

REPORT

CONSIDERING ANCESTRAL UNANGAM SELECTION BIASES IN TRANSDISCIPLINARY RESEARCH

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ABSTRACT

Multidisciplinary and transdisciplinary research combine data from multiple fields to address critical issues in the Aleutian Islands and elsewhere. One such project is the Aleutian Mercury Dynamics Project, which focuses on changes in mercury concentrations in the Aleutian Islands. The project analyzes modern and ancient bone samples from sentinel species: northern fur seal, Steller sea lion, and Pacific cod, many of which are sourced from ancestral Unangam middens across the Aleutian Islands. Ancient acts of harvest, processing, and discard impart resource acquisition selection biases, which may impact mercury concentration patterns in the study samples. Here we report on a summary of Unangam intersections with the sentinel species as expressed in primary sources such as language texts and narratives. This allows for consistent consideration of ancestral Unangam acquisition and processing selection bias factors in age, sex, species, and elements present in middens for the study focus species.

INTRODUCTION

The Aleutian Mercury Dynamics (AMD) project¹ focuses on understanding the temporal and spatial dynamics of mercury presence in northern Pacific Ocean and southern Bering Sea food webs. The AMD project is analyzing bone samples from three sentinel species—northern

fur seal, Steller sea lion, and Pacific cod (Avery et al. in review)—to determine if high total mercury concentrations in some individuals, and large ranges of concentrations among individuals (as we see in modern Steller sea lions; Rea et al. 2020), have been a common pattern in

marine predators for thousands of years, or if this is a new phenomenon during the Anthropocene. The samples for AMD have been sourced from modern biological collections and middens of ancestral Unangaꝥ ranging from the Sanak Island in the east to Attu Island in the western Aleutian Islands. More than 95% of the study samples are from ancestral Unangam cultural contexts, spanning 5000 years. Unangam ancestors have lived in the Aleutian Islands for far longer, but their bone-preserving shell midden deposits are rarely older.

Questions about ancestral Unangam subsistence strategies, materials processing, or acquisition technologies in the context of complex Unangam family and political life are not the focus of the AMD project, yet ancestral Unangam ways of being are the driving factors behind archaeological faunal assemblages in ancestral Unangam middens. The archaeological bone samples in the AMD study originate with a series of ancient acts of harvest, processing, and discard. Thus, the bones sampled result from ancestral Unangam activities and may exhibit selection biases that impact interpretation of mercury concentrations over time. The AMD project has chosen to analyze all fur seal and sea lion bone specimens made available to us that are of sufficient mass for our analytical methods (Avery et al. in review). An understanding of ancestral Unangam selection bias will not alter the sample selection for the AMD study but will help us better interpret how realistically our resulting data set reflects the range of mercury concentrations in the overall population of marine predators from which hunters selected animals at each time in history.

This report considers Unangam approaches to three sentinel species as expressed in language texts and oral histories. Certainly, Unangaꝥ across the 1800 km Aleutian Islands and through 5000 years did not have static relationships with the sentinel species. But impacts from Russian and United States colonialism in the Aleutian Islands and limitations of the archaeological record as currently excavated do not allow for fine regional and temporal granularity across the archipelago. This report presents a generalized summary of how ancestral Unangaꝥ interacted with the three species. It also provides a consistent interpretive base for statistical patterns identified in trophic positioning and mercury content in the current AMD study and, we hope, for any future multidisciplinary studies in the region.

METHODS

This high-level meta-analysis is focused exclusively on Unangam Tunuu (UT) language and Unangam traditional narratives and lifeways explanations. UT words are provided when word stems or examples of use are present in the UT Bergsland (1994) orthography, but not when information was sourced from other materials. Note that UT words are presented exactly as they appear as the main entry in the UT dictionary (Bergsland 1994); they were not modified for use in contingent contexts. Also, the regional UT dialect for each word stem is noted, following Bergsland (1994:vi).² The source materials for this summary all have specific theoretical issues, yet for the purposes here, each data point—that is, each language reference to one of the three species—is coded as it appears without extensive context interrogation. It is particularly important to note that information coded from the narratives may be symbolic rather than literal. The connection between physical reality and symbolic cognition will not be parsed here. Coded data points all include information that had the potential to influence ancestral Unangaꝥ decisions and actions toward the key species (as in Funk 2018).

Mentions of Unangaꝥ interactions with the sentinel species as articulated in a primary reference source were recorded as a single data point in a spreadsheet database (Tables 1 and 2). A robust ethnohistoric literature exists for the region, as each explorer, government official, religious official, or itinerant traveler recorded their own personal or official notes of their observations of activities. However, unless these individuals spent significant time with Unangaꝥ, their information is considered secondary or tertiary. Regional archaeological literature is also considered secondary or tertiary, as are all interpretations derived from the same primary sources used here.

