher terrace at the far northern end of the site. Based upon an analysis of whalebone distribution, Greg Monks (Monks, McMillan and St. Claire 2001:74-77; Monks 2009) suggests that higher ranked members of the Toquaht Nation most likely

inhabited the southern portion of the site. McMillan and St. Claire (1993:97) also identified the remains of a canoe run in the intertidal zone on the southern portion of DfSj-23A, next to the defensive site. This canoe run would have provided easy access to the site.

#### **DfSi-4: A Brief History**

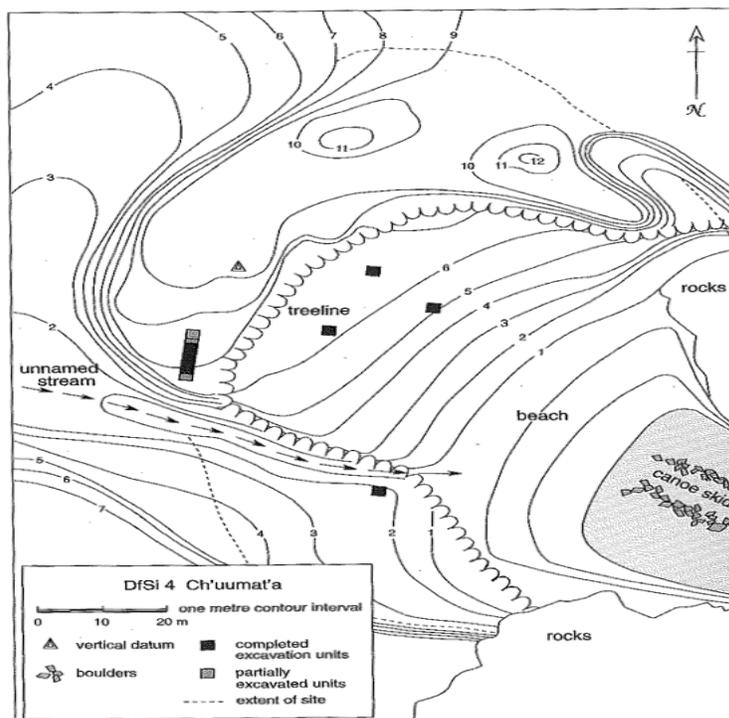
DfSi-4's traditional name is Ch'uumat'a and it was the former home to the Ch'uumat'a7ath, an *ushtakimilh* of the Toquaht. Its name comes from the mountain behind the village (McMillan and St. Claire 1993:30). Toquaht tradition says that a cave near the village extended upwards into the mountain. This cave is said to be the origin of wolves, because one day supernatural and normal wolves emerged from the cave (McMillan and St. Claire 1993:159). DfSi-4 plays an important part in the spiritual oral history of the Toquaht people; however, despite its cultural significance, it was given very little appreciation ethnographically. Boas (1891:584) dismissed the site because the Ch'uumat'a were considered to be the lowest in rank of the eleven Toquaht *ushtakimilh*. Very little ethnographic information about the site exists currently, as the site was abandoned so early. As a result of this lack of information, most of what is known about the site is through archaeological excavation.

McMillan and St. Claire (1993:138) argue that DfSi-4 fell into "decline and disuse even earlier than [DfSj-23] and was apparently not being occupied at the time of the reserve commissioner's visit". As a result, DfSi-4 is not part of the current Toquaht reserve. The site was excavated because McMillan and St. Claire (1993:138-140) felt that

the depth and association with a Toquaht subgroup might provide archaeological insight into the Toquaht cultural history. A radiocarbon estimate, taken from a thick layer of humus revealed that the site was abandoned approximately 700 years ago. Dates taken from the upper shell stratum date to approximately 2500 BP (McMillan 1999:71). The lowest levels of DfSi-4's can be dated between to 3,800 to 4,000 BP, during the Late Holocene when sea levels were at their lowest and the current eustatic/isostatic equilibrium was established (McMillan 1999:71,112-114, McMillan and St. Claire 1996:17). These radiocarbon dates indicate that DfSi-4 was occupied over a span of at least four millennia (McMillan 1999:71).

#### DfSi-4: Geography

DfSi-4 sits in a small cove approximately 2 km east of DfSj-23 at the extreme southwestern edge of Barkley Sound (Map 2-5).



Drucker (1951:33-36) and Dewhirst (1980:11-12, 15) marked this area as the edge or outside site of the Toquaht territory. The site is approximately 120 meters long and goes approximately 70 meters inland. A large midden covers the site, which at its deepest points, goes below 4 metres (McMillan and St. Claire 1993:138). A small stream cuts through the site along the western end, exposing the edge of the shell midden (McMillan and St. Claire 1994:7). Parallel rows of large rocks sit in the center of the beach in front of the site, creating a large canoe skid (McMillian and St. Claire 1993:138-140).

### **The Toquaht: Settlement, Occupation and the Seasonal Round**

Settlement patterns and seasonal occupation is a topic that is much debated in Nuu-chan-nulth literature. Dewhirst's (1980:11-12,15) observed that every *ushtakimilh* would inhabit their own summer/spring villages, harvest the resources directly available and then travel back to the winter village when provisions were exhausted and food was less plentiful. Dewhirst called this movement between sites a seasonal round. According to Dewhirst (1980:15), the seasonal round was a necessity, for a group that was limited to a single type of environment would have been subject to much hardship.

Marshall (1993:40) suggests that widespread settlement patterns along the outer coast shifted between 1500 and 1000BP and until that time the sites in this area were occupied year round. McMillian (1999:127-129) argues that older sites, like DfSi-4, were occupied year round until the expansion of the Nuu-chan-nulth down the coast to larger village sites, like DfSj-23. McMillian's observations are more in line with Ian Streeter. Streeter (2002:101-107) found evidence of rockfish harvesting taking place at both sites

throughout spring, summer and fall. Streeter concluded that DfSi-4 and DfSj-23 were most likely inhabited year round, however he also comments that he cannot reliably support year-round site occupation at either site.

### **The Toquaht: Ecology and Diet**

Archaeological evidence suggests a maritime-based economy developed as early as 4550 BP along the Northwest Coast (Coupland 1998:36-37, 41). Barkley Sound, in particular, was an area rich in maritime resources. DfSj-23's strategic location at the opening of Ucluelet Inlet provided access to a plethora of marine resources to which groups who lived further inland lacked. Resource availability at DfSi-4 was similar to, but not the same as, that of DfSj-23. Like DfSj-23, DfSi-4 does sit on the open ocean. Any variation between the sites is characteristic of the area, as each *ushtakimilh* would specialize in the exploitation of local microhabitats.

A common exploitation discussed among west coast archaeologists is the mass harvesting and storing of salmon. Many archaeologists, like Kenneth Ames (1981:790-792), argue that it was through the exploitation of local salmon runs that a complex social hierarchy was able to develop. However as Calvert (1980:240) and Haggarty (1982:166) demonstrate through their excavations in the Hesquiat area, salmon plays a smaller, less significant role in the development of Nuu-chan-nulth groups as far back as 1400 BP. Unlike the inlets and rivers on the mainland, the frequency of inlets and rivers is much lower throughout Vancouver Island. Therefore, less salmon runs exist to share between all the *ushtakimilh* and the rights of salmon runs would go to the higher ranking and more

privileged chiefs (Mitchell and Donald 1988; Monks 2006). Mitchell and Donald (1988) also suggest that it was the scarcity and unreliability of salmon among the Nootka that led them to form a confederacy. The confederacy would allow for access to the salmon, which was rarer on Vancouver Island. Matson and Coupland (1994:272) suggest that sea mammals may have played the same role that salmon did elsewhere on the coast. It must be noted that sea mammals are more commonly found in archaeological deposits of the last 1000 years. Calvert (1980) and Haggarty (1982) reported high amounts of whales and fur seals dating to the last 1200 years, but denser concentrations were found in the last 500 years. This pattern could indicate that sea mammals only became important in more recent times (Matson and Coupland 1994:272).

The faunal assemblage found during the Toquaht project is similar to the Hesquiat assemblage. The Hesquiat project reported high amounts of rockfish, dogfish sharks, whales and fur seals (Calvert 1980; Haggarty 1982). In addition to the similar results in the Hesquiat project's findings, the Toquaht faunal assemblage also shows a high frequency of bivalves, birds and land mammals. Sea mammal plays an important part in the faunal assemblages from DfSj-23 and DfSi-4. The majority of sea mammal recovered comes from members of the Carnivora family: fur seal, sea lions and harbour seals. However, whale and porpoise also make up a notable percentage of the sea mammal assemblage (Monks 1993:159-166, Monks 2009).

A preliminary analysis of the faunal remains suggests that, while a small shift in general fauna emphasis does exist between levels, this shift is not significant enough to be noteworthy (Monks 1993:159). Fish and bivalves played an important role in the daily subsistence needs of the Toquaht while sea mammals had a different importance within

the daily Toquaht subsistence needs. Sea mammals could potentially provide a significant amount of meat and oil to the Toquaht. However, further analysis is needed to fully understand the importance sea mammal played in the Toquaht economy (Monks, McMillan and St. Claire 2001:75).

### ***Callorhinus urnius*, The Northern Fur Seal**

George Wilhem Steller first described *Callorhinus urnius*, the northern fur seal (NFS), in 1742 after he came across them during an expedition (Baker et al. 1970). The northern fur seal has a short snout, small head and is covered with a soft thick fur except for below the wrist on their front flippers (Naughton 2012). The fur that covers their body is what they are most famous for, because it is most coveted by hunters. After being exposed to generations of hunting, northern fur seal populations reached an all-time low in 1911. The low NFS population forced the Canadian, Japanese, Russian and American governments to sign the Convention of 1911 and the follow-up Convention of 1957. These conventions gave protection to the NFS to allow for population recovery (Baker et al. 1970:1). There is currently evidence of the early stages of population recovery. In some cases, northern fur seals have begun to inhabit abandoned rookeries (Walker et al 2000).

Male NFS are significantly larger than females. A mature male is approximately 3.4 to 5.4 times heavier than a female, depending on his sexual maturity. Females will be at their heaviest just prior to breeding or during their northward migration in the spring (Naughton 2012)

### ***Callorhinus urnius*, The Northern Fur Seal: Geography and Migration**

Of all the northeast Pacific otariids, the NFS have the broadest range of breeding locations (Gifford-Gonzalez et al. 2005:22). Present day NFS rookeries appear to be limited to the Northern Hemisphere with rookeries being recorded in the North Pacific, the Sea of Okhotsk and the Bering Sea (Naughton 2012). NFS rookeries have been found as far south as San Miguel Island in California and as far west as northern Japan (Gifford-Gonzalez et al. 2005:20, Burton et al. 2001:108, Gentry and Kooyman 1986; Gentry 1998:15-16, 20-21; Naughton 2012). The largest NFS rookery was discovered on the Pribilof Islands (Map 2-6) in 1786 (Baker et al. 1970). Today the Pribilof Island population remains the largest known population of northern fur seals.



Map 2-6 – Map of Pribilof Islands relation to DfSj-23A & DfSi-4 (© Google 2014)

Orr (1972) and Hall (1940) have suggested that in the past northern fur seals had a

broader geographic range. Archaeologists have found evidence which supports a much more widespread archaeological distribution of northern fur seals (Gifford-Gonzalez et al. 2005:22; Burton et al. 2001; Etnier 2002; Hildebrandt 1984) than is seen in modern populations. Gifford-Gonzalez et al. (2005) suggest that population pressures from over-hunting during the fur trade forced northern fur seal populations to centralize and abandon a number of breeding grounds along the northeastern Pacific coast and possible rookeries within lower latitudes. Evidence suggests rookeries existed up and down the Pacific coast prior to European contact; however, archaeological evidence has been found at a number of sites throughout California, Washington and Oregon (Burton et al 2001; Etnier 2002; Hildebrandt 1982, 1984; Lyman 1988, Moss et al 2006; Gustafson 1968). Currently there is no evidence of a NFS Rookery at DfSj-23A, DfSi-4 or at any sites close by. However, both sites sit on known migration routes. It is possible that northern fur seal was harvested from migrant populations that passed either site.

Northern fur seal are known to be flexible in their seasonal habits in order to adapt to any disruptions in their migratory and breeding patterns (Peterson and Bartholomew 1967; Cockford and Frederick 2011:79). As contemporary northern fur seal populations have demonstrated, repeated human disturbance to a rookery will result in the species abandoning it (Gentry 1998:24-32). However, northern fur seal populations have been known to return to an abandoned rookery given the right pressures. In 1968, a rookery formed on San Miguel Island California over the remains of an abandoned rookery (Walker et al 2000).

Apart from the current breeding season, late June to early November, the northern fur seal population migrates between higher latitude rookeries to low latitude winter

foraging areas. This migration gives the northern fur seal population access to food supplies that are vast, but only available seasonally (Gentry 1998:15). Pribilof females and pups migrate as far south as California while males tend to feed offshore in the Gulf of Alaska (Burton et al. 2002:22). Gentry (1998:15-16) summarizes the migratory cycle of the NFS:

In November, females and [young of the year] of both sexes leave the breeding islands and fan out across the North Pacific Ocean. In January and February they concentrate along the continental margins, where some intermixing of stocks occurs. In mid-March, females begin migrating back towards the island following the continental margins, or across the high seas

Juvenile and some non-breeding females may not return to breeding grounds up north until they are ready to breed. Instead, they forage on small prey in offshore waters off the coasts of Canada and the United States (Gifford-Gonzalez 2011:232; Baker 1978; Baker 2007; Baker and Donohue 2000; Ragen et al. 1995; Kooyman et al). Gifford-Gonzalez et al. (2002:25) suggests that northern fur seal would have been most vulnerable to human predators during their 4-8 month breeding season. The NFS would also have been vulnerable to Nuu-chan-nulth open-water hunting practices during their mid-March migration up the coast to the Pribilof Islands (McKechnie and Wigen 2011:134, 158).

All of the information about NFS migration and breeding habits is based around observations made about modern NFS populations that live in the Pribilof Islands. There is no reason to suggest NFS that have mid-latitude rookeries would maintain the same migration patterns. Etnier (2015) suggests it is very possible that females and young of the year probably spent both their winters and their summers mid-latitude and did not

migrate. If there was a rookery within this area, there would be very little reason to migrate. As Edward Friedman and Carl Gustafson (1975:147) describe it: “[t]he fur seal is a creature of the oceanic environment except when on the breeding grounds”.

### ***Callorhinus urnius*, The Northern Fur Seal: Diet**

NFS feed on a wide variety of pelagic and near-shore resources, including over 75 different species of fish and squid. Walleye, pollock and squid seem to play the most important role in their diet in the summer, but northern fur seals do not limit themselves to these (Naughton 2012). Anchovy, squid, hake and rockfish are the staples to the northern fur seals’ diet along the Oregon to Vancouver coastal areas (Baker et al. 1970:9). Night is the prime hunting time for Northern fur seals, because prey tends rise up the water layers (Baker et al 1970:9, Naughton 2012: 426). However, hunting is not limited to night. NFS will feed at any hour of the day.

Males and females will have different diets at certain times of the year because migration determines the prey they encounter. Females spend most of their time hunting close to shore, feeding on inshore species. Males tend to spend more time hunting in the deep sea feeding on more pelagic species. The larger size of the male allows them to dive deeper than females and to stay submerged for longer (Naughton 2012).

***Callorhinus urnius*, The Northern Fur Seal: Reproduction**

Females will reach sexual maturity much sooner than males. The average female northern fur seal will be between three to five years of age when she begins to breed. Once a female is sexually active, she will produce, on average, one pup a year until she is sixteen; at this time, her successful reproductive rate begins to halve (Naughton 2012:427). The average male will reach sexual maturity between four to five years of age, but will not begin to breed until eight to nine years of age. A male's breeding capability is dependent on his ability to compete with the other males and, thus, his body size plays an important part in his ability to compete. Adult males will spend only a few years as masters of a harem. Males, on average, are usually only able to maintain dominance two to four times between the ages of 8 to 14. Therefore, it is very important for males to attract the largest harem they can (Baker et al 1970:10-12; Naughton 2012: 426).

Instinct will drive males to return to the rookery of their birth, where they will fight to establish their territory over a portion of the rookery. Males will defend this area whether or not females accompany them later on. Females will arrive about a month later and males will work to herd the females into their own areas. One or more females with a male constitutes a harem. A harem can be any size, but averages around 40. Location appears to influence the size of a harem and a bull's swiftness in acquiring a harem. Females will often look for location when it comes to selecting a male and they will abandon a male if they see another male in a location they like better. There is nothing a male can do to persuade a female to stay once she is determined to leave (Baker et al.

1970:10-12, Naughton 2012: 426). Bachelor males, who have not been able to attract any females, will attempt to intercept females as they come and go in an attempt to reproduce. This effort to intercept a female is always done at the wariness of the weaker bull and is rarely successful, as most of these females have already mated. Males will defend their territory through threat displays, vocalizations and, if necessary, fighting. During breeding seasons, territorial males will rarely leave their territory, even forgoing eating: males have been known to lose up to 25% of their body weight (Naughton 2012:427).

Based on observations taken from the Pribilof island populations, NFS usually give birth and mate sometime in late June or July. The two events usually occur within 4 to 8 days of each other. Once a female becomes receptive the male has less than 48 hours. Copulation usually occurs on land, but rare cases have been reported at sea. Northern fur seals undergo a process called delayed implantation. Delayed implantation means that a fertilized embryo will float around in the uterus before implanting and beginning the maturation process around November. This process permits parturition and mating to occur during the small time frame the whole herd is together. Including the delayed implantation phase, it takes approximately 358 days for a pup to come to term. Females usually give birth within one to two days of returning to a rookery (Naughton 2012:427).

Once a pup is born, it will be nursed on land for the first 3 to 4 months of its life. The mother will stay with her pup continuously for the first week but will leave shortly after mating to hunt. These hunting trips will last around four to five days and become successively longer as the breeding season progresses. During its mother's absence, the pup will gather with other abandoned pups in what Naughton (2012:427) calls nursery aggregations. Upon returning, the mother will call to her pup, isolate her pup's call, find

her pup, nurse her pup for the next few days and then leave again. Eventually, around October when the pup is about 4 months old, the mother will leave and migrate south. At this point the pup will begin to teach itself how to hunt. Pups will begin to show evidence of maturation after several months at sea (Baker et al 1970:10-12; Naughton 2012: 426).

## **Chapter Three – Methods, Sample and Data**

### **Methods**

The methods employed in this study were adapted from Michael Etnier (2002) in his NFS bone growth study. The procedures employed were outlined in *The Standards for Data Collection from Human Skeletal Remains* manual (Haas et al. 1994) and *A Guide to The Measurement of Animal Bones from Archaeological Sites* (von den Driesch 1976). A metric analysis using a combination of these three sources was employed to monitor changes in the NISP, or “Number of Identified Specimens Present”, of the NFS populations found at DfSi-4 and DfSj-23 ultimately creating a demographic profile from the death and subsequent burial assemblages of the hunted NFS populations found at Barkley Sound.

## **Early Examination**

First, a visual examination of each bone was conducted. Each element was assessed against comparative samples borrowed by Greg Monks from the Royal British Columbia Museum's Mammology Division. The visual inspection allowed for positive identification of NFS bones. In some cases the elements were too small or under-developed to positively identify visually as NFS. Elements that were too small or under-developed, but with similar qualities of NFS bones, were presumed to be fetal NFS and included in the study. Subsequent aDNA testing of a select sample of these bones confirmed the NFS identification.

Throughout the visual examination of each element, any information that might give hints as to the sex or age of each creature was recorded. This information included observations about epiphyseal sutures, size and any other distinctive marks like cuts, burns, or damage. These observations were recorded and kept for future analysis and reference.

## **Methods of Evaluation and Michael Etnier's Approach**

Visual inspection is an unreliable means of identifying sex and maturity of an individual at death. Therefore, the second step was to employ a non-linear growth curve algorithm, developed by Michael Etnier (2002:40,41), to estimate the age-at-death and of each immature specimen. Etnier developed his growth curve algorithm by examining the relationship between size and age as characterized by a von Bertalanffy (VB) growth

curve (von Bertalanffy 1938, 1960) and by using non-linear estimation in SPSS (Norusis 1979).

Many techniques have been developed over the years to characterize death assemblages. Anas (1970) argues that the most reliable means of determining age at death is by examining annular structures, or growth lines, in teeth. As Etnier (2002:29) points out, there are problems with this approach. First, teeth can be rare in archaeological assemblages. Second, examination of the annular structures in teeth employs thin sectioning of a tooth and is therefore destructive, leaving nothing for future analysis. An examination of annular structures at DfSj-23A and DfSi-4 would have been ineffective. Teeth are very rare at both DfSj-23A and DfSi-4, making up less than 2% of the total assemblage. Since teeth are not well represented within the assemblage, it is not possible using this method to produce an accurate demographic profile of the NFS burial assemblages at DfSj-23A and DfSi-4.

Gay Calvart (1980), Lee Lyman (1988, 1991) and others have employed broad range age categories based on development and state of fusion to characterize assemblages. These categories are often too broad and have very little association with “behaviorally meaningful age classes” (Etnier 2002:30). Etnier suggests that epiphyseal fusing of the bones has nothing to do with when a NFS has reached breeding age or behavioral maturity.

The second problem with a broad range age grouping method is that often these classes are subjective and are based on very few concrete criteria. These subjective criteria make it particularly difficult to distinguish between groups that have subtler differences, like newborn and fetal.

Scheffer and Wilke (1953) used cranial elements to create a demographic profile of NFS. While Scheffer and Wilke's (1953) body of work is useful, only a small portion of the specimens recovered are complete, un-fragmented cranial elements. Therefore cranial elements do not always give an accurate representation of the demographic profile of a site. Long bones are well represented within the sample. At DfSj-23A, cranial elements make up approximately 13% of the sample recovered and long bones make up approximately 37% of the sample recovered.

Through Etnier's techniques do not have the benefit of years of testing, they offer an approach to the assemblage that is non-destructive, uses features of relevant landmarks that preserve archaeologically and takes advantage of non-cranial or appendicular elements that are well represented within the DfSj-23A and DfSi-4 assemblages. Etnier's (2002) techniques provide a means to age each element and a means to produce a demographic profile of the total assemblage.

### **Etnier's Algorithm**

Etnier (2002:199) developed his algorithm by using non-linear growth curves for 15 different NFS elements to estimate age-at-death for a series of known-age comparative specimens. Etnier (2002:199) argues the "accuracy of (his growth algorithm) varies between skeletal elements and decreases with increasing age". Therefore Etnier's techniques are most effectively used only to look at younger sub-adult elements. In some of the cases, the elements were too small and under-developed to positively identify as NFS. Eight of the samples positively identified as fetal by Etnier's algorithm were

selected and sent for ancient DNA analysis to Michael Knapp at the University of Bangor to confirm that they were NFS.

Etnier's growth curve algorithm was developed to work with endochondral elements, or those that form initially as cartilage (Etnier 2002:32; Romer 1963). During the first step of this study each element was visually evaluated for its compatibility with Etnier's growth curve algorithm (2002). Cranial elements and vertebra were not compatible with Etnier's algorithms and thus were not considered. The only exception to the types of bone used was the mandible that forms as a dermal bone and the baculum, a heterotopic bone (Etnier 2002: 32, Romer 1963). The baculum was not used in the analysis because only one baculum was positively identified within the assemblage and it did not retain any of the landmarks needed to take measurements. Mandible, humerus, scapula, femur, fibula, metacarpal, metatarsal, radius, tibia, and ulna were all determined as usable because they gradually form over time as the individual reaches physical maturity.

The second step of this study was to take measurements from each element. Appendix B of Etnier's (2002) thesis maps out clearly the landmarks of each element for which the measurements should be taken. Etnier (2002:32) determined which landmarks were relevant, based upon centers of ossification, for each element with the expectation that each element would approximate logarithmic growth (see below for measurement descriptions). Etnier (2002) designed his measurements so they might easily accommodate changes in morphology associated with ontogenetic development and epiphyseal fusion. *A guide to the measurement of animal bones from archaeological sites* (von den Driesch 1976) was kept on hand for any clarification of Etnier's descriptions.

Long bones are an exception to a logarithmic growth model, as they ossify from multiple growth plates (Etnier 2002; Romer 1963). Etnier (2002:33) describes the growth model of the long bone as a “step-function with the fusion of each epiphysis”. According to Etnier (2002:33) the growth of each long bone differs by element and thus “the number and size of steps (varies) by each element and measurement within an element”.

Etnier (2002:33) dismissed fused elements in his growth models because after epiphyseal fusion, linear measurements have very little association with age. However, Etnier (2002:33) also remarked that epiphyseal fusion would not disturb the growth landmarks if fusion did not include the relevant metaphysis, which means that if an element has fused on one end but not the other it is still compatible with the growth curve algorithm. Etnier (2002:33) made sure to assign each fused element to a “minimum age category” based on the pattern of fusion: fused or partially fused.

Since any measurements taken from a fused element have very little relationship with age, the question arose about how to analyse fused elements. Etnier (2002:131) chose for his analysis to apply a minimum age value to any element that was fused “according to the patterns of fusion documented for that particular element”. Rather than follow Etnier and apply a minimum age value to fused elements, this study chose to compare size post-fusion by examining the differences between certain relevant landmarks as discussed below. This method allows one to distinguish between possible sexes, but does not allow for any observations about age. This study chose to forgo the minimum age estimate route because it found that the estimates were too inconsistent and showed no pattern.

Etnier (2002:40, 2007) broke his measurements into different categories. Etnier (2002, 2007) separated the equations for males and females, making sure to take into account cases where it was not possible to distinguish sex based on the characteristics of size and degree of development from the element. As a result each element is broken into two categories: male and sex unknown. In a few cases, an algorithm is provided for females, but rarely. For example, a female algorithm is provided for the mandible as sex and age determinations are much more easily determined because mandibular size and an examination of the canine can provide telling information about an individual (Huber 1994; Lowry and Folk 1990; Scheffer and Kraus 1964; Etnier 2002, 2007). However the female mandible algorithm was never used in this thesis as it was not possible to positively identify any female mandibles within the sample.

The procedures for taking each measurement were adapted from the standards set out by Johnathan Haas et al. (1994) and by Angela von den Driesch (1976). These standards were applied to the parameters set out by Etnier (2002) in his thesis. All of the data were collected using sliding calipers and was recorded to the 0.01mm. In elements where landmarks had been eroded or worn, measurements were still taken provided the features were still discernable. Instances of erosion and wear were noted within the data. Each measurement was taken three times, averaged and then inserted into Etnier's (2002) algorithm. By taking each measurement three times, all on separate occasions, this study was better able to account for subjective error (Haas et al. 1994, von den Driesch 1976). An age-at-death range was estimated by looking at the age range for each measurement entered into Etnier's (2002) algorithm. Using the age range a central tendency for each age estimate was determined and then that element was placed it into an appropriate age

category: fetal/newborn, juvenile, adult or adult male. This process was repeated for each element.

### **Ageable NISP and Bimodel Modeling of Death Assemblages**

Once Etnier's age algorithms have been applied, the elements were divided into subcategories based upon Lee Lyman's "ageable NISP" (Lyman 1984, 1987, 2008; Cannon 2012). NISP has been noted as a flawed measure (Lyman 2008:29; Cannon 2012, Grayson 1984); however it is also one of the most consistently used. It has commonly been criticized for its variation in counts due to the fragmentation of elements or the inflation of NISP within species; however, NISP's effectiveness as a tally of remains makes it the perfect measure of individual specimens for the purposes of this study.

Ageable NISP is a means of identifying observable age groups based around a series of criteria (Lyman 1987:127-128). For the purposes of this study, the criteria are determined by the age at death determined using Etnier's (2002) algorithm. Once each age group is determined, an age profile can be generated. The distribution of the age profile will allow understanding of the death profiles of the assemblages from DfSj-223A and DfSi-4. Lyman (1987) warns that sample size can skew the results of determining what a death profile will look like when only using age as a qualifier. Lyman suggests creating equal categories that represent a certain statistical marker, such as 10%, of an individual's life. This study is only trying to demonstrate the presence or absence of certain broader age categories within a death assemblage, therefore identifying remains as adult, adult male, juvenile and fetal/newborn is sufficient.

