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# Indigenous use and conservation of harbor seals (*Phoca vitulina*) at Yakutat, Alaska since the sixteenth century

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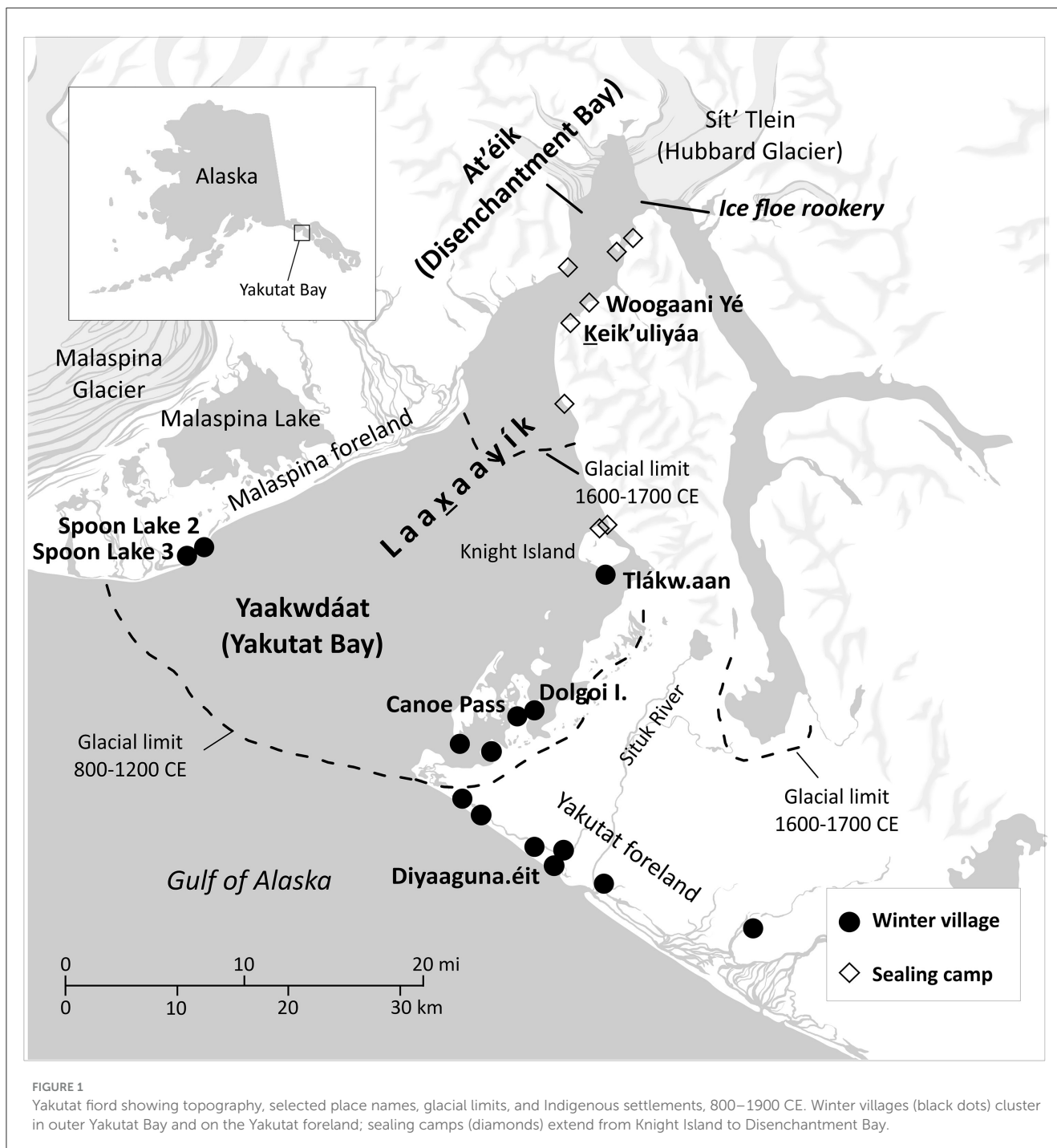
Sustainable Indigenous resource use reflects balance between animal populations and levels of human consumption, influenced by natural cycles of faunal abundance, community size and subsistence needs, procurement technologies, and the requirements of trade or commodity production. Sustainability is “epiphenomenal” when animal populations are preserved, and community needs met, without deliberate measures to prevent overharvesting. Alternatively, Indigenous conservation—cultural practices that moderate use of a resource to prevent its depletion—may play a determinative role. In this study from the Tlingit community of Yakutat, Alaska in the Northwest Coast cultural region, we interweave Indigenous and scientific perspectives to trace the use and conservation of harbor seals (*Phoca vitulina*) from before Western contact through the Russian and American colonial periods to the present. Harbor seals, which concentrate in large numbers at a summer ice floe rookery near Hubbard Glacier, are the community’s most important subsistence food and a key to its culture and history. The Smithsonian Institution and Yakutat Tlingit Tribe undertook collaborative research in historical ecology and archaeology in 2011–2014 including oral interviews with elders and subsistence providers, excavations at sealing sites, archaeofaunal analysis, historical and archival research, and consideration of climate cycles and biological regime shifts that influence the harbor seal population in the Gulf of Alaska. We compare technologies and hunting practices before and after Western contact, estimate harvest levels in different periods, and evaluate the effectiveness of traditional conservation practices that included hunting quotas enforced by clan leaders and the seasonal delay of hunting with firearms to prevent abandonment of the rookery by the seal herd.