Table 1. Database categories

Database fields	Purpose of field
Animal	Animal mentioned
Activity	Activity related to animal, e.g., hunting, cooking, sentence
Age/Sex of Animal	If provided
Region	Language dialect region
Notes	Unangam Tunuu word and/or context of mention
Reference	Source material

Table 2. Primary source materials (full citations in references)

Author	Year	Type
Alaska Native Tribal Health Consortium	2015	Traditional lifeways
Bergsland	1994	Language
Bergsland and Dirks	1990	Traditional narrative
Black	1998	Traditional lifeways
Hudson et al.	1992	Traditional narrative/ traditional lifeways
Jochelson	1925	Traditional lifeways
Jochelson	1933	Traditional lifeways
Unger	2014	Traditional lifeways
Veniaminov	1984	Traditional lifeways

The summary is organized by animal type. For each animal type this report summarizes biological context and nutritional value, acquisition techniques, use as food, use as raw material, and culture context.³ Possible selection bias impacts are noted for each sentinel species. Others have addressed Unangam intersections with animals. Lucille Lewis Johnson (2004, 2005) presented summaries of sea mammal hunting and fishing, and Lydia Black (1998) presented early work on Unanga–animal intersections. This summary is different from earlier work in that it systematically codes data from primary sources and specifically provides potential bias impacts for multidisciplinary studies in the region, including the current AMD project.

THE ANIMALS

PACIFIC COD | *ATXIDAX* (E) | *GADUS MACROCEPHALUS*

Cod today are a critically important commercial harvest for Unanga and others in the North Pacific and Bering Sea fisheries and have been since the CE 1800s, when Scandinavian fishermen began commercial fishing in the area (Unger 2014). Cod bones are present in the earliest ancestral Unangam middens and remain a culturally important food today (Alaska Native Tribal Health Consortium 2015; Unger 2014). A 3 oz (85 g) cooked serving has 89 calories, 20 g protein, 9 carbs, 1 g fat, 0 g saturated fat, 0 fiber, 40 mg cholesterol, 77 mg sodium, 27 IU vitamin A, and 3 mg vitamin C (Alaska Native Tribal Health Consortium 2015:62).

Ancestral Unanga classified cod as “bottom fish,” along with halibut, flounder, sculpin, and others (Black 1998:132; Johnson 2004). According to Waldemar

Jochelson’s (1933:51) ethnographic work in the early 1900s, cod is the second most preferred fish, following only halibut. To this day, Pacific cod is the fifth most valuable fishery in Alaska (NMFS 2018). Pacific cod is a wide-ranging species, whose habitat stretches east to west across the entire North Pacific and as far south as California and north to the Chukchi. Cod migrate 300–500 km annually, spawn in late winter at 110–120 m below surface, and then move to shallow water at 37–55 m for summer (Johnson 2004:47). Juvenile Pacific cod are found along the shelf up to 60–150 m in depth while adults can be found up to 500 m in depth (Thompson and Palsson 2015). Recent genetic research has shown that there is limited population connectivity between the Bering Sea and the Aleutian Island stocks, with possible separations along the Aleutian Islands as well (Cunningham et al. 2009; Spies 2012).

Traditional harvest of cod, as expressed through language texts and narratives, includes several techniques:

- Line fishing: harvested with a seaweed or twisted sinew fishing line from a kayak. Men fished for cod offshore in winter and returned home exhausted; they fished for cod closer to shore, about 2.5 km, in summer (Bergsland and Dirks 1990:Narrative 56; Jochelson 1933:5–11; Veniaminov 1984).
- Bow hunting: by lying on a rock and shooting cod (Bergsland and Dirks 1990:Narrative 77).
- *Imitxi-lix* (Eu) (shore fishing): fishing halibut or cod from the beach (Bergsland 1994:1980).

Cod was a primary subsistence food in the past and remains a significant food today. Cod were variously prepared, stored, and consumed but were always cooked or cured by drying to remove parasites (Black 1998; Jochelson 1933:21; Johnson 2004; Unger 2014; Veniaminov 1984).

- Fillets, head, tongue, stomach, and liver are and were eaten (Unger 2014); *atxidum maatuudaa* (Ea) (cod tongue), includes the phrase *ma-aatu-aada* (Ea), which means “enjoyable little thing” (Bergsland 1994:276).
- Cod livers were fried, *ayagitaayaxtaku* (AU) (frying just one) (Bergsland 1994:11), or *una-lix* (E) (cooked) (Bergsland 1994:44; Bergsland and Dirks 1990:Narrative 77, 82), sometimes stuffed into fried cod bladders (Bergsland and Dirks 1990:Narrative 82) or cod stomachs, as in *atxidam chdugan aagiin itaa* (Ea) (cod stomach with liver in it) (Bergsland 1994:134). Other dishes included *qaa-yum qaluḡaḡingin* (En) (cod liver mixed with berries and salmon milt) (Bergsland 1994:305) or, similarly,

taaġu-x̂ (Ea), which incorporated fish or cod liver with seal oil along with berries (Bergsland 1994:384).