Lyman (1987:126-128) identifies two basic models of mortality: catastrophic (or mass) and attritional (or normal). Catastrophic or mass mortality is when gradually less individuals represent successively older classes. This model of mortality usually demonstrates a L-shape (Klein 1982), because the older individuals will often make up a smaller portion of the total death assemblage. This profile often provides a snapshot of what a living population would look like. In the case of DfSj-23A and DfSi-4, a L-shape distribution would most likely be seen if the NFS were being harvested *en mass* by the Toquaht. An example of this model of mortality or mass harvest profile would be apparent in the NFS were surrounded with floating nets then clubbed and speared as the NFS floundered while attempting to escape. However, it is very unlikely that the Toquaht were mass harvesting NFS as this could lead to an exploitation depression of local populations (Charnov et al. 1976). Lower intensity harvesting would have a smaller impact on the NFS population.

Attritional or normal mortality is represented by normal or routine ecologically related deaths of individuals. This profile is commonly represented by a U-shape (Klein 1982). The age categories being targeted in an attritional or normal profile could clarify how the Toquaht were hunting NFS. If the Toquaht were only hunting individuals at haul-out sites or during migration, a larger distribution of young male or young female remains would be seen while some age categories would not be represented at all. If a rookery is present, then all age categories would be represented, but a larger distribution of young breeding females and newborn/fetal remains would exist as they inhabit the rookery for a longer period of time.

## **Sample**

The sample for this study consisted of the NFS remains from DfSj-23A and DfSi-4. The substantial size of the faunal sample collected from these sites made analysis of the entire sample time consuming and impractical. To save on resources and time, an arbitrary sampling method was used. Excavation units and associated levels that contained C14 dates were automatically included within the sample so that the cross-dating of deposits could be applied in order to develop the longest possible chronology at each site. A random 40% sample was chosen within the units that contained C14 dates. In some cases, levels were added to fill in gaps between randomly chosen levels within an excavation unit (Monks 2009).

The faunal material had been previously identified as sea mammal by student assistants and then verified by Gregory Monks. The material was then set aside for future analysis. Preliminary analysis and data preparation was conducted by Ainslie Cogswell and Kaitlynn Alarie, but very little of their findings was used. To guarantee a consistency of methodology, the entire element identification was verified and all measurements were retaken for the purpose of this study.

Sample size is one of the largest obstacles to overcome, as many of the elements are only represented by one or two samples. The small sample size is especially apparent at DfSi-4. Determining the population distribution and hunting practices will be particularly difficult in these cases due to a lack of data.

### **Fetal Evaluation and Ancient DNA Analysis**

In 1989 Hagelberg et al. successfully found a way to amplify the DNA from archaeological bone, allowing archaeologists to positively identify even the smallest pieces of biological material. The ability to positively identify faunal material is significant because it represents the largest portion of material gathered from many archaeological sites. From Hagelberg's et al (1989) work, researchers have since developed the ability to distinguish between human and animal DNA using fragments of bone that are anywhere from pristinely to poorly preserved (Hummel 2003).

A number of the samples recovered from DfSj-23A and DfSi-4 were too underdeveloped to be positively confirmed as NFS visually. Eight fetal or newborn samples were sent to Michael Knapp and his assistant Jessica Thomas at Bangor University, Wales, to undergo ancient DNA (aDNA) analysis. As aDNA analysis is destructive, detailed information and photographs of each element were recorded before it was sent to Bangor University.

When performing DNA analysis, either mitochondrial or chromosomal DNA can be examined. The mitochondrial DNA genome is purely maternal in its origin and contains many sections of highly conserved sequences. Cytochrome-B is a protein found within the mitochondrial genome and is involved in a number of biochemical processes, making it one of the most effective means for aDNA analysis (Hummel 2003). By comparing differences within the Cytochrome-B gene using sequence analysis, it is possible to distinguish not only between species but subspecies as well.

Knapp chose to look at the mitochondrial DNA during his evaluation of the fetal

samples from DfSj-23A and DfSi-4. Small core samples were drilled from each element for analysis. Using a small micro fragment from the core of each element increases the chances of success and decreases the risk of external contamination (Hummel 2003). The DNA was transformed with primers and the DNA amplified for a 130base pair fragment of CO1. A similar fragment was used for Cytochrome-B analyses to confirm the results (Knapp 2014).

aDNA analysis is not a definite answer to species identification. In some cases no usable samples can be found for positive identification because DNA is susceptible to degradation. Many different factors can lead to the degradation of DNA including environment, age and storage factors (Hummel 2003:66-79).

Regular controls can be used to reduce the risk of contamination and increase the chance of successful analysis. These include: strict separation for the handling of all samples; effective cleaning management of all equipment; changing of disposable gloves between the handling of samples and strict handling and proper use of all materials and equipment (Hummel 2003). All confidence is placed in Micheal Knapp and Jessica Thomas that all samples were handled correctly and without incident.

## **Data**

This section summarizes the 10 elements that were examined for the purpose of this study including the: femur, fibula, humerus, mandible, metacarpal, metatarsal, radius, scapula, tibia and ulna. Each section gives a brief summary of the measurements taken from each element, the sample size from DfSj-23A and DfSi-4, a summary of the age

categories and any problems or issues that arose. For greater detail on the measurements taken for each element refer to Etnier (2002:305-315). Etnier includes in his thesis a set of drawings that outline the landmarks and contact points used for each specific measurement. For greater detail on the age summaries refer to Appendix A. Appendix A includes the complete findings of the age estimate algorithms, as well as a series of box and whisker plots that demonstrate the distribution of age estimates for each newborn-fetal and juvenile element. Also included in Appendix A are measurement comparisons for the adult elements. The fetal/newborn, juvenile and adult findings will be discussed in greater detail in the next chapter according to site.

Any elements that did not fit the criteria determined by Etnier (2002:305-315) for analysis were removed from consideration. If an element was too degraded, or the proper landmarks could not be distinguished, the element was determined to be unusable. In a select number of cases entire element categories were removed from this study. The first phalange, baculum, astragalus and pelvis are all elements for which Etnier (2002) provided measurements and age estimate algorithms, but these elements were removed from this study. These four elements were left out of the study for various reasons. The two biggest reasons were: small sample size and element fragmentation

### **Data – Femur**

Nine measurements were taken for the femur according to the parameters designated by Etnier (2002:307) (Fig 3-1). The measurements for the femur included: total length, midline length, distal width, distal thickness/breadth, midshaft width,

midshaft thickness/breadth, proximal width, minimum proximal thickness and maximum proximal thickness. The following table describes each measurement in more detail and is summarized from Etnier (2002:314):

<b>Element</b>	<b>Description</b>
Total Length	Length of the femur shaft from the distal condyles to the most proximal point of the femur
Midline Length	Length of the femur shaft along the sagittal plane from the notch on the femur head to the notch on the intercondyloid fossa
Distal Width	The maximum medio-lateral distance between the medial and lateral epicondyles
Distal Thickness/Breadth	The maximum antero-posterior distance between the condyles and the patellar articular surface
Midshaft Width	Medio-lateral width of the approximate mid-point of the femur shaft
Midshaft Thickness/Breadth	Antero-posterior thickness measured at the same point as the midshaft width
Proximal Width	Width across the head of the femur, perpendicular to the long axis of the bone
Minimum Proximal Thickness	Antero-posterior thickness of the notch between the femur head and the greater trochanter
Maximum Proximal Thickness	Antero-posterior thickness of the femur head or the greater trochanter

Thirty femora were identified from DfSj-23A. Of the 30 femora, seven proved unusable for the purposes of this study because they were either too fragmented or weathered to provide accurate measurements. The remaining femora were identified as belonging to the following age categories:

<b>Age Category</b>	<b>NISP</b>
Fetal/Newborn	5
Unfused Juvenile	7
Adult	7
Adult Male	4

Eight femora were identified from DfSi-4. Of the eight femora available only measurements for six of the elements were obtainable. Those six femora were identified as belonging to the following age:

<b>Age Category</b>	<b>NISP</b>
Fetal/Newborn	1
Unfused Juvenile	2
Adult	3

The adult male femora did not preserve as well as the fetal/newborn and juvenile femora. The adult femora tended to be more fragmented. As a result, total length and total midline length were often not obtainable. The shaft of each femur preserved the best for adult remains compared to the other elements. Therefore, the midshaft width and thickness are best represented within the data collected from the measurements of the adult femora. However the midshaft width and thickness has the greatest standard deviation between all the measurements, because it has the least consistently distinguishable landmarks to rely on for measurements.

### Data – Fibula

Six measurements were taken for the fibula including: proximal width, proximal thickness, total length, distal width, distal thickness and diagonal distal width in accordance with Etnier (2002:309) (Fig 3-2). The following table describes each measurement in more detail and is summarized from Etnier (2002:315):

<b>Element</b>	<b>Description</b>
Proximal Width	Maximum dimension of the proximal end
Proximal Thickness	Minimum dimension of the proximal end
Total Length	Maximum length of the fibula shaft
Distal Width	Maximum dimension of the distal end
Distal Thickness	Minimum dimension of the distal end
Diagonal Distal Width	Maximum dimension of the distal fibula from the lateral maleolus

The fibula is not well represented within the sample. Only two fibulae were identified from DfSj-23A and one fibula was positively identified from DfSi-4. None of the identified fibulae were complete. Only the distal end of the fibula from DfSi-4 remained intact. Measurements taken from the fibula from DfSi-4 determined that it was fetal. Enough of the distal ends of the two fibulae from DfSj-23A remained allowing Etnier's (2002) age algorithm to estimate that they belonged to two young, juvenile NFS.

### Data – Humerus

The humerus is one of the consistently most intact elements from samples taken from both DfSi-4 and DfSj-23A. Proximal width, proximal breadth, total length, midline

length, minimum distal breadth, maximum distal breadth and distal width were the seven measurements taken from humeri according to the Etnier's parameters (2002:56) (Fig 3-3). The following table describes each measurement in more detail and is summarized from Etnier (2002:72):

<b>Element</b>	<b>Description</b>
Proximal Width	The antero-posterior dimension of the proximal end
Proximal Breadth	The medio-lateral dimension of the proximal end
Total Length	Maximum dimension of the shaft
Midline Length	Length of shaft from the greater tuberosity to the notch at the midline of the trochlea, measured in alignment with the deltoid crest
Minimum Distal Breadth	Minimum dimension of the trochlea
Maximum Distal Breadth	Maximum dimension in the antero-posterior aspect of the distal end
Distal Width	Maximum dimension of the medio-lateral aspect of the distal end, measured perpendicular to the long axis of the shaft

Complete fetal, newborn and juvenile humeri can be found at both sites. Interestingly, there were no adult humeri to be found at DfSi-4. Given the humerus is a robust bone that preserves very well, the absence of any identifiable adult humeri at DfSi-4 is key to the examination of the site's death assemblage.

Twenty-nine humeri were identified from DfSj-23A. Of those 29, measurements were obtained from 15 of the elements. Those 15 humeri were identified as belonging to the following age categories:

<b>Age Category</b>	<b>NISP</b>
Fetal/Newborn	4

Unfused Juvenile	3
Adult	6
Adult Male	2

Interestingly, of the 14 unidentifiable humeri 11 of them were either distal or proximal ephiphysis.

Nineteen humeri were identified from DfSi-4. Eleven of the humeri were unusable for the purposes of this study. However, unlike DfSj-23A, the majority of the unusable humeri from DfSi-4 were shaft fragments. The remaining eight humeri were identified as belonging to the following age categories:

<b>Age Category</b>	<b>NISP</b>
Fetal/Newborn	6
Unfused Juvenile	2

### **Data – Mandible and Teeth**

The mandible is one of the most interesting elements to work with because it has been commonly used in archaeological contexts to age and sex NFS (Etnier 2002; Huber 1994; Lowry and Folk 1990; Scheffer and Kraus 1964; Woodborne 1996). As a result, Etnier was able to utilize a large database of known mandible measurements with known age to allow his measurements to represent all age categories. Etnier (2002:43) also

argues “for each measurement there is a maximum dimension females are not likely to exceed”. This measurement limitation means any mandible that exceeds a certain measurement can be clearly identified as male. This measurement limitation also makes sex identification much easier, in the absence of a canine tooth. Since male and female mandibles share the same characteristics if they have not exceeded this maximum dimension, the mandible was automatically assumed to be female or young male.

Etnier (2002:57) outlined six measurements that could be used for his algorithms: “mindep”, “width at mindep”, “prosterior three alveoli”, “shortlength”, “condyle width” and “condyle thickness”. While the majority of mandibles from DfSj-23A and DfSi-4 were very fragmented, measurements were still obtainable from almost all identified mandible elements. The following table describes each measurement in more detail and is summarized from Etnier (2002:72):

<b>Element</b>	<b>Description</b>
Mindep	Minimum dimension of the ramus at any point posterior to the last post-canine
Width at Mindep	Width of the ramus measured at the same point as the mindep
Prosterior Three Alveoli	Length of the alveoli of the posterior three post canines
Shortlength	Distance from the posterior margin of the last post-canine to the lateral margin of the mandibular condyle
Condyle Width	Maximum dimension of the mandibular condyle taken in a medio-lateral aspect
Condyle Thickness	Maximum dimension of the mandibular condyle taken in a dorso-ventral aspect

Twenty-seven mandible elements were identified from DfSj-23A. Only one of the

identified mandible elements was determined to not be usable according to Etnier's (2002) algorithms. Visual observations of this element determined, based on Huber (1994), that it was possibly an adult female mandible. The rest of the 26 mandibles from DfSj-23A were identified as belonging to the following age categories:

<b>Age Category</b>	<b>NISP</b>
Fetal/Newborn	7
Juvenile	18
Adult	1

The mandible is underrepresented at DfSi-4. Of the six identifiable mandibles found at DfSi-4 only two of them could be used in Etnier's (2002) algorithms. Both of the usable mandibles were identified as juvenile.

### **Data – Metacarpal and Metatarsal**

The metacarpal and the metatarsal are represented poorly at both DfSj-23A and DfSi-4. Etnier (2002:310,311) utilized the first metacarpal and metatarsal for his algorithms. For each element he measured the total length, proximal height and proximal width. The limited sample size of the metacarpal and metatarsal is due in part to Etnier limiting his examinations to the first metacarpal and metatarsal. The following table describes each measurement in more detail and is summarized from Etnier (2002:316):

<b>Element</b>	<b>Description</b>
Total Length	Maximum length along the long axis
Proximal Height	Maximum dorso-ventral dimension of the proximal end
Proximal Width	Maximum medio-lateral dimension of the proximal end

Of the 32 metacarpals found from DfSj-23A, six were identified as the first metacarpal. Five of the metacarpals from DfSj-23A were determined to be from juveniles and one was identified as an adult metacarpal. 26 metatarsals were identified from DfSj-23A, however only one of the samples was the first metatarsal. The metatarsal from DfSj-23A was identified as juvenile.

DfSi-4 provided a very poor selection of metacarpals and metatarsals. Only two metacarpals were identified at DfSi-4 and only one of the identified metacarpals was usable. The usable metacarpal from DfSi-4 was identified as juvenile. Three metatarsals were identified from DfSi-4. Of the three identified metatarsals two of the elements were distal epiphysis and were not suitable for Etnier's measurements. The third metatarsal was identified as adult.

The small sample of metatarsals and metacarpals found at both DfSj-23A and DfSi-4 raises concerns over sample size. The question arises as to whether any valuable information can be discerned from such a small sample. Neither site provides enough information for an effective cross comparison of the two sites. None of the samples come from levels with associated C14 dates. Ultimately, very little information in regards to the demographic profile can be determined from such a small sample. All that can be determined from the metacarpal and metatarsal samples at DfSi-4 and DfSj-23A is that adult and juveniles were a part of the death assemblage from each site.

### Data – Radius

The radius was an element that was well represented at DfSj-23A, but less so at DfSi-4. Five measurements were taken from each radius, according to Etnier (2002:311), including: distal width, distal height, total length, proximal height, and proximal width. The following table describes each measurement in more detail and is summarized from Etnier (2002:315):

<b>Element</b>	<b>Description</b>
Distal Width	Maximum medio-lateral dimension on the distal end
Distal Height	Maximum antero-posterior dimension on the distal end
Total Length	Maximum length along the long axis
Proximal Height	Maximum antero-posterior dimension on the proximal end
Proximal Width	Maximum medio-lateral dimension on the proximal end

Thirty-six radii were identified from DfSj-23A. Fifteen of these radii were determined to be unusable according to Etnier's algorithms. Of the 15 unusable radii from DfSj-23A, 9 were either proximal or distal epiphysis. The other 21 elements were identified as belonging to the following age categories:

<b>Age Category</b>	<b>NISP</b>
Fetal/Newborn	5
Juvenile	6

Adult	8
Adult Male	2

Eight radii were identified from DfSi-4. Four of these radii were unusable as they were too fragmented. The remaining 4 radii were identified as belonging to the following age categories:

<b>Age Category</b>	<b>NISP</b>
Fetal/Newborn	1
Juvenile	3

### **Data – Scapula**

The scapula was one of the more difficult elements obtain data from. Etnier (2002:311) outlined five different measurements to gather from each scapula including: width, height, neck width, glenoid width and glenoid height. Unfortunately only three of those measurements were ever taken from any of the samples because there was not a complete scapulae to be found at either site. In a few rare cases scapula body fragments were identified but were unusable according to Etnier's algorithms (2002:311). Measurements were never taken from the width or the height of the scapulae and most of the diagnostic information was gathered from the glenoid cavity. The following table describes each measurement in more detail and is summarized from Etnier (2002:315):

<b>Element</b>	<b>Description</b>
Width	Maximum dimension from the posterior border to the anterior border
Height	Maximum dimension from the glenoid fossa to the vertebral border
Neck Width	Antero-posterior dimension of the scapula neck; the narrowest point of the scapula neck
Glenoid Width	Maximum dimension of the glenoid fossa
Glenoid Height	Minimum dimension of the glenoid fossa

Thirty-two scapulae were found at DfSj-23A. Twelve of the scapulae fragments from DfSj-23A were usable within Etnier's algorithms and can be identified as belonging to the following age categories:

<b>Age Category</b>	<b>NISP</b>
Fetal/Newborn	2
Juvenile	8
Adult Male	2

Interestingly, one of the adult male scapulae was not completely fused, but the neck width of the element (the only measurement which could be taken from this sample) placed the fragment at around 4.5 years of age. By 4.5 years of age, the epiphysis should have fused on the scapula. This fragment is unique because even for a completely fused element, the neck width was very large making it stand out as an outlier within the sample.

Twenty scapulae were identified at DfSi-4, however only five of those scapulae were usable. The five usable scapulae from DfSi-4 can be identified as belonging to the following age categories:

<b>Age Category</b>	<b>NISP</b>
Fetal/Newborn	3
Juvenile	2

### **Data – Tibia**

Nine measurements were taken from each element including: midline length, total length, proximal width, minimum proximal thickness, maximum proximal thickness, minimum midshaft, maximum midshaft, distal width and distal thickness. The following table describes each measurement in more detail and is summarized from Etnier (2002:314):

<b>Element</b>	<b>Description</b>
Midline Length	Length of the tibia shaft along the sagittal plane from the inter-condyloid fossa to the medio-lateral midpoint of the distal end
Total Length	Maximum length of the tibia shaft along the frontal plane
Proximal Width	Distance between the lateral and medial condyles on the frontal plane
Minimum Proximal Thickness	Antero-posterior distance between the popliteal notch and the tibial crest
Maximum Proximal Thickness	Antero-posterior distance between the posterior margins of the condyles and the tibial crest
Minimum Midshaft	Minimum cross-sectional dimension of the approximate midpoint of the long-axis of the tibia shaft

Maximum Midshaft	Maximum cross-sectional dimension at the same point on the shaft as the “minimum midshaft”
Distal Width	Distance between the medial malleolus and the fibular articular surface
Distal Thickness	Maximum antero-posterior dimension of the distal end

Even though tibiae are well represented in the sample at DfSj-23A, they are less frequent at DfSi-4. Nineteen tibiae have been identified at DfSj-23A, nine of which are usable, compared to DfSi-4 where only four tibiae could be identified, two of which are usable. All of the measurements taken from the two usable tibiae from DfSi-4 suggest that those elements were taken from juveniles. The tibiae from DfSj-23A were identified as belonging to the following age categories

<b>Age Category</b>	<b>NISP</b>
Fetal/Newborn	2
Juvenile	5
Adult	5

### **Data – Ulna**

Seven measurements were taken with the ulna in accordance with Etnier’s (2002:312) algorithm. These measurements included: total length, proximal height, proximal width, midshaft thickness, midshaft height, distal height and distal width. The following table describes each measurement in more detail and is summarized from Etnier (2002:316):

<b>Element</b>	<b>Description</b>
Total Length	Maximum length along the long axis
Proximal Height	Maximum dimension of the olecranon process
Proximal Width	Minimum dimension of the olecranon process
Midshaft Thickness	Maximum cross sectional dimension of the ulna measured at the approximate midshaft
Midshaft Height	Minimum cross sectional dimension of the ulna at the same point as the “midshaft thickness”
Distal Height	Maximum dimension of the distal end
Distal Width	Minimum dimension of the distal end

Problems arose with the algorithm for “proximal height <50.0mm”. Whenever a value was added into this formula, the system would not accept the input value. As a result, to calculate the estimated age for the proximal height, the value was entered into the algorithm for ulna: proximal height, male. The estimated ages for any ulna “proximal height <50.0mm” may be off slightly, but it should still provide an age estimate for that measurement which is within 12 months.

Nineteen of the 23 ulnae found within the sample at DfSj-23A were usable. Of the four ulna which were unusable, two were ephiphyses. The rest of the ulnae from DfSj-23A were identified as belonging to the following age categories:

<b>Age Category</b>	<b>NISP</b>
Fetal/Newborn	7
Juvenile	9
Adult	3

Unfortunately, ulnae are not as well represented at DfSi-4. Only six ulnae were found in the sample at DfSi-4, however of those six ulnae, five of them were usable. All of the usable ulnae at DfSi-4 were identified as juvenile.

### **Data – Ancient DNA Analysis**

Eight sea mammal elements, thought to be fetal NFS, were selected and sent for aDNA analysis at Bangor University. All eight samples represented different chronological periods of DfSj-23A and DfSi-4. Each element was positively identified as fetal or newborn using Etnier's growth algorithm. In this case, each element was within 12 months of time of birth. These samples were singled out because they were found in levels with an associated C14 dates. In a select number of cases, samples were chosen not because there were associated with C14 dates, but because they were complete samples that came from levels that were either adjacent to levels with C14 dates or were higher from up in the archaeological strata. This method guaranteed that fetal NFS elements were present throughout the occupation of the site.

In total, five samples were sent from DfSj-23A including a mandible, an ulna, a humerus and two tibiae. The oldest sample sent for DNA analysis from DfSj-23A dated to AD 1040-1220 (McMillian and St.Claire 1993:16). Three samples were sent from DfSi-4: two scapula fragments and a humerus. The samples from DfSi-4 sent for DNA analysis were dated between AD 1000 and 45 BC (McMillian and St.Claire 1994:16). The C14 dates are normalized radiocarbon dates. Please see the Canadian Archaeological Association radiocarbon database for more information.

Of the eight samples that were sent for aDNA analysis, PCR (polymerase chain reaction) products were retrieved from three of the samples, two from DfSi-4 and one from DfSj-23A. All three of these samples were positively identified as belonging to the NFS family (Fig. 3-1). The results were as follows:

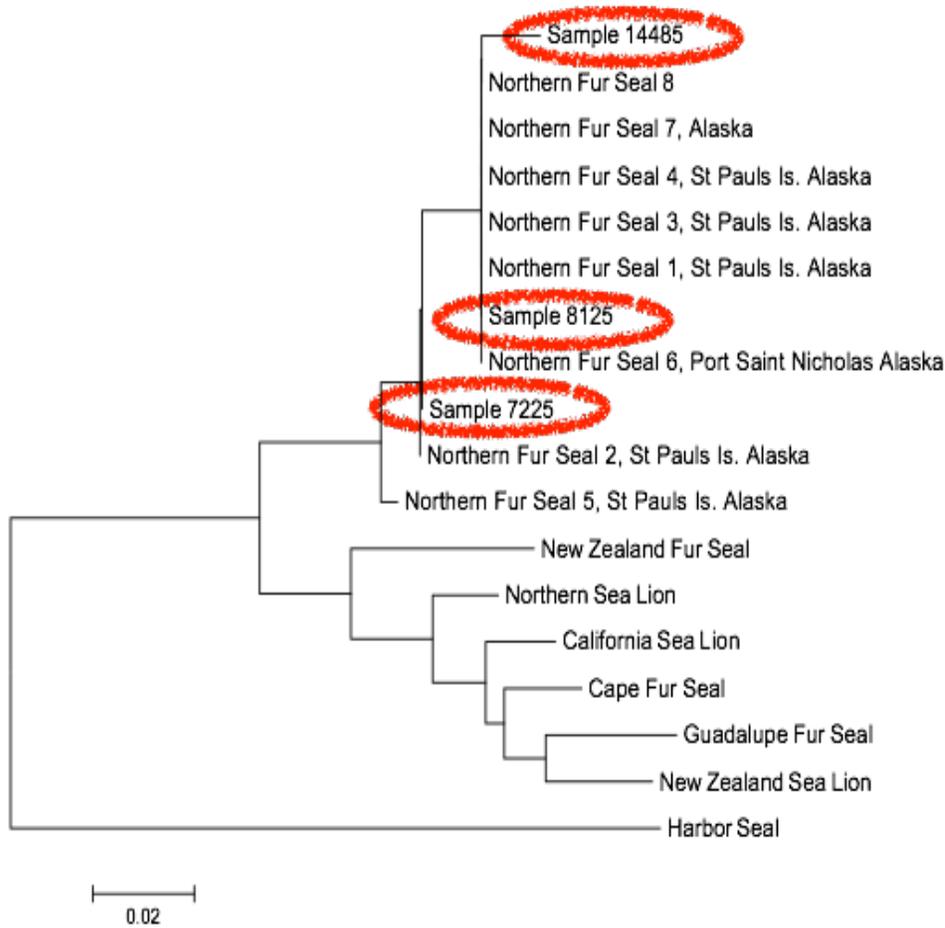


Fig. 3-1: Ancient DNA Family tree (Jessica Thomas MA 2014)

<b>Site</b>	<b>Catalogue Number</b>	<b>Unit</b>	<b>Level</b>	<b>Corresponding C14 date</b>	<b>Calibrated Date*</b>
DfSi-4	7225	N16-18	19G	1990+/- 70BP	45 BC – AD 90
DfSi-4	8125	N48-50	6C	Over 970+/- 60BP	Over AD 1000-1160
DfSj-23A	14485	E20-22	23D	879 +/- 50BP	AD 1040-1220

\*All radiocarbon dates came from wood charcoal samples submitted to Beta Analytic Inc and were calibrated by McMillian and St.Claire using Stuiver and Becker (1993). All calibrated results have a one sigma deviation. (McMillan and St.Claire 1994:14, 1996:18-19)

### **Chapter Four – Analysis and Observations**

This chapter will serve as an analysis of the data presented within *Chapter 3- Methods, Sample and Data* examining the usable death assemblages from DfSj-23A and DfSi-4 to make an estimation of the demographic profile for each site.

Each site will be presented separately. Each age category, fetal/newborn, juvenile, adult and adult male, will be reviewed and an evaluation of how that age category is represented chronologically will be presented. After each age category is examined a complete site demographic profile will be presented of the usable death assemblage. The usable death assemblage is being used to refer to the sample as a full taphonomic analysis is beyond the scope of this thesis. By centering this thesis on the usable death assemblage attention can be focused on the interaction between the Toquaht and NFS

**DfSj-23A**

Significant evidence from DfSj-23A suggests a NFS rookery was within close proximity to the site. A total of 130 NFS elements were examined and found to be usable for the study of DfSj-23A. Fetal/newborns, juveniles, adults and adult males are all well represented within the usable sample, suggesting that a rookery may have existed within hunting proximity of DfSj-23A.

**DfSj-23A – Fetal/Newborn**

Of the 130 elements examined at DfSj-23A 34 fetal/newborn elements were found. As a result, fetal/newborn make a significant portion of the usable death assemblage from DfSj-23A. aDNA analysis confirmed the fetal remains are most likely NFS. Fetal/newborn remains were found throughout DfSj-23A, at all four units examined. However fetal/newborn remains tend to be found in greater quantities in the upper levels of each unit (Fig. 4-1).