## KEYWORDS

Indigenous conservation, Tlingit and Haida, harbor seal (*Phoca vitulina*), Indigenous ecological knowledge, Yakutat, archaeofaunal analysis, Alaska (southeast), Gulf of Alaska

## Introduction

We examine Tlingit subsistence and market hunting for harbor seals (*Phoca vitulina*; in Tlingit, *tsaa*) at the glacial ice floe rookery near Yakutat, Alaska (Figure 1) with a focus on Indigenous conservation of this key resource. The Tlingit and other Northwest Coast groups of British Columbia and Alaska manage and conserve marine foods including salmon (Ramos and Mason, 2004; Langdon, 2006; Menzies and Butler, 2007; Thornton et al., 2015; Langdon, 2019), herring (Thornton et al., 2010; Thornton, 2015), shellfish



(Groesbeck et al., 2014; Deur et al., 2015; Holmes et al., 2022), and seagull eggs (Hunn et al., 2003). Reported conservation practices for sea mammals (De Laguna, 1972; Lepofsky and Caldwell, 2013; Ramos, 2020) are of particular interest because subsistence harvesting prior to European contact may in some cases have exceeded sustainable levels, leading to the depletion or local elimination of sea otters, pinnipeds (true seals including harbor seals), and otariids (including Northern fur seals and sea lions) (Simenstad et al., 1978; Etnier, 2002; Lyman, 2003; Etnier, 2007; Erlandson and Rick, 2010; Braje and Rick, 2011; Lyman, 2011;

McKechnie and Wigen, 2011; Rick et al., 2011; Etnier, 2020). Lyman's (2003) analysis of archaeofauna on the Oregon coast identified the large body size and seasonal concentration of otariids and pinnipeds at rookeries and breeding territories as key factors in their appeal as prey and vulnerability to overexploitation. Western colonial extractive industries brought new pressure on North Pacific sea mammal populations including harbor seals, which were targeted by Indigenous hunters for commercially marketable skins and oil after the U. S. purchase of Alaska from Russia in 1867 (Crowell, 2017).