- Cod were accumulated into *atxidam tamingin* (bundles) (Ea) (Bergsland 1994:386), perhaps as dried codfish. Johnson (2004:51) notes that James Cook said people dried and stored quantities of fish, and that Iakov Veniaminov reported that people stored at most 500 fish per family.
- Cod skins, skeletons, and various organs served as raw materials.
- Bones: cod ribs, lower jaw, and “nose bones” are described as serving as materials for in *iqyan* frame construction (Bergsland and Dirks 1990:Narrative 77).
- *Aqahmi-ngis* (A) (cod peritonea): the membranes of the abdominal cavity were harvested, cleaned, and dried to be sewn into *iqyan* covers (Bergsland 1994:96; Bergsland and Dirks 1990:Narrative 77).
- Livers: *atxidam aaġingis* (A) (were made into oil) (Bergsland 1994:125; Jochelson 1933:51) to oil *iqyan* skins (Bergsland and Dirks 1990:Narrative 77);
- Eyeballs: were used to make glue; they were boiled and then crushed with hands once cooled (Bill Tcheripanoff in Hudson et al. 1992:146).
- Cod attributes were sometimes assigned to people. For example, the name of a boy is mentioned as *Takanu-x̂* (Eu) (Smelling of Codfish Bladder) (Eu) (Bergsland 1994:385), and *Atxidkusax̂* (En) (Little Codfish) and *Chuxchux* (E) are perhaps masculine diminutive form names (Bergsland 1994:151, 515, 581).

The presence of cod bones in ancestral middens is impacted by acquisition, use of their bodies for food and raw materials, and feelings and beliefs about cod. Interestingly, none of the uses of cod would particularly impact the presence of the key element in the AMD study, the premaxilla. The only impact might be the location of cod processing. But if cod were brought back to the ancestral villages whole, there would be cranial elements in the midden.

STELLER SEA LION | *QAWAX̂* (E) | *EUMENTOPIAS JUBATUS*

The importance of sea lions is demonstrated in their frequent mention in the *Tales and Narratives* (Bergsland and Dirks 1990) and in the continuity of their significance. Many descendant Unanga-x̂ incorporate sea lions into their diets and in artwork (Unger 2014). Sea lion meat is an excellent source of protein, selenium (139% daily value [DV]), and iron (54% DV) and a good source of zinc (19% DV) within a single 85 g (3 oz) serving of meat

(Unger 2014). Sea lion meat also contains monounsaturated (1.87 g/serving) and polyunsaturated (1.53 g/serving) fatty acids that are important for health (APIA 2006).

Steller sea lions are the largest pinniped of the family Otariidae (or eared seals). The species is sexually dimorphic, with males being larger than females from birth (Merrick et al. 1995; Rea et al. 2020). Young sea lions (seven to nine months of age) sampled between 1998 and 2009 in the Aleutian Islands weighed 120.4 ± 5.9 kg (male) and 91.9 ± 5.6 kg (female) (Rea et al. 2016). By adulthood this difference in size is substantial: males can weigh up to 1000 kg and be up to 3.35 m (11 feet) long, while females reach only a maximum of 350 kg and up to 2.3 to 2.9 m (7.5 to 9.5 feet) long.

The largest territorial bulls begin to hold territories on traditional breeding beaches or rocky shorelines (rookeries) along the Aleutian Islands in May, and adult females typically give birth to a single pup between mid-May and mid-July (NOAA Fisheries 2023). Although the territorial breeding structure relaxes by the end of summer, transitioning from rookery to haul out, adult females can use these beaches as resting areas and a central place from which to forage and return to for provisioning their pups and dependent young. During the summer breeding season, independent juvenile sea lions, subadult males, and nonbreeding adults use haul outs at different locations as resting areas from which to forage.

Sea lions may have been impacted by ancestral Unangam harvesting. Sea lions may react to human disturbances differently depending on the time of the year and the level of social organization at the terrestrial location (e.g., breeding rookery with high social organization and haul outs used for resting on land). Kenady Wilson et al. (2011) found that the abundance of adult females and their dependent young did not change significantly after infrequent research disturbances (e.g., one time every other year for six-to-nine-hour duration) even if human presence during this time removed all adult residents of the rookery during the research activity. However, the authors could not predict if the impact would be greater if human disturbances were longer, more frequent, or occurred at haul outs or earlier in the breeding season when the social structure of the rookery was not as well established (as might be experienced from repeated harvest from the same rookery or haul-out location).

Unanga-x̂ classification of sea lions was categorized by age, sex, size, and sometimes physical attributes as represented in the Unangam Tunuu dictionary (Table 3).