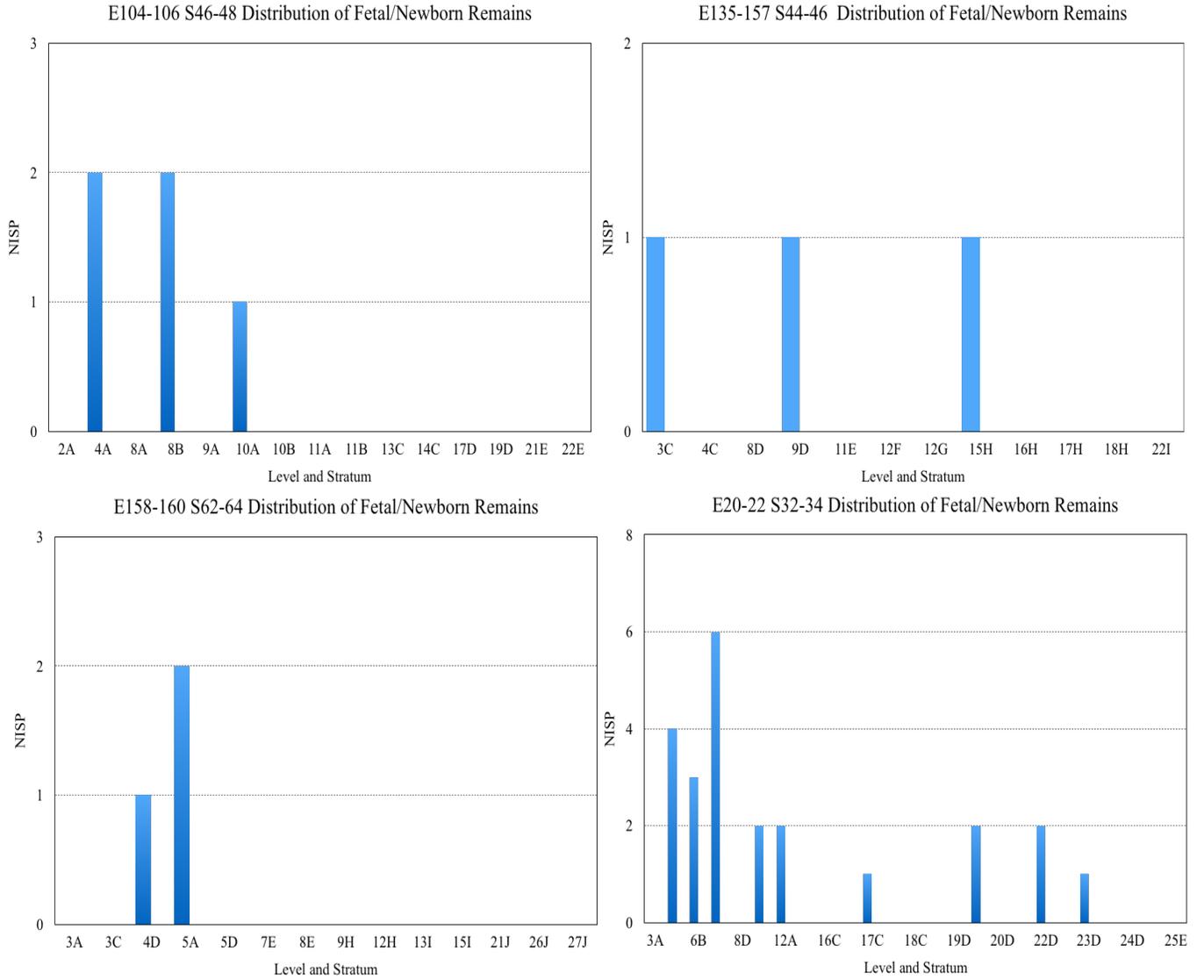


Fig 4-1: Distribution of Fetal/Newborn Remains at DfSj-23A

Some fetal/newborn remains are found in the lower levels of DfSj-23A however C14 dates those levels to AD 1040-1220. These C14 dates from E20-22 suggest the lower levels of E20-22 are approximately 200 to 300 years younger than dates taken from elsewhere at DfSj-23A. A later appearance of fetal/newborn remains could indicate a rookery was not being harvested until later into the site's history. More investigation is

needed to fully understand the chronological significance of the distribution of fetal/newborn remains at DfSj-23A.

Regardless of when fetal/newborn remains first appear at DfSj-23A, it is important to note that they make up a significant portion of the usable death assemblage. Fetal/newborns represent 26.2% of the total usable death assemblage. The appearance of fetal/newborn remains in such large quantities suggests the Toquaht were hunting from a rookery and not from a haul-out site or from a migrating population.

If the Toquaht were hunting from a haul-out site or from migrating populations, fetal/newborn remains would be significantly less. Newborns do not migrate, they do not leave the rookery before 4 months of age (Naughton 2012:427). It is possible for fetal elements to be present in a migrating population if the Toquaht were hunting pregnant NFS. It is very unlikely fetal/newborn remains would be present at a haul-out site as those sites tend to be occupied by younger, non-breeding NFS. The high percentage of newborns is particularly of interest because there is very little caloric and strategic value to hunting newborns. It is possible the high representation of newborn NFS is due to a culling of the herd. It is also possible the high number of newborns is due to accidental deaths during hunting. Ultimately, the presence of the fetal/newborn elements in the death assemblage at DfSj-23A strongly suggests that the Toquaht were hunting from a nearby rookery because, as Lyman (1988, 1989, 1991, 1995) argues, the presence of newborn pups is the only means of documenting the exploitation of a rookery.

**DfSj-23A – Juveniles**

Juveniles are the best-represented age category at DfSj-23A. Of the 130 usable elements examined at DfSj-23A juveniles make up 42.3% of the death assemblage. A total of 55 juvenile remains were identified from DfSj-23A from a variety of units and levels (Fig 4-2).

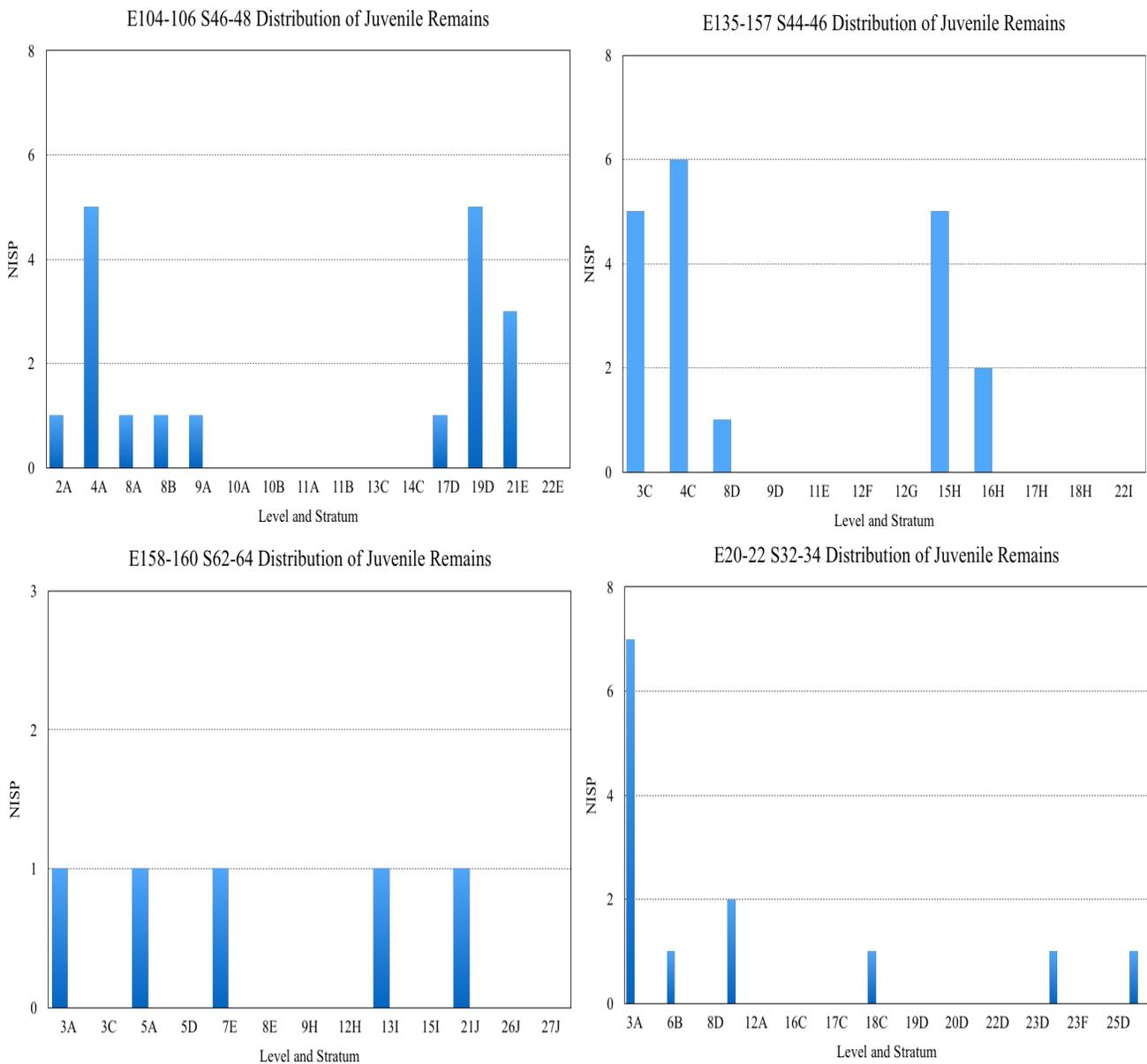


Fig 4-2: Distribution of Juvenile Remains at DfSj-23A

Juvenile remains are found throughout the site, in both the lower and upper levels. A higher concentration of juvenile remains exists within the upper levels of the site. The juvenile remains from E104-106 can be dated to AD 760-990. Given the higher concentration of fetal/newborn elements in the upper levels, it is possible that NFS hunting was more common later in DfSj-23A's history than in earlier days. However, C14 dates for E135-137, 158-160 and the upper levels of E20-22 have not been identified. Without reliable C14 dates from each unit, it is impossible to guarantee any comparison between the units chronologically.

The presence of juvenile NFS remains at DfSj-23A does very little to support the presence or absence of a NFS rookery within hunting proximity to DfSj-23A. Juveniles would be present if the Toquaht were hunting NFS from a haul-out site, a rookery, or during migration. If the Toquaht were hunting from a rookery, juvenile NFS are arguably the optimal target. Juvenile, or young males, are less risk and they can be transported easier and they would be more accessible as they usually reside on the fringes of a rookery. A juvenile may provide less return, but the reduced risk can make them more optimal prey. Smaller prey, like fetal/newborn NFS, are less dangerous, but they provide less return than juveniles or adult NFS (Gifford-Gonzalez et al. 2005:22-23). Adult females and fetal/newborn NFS are also less accessible than juvenile NFS as they usually reside in the interior of the rookery. Smaller prey and can also be more optimal because they can be transported whole for processing, storage and consumption (Betts and Maschner 2011, Lyman 1987,1991, Rapson 1990). Therefore even though juveniles are not indicators of a rookery, their overwhelming dominance of the death assemblage at DfSj-23A could be explained through optimal foraging and selective hunting.

**DfSj-23A – Adult/ Adult Male**

Adult remains are the second largest age category at DfSj-23A making up 31.5% of the total usable death assemblage. In total, 41 adult and adult male remains were identified at DfSj-23A. However, unlike juvenile and newborn, adult and adult male remains are found consistently throughout the upper and lower levels of DfSj-23A (Fig 4-3). The consistency of adult NFS remains suggests the hunting of NFS was happening in some form or other throughout the occupation of the site. Unfortunately, with such a

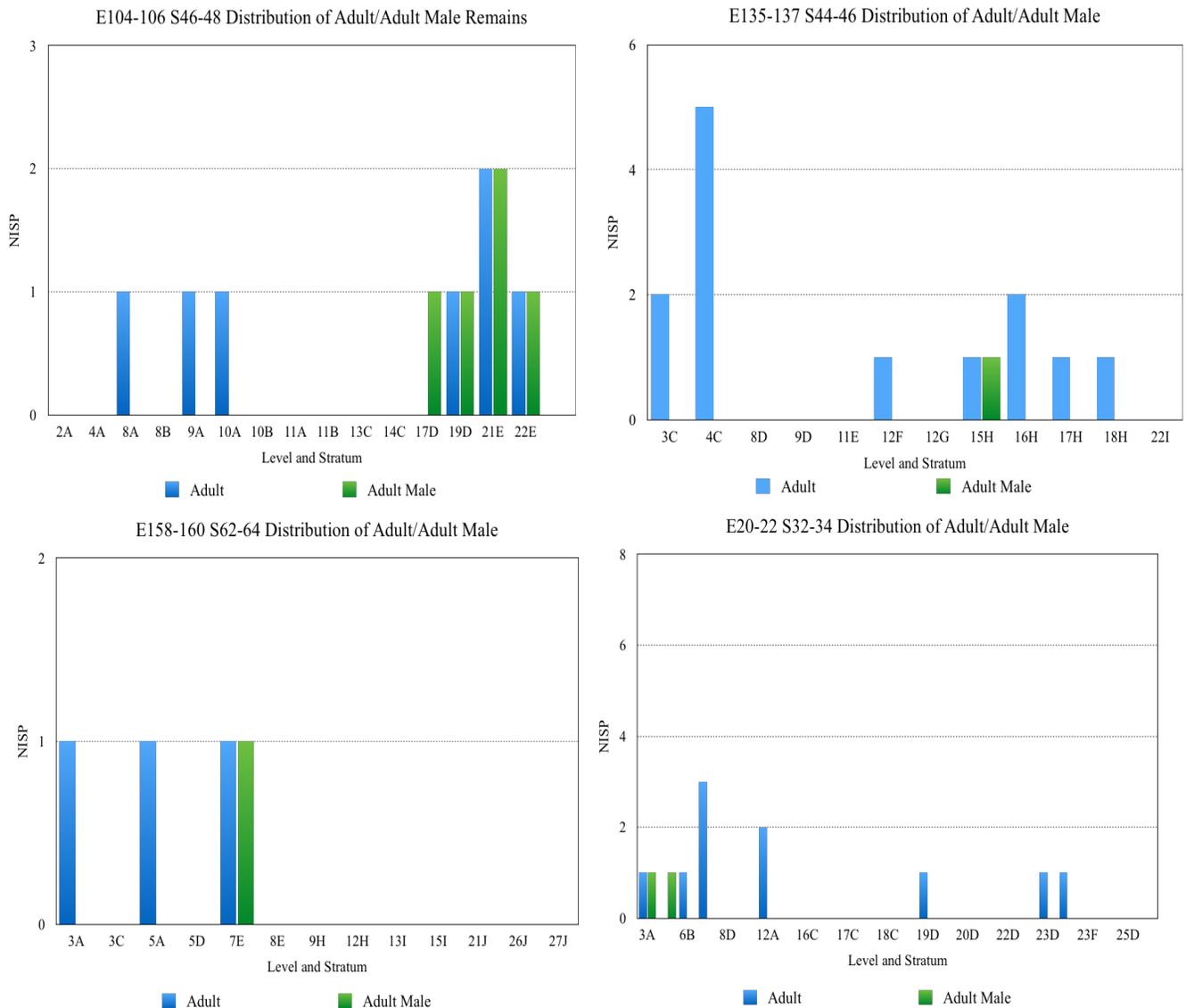


Fig 4-3: Distribution of Adult/Adult Male Remains at DfSj-23A

limited sample size and without more conclusive dating, nothing more than suppositions can be made about the changes in NFS hunting practices at DfSj-23A.

Out of the 41 identified adult remains from DfSj-23A, 10 of those remains were positively identified as adult male. Doing a basic size comparison between different elements can positively identify adult male elements. As Etnier (2002:46, 55) shows, it is reasonable to expect that a female humerus will not exceed a maximum length of 120 mm, compared to male humeri, which have been known to reach up to a total length of 200 mm. Size comparisons of measurements from different elements were considered in order to best estimate the portion of the adult population that was male, for example the humerus. An examination of the difference of minimum and maximum distal thickness for the humeri shows very little variation between male and female. However, when the total length and midline length are examined, greater variation is seen and two specimens from DfSj-23A clearly emerge as adult male, specimens 36033 and 14481 (Fig 4-4). For more size comparison graphs please see Appendix A.

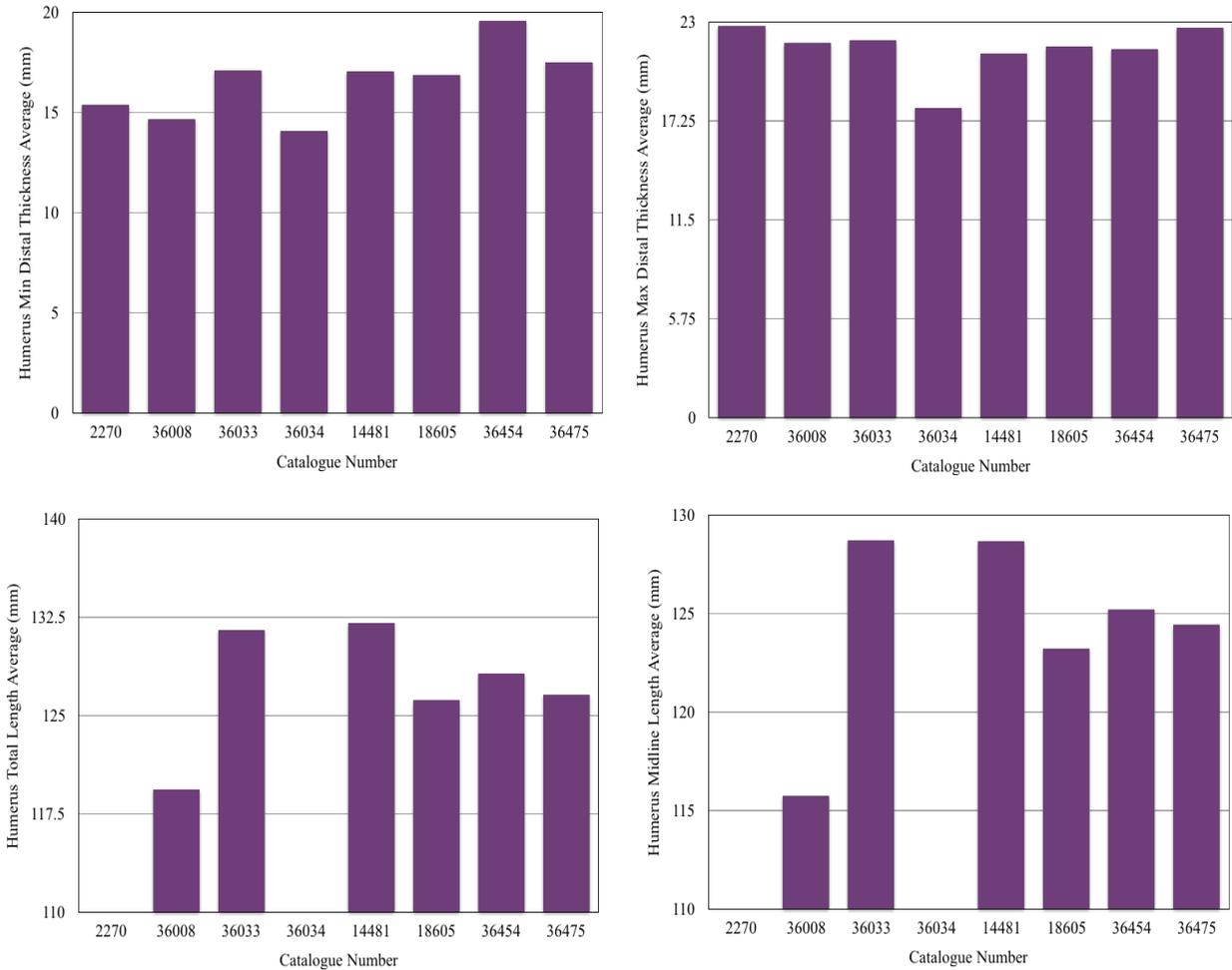


Fig 4-4: Size comparison graphs of different humeri measurements. Length measurements for 2270 and 36034 were unobtainable and are thus left blank in the graphs above.

As with juveniles, the presence of adult NFS remains does very little to support the presence or absence of a NFS rookery within hunting proximity to DfSj-23A. Adults would be present if the Toquaht were hunting from a haul-out site, a rookery or during migration. What is significant is that adult male and adult female remains have been found at DfSj-23A together. Adult male and female NFS are only known to congregate together at rookeries for breeding purposes (Baker et al 1970, Naughton 2012). While we are not able to definitely determine what the percentage of female remains makes up in the adult portion of the usable death assemblage, it is reasonable to presume adult

females were present because fetal elements were identified. As mentioned earlier, female elements and male elements are difficult to distinguish between before female elements stop growing around the age of 4. As a result, this study has grouped remains from the smaller fused adult males and adult females together.

### **DfSj-23A – Observations and Analysis**

Fetal/newborns, juveniles, adults and adult males have all been positively identified at DfSj-23A. The combination of all four age categories within the usable death assemblage gives reasonable evidence to suggest that a rookery did exist within hunting proximity to DfSj-23A. Interestingly, the majority of the death assemblage does appear to sit in the upper levels of the site. However, enough evidence exists that there was a rookery within close proximity to DfSj-23A earlier in the site's history. The distribution of NFS remains from each age category in the upper levels of the site could suggest that DfSj-23A did not become a center for NFS hunting until later into its history. The suggestion that DfSj-23A became a center for NFS hunting later into its history is consistent with O'Reilly's (1883) description of the site as a spring and summer fishing and sealing destination.

The usable death assemblage model from DfSj-23A provides an interesting picture (Fig 4-5). The Toquaht appear to have been practicing selective hunting, targeting

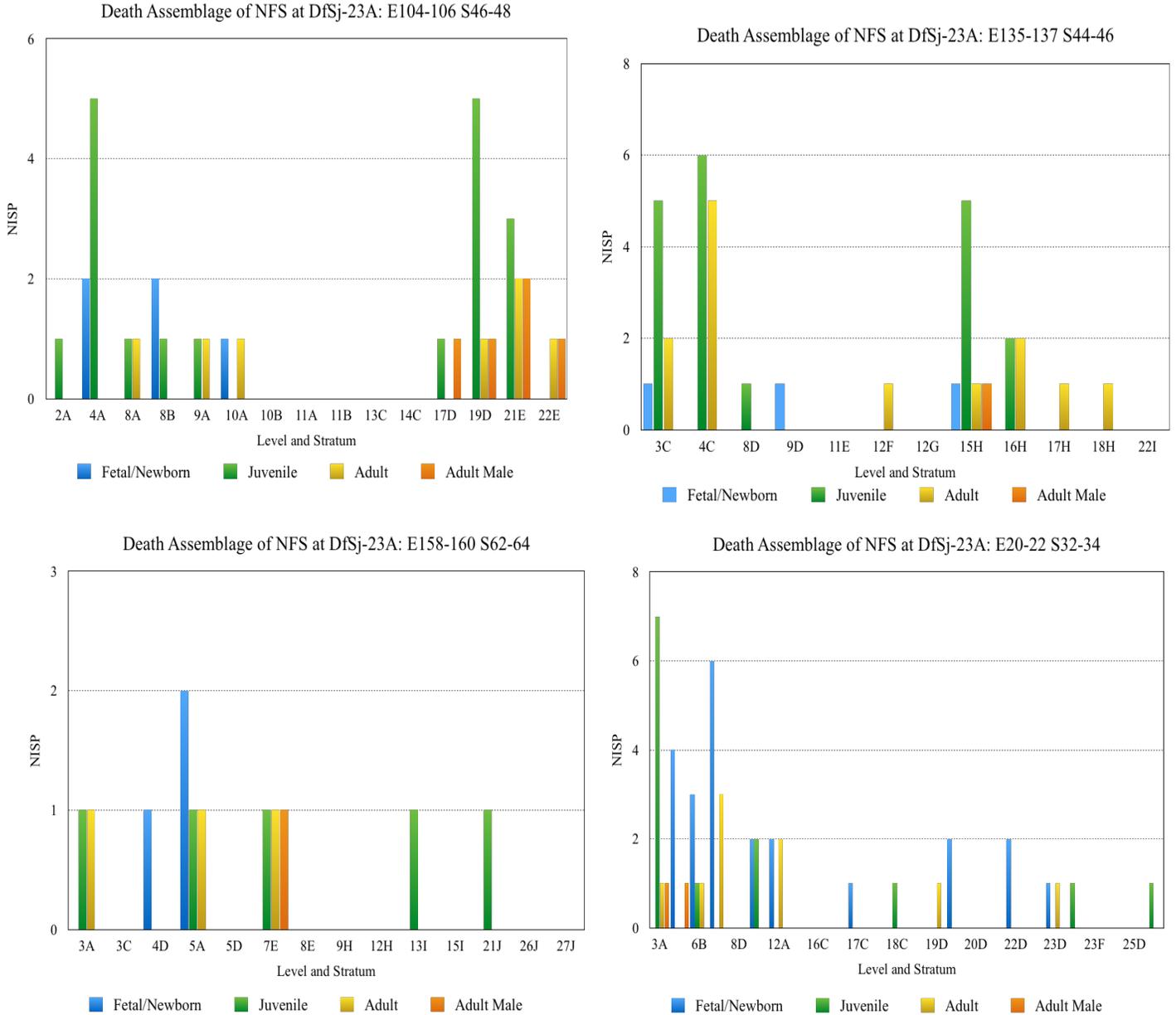


Fig 4-5: Death Assemblage of DfSj-23A

mostly juvenile NFS. As discussed above, juvenile NFS would be an optimal target, as they are less risk than fully developed adult males and females and are easier to transport whole for processing, storage and consumption.

Another interesting trend in the death assemblage model is the lack of fetal/newborn remains in the lower levels DfSj-23A. The lack of fetal/newborn remains could be another symptom of selective hunting, or it could be because the Toquaht were not hunting from a rookery until later into the site's history. Fetal remains have been found in the lower levels of E20-22 and C14 dates place those levels between approximately AD 1040 to 1310, but there is very little means of comparing that to any of the other units because of a lack of C14 data. Given that the presence of a NFS rookery is dependent on the appearance of fetal/newborn remains in conjunction with juvenile, adult and adult male remains, it can be reasonably argued that the Toquaht may have been hunting from a NFS rookery at DfSj-23A as early as AD 1040.

Interestingly, there appears to be a gap in the presence of NFS remains at DfSj-23A. NFS appear to be absent from a number of levels within different units excavated from DfSj-23A. The absence of NFS during these levels indicates the possibility of a major event that may have occurred and interrupted the NFS hunt. However, without C14 dates to show that the gaps from each unit are related, it is difficult to estimate what that event may have been or if it was just not an indicator that the NFS processing areas were being shifted around the site.

**DfSi-4**

The evidence a rookery existed within hunting distance of DfSi-4 is less convincing. This is in part due to the smaller sample size of DfSi-4. Only 34 elements were found to be usable for evaluation. Of the 34 elements, adults were severely under-represented in the sample. There are many reasons adults could be under-represented within the sample. Given the small sample size, the under representation of adult elements and fetal/newborns and the higher number of juvenile remains, it is most likely that Toquaht at DfSi-4 were hunting from either a haul-out location or from a migrating population. It is possible that the Toquaht were choosing to prey on the peripheral herd or bachelor males who sat on the edge of the rookery, but that does not explain the lack of adult or fetal/juvenile remains at DfSi-4. Given the condition the fragments were in, it is most likely that butchering was happening at the killing site and NFS were being transported back to DfSi-4 for consumption. If butchering was happening elsewhere, it is possible that the DfSi-4 Toquaht had to travel a great distance to have access to NFS or that they had to minimize the weight/size to fit the meat in a canoe.

Another interesting trend in DfSi-4 is that only two of the five trenches or units excavated at DfSi-4 yielded any NFS remains: N16-18 W54-56 and N48-50 W62-64. N16-18 W54-56 was located along the southern edge of the site in an area covered by mature forest growth (McMillan and St.Claire 1996:14). N48-50 W62-64 was located at the back of the site, in the bush-covered area. McMillan and St. Claire (1994,1996) describe both units as having a markedly different stratigraphy compared to other units at DfSi-4, because they contained more typical shell midden deposits. McMillan and St.

Claire (1994,1996) comment that N16-18 W54-56 yielded a greater number of faunal remains, while faunal remains in N48-50 W62-64 were present, but not abundant. The concentrations of faunal remains within these two areas suggest processing was being conducted on the periphery of the site away from the main living areas.

**DfSi-4 – Fetal/Newborn**

Fetal/newborn remains make up 35.3% of the usable faunal found at DfSi-4. Curiously, all of the fetal/newborn remains seem to be restricted to one or two levels from each unit (Fig 4-6).