Tlingit harbor seal conservation evokes the “ecological Indian” debate, in which the view that “North American Indians were the original ecologists and conservationists” has been questioned (Krech, 2005). Skeptics point to declines of prey animals due to Indigenous overexploitation, particularly during the colonial period when the use of imported firearms and traps was seemingly unconstrained. They propose that sustainable hunting is most often an epiphenomenon of small-scale human societies, low subsistence demand relative to available resources, lack of external markets, and limited technologies for mass harvesting, rather than the outcome of intentional conservation (Martin, 1978; Krech, 1981; Redford and Robinson, 1985; Hames, 1987; Alvard, 1998; Redford, 1990; Krech, 1999; Krupnik, 1988; Smith, 2001; Burch, 2007; Hames, 2007; Harkin and Lewis, 2007).

The conservationist stance emphasizes the depth of ecological knowledge held by Indigenous peoples, explicit conservation practices reported for many groups, archaeological and historical evidence for long-term sustainability of resource use, and an ethic of stewardship and “taking care of the land” that remains vital in northern communities (Berkes, 1987, 1999; Nadasdy, 2005; Berkes and Davidson-Hunt, 2006; Menzies and Butler, 2007; De Echeverria and Thornton, 2019; Buschman, 2021). Berkes has discussed Indigenous conservation as an outcome of “common pool” systems of social control and use, which “through access limitation and self-regulation, result in the maintenance of productivity of a resource” (Berkes, 2005, p. 17). Matrilineal social organization and clan-based land ownership provide this foundation for conservation on the Northwest Coast (Lepofsky and Caldwell, 2013).

Some Indigenous conservation measures were adopted after Western contact as depletions caused by intensive market hunting prompted self-regulation, for example beaver conservation by the East Main Cree in cooperation with the Hudson Bay Company (Berkes, 1987; Krech, 1999: 186–188). Similarly, Zavaleta (1999) suggested that western Alaskan Yup'ik waterfowl conservation emerged through interaction with state and federal game managers rather than in the traditional culture. In this article, we discuss the adoption of harbor seal conservation measures by the Yakutat Tlingit after the resource was commodified in the late 19th century.

To draw distinctions between *de facto* sustainability and conservation, Smith and Wishnie (2000) defined the latter as intentionally designed, costly in the short term but providing long-term benefits, and measurable in its effects. In their view, spiritual regard for animals—fundamental to Indigenous sacred ecology (Berkes, 1999)—can be a foundation for conservation but does not necessarily result in its effective practice. Moreover, Indigenous beliefs may contradict Western concepts of conservation, such as that animals renew themselves by reincarnation, increase rather than decrease when hunted, and move away or make themselves unavailable in response to human disrespect (Fienup-Riordan, 1990, 1999; Krech, 2005; Krupnik, 2020).

Natural fluctuations in animal populations due to climatic variation and ecosystem change are a key driver of human-environmental relationships because they shift the balance between community needs and harvestable resources, trigger human responses such as prey switching and migration, and mask or exaggerate the impacts of hunting (Krupnik and Crowell, 2020; Crowell and Arimitsu, 2023). The Gulf of Alaska harbor seal population is influenced by changes in sea surface temperatures

associated with the Pacific Decadal Oscillation (PDO), increasing during negative (cool) phases when shrimp, capelin, and other fish important in the seals' diet are more abundant and decreasing during positive (warm) phases (Francis and Hare, 1994; Anderson and Piatt, 1999; Benson and Trites, 2002; Litzow and Mueter, 2014). Dendrochronological studies indicate cool PDO phases during 1662–1680, 1696–1712, 1734–1758, 1798–1816, 1840–1923, and 1946–1976 CE (Geladof and Smith, 2001; Wiles et al., 2014). During the 1946–1976 PDO cool phase, Alaska Native hunters reported very high and seemingly inexhaustible seal numbers (Haynes and Wolfe, 1999) and Yakutat community member George Ramos, Sr. recalled that rookery ice floes were “just black, I'm talking about thousands of seals” (G. Ramos, 11 June 2011, IN-3) (Table 1). A concurrent rise in the commercial market for harbor seal skins led to greatly increased sealing during this period.