Table 3. Sea lion age/sex classifications (Bergsland 1994)

Age/sex	Unangam Tunuu word	Page in Bergsland 1994
Bull	<i>Qawam aliğa</i> (Ep)	106
Adult male	<i>Qavam aliğa</i> (Au)	54
Yearling	<i>Qawaada-x̂</i> (E)	313
Half-grown	<i>Qawáğax̂</i> (A)	313
Young (up to 4 months)	<i>Ungaalgi-x̂</i> (E)	447
Female	<i>Qawam ayagaa</i> (E)	115
Pup	<i>Qawam anniidangis</i> (A)	77
Old bull (with a bent nose)	<i>Iguana Qangtxali-x̂</i> (Eu)	181
Adult	<i>Qawaagamax</i> (Eu)	313
Big bull (with broad shoulders and slender waist)	<i>Ugina-x̂</i> (E)	419

Traditional harvest of sea lions varied throughout the study source materials:

- *Idugaya-x̂* (A) (throwing lances) (Bergsland 1994:174) or *igiqax̂* (E) (spears) (Bergsland 1994:178): approaching sea lions while sleeping or resting at *qavam ixsii* (Au) (sea lion rookeries) (Bergsland 1994:180) or haul outs seemed to be a favored tactical choice of hunters. Hunters would approach the sea lions from the water and throw the lances at them (Jochelson 1925:88).
- *Igi'ka-x̂* (Au) (harpoons): were used on shore and thrown at young sea lions or seals (Jochelson 1925:78).
- *Nugda-x̂* (A) (large rocks): ~2 kg rocks were tied to a line by the hunter to kill sea lions in rookeries (Bergsland 1994:284).
- *Imgaasi-x̂* (En) (pole): a pole was used for reeling in a sea lion (presumably incapacitated or dead) (Bergsland 1994:197).
- Club: *Tales and Narratives* discuss a woman who kills sea lions using a club (Bergsland and Dirks 1990:Narrative 69).
- Net: capturing sea lions using a net (Bergsland and Dirks 1990:Narrative 85).
- Spear/club (from boat): Sergie Sovoroff describes hunting from a boat (Hudson et al. 1992:179). This took two people, one in back to steady the boat and one in front to throw the spear: “The point is inside the animal and the shaft comes off and floats on the top of the water. That tires the animal and they used to club the animal and put it in the skin boat.” This method was not solely for sea lions but was used to acquire a variety of sea mammals.

Regardless of the capture method, hunters often butchered sea lions before returning home (Unger 2014). This was not only for practical reasons (easier to transport)

but also due to taste preferences: butchering cooled the carcass and made the meat taste better later (Moses Dirks as quoted in Unger 2014).

Sea lion meat is a significant traditional subsistence food. Sea lions were regarded as highly nutritious animals, as in *hawan qawax̂ agacha algam haaganaayula-x̂ aku-x̂* (“the sea lion is the most nutritious animal, lit. not to starve of”) (Bergsland 1994:19). The meat, as well as the organs (heart, liver, kidney), were all consumed (Unger 2014). There are several methods of preparation:

- Dried: when butchering, the arm and shoulder are removed and used for dried meat. “This part of the sea lion is the heaviest and contains the most meat of any part” (Anfesia Shapsnikoff as quoted in Hudson et al. 1992:199–200).
- Sea lion heart: could be consumed baked, boiled, or raw. Prior to consumption, the outer tissue must be removed and then it must soak in saltwater (Hudson et al. 1992:200).
- Sea lion liver: “Eat the liver from a young sea lion. The liver of big sea lions is bitter to the taste” (Anfesia Shapsnikoff as quoted in Hudson et al. 1992:200). Sea lions provided raw materials for daily life, with nearly every part of the sea lion used:
- Sea lion skins: used for ropes and *hağux̂siisi-x̂* (A) (pack straps made of sea lion skins) (Bergsland 1994:41; Hudson et al. 1992) and to wrap the dead (Jochelson 1925:42; Unger 2014). Skins also provided materials for coverings for the *iqyan* frames, the primary traditional Unangam hunting tool (Black 1998; Jochelson 1933; Johnson 2005:41; Unger 2014). According to Anfesia Shapsnikoff, five to six sea lion skins were needed for one boat (Hudson et al. 1992:198).