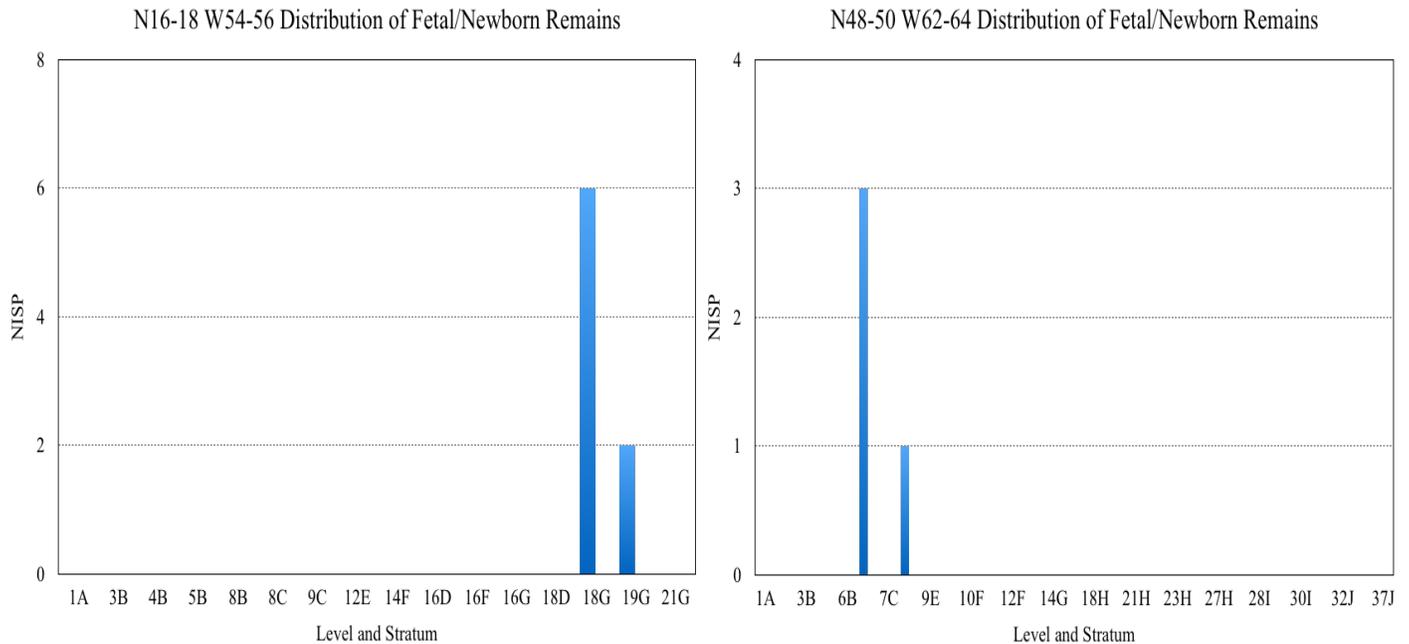


Fig 4-6: Distribution of Fetal/Newborn Remains at DfSi-4

The appearance of fetal/newborn remains in either of these units has very little chronological correlation to each other. The fetal/newborn elements at N16-18 W54-56

appear in the lower levels of the unit. C14 dates the lower levels of N16-18 W54-56 to around 45 BC –AD 90. The fetal/newborn elements found in N48-50 W62-64 appear in the upper levels of the unit. C14 dates the upper levels of N48-50 W62-64 to just little over AD 1000-1160 (based on C14 sample taken from level 3B). There is very little evidence to suggest that the appearance of the fetal/newborn remains in these two units is related, because there are approximately 900 years between the deposits from each unit. The chronological appearance of fetal/newborn remains could be in indication of sporadic exploitation of a rookery over DfSi-4's occupation. However there is not a sufficient sample to fully support this hypothesis.

The number of fetal/newborn remains at DfSi-4 does not make a solid case that the DfSi-4 Toquaht was hunting from a rookery. It could be easily argued that the appearance of fetal NFS at DfSi-4 is more coincidental or due to a mortality event of some kind. However, the small sample size of this site provides a large obstacle in accurately depicting a death assemblage model for DfSi-4. Further investigation is needed to fully understand the presence of fetal/newborn remains at DfSi-4.

#### **DfSi-4 – Juveniles**

Juveniles are the most well represented age category at DfSi-4. Juveniles make up 55.9% of the usable sample excavated from DfSi-4. While the distribution of juveniles at DfSi-4 is concentrated in certain levels, it is better represented across a number of levels from both N16-18 W54-56 and N48-50 W62-64 compared to fetal/newborn remains which were limited to one or two levels per a unit (Fig 4-7).

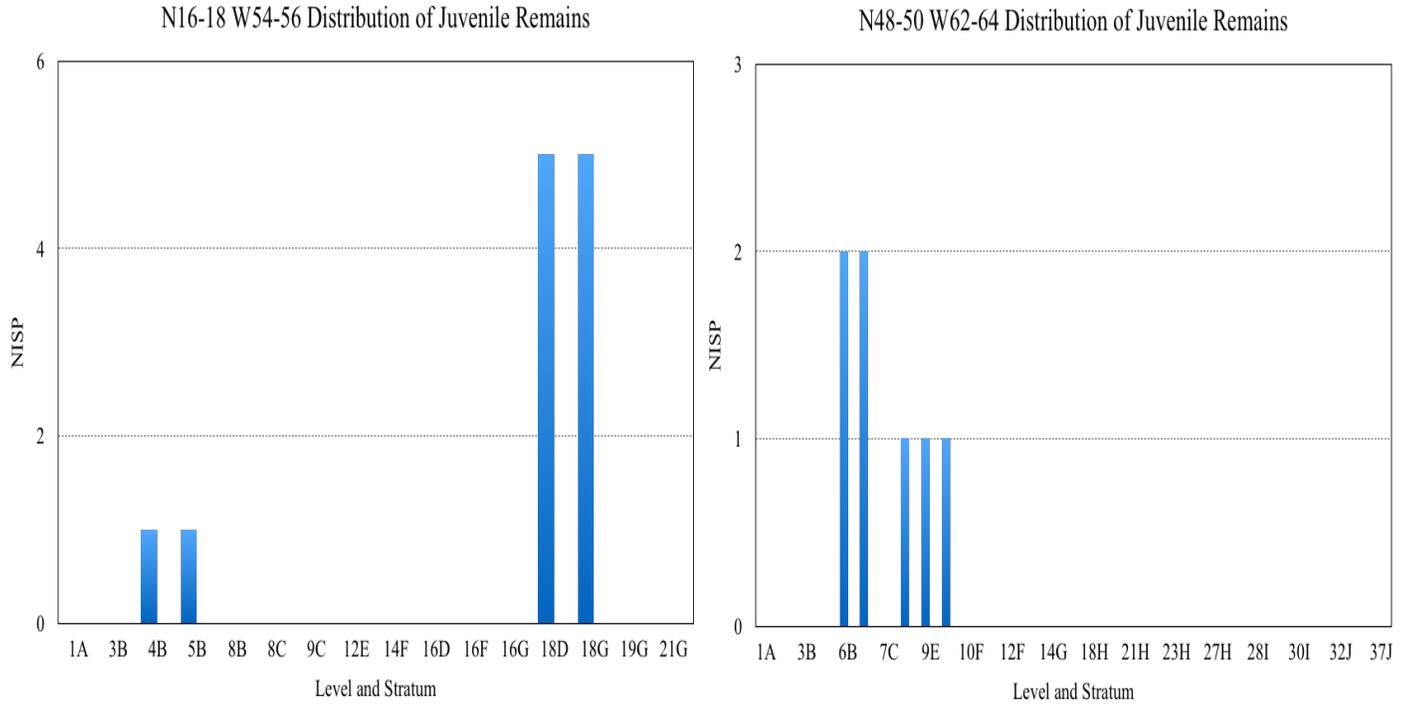


Fig 4-7: Distribution of Juvenile Remains at DfSi-4

The juvenile death assemblage from DfSi-4 suggests NFS hunting was not a practice that occurred throughout the entire history of the site. The appearance of juvenile NFS in the death assemblage says very little about whether the Toquaht were harvesting NFS from a rookery, haul-out site or migrating populations. However, an overlap with the appearance of juvenile and fetal/newborn remains at DfSi-4. The overlap of juvenile and fetal/newborn could indicate that the Toquaht from DfSi-4 were hunting from a rookery, but only in limited numbers. The small NFS sample size makes it very difficult to interpret the death assemblage from DfSi-4.

**DfSi-4 - Adult/Adult Male**

The adult/adult male assemblage offers the most challenge in the interpretation of the DfSi-4 death assemblage. Only three adult elements were identified at DfSi-4. All three elements were femora and none of them could be confirmed as adult male. None of the femora are from the same levels (Fig 4-8). Their appearance appears more random than having any relationship or connection with the appearance of the fetal/newborn or the juvenile remains at DfSi-4. In all three cases, each element shows evidence of butchering. This leads one to conclude that these femora came from migrating NFS who were caught and processed elsewhere before they were brought back to DfSi-4.

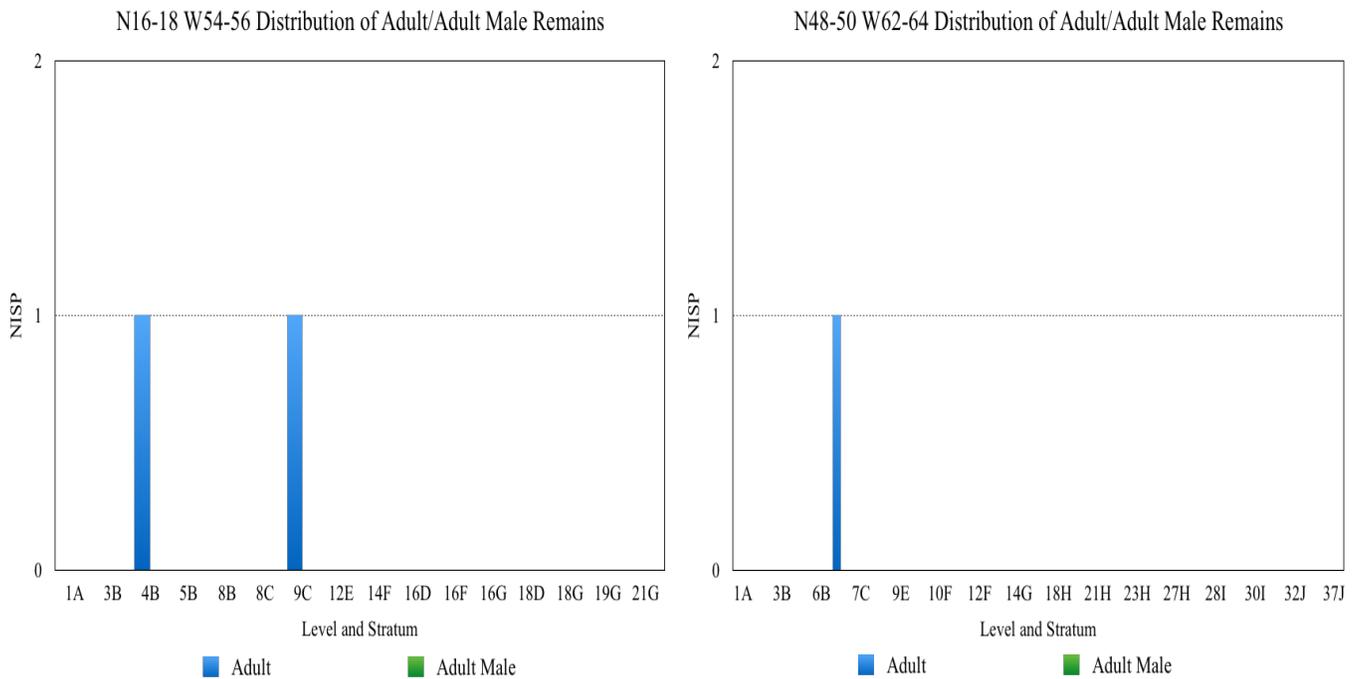


Fig 4-8: Distribution of Adult/Adult Male Remains at DfSi-4

**DfSi-4 – Observations and Analysis**

The usable death assemblage at DfSi-4 offers a very interesting picture (Fig 4-9). However, three important issues must be addressed before the death assemblage can be fully discussed.

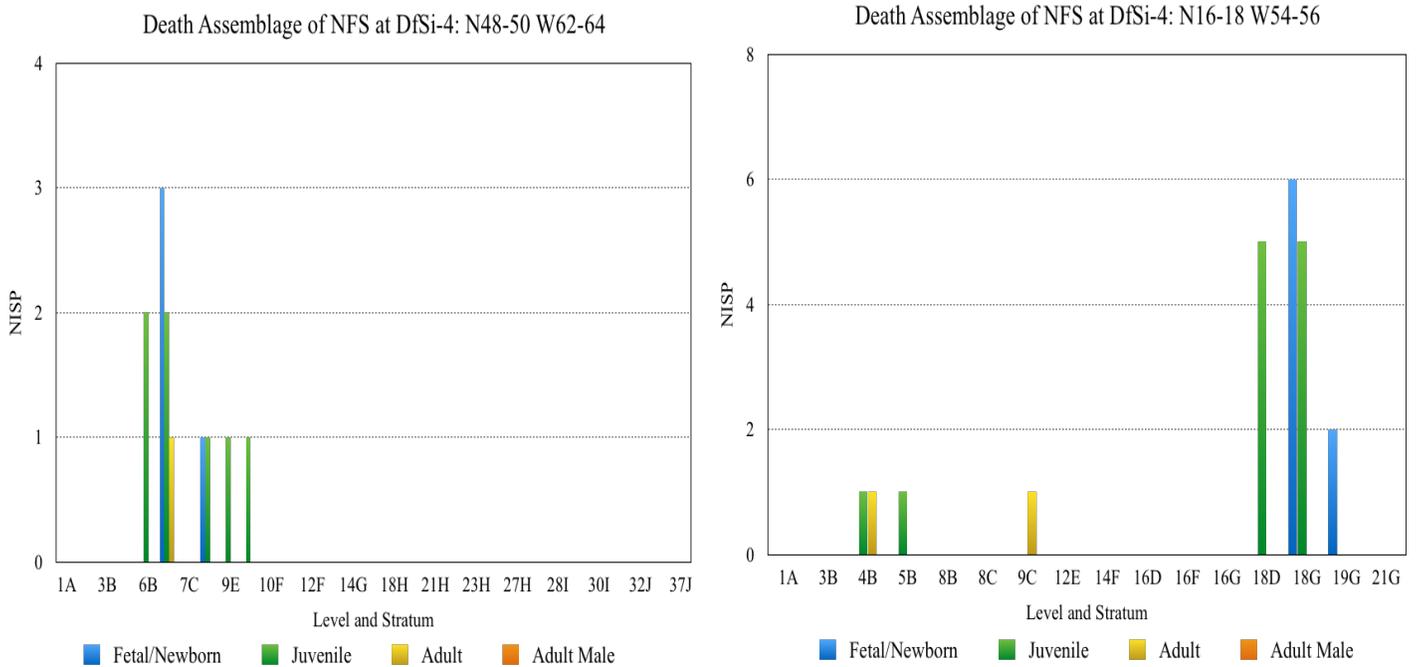


Fig 4-9: Death Assemblage of DfSi-4

Firstly, not all age categories are equally represented within the assemblage. Fetal/newborn and juvenile remains appear around the same time, but there are no adult remains during those periods. The adult remains that appear in the death assemblage from DfSi-4 are rare and spread out across the site’s levels. There is little overlap between adult, juvenile and fetal/newborn in N48-50 W62-64. The small sample size of adult makes any overlap with juvenile and fetal/newborn feel more random. Is the presence of one adult femur enough to demonstrate that adults were at DfSi-4 and thus suggest the

possibility of a rookery? The absence of any adult males is particularly troubling. Adult males and females along with fetal/newborn are key components to confirming the existence of a rookery. However, here at DfSi-4, there is no evidence of any adult males. Without any adult males one must call into question the existence of a rookery.

Secondly, fetal/newborn are present within the assemblage. Fetal/newborn NFS do not leave a rookery before 4 months of age, so their presence alone is usually a key indicator of a rookery. The appearance of fetal/newborn at DfSi-4 raises some interesting questions. The age estimates for the fetal/newborn do tend to range closer to the 0 months of age. The significantly younger median age of the fetal/newborn remains suggest that the fetal/newborn from DfSi-4 could be from pregnant NFS that are in the midst of migrating towards a NFS rookery. It is also possible that the concentrated presence of fetal/newborn remains in four levels across two units suggest a mortality event that caused fetal/newborns to die around those particular times. Another possibility is that the presence of fetal/newborn remains is an indicator that the DfSi-4 Toquaht were hunting from a rookery.

Lastly, the usable number of NFS elements from DfSi-4 is extremely low. Of the 92 identified NFS remains from DfSi-4 only 34 of the elements were usable for the purposes of this study. That means 63% of the identified remains from DfSi-4 were not usable because they were too fragmented. The large quantity of fragmented elements, along with the butchering marks, suggests the processing of NFS was happening elsewhere. If butchering was happening elsewhere, that could explain the small sample size of the NFS death assemblage from DfSi-4. Also, if butchering of the NFS was occurring elsewhere, it could skew the appearance of the death assemblage profile and

provide an inaccurate depiction of what kind of population the DfSi-4 Toquaht were hunting. Lech, Betts and Maschner (2011:126) suggest that butchery patterns will change as a result of resource stress. Based on Lech, Betts and Maschner's findings (2011) one could assume that the environmental stress was influencing the sealing practices at DfSi-4 and the DfSi-4 Toquaht were utilizing the prey choice model to select their prey. However, to support the assertion that butchering was taking place off site an element analysis would have to be conducted. Since an element analysis was not conducted any observations that butchering was taking place offsite is speculation.

Keeping the three points mentioned above in mind, plus: the under representation of adults in the death assemblage, the concentration of fetal/newborn elements within the units and the higher representation of juvenile remains found more consistently throughout the levels at DfSi-4, it is more likely that the Toquaht were hunting from a haul-out or migrating population than a rookery. It could be argued that rookery may have served as the main source for NFS for the DfSi-4 Toquaht. This evidence includes the presence of fetal remains, the overwhelming evidence of a rookery at DfSj-23A and DfSi-4's proximity to DfSj-23A; but this evidence is circumstantial. DfSi-4 was occupied much earlier than DfSj-23A and the environmental conditions of earlier times may have been different and not favor NFS breeding in the area. Also NFS move breeding locations for poorly understood reasons, suggesting that any rookery that existed may have periodically appeared or disappeared. The evidence that the DfSi-4 Toquaht could have been hunting from a rookery is just not conclusive enough because the sample size is too limited. Further investigation at DfSi-4 is needed to demonstrate the presence of a rookery within close proximity to DfSi-4.

## **Analysis and Conclusions**

DfSj-23A and DfSi-4 are two very different sites. The length of site occupation between the two sites alone makes comparisons between the sites difficult. However, the one thing both sites demonstrate is that NFS hunting did play a role in the Toquaht way of life. Both DfSj-23A and DfSi-4 demonstrated that the role NFS played in the Toquaht livelihood was one that evolved over time. DfSj-23A shows long periods of heavy NFS hunting from what can only be interpreted as a NFS rookery. DfSi-4 demonstrates that NFS were being hunted and transported back to the site for consumption intermittently throughout the sites occupation. However, NFS was not consistently consumed throughout the sites occupation. There is some suggestion that the butchering of NFS at DfSi-4 was not occurring onsite, but was occurring at another location. Larger amounts of NFS were being hunted fairly consistently throughout DfSj-23A's occupation, whereas the hunting of NFS at DfSi-4 appears to ebb and flow most likely as NFS were available to its inhabitants. NFS may have been a significant resource at DfSj-23A however at DfSi-4 NFS appears to be a supplementary resource which was exploited depending on its abundance, predictability and risk.

The difference between how NFS is represented at DfSj-23A and DfSi-4 shows a shift in NFS significance for the Toquaht economy. The shift in NFS significance could be due to many reasons. Some of these reasons include: accessibility to the resource, ecological changes and sociological limitations (eg. social hierarchy, accessibility, resource rights). At this point, it is only possible to speculate what could have caused any

shift in the role NFS played within the Toquaht economy. Further investigation is needed to fully understand the significance of NFS within the Toquaht economy.

As Monks (2005:170) states, the relationship between humans and sea mammals is not a “deterministic relationship”; instead it is based around a “dynamic mutual interrelationship.” DfSj-23A and DfSi-4 have both provided significant evidence that NFS played a role within the Toquaht lifestyle. Given that NFS existed significantly within the Toquaht livelihood for over 2000 years it can be argued that the Toquaht recognized early on that the NFS were a resource to be protected and valued.

## Chapter Five - Conclusion

This thesis worked to build a demographic profile of the NFS death assemblages at DfSj-23A and DfSi-4 to explore the possibility that a rookery may have existed within the Barkley Sound Area in the past. To determine if a rookery existed, this study employed a non-linear growth curve algorithm developed by Michael Etnier (2002), and ancient DNA analysis to build a demographic profile of the NFS death assemblages. The following section explores the patterns and observations that emerged from the analysis of the NFS death assemblage profiles.

### **Conclusion: Evidence of a Rookery**

For a rookery to have existed at Barkley Sound, four age categories must be represented within the death assemblages from DfSj-23A and DfSi-4. These age

categories are: fetal/newborn, juvenile, adult and adult male (Etnier 2002, Friedman 1976; Gifford-Gonzalez 2005, Lyman 1988, 1991, McMillan and St. Claire 2003).

DfSj-23A presented significant evidence that a rookery existed within hunting proximity to the site. Fetal/newborn, juvenile, adult and adult male remains were found at the site dating to as early as AD 1040. These age categories were also represented fairly consistently throughout the site's history, suggesting that the Toquaht of DfSj-23A were hunting from a rookery over a significant period of time.

DfSi-4 presented a very different picture of the NFS hunting habits of the Toquaht. While each age category was represented in some manner at DfSi-4, they were not represented consistently or in significant enough quantities to suggest the presence of a NFS rookery. Consequently, the evidence from DfSi-4 would lead to the assumption that the DfSi-4 Toquaht were gathering NFS from a haul-out site or during migration. Yet, the sample size issues at DfSi-4 leave everything unresolved, meaning it is still possible that the DfSi-4 Toquaht were hunting from a rookery.

However, DfSi-4 displayed an interesting insight into the NFS hunting practices taking place at the site. The majority of the remains from DfSi-4 were too fragmented to gather any information on age at death and thus were useless for the purposes of this thesis. However, given the fragmentation of many of the remains, the smaller sample size from DfSi-4 and the butchering marks seen on quite a few of the remains, it is possible that the butchering of any NFS consumed at the site took place elsewhere. If butchering was taking place somewhere else and the NFS were being transported back to DfSi-4 for consumption, then a demographic age profile of the death assemblage would be skewed and inconclusive. Further investigation and an analysis of body part representation is

needed to fully understand the nature of the butchering practices that were being done at DfSi-4 and to determine if butchering practices were occurring offsite.

### **Conclusion: Optimal Foraging and Targeted Hunting**

The death assemblages from DfSj-23A and DfSi-4 both demonstrated that selective hunting and optimal foraging practices were utilized. Both sites demonstrated a preference for smaller prey like juveniles. Juveniles made up the majority of the death assemblages at both sites. Gifford-Gonzalez et al. (2005:22-23) predicted smaller NFS would be a higher ranked prey because there is less risk in hunting them and they are more accessible. While juveniles may provide less return, they would be easier to transport whole for processing, storage and consumption. The ease of transporting juveniles whole may be why they make up the majority of the assemblages from DfSj-23A and DfSi-4. If adults and adult males were also being targeted, they may have been butchered off site. If adults were being butchered off site, any findings of adults the death assemblage would be skewed. The findings would be skewed as any remains that were too badly damaged were not used in the analysis of this study.

### **Conclusion: Historical Ecology and the Importance of NFS in the Toquaht Economy**

Very little can be determined about the cultural or social significance of the NFS in the Toquaht livelihood from the findings of this thesis. However, it can be said that the NFS was a significant resource. NFS hunting did not appear to become a regular part of

the Toquaht livelihood until around AD 1040. Prior to AD 1040 NFS only appear in the faunal record sporadically. The timeline of the NFS appearance suggests a shift in the economy and livelihood of the Toquaht around AD 1040. Whether this shift was due to sociological or ecological influences is open to speculation at this point. In his continued studies of DfSj-23A and DfSi-4, Greg Monks (2009) has made note of a Medieval Climatic anomaly that occurred around this time period.

One possible theory is the establishment of a rookery could have led to the settlement of DfSj-23 and thus initiated a social development catalyst for the Nuu-CHAN-nulth resulting in DfSj-23 becoming an important economic center in its later years and DfSi-4's corresponding drop in importance. NFS would have the potential to provide the Toquaht with food, tools, oil, skins and other resources and thus would have played an important subsistence role in the Toquaht economy. It would be important to protect and lay claim to any such resource.

### **Limitations with the research**

There are two main limitations with the research conducted in this thesis. Firstly, the conclusions in this thesis are largely based on observations that are limited by the small number of usable elements that worked with Michael Etnier's algorithm. A re-examination of all of the remains found at DfSj-23A and DfSi-4, regardless of their suitability in Etnier's algorithms, would provide more data and thus provide a more accurate death assemblage profile. Part of the examination of unusable elements from DfSj-23A and DfSi-4 would be an exploration into the butchering techniques and the

hunting techniques used at each site. By exploring the butchering and hunting techniques, one would be better able to understand the fragmented NFS element and thus create a more accurate death assemblage profile or better understand the limitations of the death assemblage profiles.

Secondly, the NFS sample size from DfSi-4 alone provides great limitations. Only 34 elements of the 92 NFS remains from DfSi-4 were usable for the purposes of this study. Any observations or patterns that emerged from the data are just as likely to be coincidence. More data is needed to create an accurate death assemblage profile for DfSi-4. In order for NFS to better represented at DfSi-4 the 40% random sampling method, employed by Monks in his research of DfSi-4, may have to be forgone. Alternatively, other aging methods, that allow the aging of fragmented bones, may also be of some use in the creation of a death assemblage profile at DfSi-4.

### **Future Directions**

This thesis has demonstrated that NFS played a long-term and varying role within the Toquaht economy. However, this is only the first step in understanding the dynamic coexistence of the Toquaht people and NFS over an extended period of time. This mutual interrelationship between the Toquaht people and NFS leads to interesting economic, social and environmental questions. For example, did, as has been suggested by Dewhirst (1980:344) and Matson and Coupland (1995:272-274), NFS act as a social development catalyst for the Nuu-chan-nulth and, by extension, the Toquaht? Was NFS available equally to all group members? What led to the decline of NFS hunting within

Toquaht territory, and what impact did the decline of NFS hunting have on the Toquaht? What importance did NFS have in the subsistence economy relative to other food resources? At the heart of all of these questions lies the biggest question of all: what was the role and importance NFS hunting played in Toquaht culture? By better understanding this role, other questions about the Toquaht and their relationships with different aspects of their environment over deep time can be investigated. Some of the questions that arise from such investigations may not ultimately have anything to do with NFS. However, NFS and this thesis are just small pieces of a much larger examination into the Toquaht cultural history.

## **Conclusion**

This thesis determined that sufficient evidence existed to support the existence of a rookery within the Barkley Sound area of Vancouver Island, British Columbia and thus within close proximity to DfSj-23 and DfSi-4 during certain periods of each sites' occupation. The death assemblage at DfSj-23A demonstrated the presence of fetal/newborn, juvenile, adult and adult male remains. All of which are required to demonstrate the presence of a rookery. Therefore it can be concluded that a rookery was most likely being exploited by the DfSj-23A Toquaht.

While the death assemblage from DfSi-4 does not demonstrate a population consistent with a rookery that does not mean a rookery never existed. The death assemblage from DfSi-4 could be interpreted a number of ways including that that the DfSi-4 Toquaht may have been exploiting NFS from another source such as a haul-out site, during migration, open ocean NFS or the DfSi-4 Toquaht could have been traveling

to a rookery. However the sample size limitation of DfSi-4 makes it impossible to come to any conclusions as to the hunting practices of the DfSi-4 Toquaht and further analysis is needed.

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## **Appendix A: Age Distribution Graphs & Adult Comparison Graphs**

The following graphs demonstrate the age distributions used to determine the estimated age for each fetal/newborn and juvenile element. Each element was measured three times and then an average of each measurement was used to determine an age range for each measurement. For a description of each measurement please see chapter 3. The following box and whisker plots demonstrate the age range for each element and the central tendency of the age estimates for each element. It is from the central tendency that the estimated age at death was determined from each fetal/newborn and juvenile element. The dots on the box and whisker plots show outliers. Each graph was constructed using SPSS.