Hames's summary of the dynamic interplay between sustainable use, conservation, market demand, environmental change, and hunting technologies is relevant to our discussion:

If one historically uses resources on a sustainable basis, but a change occurs, such as increased outside demand (fur, skin, and feather trade), reduction of land base, or the introduction of superior technology (shotguns), then resources will likely no longer be taken on a sustainable basis. If, however, a group is practicing true conservation, then there is a much greater chance that the group will be able to adjust to changes in demand, efficiency of capture, or habitat loss (Hames, 2007, p. 180–181).

In this study we employ Tlingit oral historical and ecological knowledge, ethnohistoric documentation, and archaeological evidence from three seal procurement sites in Yakutat fiord—pre-contact Tlákwaan village (1450–1750 cal. CE); Keik'uliyáa, an early American period sealing camp (ca. 1867–1915 CE); and Woogaani Yé, a mid-20th century sealing camp (1950s–1970s)—to analyze harbor seal hunting and conservation at the Yakutat ice floe rookery.

We compare technologies and hunting practices before and after Western contact, estimate harvest levels, and evaluate the effectiveness of reported conservation practices that included hunting quotas imposed by clan leaders, seasonal delay of firearms use to avoid frightening the seal herd into abandoning the rookery, and proscriptions against wasting seal products (De Laguna, 1972; Ramos, 2020; Crowell, 2024). We note the 20th century transition from traditional clan ownership and control of the resource to individual or small group entrepreneurial hunting, leading to unsustainable use (cf. Morseth, 1997; Berkes, 1999). This multi-perspective study informs contemporary issues including the integration of scientific and Indigenous knowledge and the design of resource co-management programs (Bartlett et al., 2012; Mistry and Berardi, 2016; De Echeverria and Thornton, 2019; Buschman, 2021; Mansuy et al., 2023).

## Methods

We conducted collaborative co-production of knowledge at Yakutat during 2011–2014, supported by the National Science Foundation, National Parks Foundation, Smithsonian Institution,

TABLE 1 Interviews conducted at Yakutat, 2011–2014.