- Bladders: kept in the *iqyan* to use as containers for bailing out if the boat was taking on water, or could be used as a float to keep an *iqyan* from capsizing (Jochelson 1933:25).
- *Imguġda-ġ* (E) (gut sewing kits): kept in the *iqyan* for on-the-go repairs; these kits contained elements made of sea lion (or seal) gut (Bergsland 1994:197). The gut was also used for making *chigdan* (raincoats) (Hudson et al. 1992).
- *Uxxxi-ġ* (En) (sea lion and seal stomachs) (Bergsland 1994:285): inflated and used to store provisions, such as dried fish or water (Bergsland and Dirks 1990:Narrative 17; Jochelson 1925). Stomachs and gullets also served as material for waterproof clothing, such as boots and *chigdan* (Jochelson 1933; Unger 2014).
- *Qayaatxu-ġ* (E) (whisker decorated hats) (Bergsland 1994:314): decorated with whiskers; whiskers and teeth were also used for bodily adornments such as pendants and ear plugs or for decorating wooden visors (Bergsland and Dirks 1990:Narrative 15, 82; Hudson et al. 1992; Jochelson 1933). Teeth were also noted as being used for *umxi-ġ* (En) (fish hooks) (Bergsland 1994:440).
- Sinew: used for sewing (Hudson et al. 1992).
- *Tayaga-ġ* (Au) (mukluk sole of sea lion) (Bergsland 1994:379): often made of sea lion or seal skin flippers, and Anfesia Shapsnikoff notes that the “rubbery part of the flipper makes a gripping surface” (Hudson et al. 1992:199).

Sea lion parts were and are important to Unangaġ, and sea lions are often central characters in tales and narratives. Multiple sources indicated that sea lions can transform into people and that any given sea lion may be a transformed person (Black 1998). Physically, sea lions were important in ancestral Unangam cultural lives:

- *Saliiti-ġ*, (A) (women’s dancing shawl) (Bergsland 1994:349): skin, gut, or throat shawl used for dance.
- *Inigaġ* (En) (Bergsland 1994:202): a hide-tossing game using sea lion skins.
- Sea lion humerus: used in the game *kuuguta* (as described by Bill Tcheripanoff in Hudson et al. 1992:108). Anfesia Shapsnikoff further discusses this game and notes that it was a way to encourage young children to gain dexterity and create strong wrists “because they had to paddle, had to throw the spear,

and so in whatever games they had they had to use their wrist” (Hudson et al. 1992:186).

- Sea lion size sometimes conveyed status: storied heroes had to capture “the oldest bull” (Black 1998:127), and the older and larger the animal taken, the more honor accrued to the hunter. Small animals were “helpers” (Black 1998:133). It is worth noting that many of the UT words for sea lions are for adult males (Table 3). However, in Unger (2014), hunters preferred smaller sea lions because the meat tasted better, they were easier to kill, and the large old bulls had scarred hides that weren’t good for making things.

The intensive use of sea lions for multiple purposes would have impacted the presence of their remains in village middens. A close examination of the practices summarized above reveals that many uses involved nonbone components of sea lions. If animals were butchered elsewhere, removing blood and leaving less-used parts behind, most skeletal elements would still make it to the village to be discarded during processing. Further, the number of sea lions needed to make boats would result in the harvest of a large number of the animals. And while cultural cues suggest the larger bulls are ideal harvests, more practical sources tell us that younger animals are better for food and skin boat coverings. The AMD study needs only one bone per animal. This means that even though sea lions ostensibly have significant selection biases because of their heavy use, many of the young and old sea lions harvested should be present in the archaeological middens. If they are absent, it may be necessary to consider that sea lions were not present in the seascape, perhaps because, according to Lucille Lewis Johnson (2005:42), “given how intensively the Aleuts exploited their marine resource, some effects on marine species distribution and population dynamics would be expected.”

NORTHERN FUR SEAL | *ALGAMIKLU-ġ* (E) | *CALLORHINUS URSINUS*

Northern fur seals are important throughout Unangam history, and this summary differentiates between ancestral use of fur seals along the Aleutian archipelago and the historic commercially driven harvest in the Pribilof Islands (Jones 1980). Practices of harvest and disposal developed for the commercial fur sealing enterprise are different from those in the deeper Unangam past. The summary presented here targets practices from the deeper past.

Fur seal bones are present in most ancestral Unanga middens, and they remain a culturally important food today (Alaska Native Tribal Health Consortium 2015; Unger 2014). Although specific nutritive data are not readily available for northern fur seal meat, it is likely that they are similar to other pinnipeds, as an excellent source of protein and iron and a good source of vitamin A (Alaska Native Tribal Health Consortium 2015:82). Similar to Steller sea lions, per 85 g (3 oz), seal (phocid) meat contains 121 kcal, 24 g protein, 3 g fat, 1 g saturated fat, 76 mg cholesterol, 9 mg sodium, 327 IU vitamin A, and 17 mg iron (Alaska Native Tribal Health Consortium 2015:82).