Also included in appendix A is a series of graphs that compare certain measurements (e.g. Length) between the adult elements. These comparisons helped to determine between adult and adult male. However not all the measurements are included in these comparisons as only the measurements that were best represented among each collection were used. Each graph was constructed using numbers.

The specimens are grouped according to element and site. If there is a chart missing for an element or age category it is because there was not enough data.

**DfSj-23A - Femur**

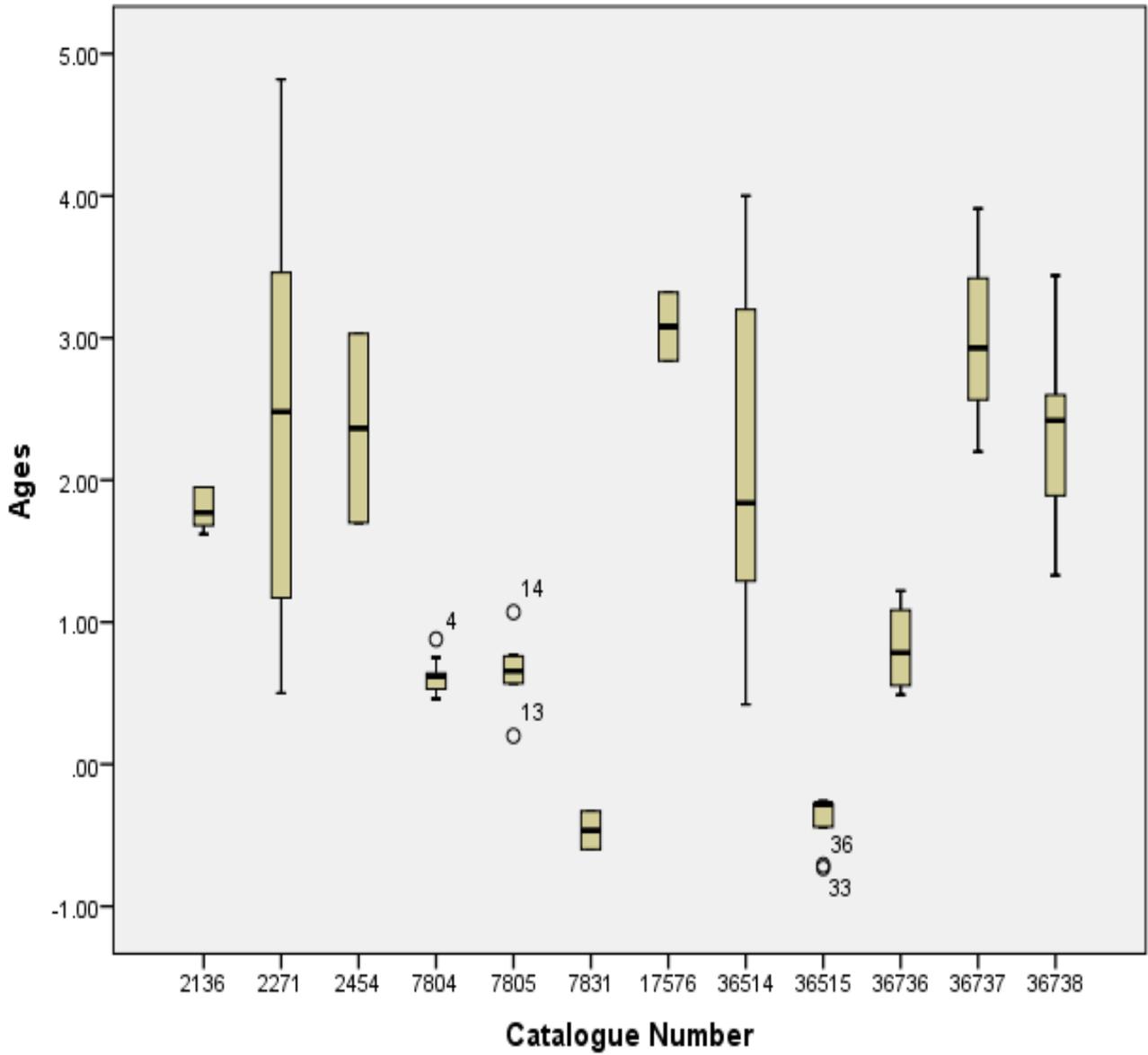


Fig A-1 – Fetal/newborn and juvenile age distributions for femora from DfSj-23A

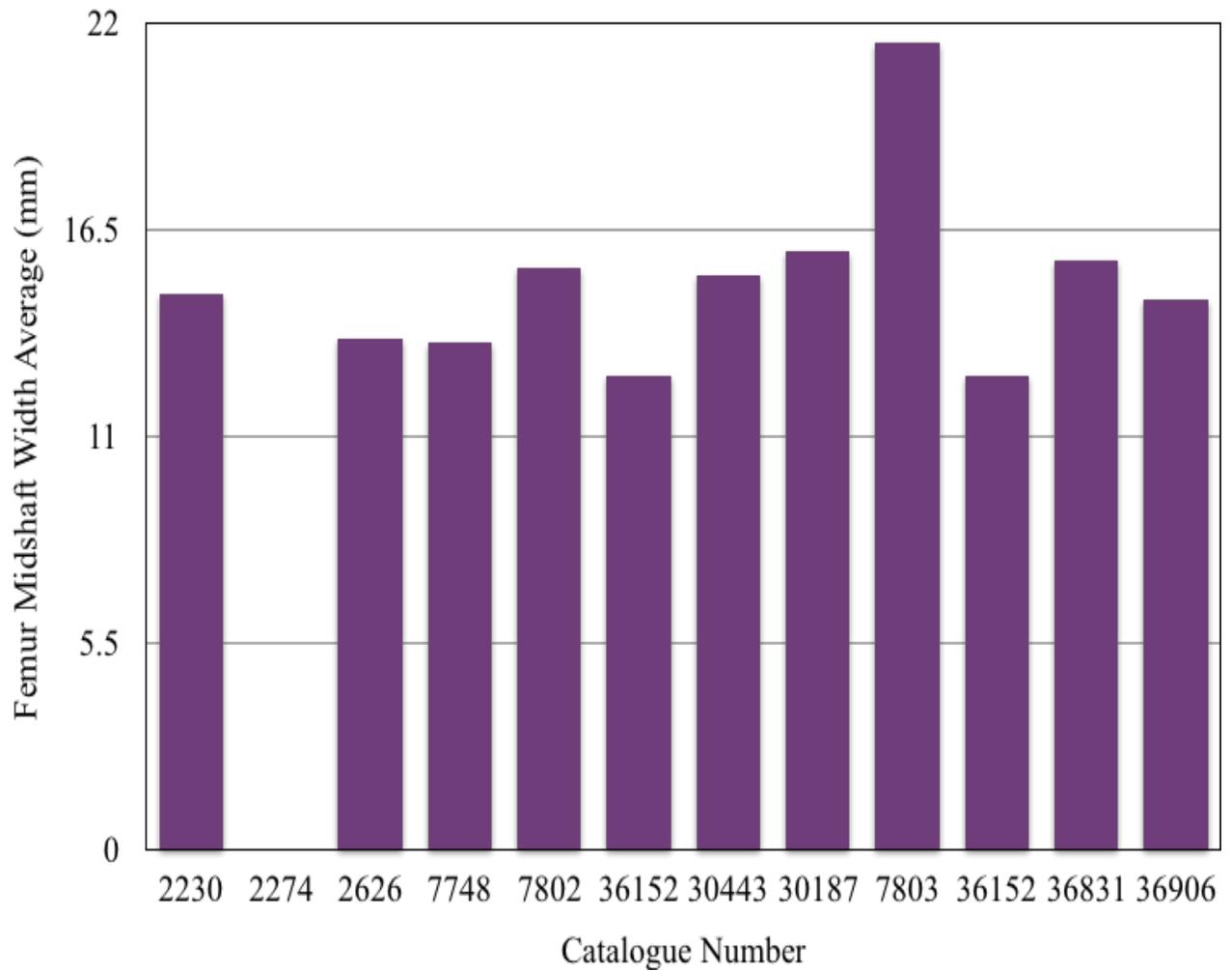


Fig A-2 – Adult femora midshaft width and thickness average comparisons. Midshaft thickness was not available. The midshaft width for 2274 was unobtainable and is thus left blank in the graph above.

**DfSj-23A - Fibula**

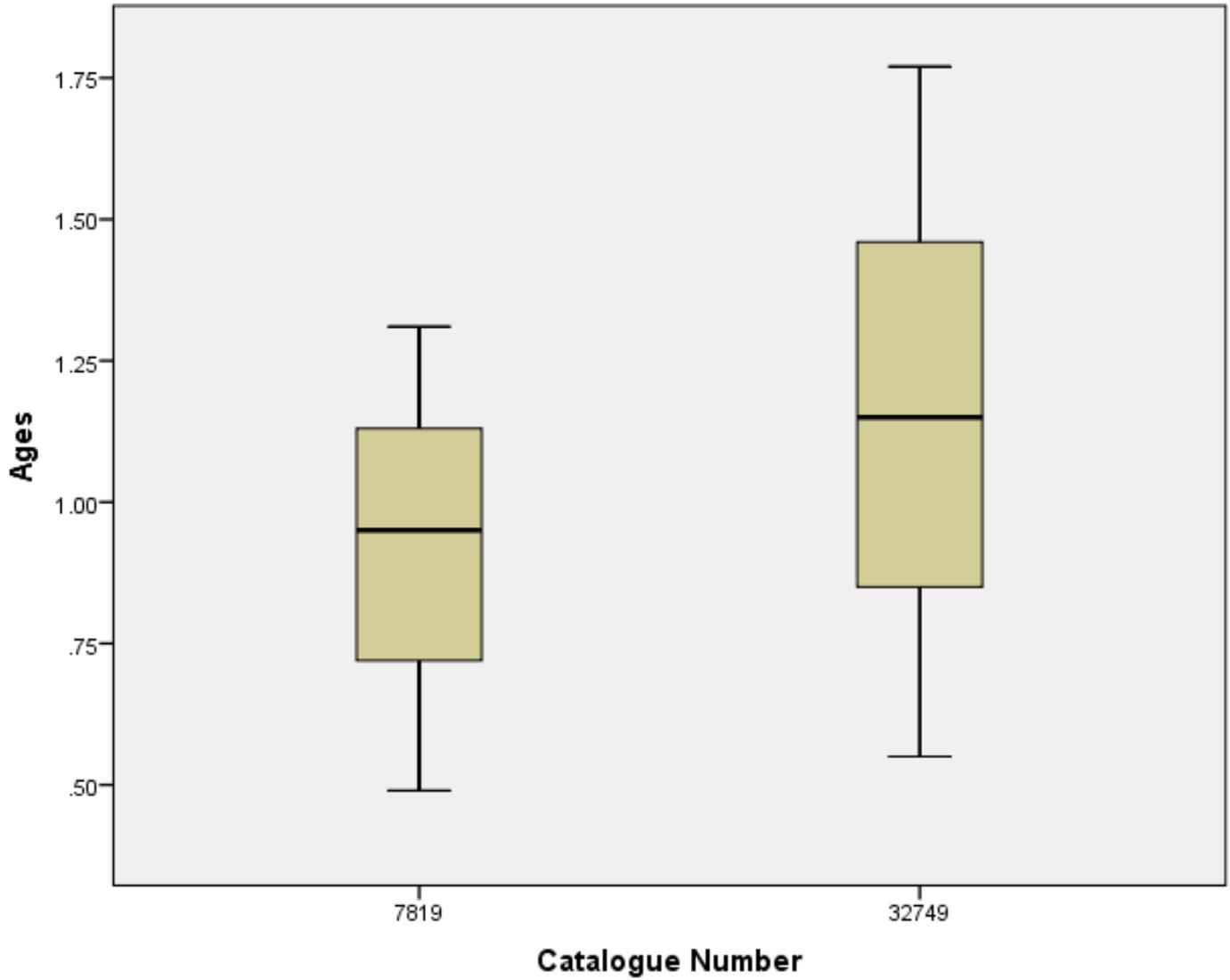


Fig A-3 – Fetal/newborn age distributions for fibulae from DfSj-23A. There were no juvenile fibulae at DfSj-23A

**DfSj-23A - Humerus**

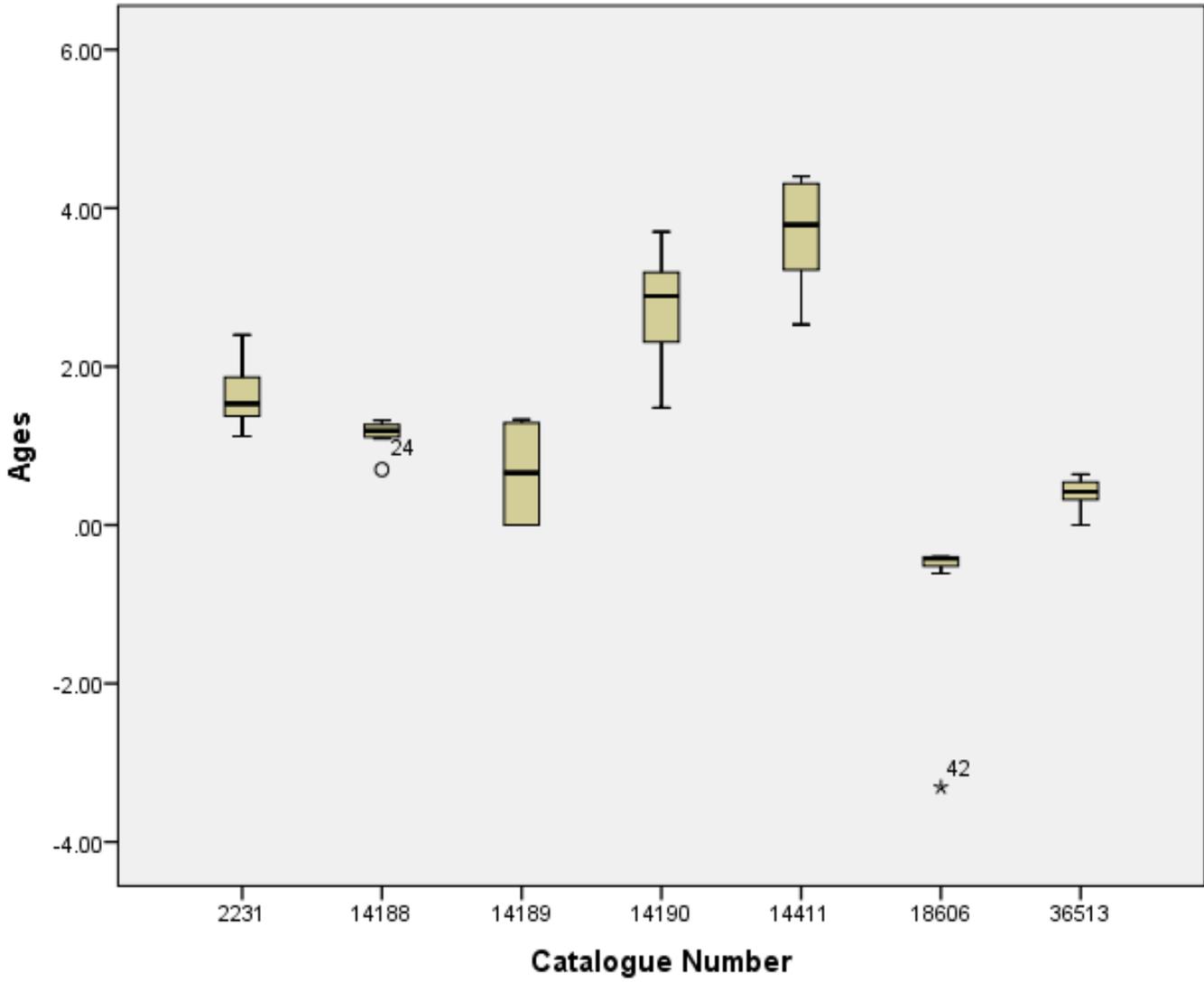


Fig A-4 – Fetal/newborn and juvenile age distributions for humeri from DfSj-23A

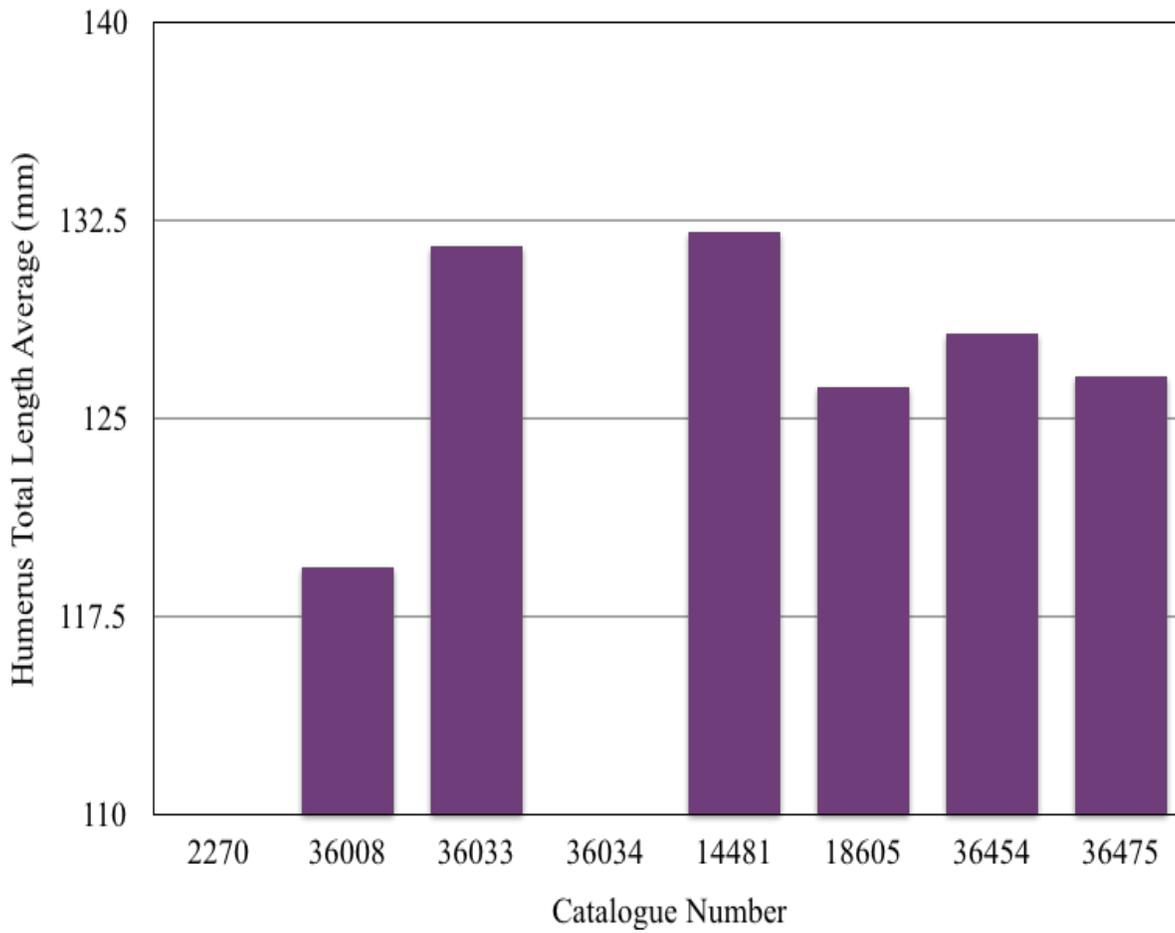


Fig A-5 – Adult humeri total length average comparisons. The length measurements for 2270 and 36034 were unobtainable and are thus left blank in the graphs above.

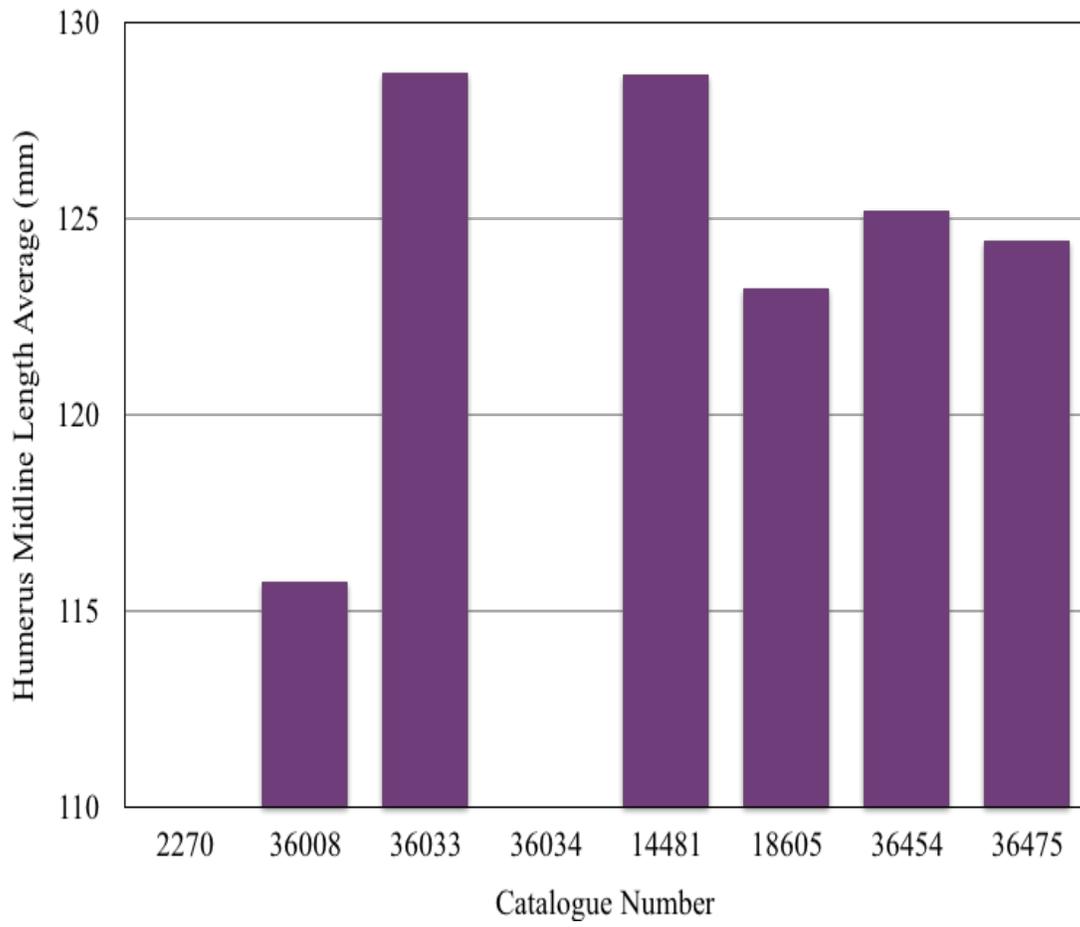


Fig A-6 – Adult humeri total midline length average . The length measurements for 2270 and 36034 were unobtainable and are thus left blank in the graphs above

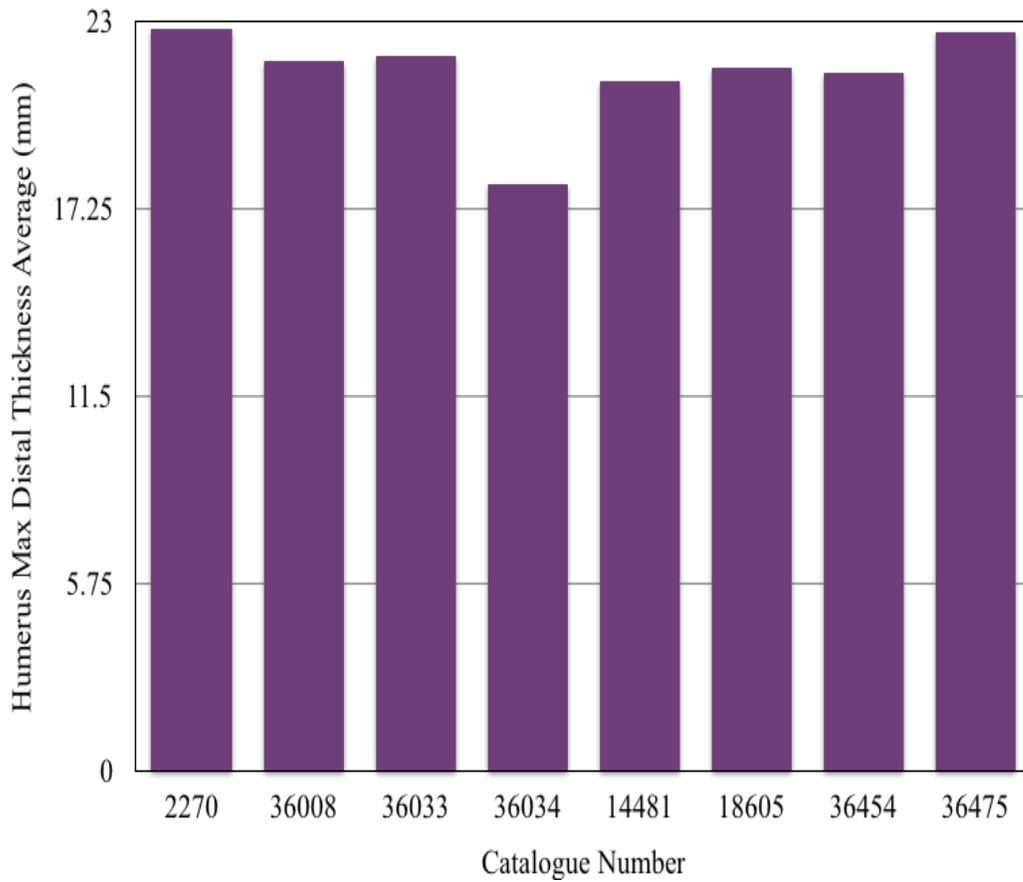
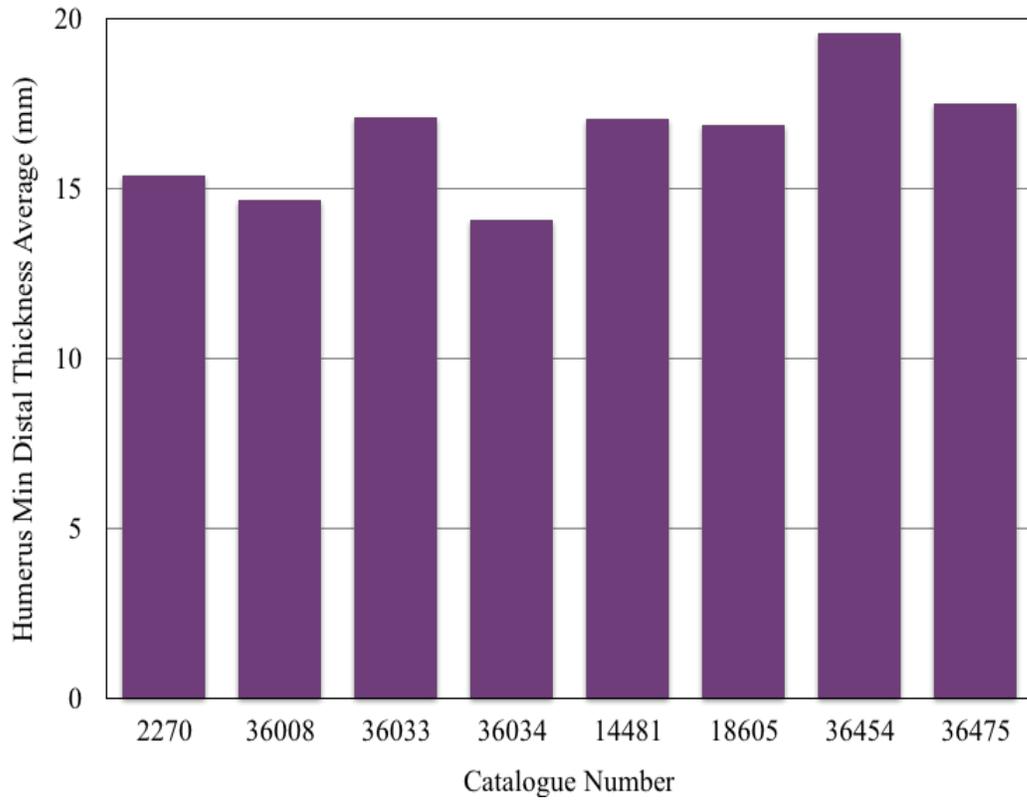