	Clan	Life dates	Interviews, IN-# = interview reference number
Elaine Abraham	Kwáashk'i Kwáan	1929–2016	10 June 2011 Orientation [IN-1] 11 June 2011 Life history, sealing [IN-2] 15 June 2012 Repatriation [IN-11] 16 June 2012 Place names [IN-13A] 17 June 2012 Clan history, oral traditions [IN-13B] 19 June 2012 Egg Island seal camp [IN-17] 27 June 2013 Sealing in Disenchantment Bay [IN-28] 27 July 2013 Elders' visit to Keik'uliyáa camp [IN-34] 4 August 2013 Discuss elders' visit to Keik'uliyáa [IN-29]
Bertrand J. Adams, Sr.	L'uknax.ádi	1937	16 June 2012 Life history, sealing, Dry Bay [IN-12]
Devlin Anderstrom	Kwáashk'i Kwáan	1997	27 May 2014 Cultural heritage, sealing [IN-39] 17 June 2014 Cultural heritage, sealing [IN-40]
Ronnie G. Converse, Sr.	Galyáx Kaagwaantaan	1952	21 June 2012 Preparation of seal meat, oil [IN-27] 28 May 2014 Preparation of seal meat, oil [IN-54]
Victoria L. Demmert	Kwáashk'i Kwáan	1946	16 July 2014 Visit to Tlákwaan [IN-56]
Lena Farkas	Kwáashk'i Kwáan	1933–2017	11 June 2011 Life history, sealing [IN-4] 16 June 2012 Place names [IN-13A] 17 June 2012 Clan history, oral traditions [IN-13B]
Eli Hanlon		1980	17 June 2012 Seal hunting [IN-14]
Jeremiah James	Galyáx Kaagwaantaan	1981	20 June 2012 Seal hunting, tanning skins [IN-24] 22 May 2014 Seal hunting, sewing seal skins [IN-44, IN-45] 25 May 2014 Seal hunting trip with Gary Johnson 26 May 2014 Demonstrates cutting up seals [IN-46] 29 May 2014 Learning to hunt, sharing [IN-47]
Gary S. Johnson	Kwáashk'i Kwáan	1944–2019	27 May 2014 Sealing, future of the community [IN-41]
Kai Monture	Kwáashk'i Kwáan	1990	21 June 2013 Keik'uliyáa seal camp YAK-012 [IN-31] 29 July 2013 Egg Island and Disenchantment Bay [IN-32] 29 July 2013 Cultural heritage and change [IN-33]
Sheri A. Nelson	Kiks'sadi	1956	21 June 2012 Life history, subsistence, sealing [IN-25]
Elizabeth "Janice" Piccard	Kwáashk'i Kwáan	1945–2015	28 May 2014 Preparing seal meat, oil [IN-54]
George Ramos, Sr.	L'uknax.ádi	1930–2019	11 June 2011 Traditional sealing methods [IN-3]; 12 June 2011 Glacier prayer [IN-10]; 13 June 2011 Calling seals [IN-5]; 13 June 2011 Disenchantment Bay place names and history [IN-8]; 13 June 2011 Seal hunt with David Ramos [IN-9]; 18 June 2012 Yakutat place names and sealing camps [IN-15]; 19 June 2012 Daak Léin men's camp on Egg Island [IN-18]; 19 June 2012 Woogaani Yé battle [IN-19, IN-22]; 19 June 2012 Glacier prayer [IN-20]; 19 June 2012 Place names [IN-21]; 20 June 2012 Yakutat canoe [IN-23]; 23 May 2014 Seal hunting with Kai Monture; 24 May 2014 Discussion of sealing trip, picking wild celery [IN-42]
David Ramos	Kwáashk'i Kwáan	1960	10 June 2011 Orientation with Elaine Abraham [IN-1] 13 June 2011 Seal hunt with George Ramos, Sr. [IN-9]
Judith Ramos	Kwáashk'i Kwáan	1959	27 June 2013 Sealing at Disenchantment Bay, w/Elaine Abraham [IN-28] 4 August 2013 Discussion of elders' visit to Keik'uliyáa site [IN-29] 16 July 2014 Visit to Tlákwaan site [IN-57] 29 July 2014 Personal history, Yakutat language and culture [IN-48]
Ray Sensmeier	Kwáashk'i Kwáan	1944	12 June 2011 Sealing at Disenchantment Bay [IN-6] 18 June 2012 Seal conservation, disturbance by cruise ships [IN-16] 27 July 2013 Visit to Keik'uliyáa [IN-37] 26 May 2014 Yakutat subsistence [IN-53]
Ingrid L. Shodda	Wooshkeetaan	1946	21 June 2012 Seal hunting and subsistence [IN-26]
Ted Valle, Sr.	Galyáx Kaagwaantaan	1938	12 June 2011 Sealing and subsistence [IN-7]
Jennie Wheeler	Teikweidí	1954	27 June 2013 Sewing and beadwork on seal skin [IN-30]

Interview data and quotes are attributed by name to speakers with their informed consent and release for publication.



Sealaska Heritage Institute, and the Yakutat Tlingit Tribe. The project was led by principal investigator Aron L. Crowell (Arctic Studies Center, Smithsonian Institution), the late senior researcher Elaine Chewshaa Abraham (Alaska Native Science Commission) and senior researcher Judith Daxootsú Ramos (University of Alaska Southeast) (Crowell, 2024). The work builds on Frederica de Laguna's studies of Yakutat Tlingit culture and history (De Laguna, 1972) and archaeology (De Laguna et al., 1964).

Fifty-seven research interviews were conducted in English and Lingit (the Tlingit language) with Yakutat elders and subsistence providers and are cited here by IN- number and date (Table 1). Interviews were authorized by the Yakutat Tlingit Tribe through a National Historic Preservation Act Memorandum of Understanding (National Science Foundation, 2014). Research protocols emphasized community codesign and oversight, access to data, and respect for Indigenous knowledge and culture. All persons who were interviewed provided written consent for their contributions to be published and credited by name.