Northern fur seals, like Steller sea lions, are a male-dominated sexually dimorphic otariid. Males (270 kg, 2.2 m) are approximately four times the size of females (65 kg, 1.5 m). Pups weigh approximately 5 kg at birth and slowly gain about 0.6 kg per week until weaning. They are a subpolar species living in the Bering Sea and northern Pacific Ocean (Gelatt and Gentry 2018), with currently around one half of the global population of northern fur seals inhabiting the Pribilof Islands. In July, males haul out on land and establish territories where the female will come ashore to give birth in August. Pups remain on rookeries until they are four to five months of age and depart for the North Pacific Ocean or Bering Sea (Gelatt and Gentry 2018).

The importance of fur seals in traditional culture is indicated by the number of words in Unangam Tunuu related to the animals, acquisition techniques, and use, although they are mentioned less often than sea lions. Ancestral Unanga seem to have thought about fur seals differently from sea lions, generally grouping them with seals. Age classifications for fur seals are fine-grained during the Russian era, but when commercial harvest and Russian root words are removed, there are fewer names for fur seals than for sea lions (see Tables 3 and 4).

Traditional harvest of fur seals included several techniques. Like sea lions, fur seals were often pursued at their rookeries by hunters. Other various techniques are noted in Bergsland (1994) with Jochelson (1925) as the original source:

- *Agalgaaya-x̂* (Au) (harpoon) (Bergsland 1994:20): used in hunting fur seals and seals; also *tunumulgu-x̂* (E) (simple harpoon) (Bergsland 1994:409): for hunting sea otter and fur seal. *Ayaasaga-x̂* (E/En/Ea) (harpoon) (Bergsland 1994:115): used from shore with a float and line on seal (and sea otter) that are within close proximity to the hunter. *Akliga-x̂* (A/Au) (small harpoon) (Bergsland 1994:45; Jochelson 1925:80): for short-range attacks on fur seals and other sea mammals at rookeries.
- *Agalgi-x̂* (En) (spear) (Bergsland 1994:20): a long spear that was used for hunting fur seals in addition to hair seal and sea otter.
- Seal decoys: used to attract other seals to be killed (Bergsland and Dirks 1990:Narrative 35; Jochelson 1933).
- *Anagusi-x̂* (Ab) (club) (Bergsland 1994:70): for killing fur seals.
- *Chmax-six* (E) (to round up) (Bergsland 1994:147): a method of pursuing fur seal with several other hunters (as well as sea otter and other animals) by *iqyan* and working to corral them. Jochelson (1933:85) also describes approaching seals by water. The method he discusses entails the hunter approaching a sleeping fur seal by *iqyan* and using a throwing lance from close quarters.

Fur seals served as a significant traditional subsistence resource, and still do if less so than in the past (Unger 2014). *Laaqudam ulungin* (En) (Bergsland 1994:443), fur seal meat, could be cut into filets, prepared in a soup, or served raw, dried, boiled, or baked (see also seal meat in Unger 2014). Fur seals were prepared, stored, and con-

Table 4. Fur seal age/sex classifications (Bergsland 1994)

Age/sex of seal	Unangam Tunuu word	Page in Bergsland 1994
Bull	<i>aataagi-x̂</i> (Ep Au) (noted as “bull of fur seal, beach master”)	106
Smaller bull	<i>aataagaada-x̂</i> (Ep)	106
Pup	<i>laaq(u)daada-x̂</i> (Ep, En)	254
3-year-old	<i>qankus qan'gita-x̂</i> (Ab)	308

sumed in a variety of ways, and nearly all parts of the animal were consumed:

- Oil and fat: commonly used for dipping meats or dried fish into and to make *taaġu-ġ* (E) (Bergsland 1994:384) or “Aleut ice cream,” which consisted of mashed berries and some type of fish liver mixed with seal oil. Seal fat was also placed in a bottle for infants, as in *inuuluġ* (A) (sucking bottle) (Bergsland 1994:203) and used as *udġinu-ġ* (Ea) (a remedy), to help loosen bowels or to help a mother’s milk to come in after giving birth (Bergsland 1994:415).
- *Lasta-ġ* (E) (flipper): served fermented or salted, referring to any sea mammal flipper served in this fashion, but especially fur seal (Bergsland 1994:254).
- Fur seal pups: most preferred as food in part because they were tender and the pups had less blood (Unger 2014).

Fur seal skins served as raw materials:

- Skins: for storage receptacles (Unger 2014).
- Skins: as a boat covering and also as a pliable reinforcement for the frame so that it did not break apart (Jochelson 1933).
- Skins: to make *chuga-ġ* (E) (parkas) worn by women and children (Bergsland 1994:150) and for *tamix* (En) (bracelets) for women (Bergsland 1994:388).