Fig A-7 – Adult humeri min and max distal thickness average comparisons

**DfSj-23A - Mandible and Teeth**

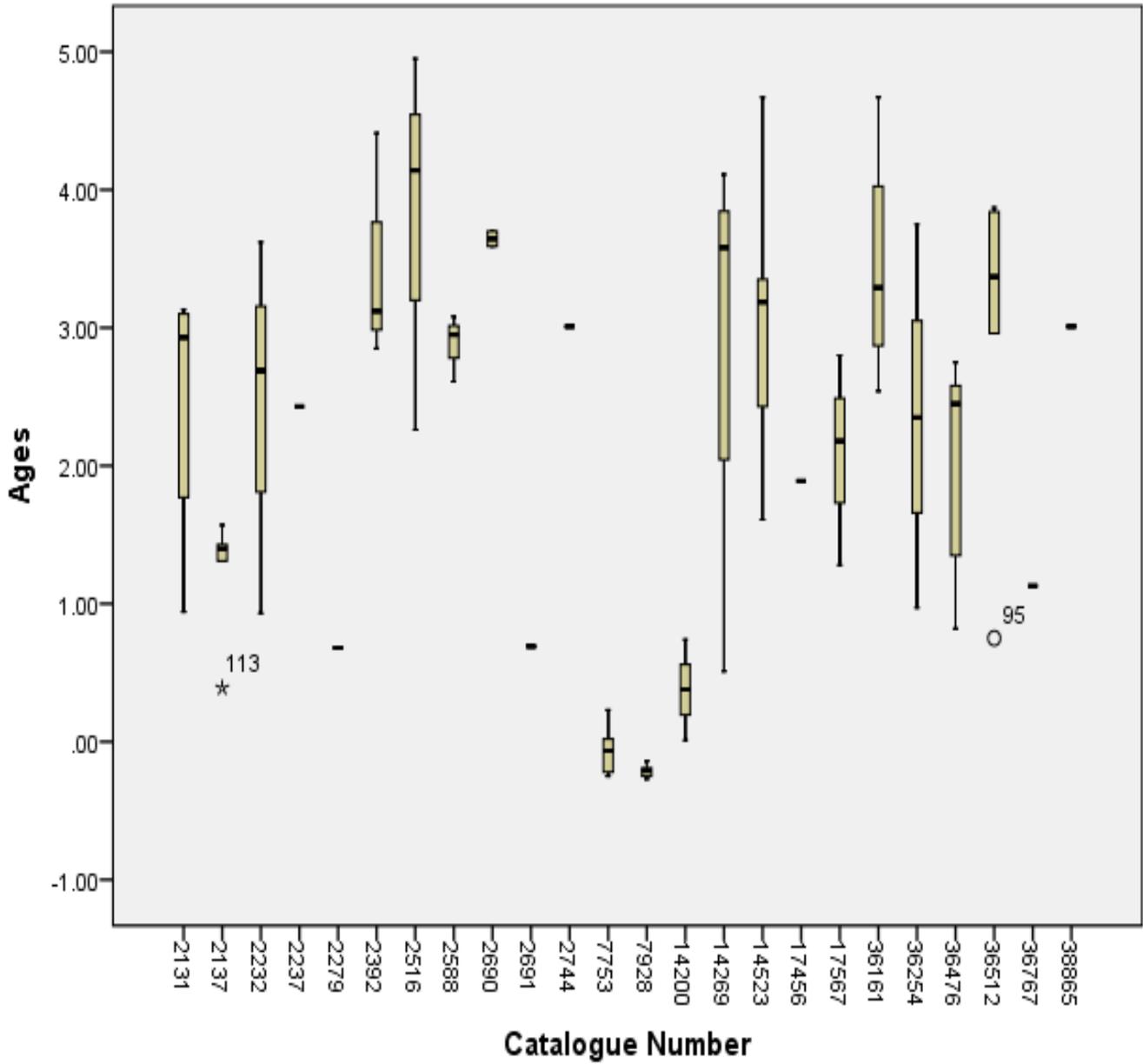


Fig A-8 – Fetal/newborn and juvenile age distributions for mandible and teeth from DfSj-23A

**DfSj-23A - Metacarpal**

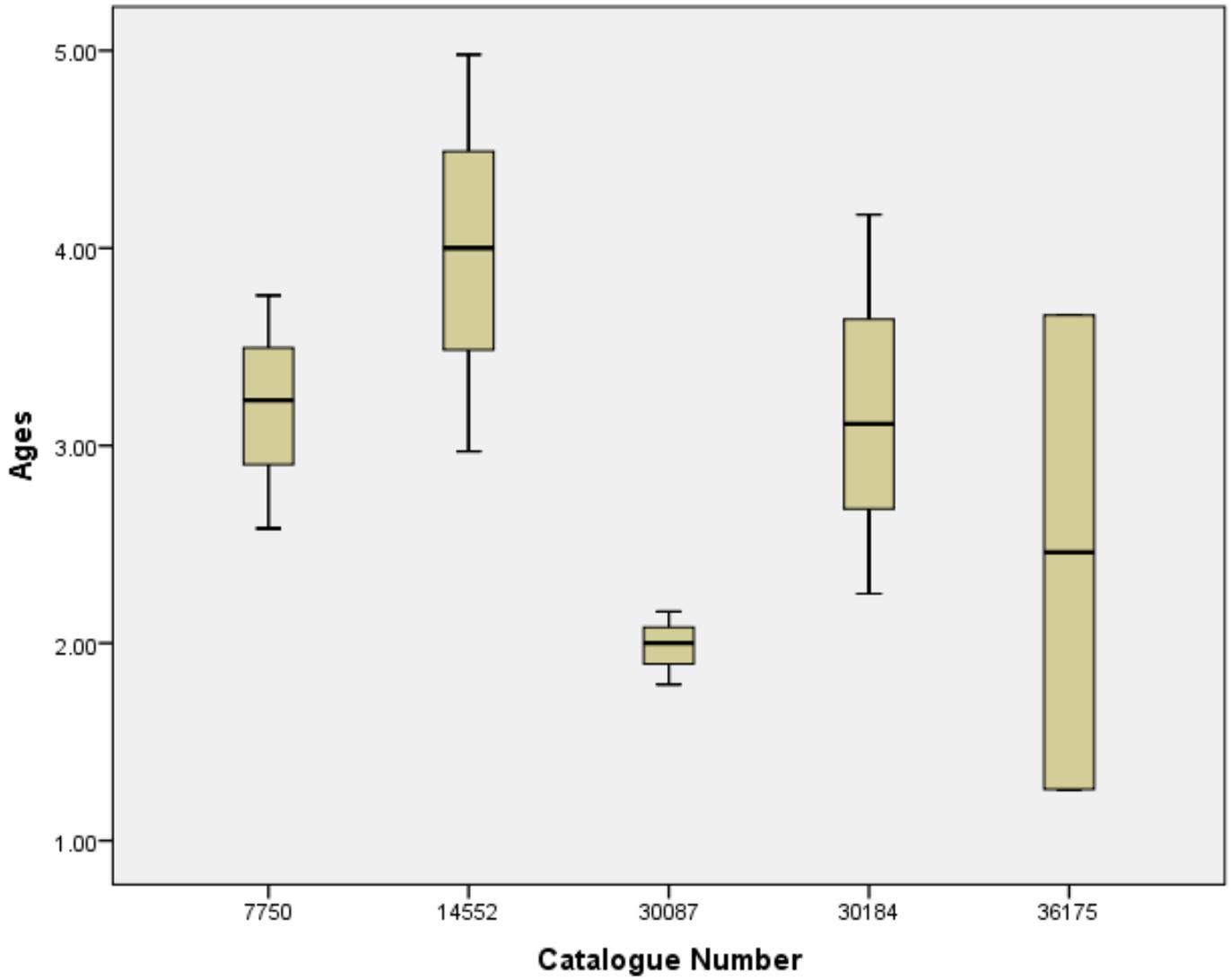


Fig A-9 – Juvenile age distributions for metacarpal from DfSj-23A. There were no fetal/newborn metacarpal at DfSj-23A

**DfSj-23A - Metatarsal**

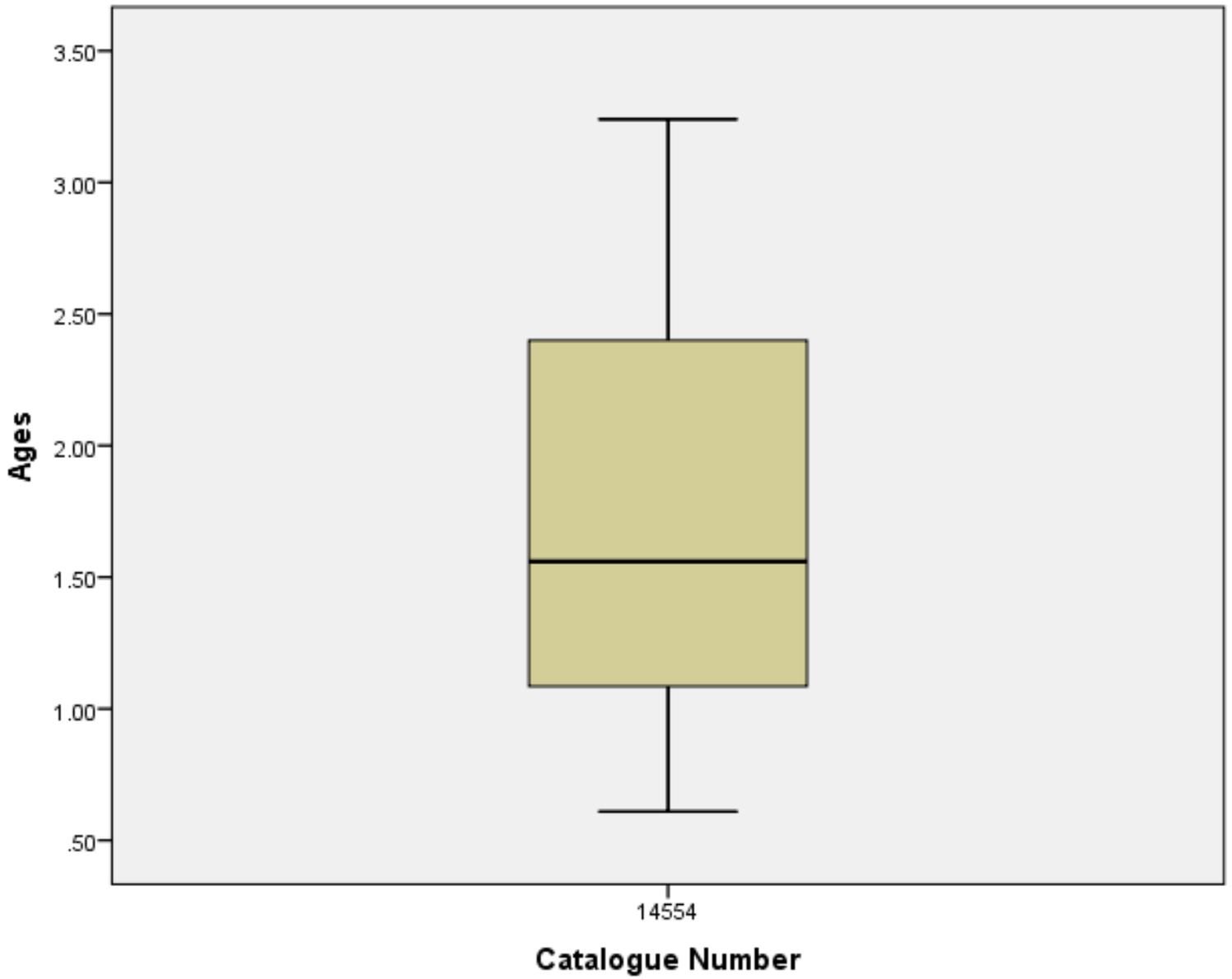


Fig A-10 – Juvenile age distributions for metatarsal from DfSj-23A. There were no fetal/newborn metatarsal at DfSj-23A

**DfSj-23A - Radius**

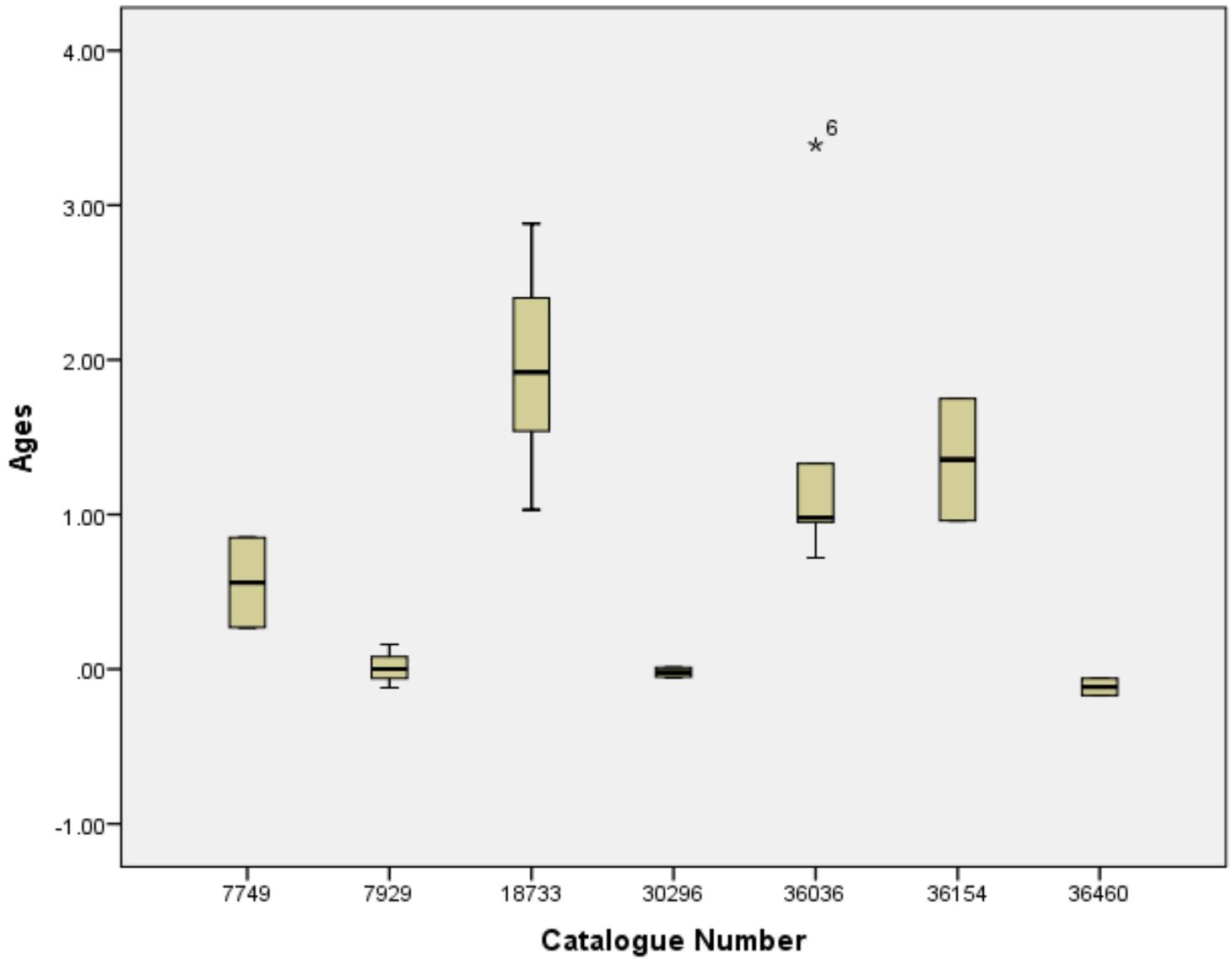


Fig A-11 – Fetal/newborn and juvenile age distributions for radii from DfSj-23A

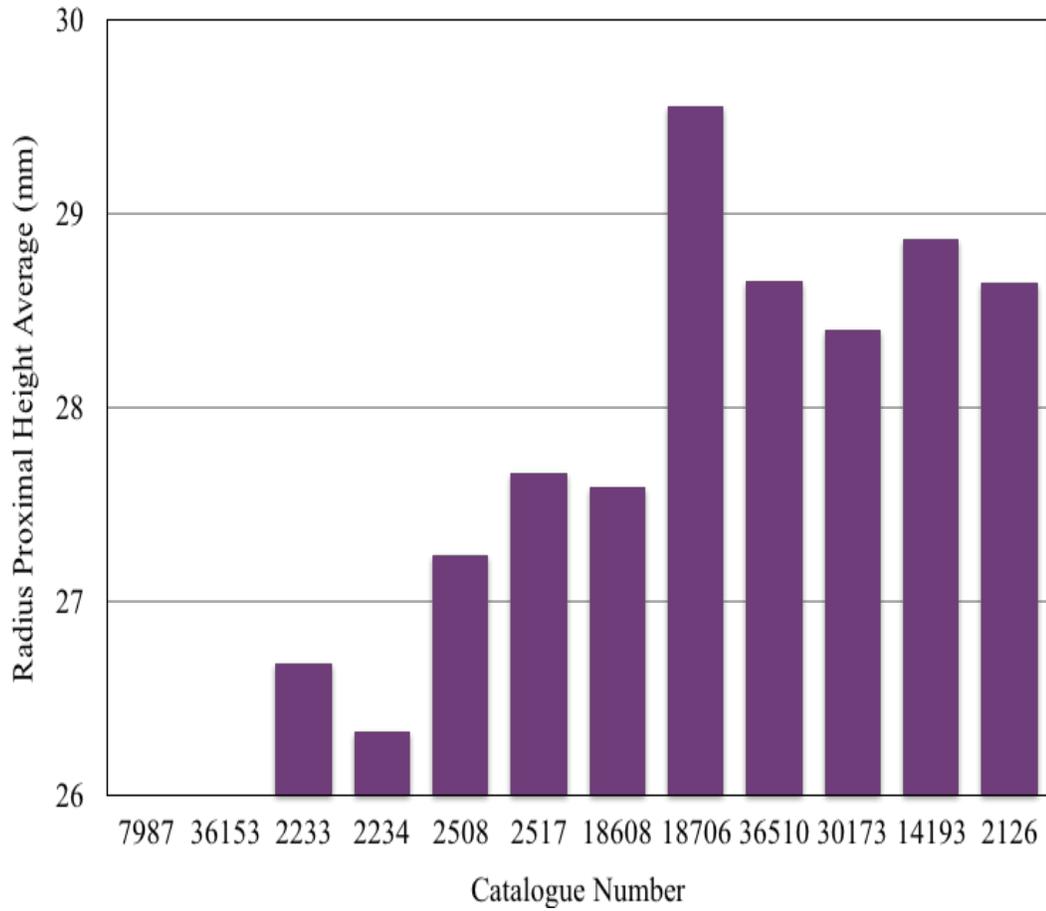


Fig A-12– Adult radii proximal height average comparisons. The proximal height measurements for 7987 and 36153 were unobtainable and are thus left blank in the graphs above

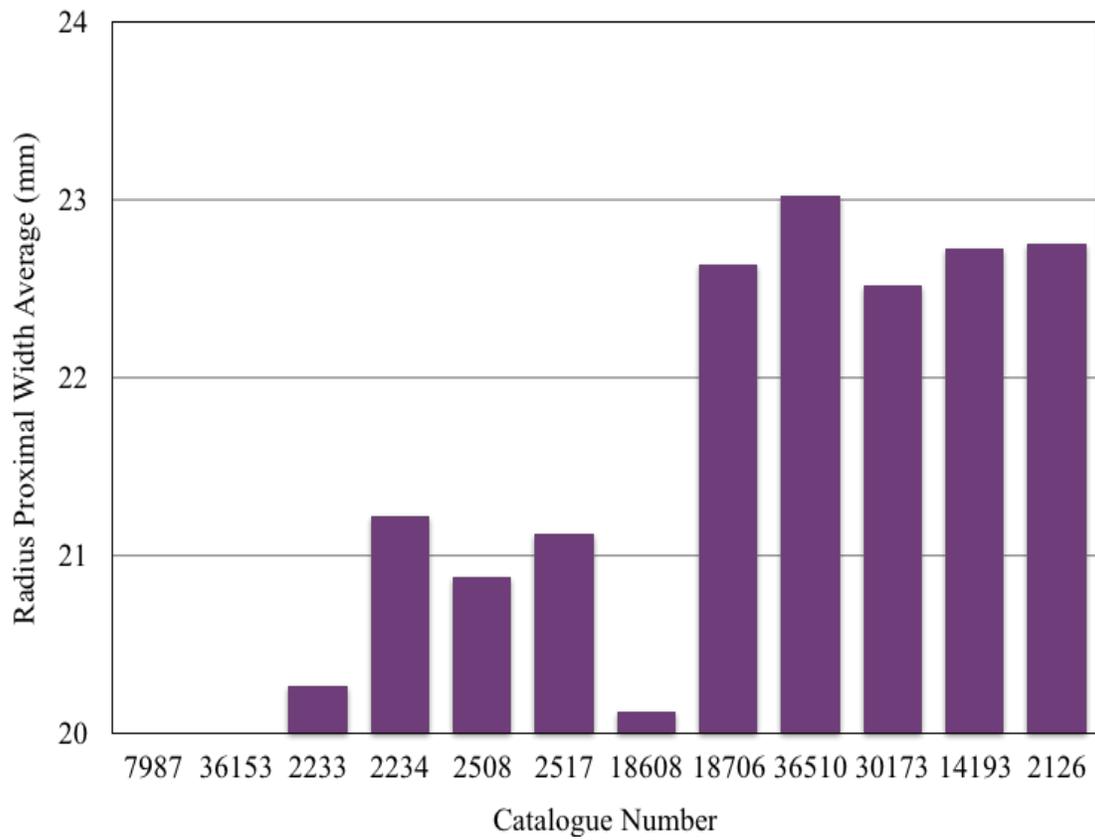


Fig A-13– Adult radii proximal width average comparisons. The proximal width measurements for 7987 and 36153 were unobtainable and are thus left blank in the graphs above

**DfSj-23A - Scapula**

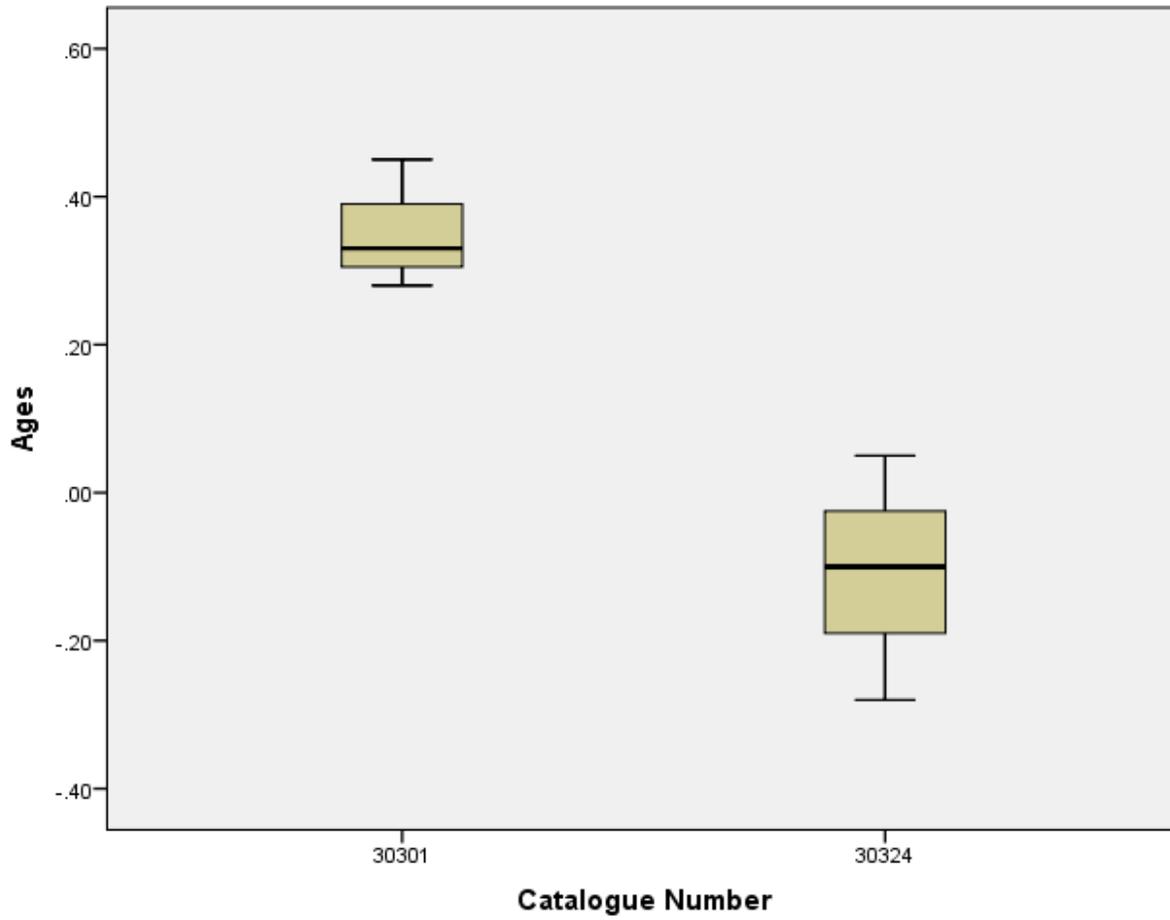


Fig A-14– Fetal/newborn age distributions for scapulae from DfSj-23A. There were no juvenile scapulae at DfSj-23A