Archaeological fieldwork was coordinated with the Yakutat Tlingit Tribe, U. S. National Forest Service, U. S. National Park Service, Sealaska Corporation, and the State of Alaska's Office of History and Archaeology. These organizations provided permissions and permits for excavations on their lands, which include parts of Tongass National Forest, Wrangell-St. Elias National Park, and Sealaska Corporation's Alaska Native Claims Settlement Act (ANCSA) allotment on Knight Island. Field teams conducted surveys and site investigations around Yakutat fiord, including excavations at Tlákw.aaan (Alaska Heritage Resources Survey number YAK-007), Keik'uliyáa (YAK-012), and Woogaani Yé (YAK-202) (De Laguna et al., 1964; Crowell, 2024). Work at these and other sites allowed reconstruction of the settlement history of the fiord following glacial retreat and provided data on harbor seal harvesting patterns and hunting technologies. AMS (accelerated mass spectroscopy) radiocarbon dates from Tlákw.aaan and other sites are reported with calibrated age ranges at two standard deviations (95.4% confidence interval) with the computed median date in parentheses. All dates were calculated using OxCal 4.4.4 (<https://c14.arch.ox.ac.uk/>, accessed 17 April 2023).

Archaeofaunal analysis (Etnier, 2017) included taxonomic identifications of fish, mammal, bird, and invertebrate samples from Tlákw.aaan with reference to skeletal material at Western Washington University. To test for evidence of rookery sealing at Tlákw.aaan complete harbor seal bones from the 2014 archaeological sample were measured and aged using methods presented in Etnier (2002) and Ericson and Storå (1999). Twenty-three different skeletal elements were measured on a total of 26 indices. These measurements were compared with growth curves generated from 41 known-age reference skeletons collected in collaboration with the Whatcom Marine Mammal Stranding Network and the Central Puget Sound Marine Mammal Stranding Network. The minimum number of individual harbor seals (MNI) in Tlákw.aaan Mound B was estimated from complete and partial humerus bones, considering counts, anatomical position (side of body, proximal vs. distal), ontogenetic stage of development, and chronostratigraphic level. Few faunal remains were recovered at Keik'uliyáa or Woogaani Yé due to poor organic preservation.

To quantify human impacts on the Alaskan harbor seal meta-population, Crowell (2020) aggregated historical records on commercial takes (Morris et al., 1898; U. S. Department of Labor, Bureau of Fisheries, 1907, 1908, 1911, 1912, 1915; Institute of Social, Economic, and Government Research, 1966; Interagency Task Group, 1976); subsistence harvests based on U. S. Census data and ethnographically reported per-person consumption rates (Wolfe and Mishler, 1994); seal bounties paid after 1927 by the U. S. Fish and Wildlife Service and Alaska Department of Fish and Game to reduce seal predation on salmon (Paige, 1993); and "predator control" kills by the Alaska Department of Fish and Game (Alaska Fisheries Board and Alaska Department of Fisheries, 1950-1959). Data were summarized in four-year increments from 1880 to 2007.

## Results

### The history of sealing at Yakutat

Most of Yakutat's 350 Indigenous residents identify as Tlingit while recognizing multiple strands of ancestry resulting from migrations to Yakutat fiord by Prince William Sound Eyak in about 900 CE, Copper River Ahtna in about 1500 CE, and southeast Alaska Tlingit in about 1700 CE (Crowell, 2024). Social organization is matrilineal with division into Raven and Eagle moieties and five principal clans (*naa*): Kwáashk'i Kwáan (Raven), Luknaxádi (Raven), Galyáx Kaagwaantaan (Eagle), Teikweidí (Eagle), and Shankukeidí (Eagle). Matrilineal clans are divided into houses (*hít*) whose members traditionally occupied one or several large winter dwellings together with affinal relatives from clans of the opposite moiety and who cooperated in food production. Traditional society was additionally structured by rank, with a privileged elite including house and clan leaders ("chiefs") and their close relatives, commoners, and enslaved people. The Kwáashk'i Kwáan, of Ahtna origin, are the traditional owners of Yakutat fiord and the seal rookery, which they acquired from the Eyak in exchange for ceremonial crest shields made of native copper (De Laguna, 1972; Crowell, 2022, 2024).