Fur seals as part of ancestral Unangam traditional culture are present in the *Tales and Narratives* often in contexts that are dramatic and symbolic, involving physical transmogrification, violence, spousal betrayal, and competition among men (Bergsland and Dirks 1990:Narrative 28, 33, 49). These animals are significant in tale and story. Fur seal skins were used in dancing and as drum covers (Bergsland and Dirks 1990; Jochelson 1933). And fur seals feature in personal names, for example, *Aataax Malinaġ* (Eu) (Bergsland 1994:106), or “Took Away the Fur Seal Bull,” was the name of a tributary man at Unalaska.

Fur seals are mentioned less often than sea lions and ostensibly have fewer practical uses. Yet their uses are processing-intense, except for fur seal pups, which were simply eaten. The processing of fur seal bodies for oil and fat may have resulted in fewer intact bones in the village middens, as this could destroy the long bone elements critical for identifying individual animals. The use of their skins for garments, storage, and jewelry would also have been processing-intense, but these tasks alone likely would not impact the presence of fauna in middens.

SUMMARY

This meta-analysis summary of Unangam primary source mentions of three sentinel species in the Aleutian Islands demonstrates that the number of times an animal is mentioned does not directly link to the potential for selection bias impacting faunal remains in village middens. Sea lions, for example, are mentioned by far the largest number of times, indicating their importance and likely widespread use in ancestral Unangam lives. Yet the uses to which sea lions are put may not have impacted subsequent deposition in village middens. Contrary to this, the processing of fur seals for fuel oil for lamps and cooking could have significantly reduced the number of faunal remains deposited in middens. This anti-intuitive selection bias is precisely the information needed for multidisciplinary studies in the region to better understand impacts on statistical patterns over time and space.

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NOTES

1. Collaborative Research: Mercury Dynamics from the Holocene to the Anthropocene: Tracking Aleutian Mercury in Ocean Species Important to Native Alaskan Diets. PI Avery, co-I Misarti, co-I Rea NSF-ARCSS/ASSP 1935816; PI Funk ARCSS/ASSP 1935823. <https://ine.uaf.edu/werc/aleutian-mercury>
2. Unangam Tunuu regional dialects following Bergsland (1994:vi): (E) Eastern Aleut; (Ea) E of Akutan; (Eu) E of Unalaska; (Ep) E of Pribilof Islands; (A) Atkan Aleut; (Au) Attuan Aleut; (Ab) Atkan of Bering Island.
3. For nutrition values presented, food items with nutrient content (macronutrients, vitamins, and minerals) greater than 20% of the recommended daily value

established by the Food and Drug Administration (FDA) based on a 2000 kcal diet are considered “high in” or an “excellent source” of the specific named nutrient (FDA 2016). Food items with nutrient values 10–19% of the daily value are identified as a “good source” (FDA 2016). The term “low fat” refers to food items with less than 2 g of saturated fat per serving (FDA 2016).

REFERENCES

- Alaska Native Tribal Health Consortium
2015 *Traditional Food Guide for the Alaska Native People*, 2nd ed. Alaska Native Tribal Health Consortium, Anchorage, AK.
- APIA (Aleutian Pribilof Islands Association) and Atka IRA Council
2006 *Atka Traditional Foods Program Report on Steller Sea Lion Qawax (Eumetopias jubatus)*. http://www.apiai.org/wp-content/uploads/2013/10/low-resolutionATKA-Sea-Lion-Report_150.pdf
- Avery, J.P., J.M. Castellini, M. Keenan, N. Misarti, C. Funk, T.M. O'Hara, and L.D. Rea
in review Mercury Concentrations in Ancient Marine Fish and Mammal Bones: A Novel Method to Determine Long-Term Natural Fluctuations of Mercury in Marine Ecosystems. *Frontiers in Ecology and Evolution*.
- Bergsland, Knut
1994 *Aleut Dictionary = Unangam Tunudgusii: An Unabridged Lexicon of the Aleutian, Pribilof, and Commander Islands Aleut Language*. Alaska Native Language Center, University of Alaska, Fairbanks.
- Bergsland, Knut, and Moses L. Dirks, editors
1990 *Unangam Ungiikangin Kayux Tunusangin Unangam Uniikangis Ama Tunuzangis/Aleut Tales and Narratives*. Alaska Native Language Center, University of Alaska, Fairbanks.
- Black, Lydia
1998 Animal World of the Aleuts. *Arctic Anthropology* 35(2):126–135.
- Cunningham, K.M., M.F. Canino, I.B. Spies, and L. Hauser
2009 Genetic Isolation by Distance and Localized Fjord Population Structure in Pacific Cod (*Gadus macrocephalus*): Limited Effective Dispersal in the Northeastern Pacific Ocean. *Canadian Journal of Fisheries and Aquatic Science* 66(1):153–166.
- FDA (Food and Drug Administration)
2016 *Food Labeling: Revision of the Nutrition and Supplement Facts Labels*. Document 81 FR 33741. Pages 33741–33999. <http://www.federalregister.gov/documents/2016/05/27/2016-11867/food-labeling-revision-of-the-nutrition-and-supplement-facts-labels>
- Funk, Caroline
2018 Ethno-ornithology in the Rat Islands: Prehistoric Aleut Relationships with Birds in the Western Aleutians, Alaska. *Journal of Anthropological Archaeology* 51:144–158.
- Gelatt, Thomas S., and Roger Gentry
2018 Northern Fur Seal. In *Encyclopedia of Marine Mammals*, 3rd ed., edited by Bernd Würsig, J.G.M. Thewissen, and Kit M. Kovacs, pp. 645–648. Elsevier, Amsterdam.
- Hudson, Ray, Augusta Dushkin, and Unalaska City School District
1992 *Unugulux Tunusangin, Oldtime Stories: Aleut Crafts and Traditions as Taught to Students at the Unalaska City School*. Unalaska City School District, Unalaska.
- Jochelson, Waldemar
1925 *Archaeological Investigations in the Aleutian Islands*. No. 367. Carnegie Institution of Washington.
1933 *History, Ethnology, and Anthropology of the Aleut*. No. 432. Carnegie Institution of Washington.
- Johnson, Lucille Lewis
2004 Prehistoric Fishing Technologies and Species Targeted in the Aleutian Islands: Archaeological and Ethnohistoric Evidence. *New Zealand Journal of Archaeology* 24:45–59.
2005 Aleut Sea Mammal Hunting: Ethnohistorical and Archaeological Evidence. In *Proceedings of the 9th Conference of the International Council of Archaeozoology, International Council for Archaeozoology Conference (Durham, England). Proceedings of the 9th ICAZ Conference Series*, vol. 5, edited by Greg Monks, pp. 39–61. Oxbow Books, Oxford.
- Jones, Dorothy Knee
1980 *A Century of Servitude: Pribilof Aleuts Under U.S. Rule*. University Press of America, Washington, DC.
- Merrick, R.L., R. Brown, D.G. Calkins, and T.R. Loughlin
1995 A Comparison of Steller Sea Lion, *Eumetopias jubatus*, Pup Masses Between Rookeries with Increasing and Decreasing Populations. *Fishery Bulletin* 93:753–758.