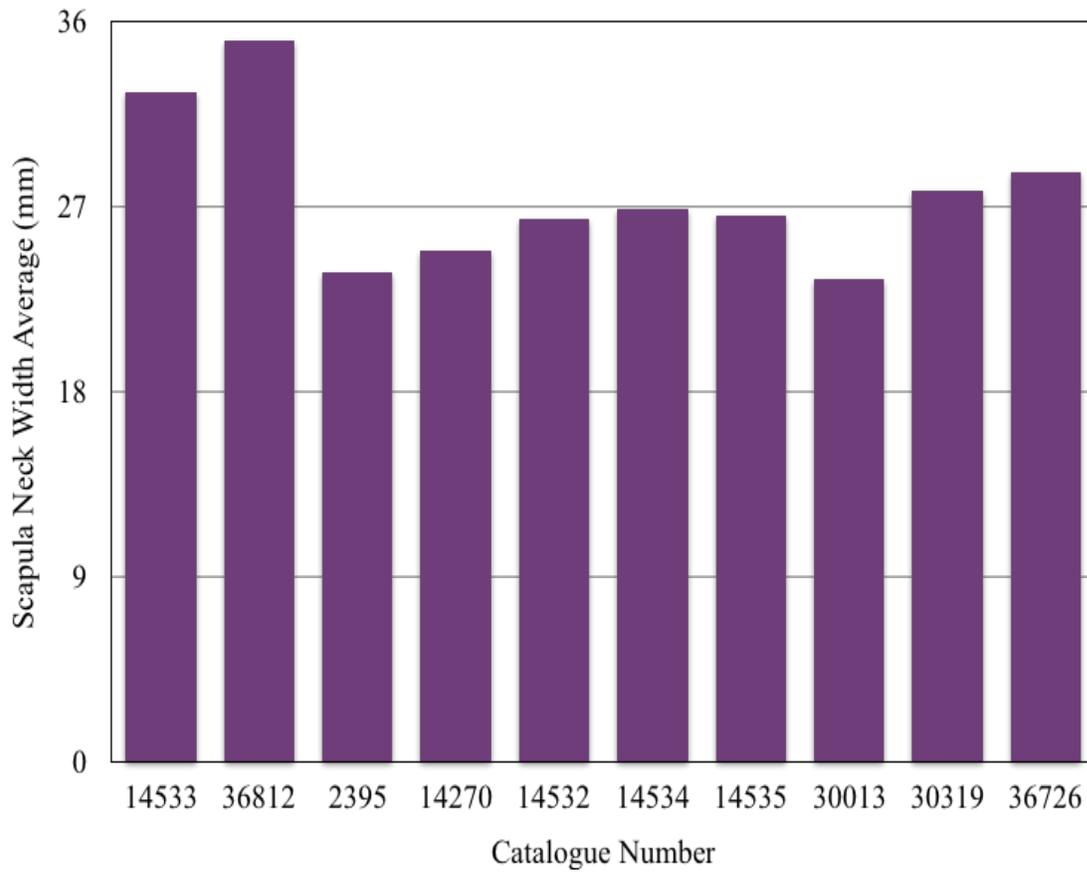


Fig A-15– Adult scapulae neck width average comparisons

**DfSj-23A - Tibia**

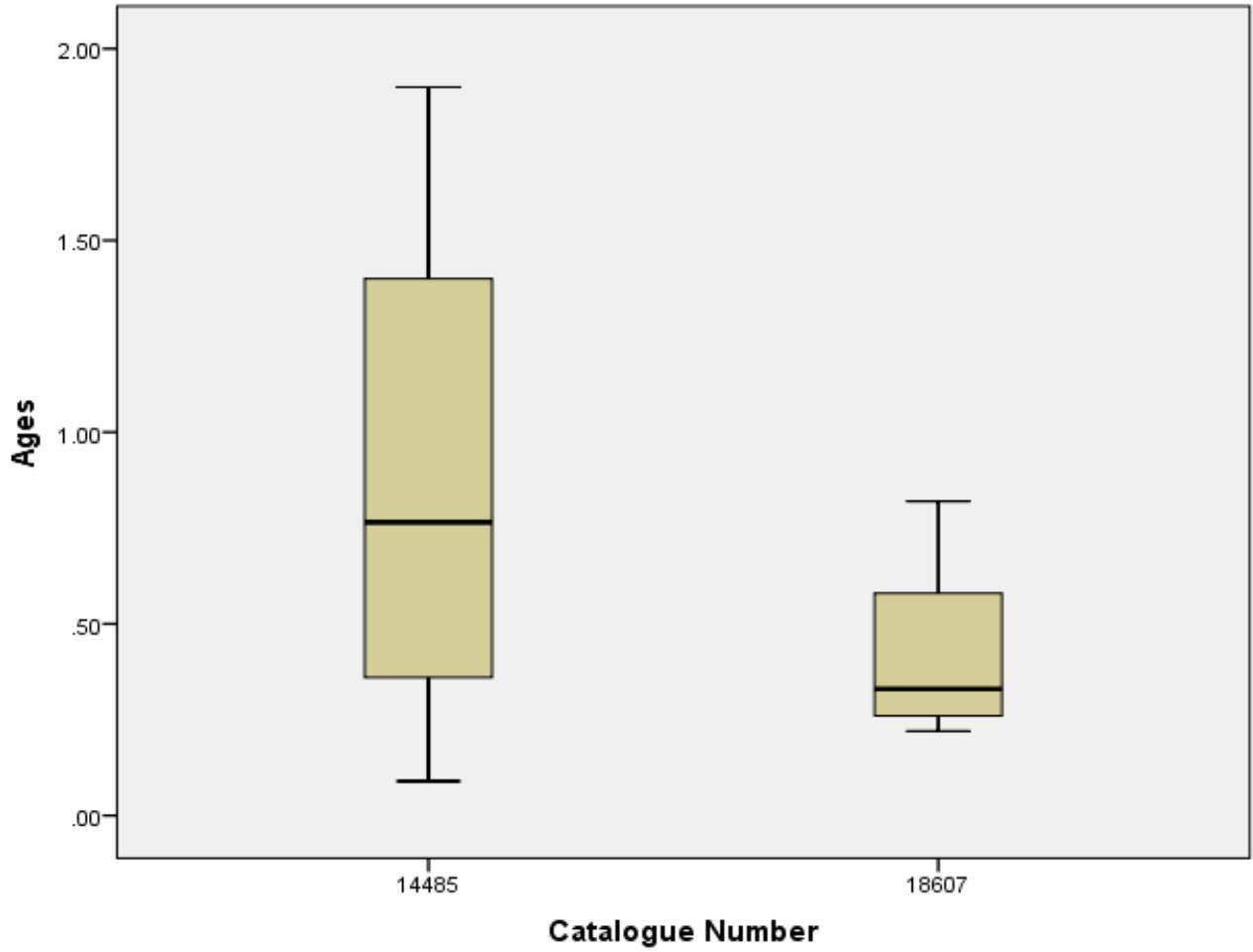


Fig A-16– Fetal/Newborn age distributions for tibiae from DfSj-23A. There were no juvenile tibiae at DfSj-23A

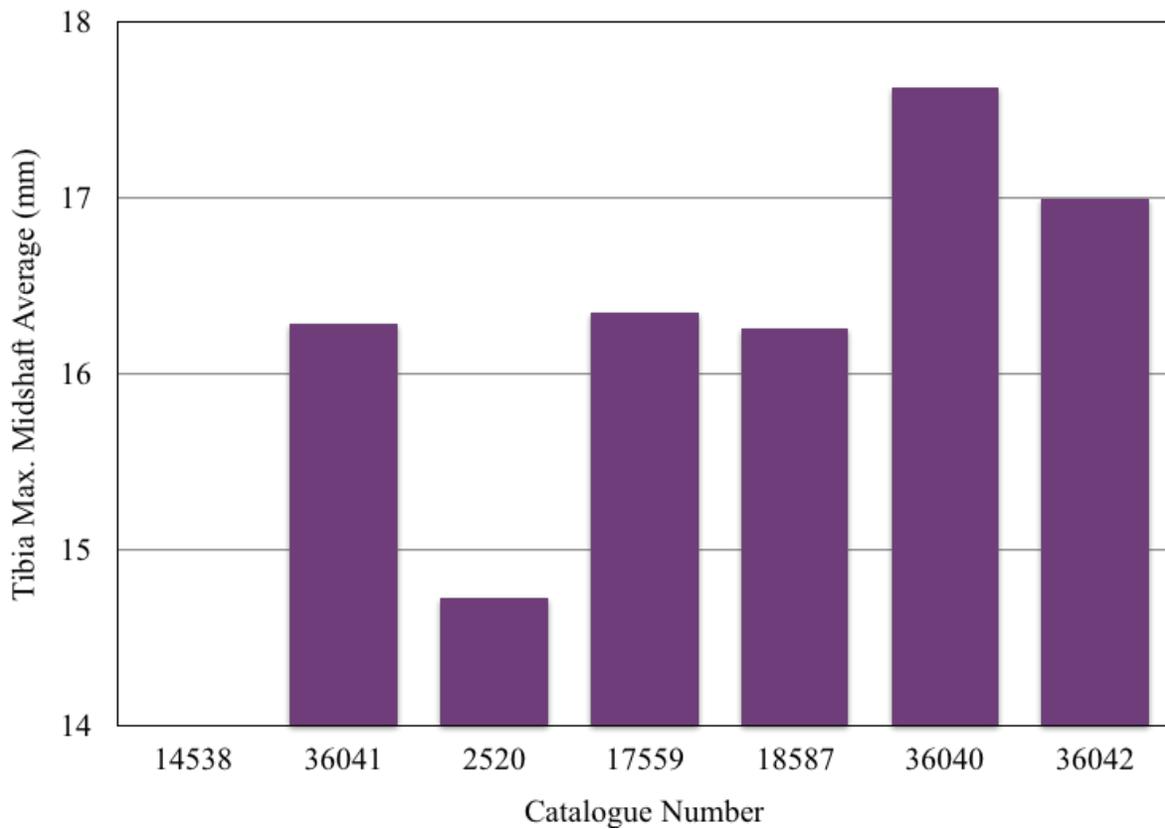
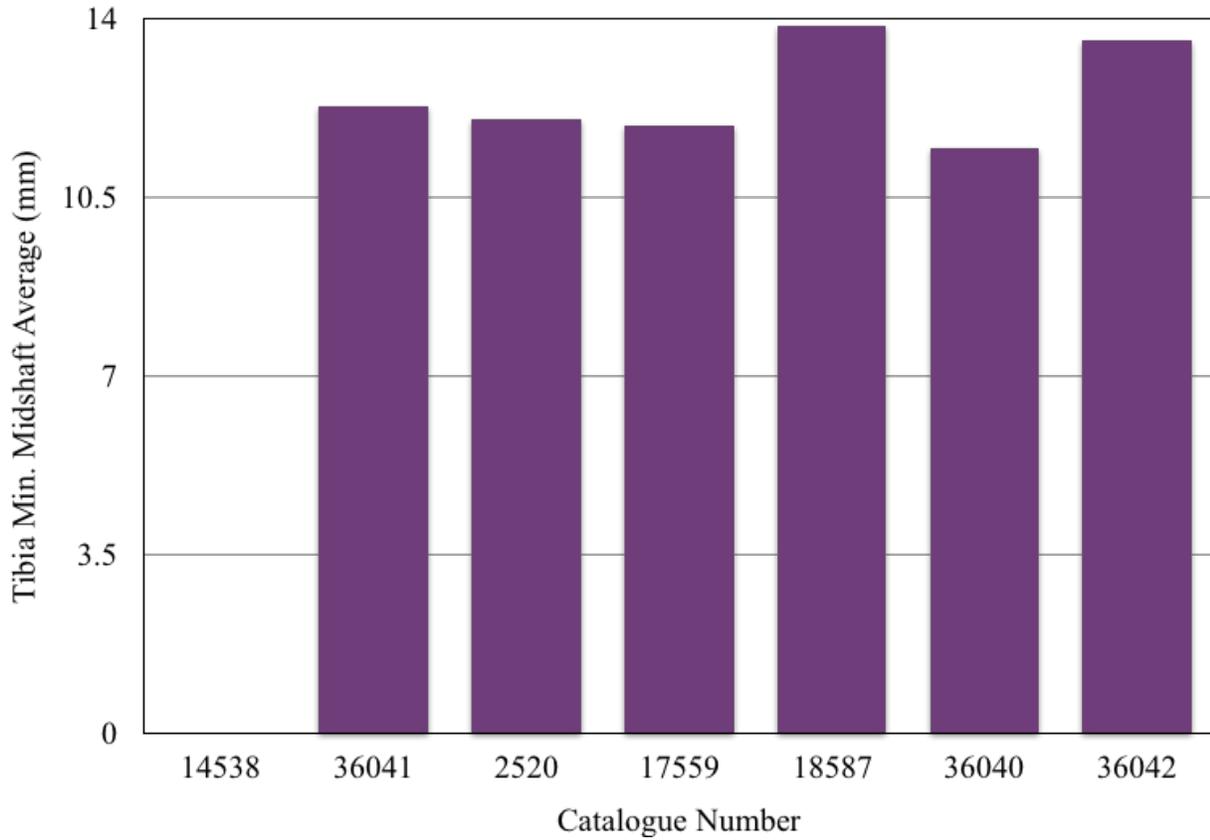


Fig A-17 – Adult tibiae min and max midshaft average comparisons. The min. and max midshaft measurements for 14538 were unobtainable and are thus left blank in the graphs above

**DfSj-23A - Ulna**

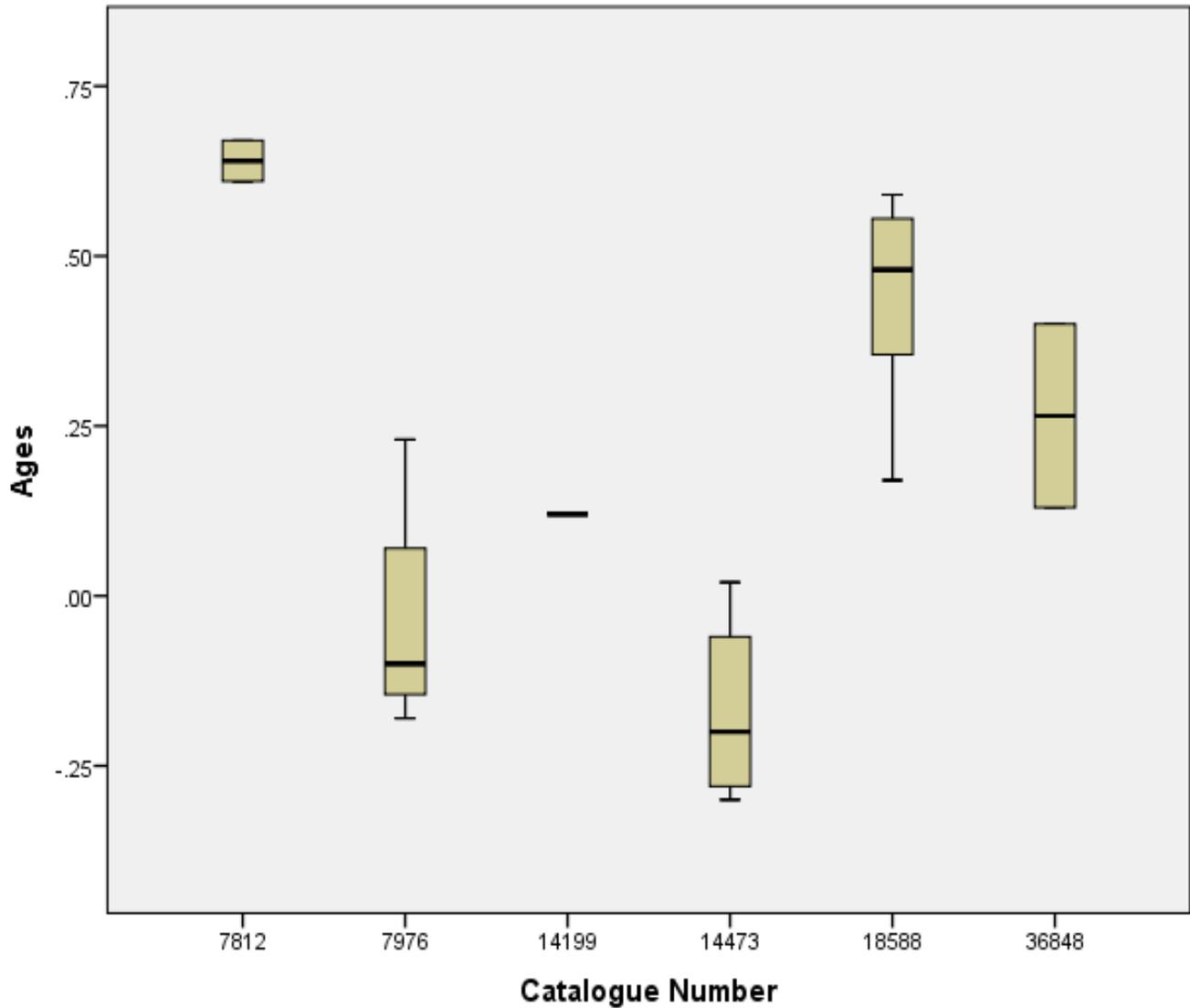


Fig A-18— Fetal/newborn age distributions for ulnae from DfSj-23A. There were no juvenile ulnae at DfSj-23A

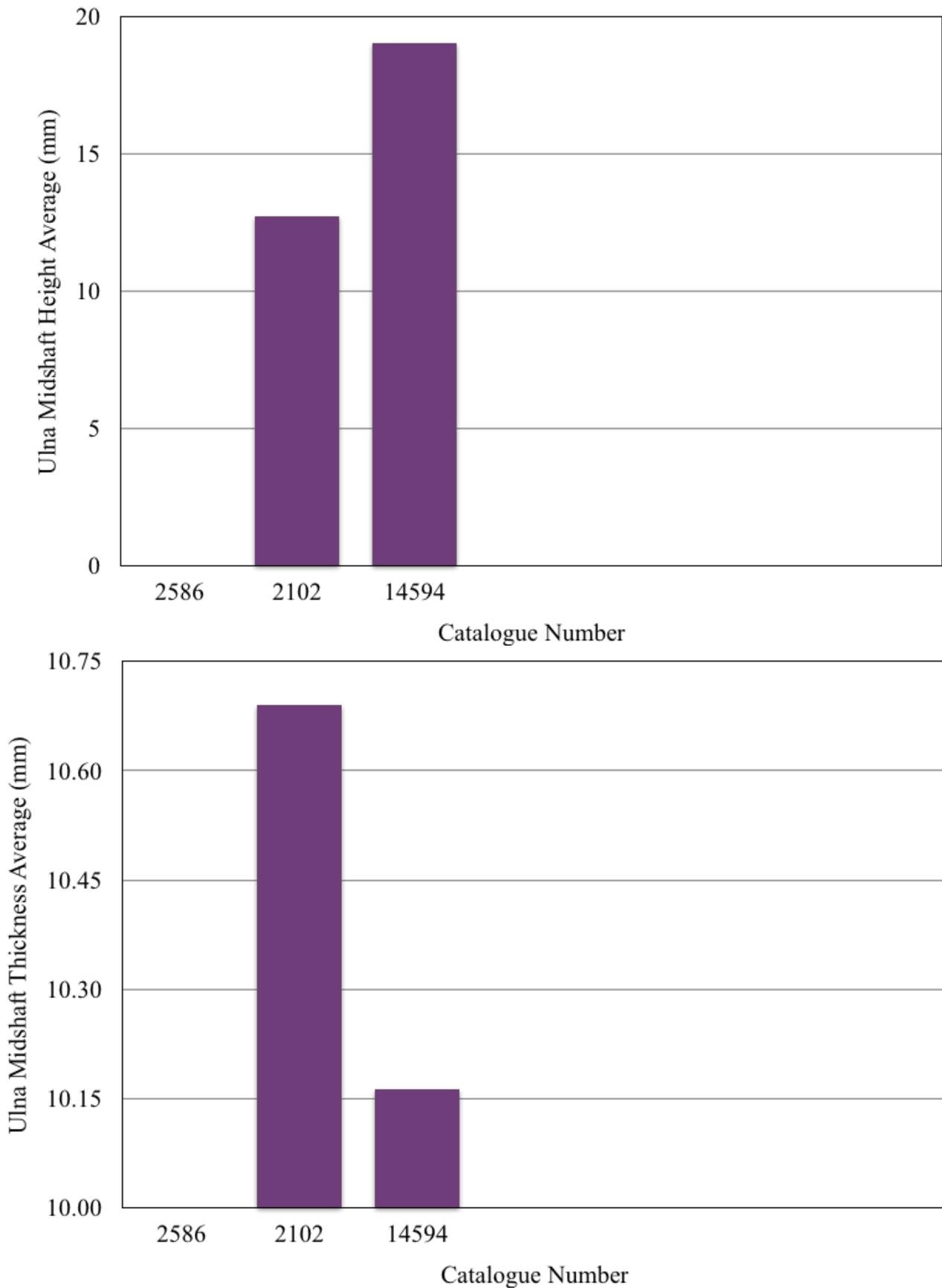


Fig A-19 – Adult ulnae midshaft height and thickness average comparisons. The midshaft height measurements for 2586 were unobtainable and are thus left blank in the graphs above

**DfSi-4 – Femur**

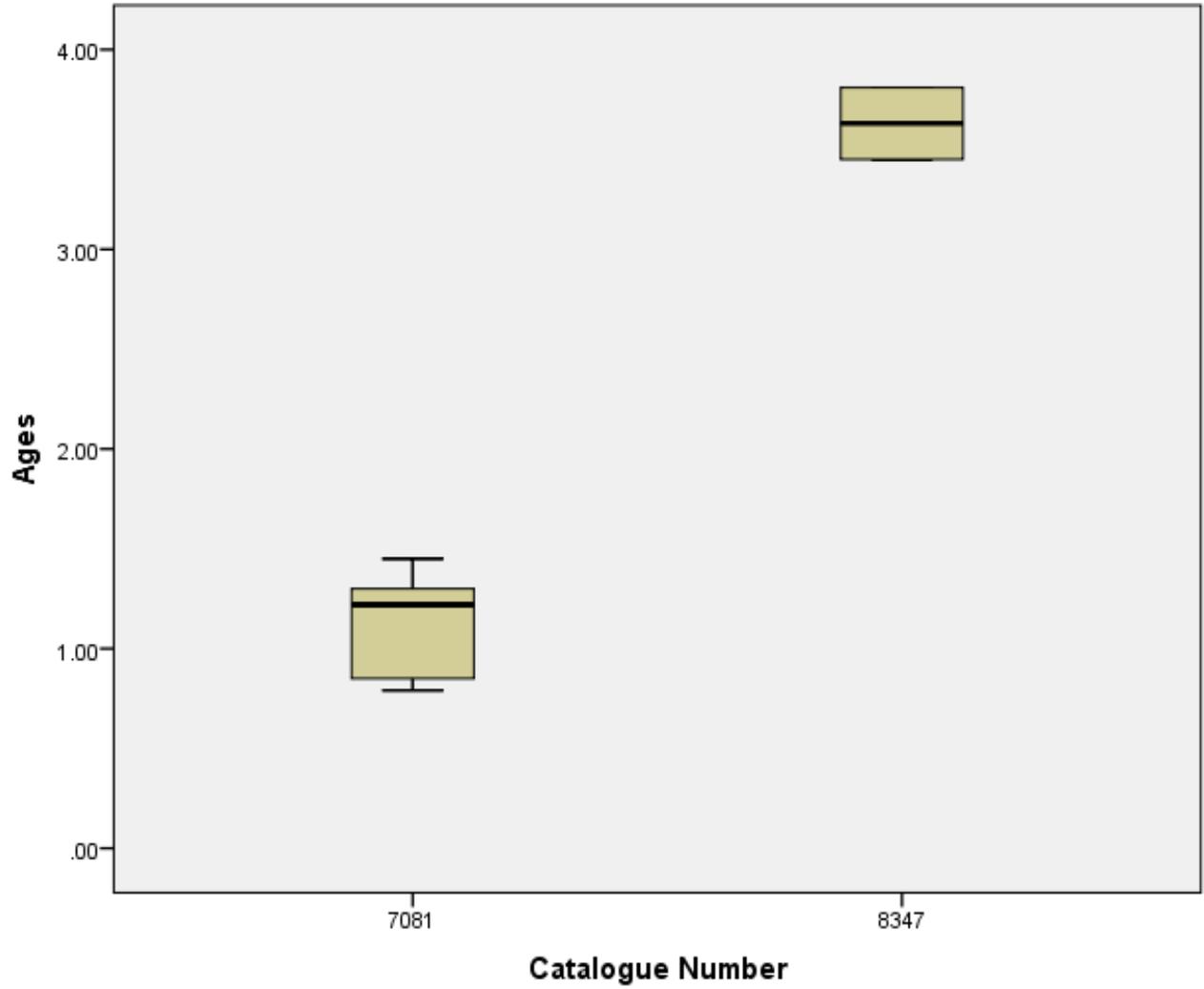


Fig A-20 – Juvenile age distributions for femora from DfSi-4. There were no fetal/newborn femora at DfSi-4

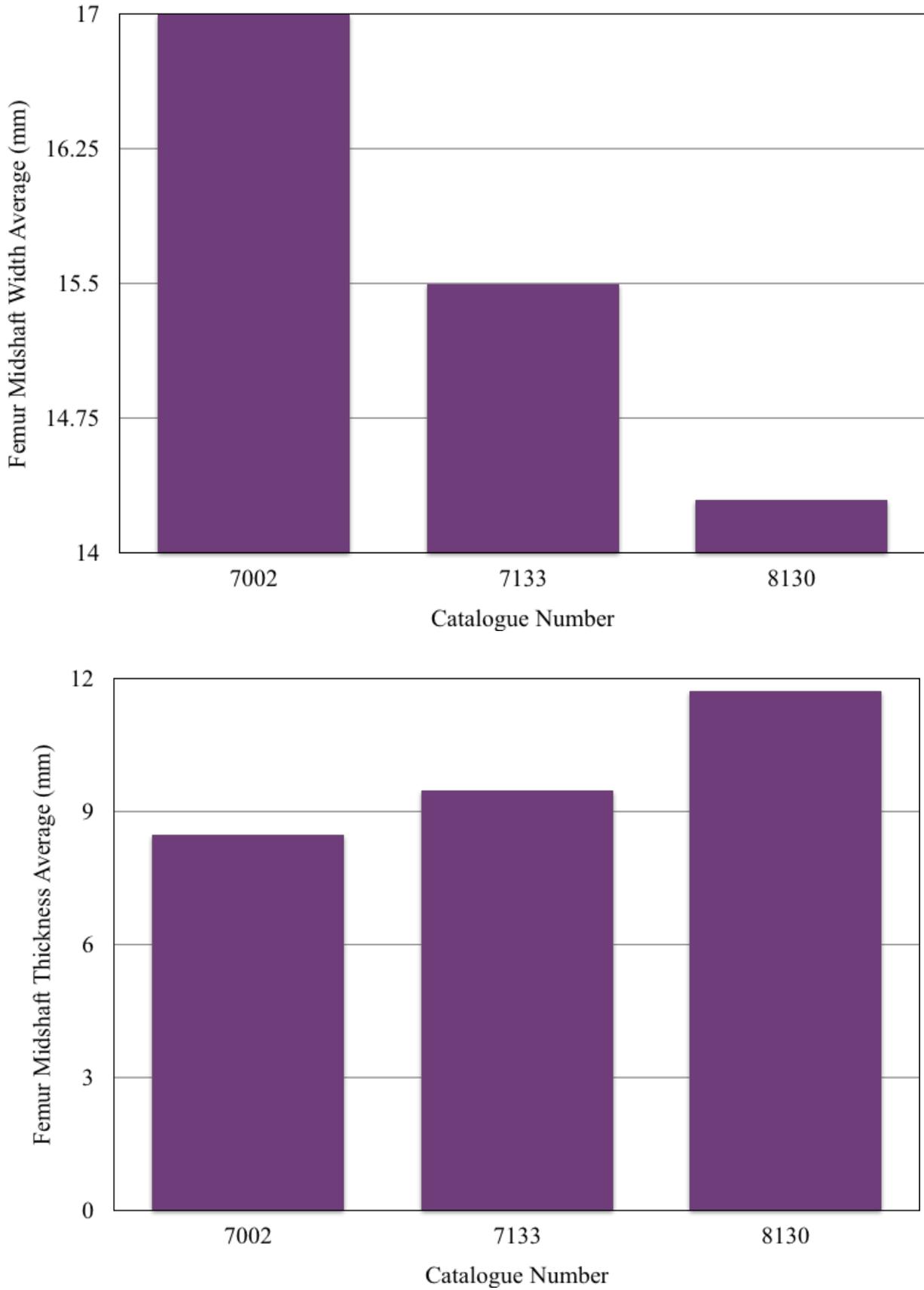


Fig A-21 – Adult femora midshaft width and thickness average comparisons

**DfSi-4 – Fibula**

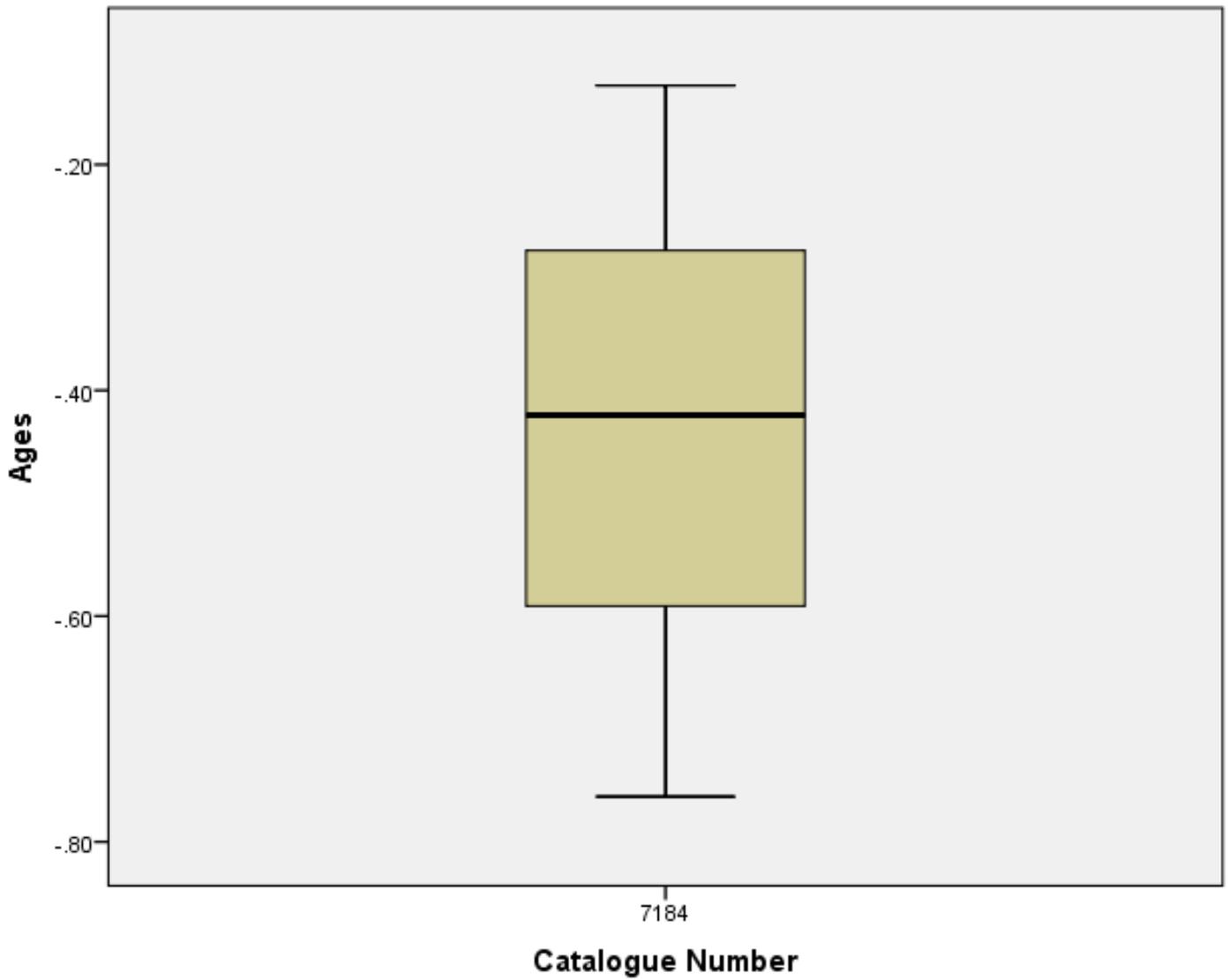


Fig A-22– Fetal/newborn age distributions for fibulae from DfSi-4. There were no juvenile fibulae at DfSi-4