Yakutat fiord is surrounded by mountains of the St. Elias Range and includes outer Yakutat Bay (in Tlingit, Laaxaayík) and inner Disenchantment Bay (in Tlingit, At'éik). Hubbard and Malaspina glaciers advanced and retreated several times during the Pleistocene and Holocene, receding to their modern positions over the last 800 years (Barclay et al., 2001; Elmore et al., 2015). Large quantities of glacial meltwater flow into the fiord in summer, carrying mineral nutrients that support a flourishing food web of phytoplankton, zooplankton, invertebrates, fish, seabirds, and marine mammals (Arimitsu et al., 2016).

In Disenchantment Bay, ice floes calved from Hubbard Glacier (in Tlingit, Sít Tlein, "big glacier") and Turner Glacier provide floating platforms for female harbor seals to give birth and raise their pups in safety from bears, killer whales, and sharks (Figure 2). Parturition begins in early May, with peak numbers of pups observed on the ice by mid to late June (Jansen et al., 2014). Pups are weaned and independent of their mothers in 4–6 weeks (Pitcher



FIGURE 2

Aerial view of harbor seals on ice floes in Disenchantment Bay near Hubbard Glacier, 2016. Photo by John Jansen, courtesy of the National Atmospheric and Oceanic Administration, Alaska Fisheries Science Center, Seattle.

and Calkins, 1979). Male, female, and young-of-the-year (YOY) seals reside at the rookery until early August, then disperse. The number of seals at the rookery, today about 2,100, may have been five times or more higher prior to a major Gulf of Alaska population crash in the 1960s (Jansen et al., 2014; Crowell, 2020), although no pre-crash aerial survey data are available.

Harbor seals are non-migratory and the Gulf of Alaska-Bering Sea metapopulation includes 12 genetically distinct stocks (O’Corry-Crowe et al., 2003). Yakutat harbor seals are part of the Prince William Sound stock that extends from Cape Elizabeth on the Kenai Peninsula to Cape Fairweather southeast of Yakutat, with an estimated population of about 45,000 out of a total Alaskan harbor seal population of over 240,000 (Young et al., 2023).

The Yakutat ice floe rookery has likely been in existence since glacial ice began to retreat from the mouth of Yakutat Bay around 1200 CE. Oral narratives and archaeological evidence indicate that as Eyak, Ahtna, and Tlingit groups migrated to the emerging fiord they established settlements and hunting camps near the receding ice edge (De Laguna et al., 1964; De Laguna, 1972; Crowell, 2024). Archaeofaunal evidence from the Eyak site of Diyaaguna.éit, established on the Yakutat foreland by 774 (933) 1025 cal. CE, indicates hunting of harbor seals combined with fishing and forest hunting (Davis, 1996). Probable Eyak sites including Spoon Lake 3, 1045 (1257) 1406 cal. CE, Spoon Lake 2 1180 (1397) 1605 cal. CE, Canoe Pass (undated), and Dolgoi Island (undated) were founded on the shores of Yakutat Bay as the glaciers receded, with a possible focus on sealing although faunal evidence is lacking and only Spoon Lake 3 has been substantially excavated (Crowell, 2024, p. 85–111). After emigrating from the Copper River, the Ahtna constructed Tlákw.aan in 1454 (1509) 1631 cal. CE on Knight Island near the 16th century ice edge and conducted rookery sealing from the site (De Laguna et al., 1964; Crowell, 2022, 2024). In oral traditions

recounted by Yakutat elder George Ramos, Sr., sealers of this era employed dugout spruce canoes fitted with a skin-wrapped bow bumper to push aside ice floes and hunted with hand-thrown, bone-tipped harpoons attached to sealskin floats (G. Ramos, 11 June 2011, IN-3; Ramos, 2020) (Figure 3).