- NMFS (National Marine Fisheries Service)
- 2018 Fisheries of the United States, 2018. U.S. Department of Commerce. <https://www.fisheries.noaa.gov/national/commercial-fishing/fisheries-united-states-2018>
- NOAA Fisheries
- 2023 Species Overviews: Steller Sea Lion. <https://www.fisheries.noaa.gov/species/steller-sea-lion#overview>
- Rea, L. D., J. M. Castellini, J. P. Avery, B. S. Fadely, V. N. Burkanov, M. J. Rehberg, and T. M. O'Hara
- 2020 Regional Variations and Drivers of Mercury and Selenium Concentrations in Steller Sea Lions. *Science of the Total Environment* 744(20 Nov):140787. <https://doi.org/10.1016/j.scitotenv.2020.140787>
- Rea, L. D., B. S. Fadely, S. D. Farley, J. P. Avery, W. S. Dunlap-Harding, V. Stegall, C. A. B. Eischens, T. S. Gelatt, and K. W. Pitcher
- 2016 Comparing Total Body Lipid Content of Young-of-the-Year Steller Sea Lions Between Areas of Contrasting Population Trends. *Marine Mammal Science* 32(4):1200–1218. <https://doi.org/10.1111/mms.12327>
- Spies, I.
- 2012 Landscape Genetics Reveals Population Subdivision in Bering Sea and Aleutian Islands Pacific Cod. *Transactions of the American Fisheries Society* 141(6):1557–1573.
- Thompson, Grant G., and Wayne A. Palsson
- 2015 *Assessment of the Pacific Cod Stock in the Aleutian Islands*. Alaska Fisheries Science Center. National Marine Fisheries Service, December 2015.
- Unger, Suanne
- 2014 *Qaqamiġuġ: Traditional Foods and Recipes from the Aleutian and Pribilof Islands: Nourishing Our Mind, Body and Spirit for Generations*. Aleutian Pribilof Islands Association, Anchorage.
- Veniaminov, Iakov
- 1984 *Notes on the Islands of the Unalashka District*. Translated by Lydia T. Black and R. H. Geoghegan, edited by Richard A. Pierce. Elmer E. Rasmuson Library Translation Program, Fairbanks, and Limestone Press, Kingston, Ontario.
- Wilson, Kenady, Lowell Fritz, Erin Kunisch, Kathryn Chumbley, and Devin Johnson
- 2011 Effects of Research Disturbance on the Behavior and Abundance of Steller Sea Lions (*Eumetopias jubatus*) at Two Rookeries in Alaska. *Marine Mammal Science* 28(1):E58–E74. <https://doi.org/10.1111/j.1748-7692.2011.00485>