**DfSi-4 – Humerus**

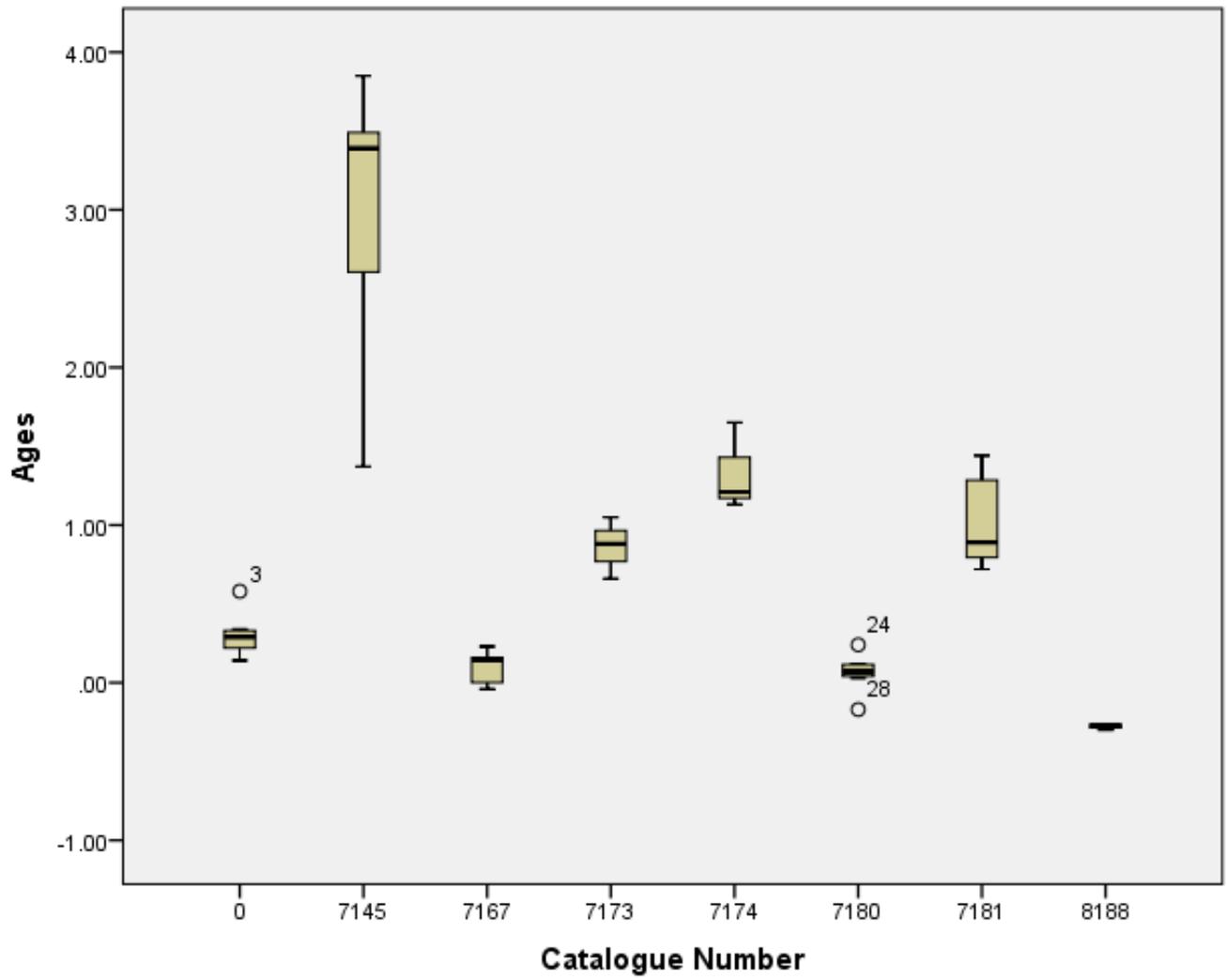


Fig A-23– Fetal/newborn and juvenile age distributions for humeri from DfSi-4

**DfSi-4 – Mandible and Teeth**

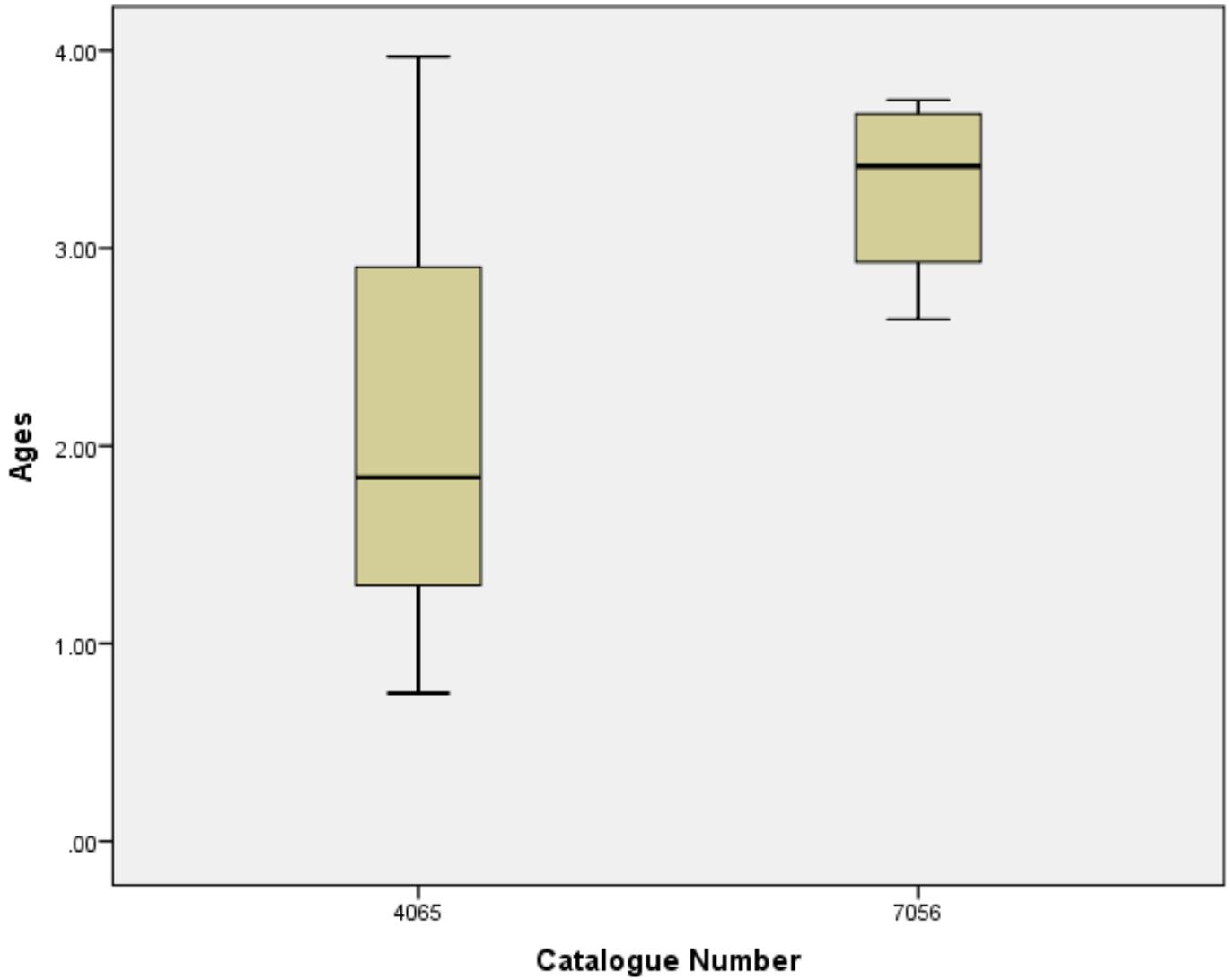


Fig A-24 – Juvenile age distributions for mandible and teeth from DfSi-4. There were no fetal/newborn mandible and teeth at DfSi-4

**DfSi-4 – Metacarpal**

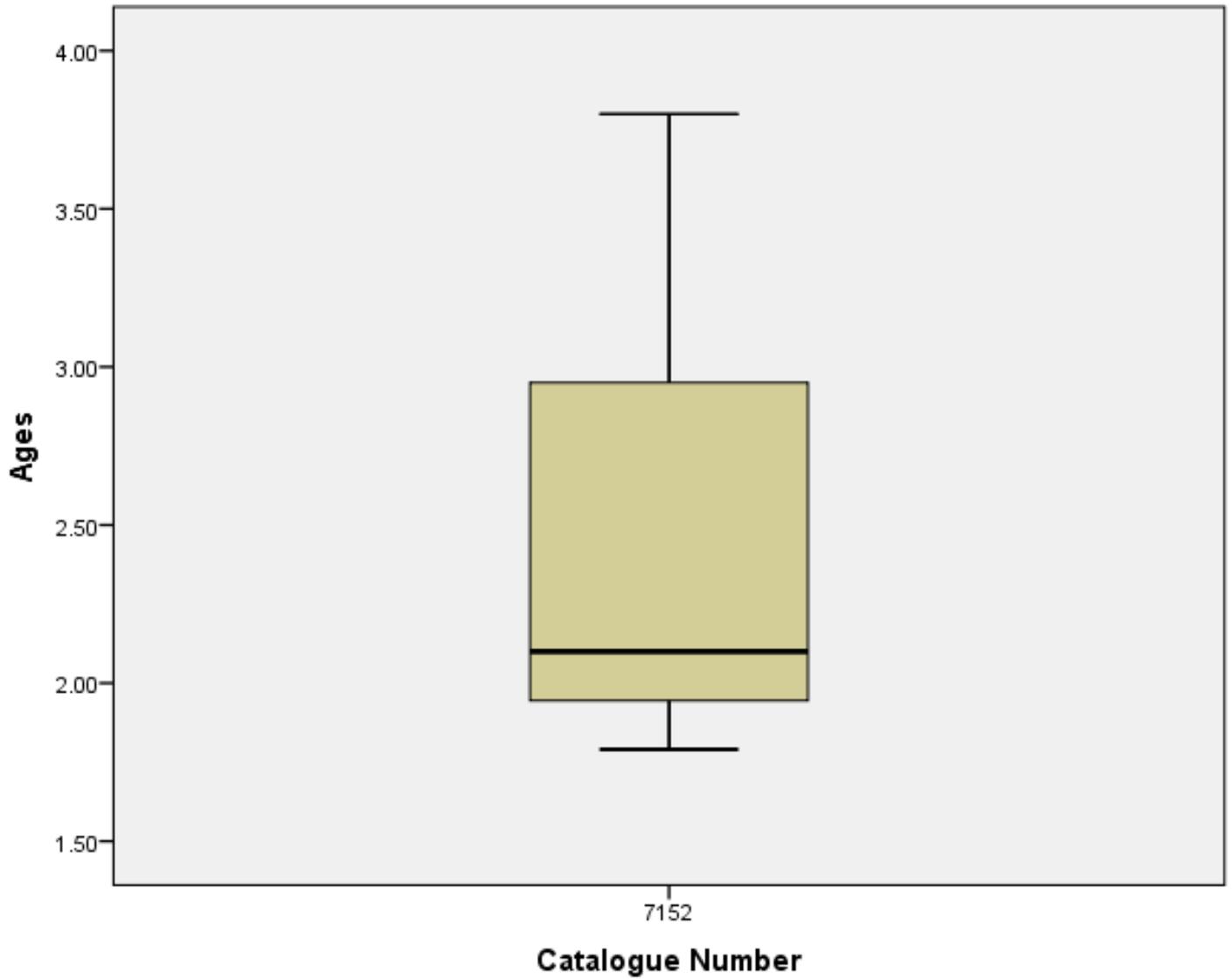


Fig A-25 – Juvenile age distributions for metacarpal from DfSi-4. There were no fetal/newborn metacarpal at DfSi-4

**DfSi-4 – Radius**

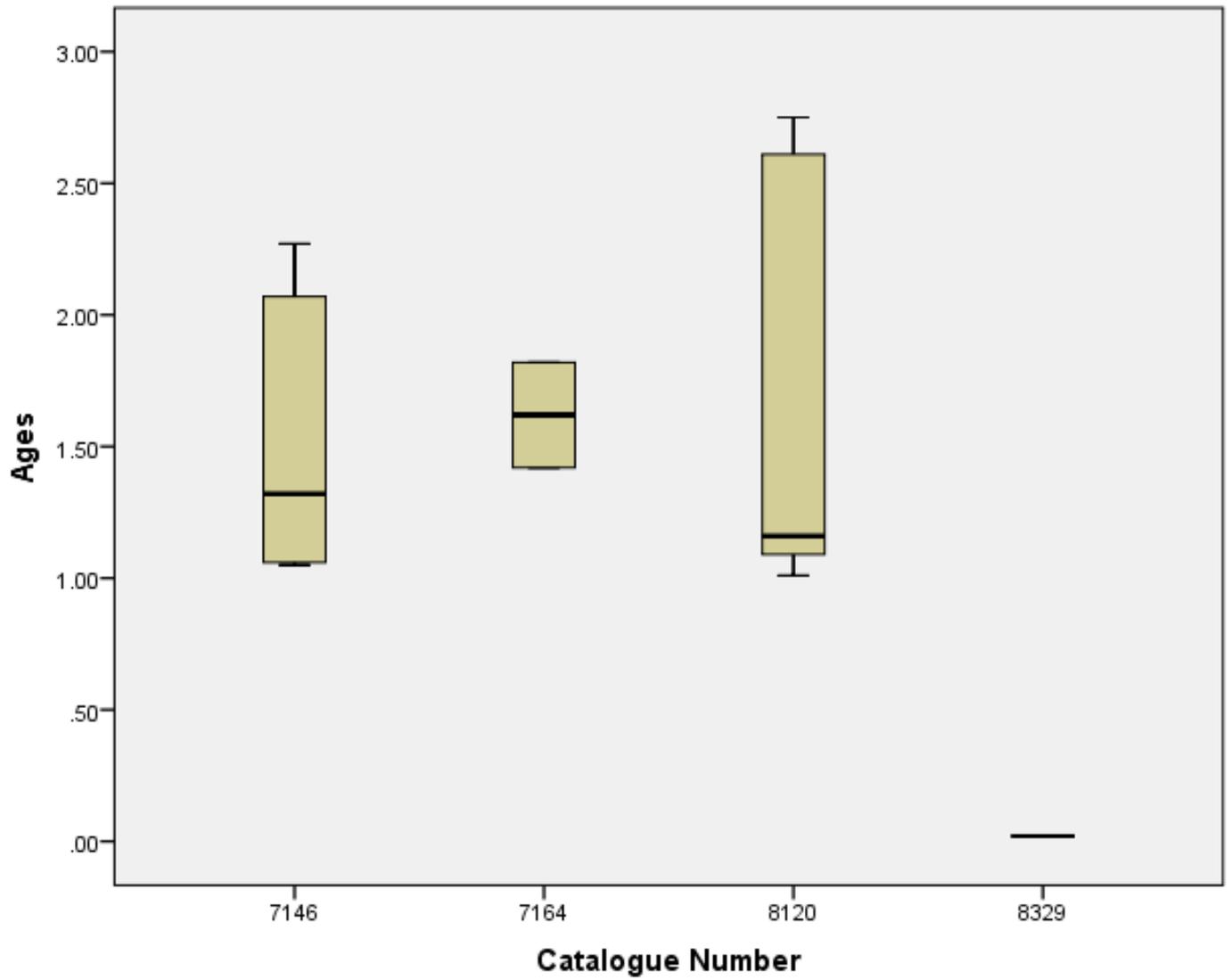


Fig A-26– Fetal/newborn and juvenile age distributions for radii from DfSi-4.

**DfSi-4 – Scapula**

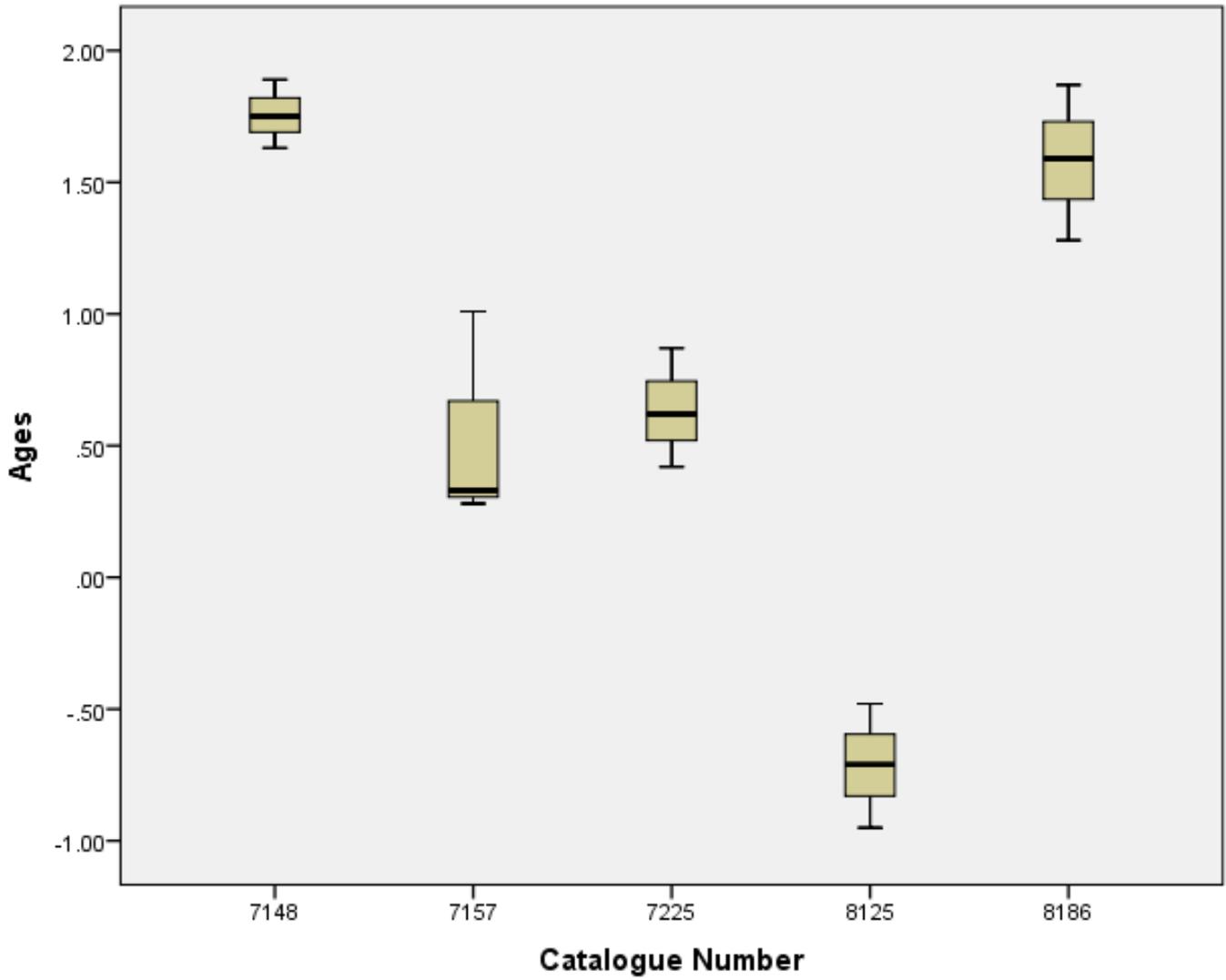


Fig A-27– Fetal/newborn and juvenile age distributions for scapulae from DfSi-4.

**DfSi-4 – Tibia**

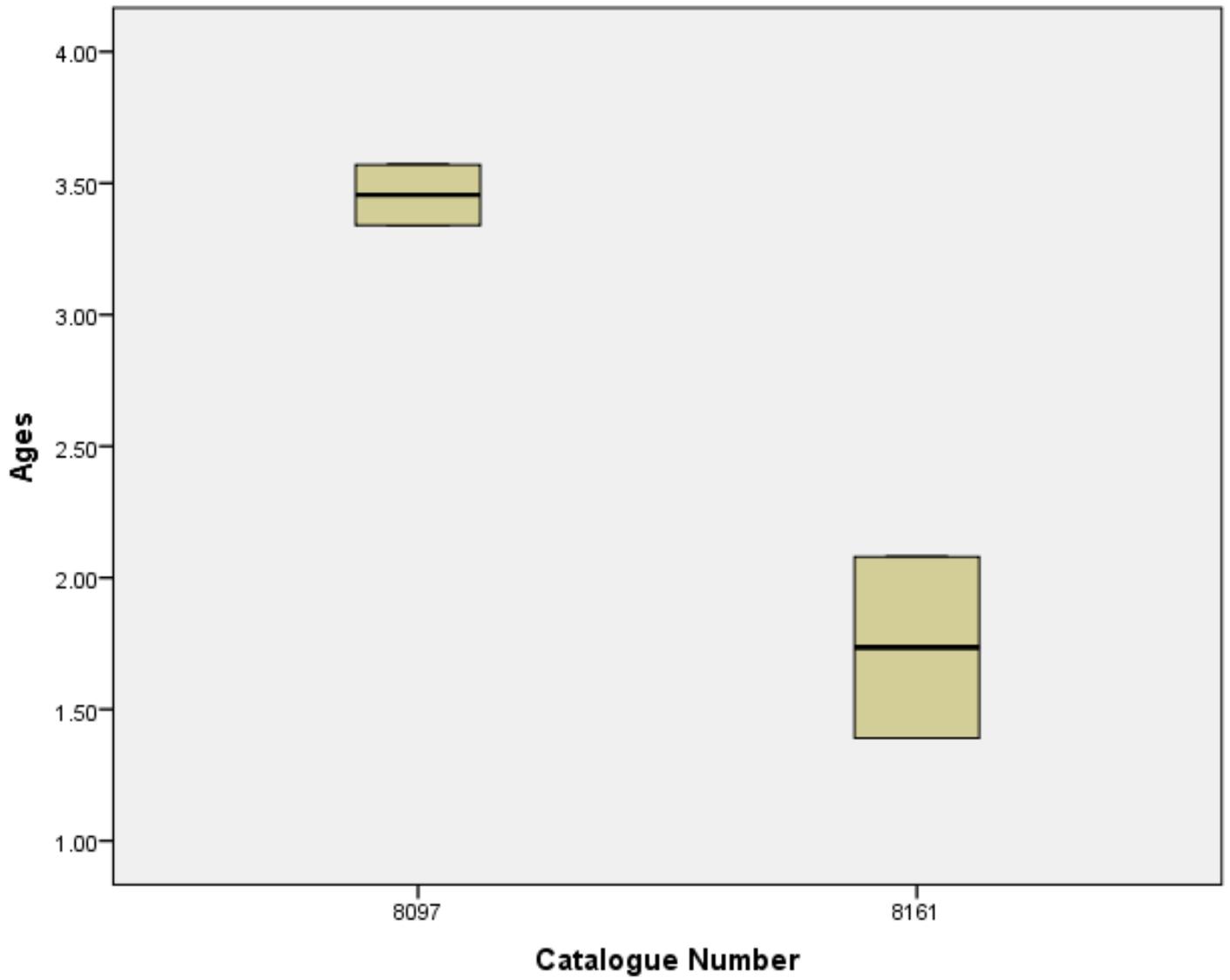


Fig A-28– Juvenile age distributions for tibiae from DfSi-4. There were no fetal/newborn tibiae at DfSi-4

**DfSi-4 – Ulna**

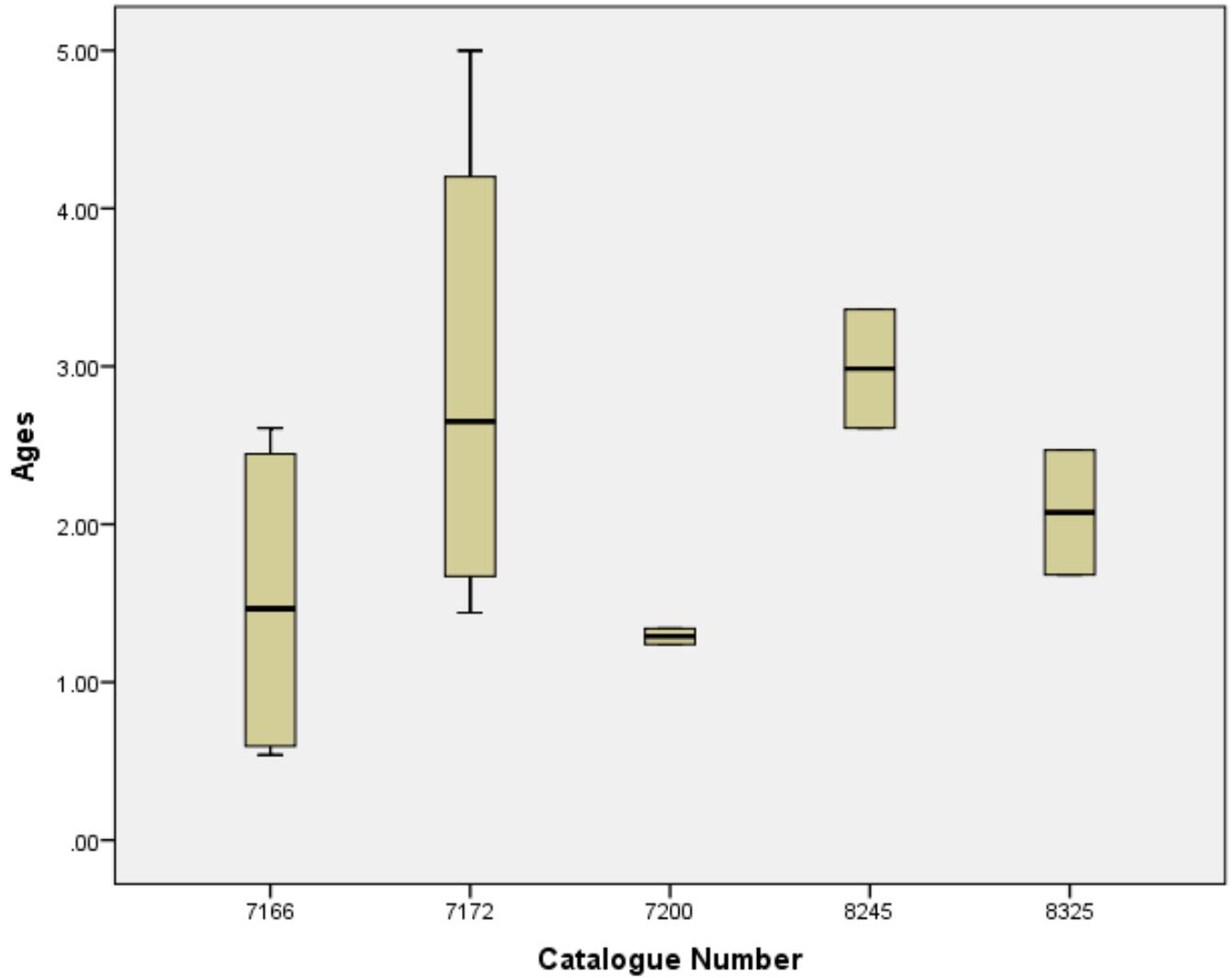


Fig A-29 – Juvenile age distributions for ulnae from DfSi-4. There were no fetal/newborn ulnae at DfSi-4