After Tlingit clans arrived in the early 18th century, they established villages on the Yakutat foreland and sealing camps close to the head of the fiord. Russian, Spanish, British, and American fur trading expeditions visited Yakutat in the 1780s–1790s and a Russian trade fort was built in 1795 but destroyed in 1805 by Tlingit residents (De Laguna, 1972: 107–176). Commercial trade focused on sea otters and fur seals, and although some harbor seal skins were requisitioned by the Russian-American Company there was no external market for harbor seal products (Crowell, 2017).

The Alaska Commercial Company took over former Russian trading posts in 1867 and encouraged Alaska Natives to produce seal skins and oil extracted from seal blubber in exchange for guns, clothing, metal tools, glass beads, and other factory-made goods (Petroff, 1884; Crowell, 2017). Disenchantment Bay became known as “the greatest hair [harbor] sealing ground on the coast” (Burroughs et al., 1901: 161) where hundreds of Yakutat residents and visitors from other Tlingit communities conducted annual communal hunts. They paddled dugout canoes and shot seals with breech-loading rifles, employing harpoons to secure and retrieve shot seals. The main hunting camp, Keik’uliyáa, is discussed below. Commercial harbor seal hide production in the southern Bering Sea and Gulf of Alaska (including Yakutat and other coastal communities) reached 51,921 in 1904–1907, almost 13,000 per year (Figure 4) (Crowell, 2020). This level of hunting may have depressed the overall population; as reported in 1898, “the common hair seal [harbor and spotted seals] and the sea lion have decreased in numbers to such an extent that their pursuit no longer occupies a





FIGURE 3

Ancestral sealing in Disenchantment Bay as recounted by George Ramos, Sr. The hunting canoe had a skin-covered ice bumper that projected from the bow. The harpoon had a detachable head connected by line to a skin float that was thrown overboard after a seal was hit to hinder its escape. A club, visible in the foreground canoe, was used to kill harpooned seals. Illustration by Emily Kearney-Williams © Smithsonian Institution.

place among the industries of the country, and they supply a wholly local demand” (Morris et al., 1898). However, there is no direct evidence that the local harbor seal population at Yakutat diminished and commercial sealing at the rookery continued until about 1915, ending when market demand for oil and skins declined.

In the mid-20th century, high market prices for seal skins—up to \$60 for a large hide in good condition—and seal bounties paid by the U. S. Fish and Wildlife Service and Alaska Department of Fish and Game led to renewed, intensive commercial hunting by Alaska Natives, peaking at 155,000 seals in the 1964–1967 period (Figure 4). The standing harbor seal population in the 1960s is unknown, but increased hunting evidently exceeded the sustainable threshold, tipping off a severe crash estimated at up to 90% for some stocks (Pitcher, 1990; Mathews and Womble, 1997; Jemison et al., 2006; Womble et al., 2010; Hoover-Miller et al., 2011). Yakutat sealing in this period was pursued by individual hunters or small groups who used Woogaani Yé and other sealing camps in Disenchantment Bay, taking large numbers of seals each season (De Laguna, 1972, p. 373–374; Crowell, 2020, p. 65–83). Elaine Abraham recalled that “...seal hunters would go up there [to Disenchantment Bay] and they’d come down with 600 seals, 300 seals, 1,200 seals” (E. Abraham, 27 June 2013, IN-28). These totals far exceeded subsistence needs and most of the meat is reported to have been wasted (De Laguna, 1972:373–374; G. Johnson, 27 May 2014, IN-41; T. Vale, 12 June 2011, IN-7). Bounties and commercial sealing were ended by the federal Marine Mammal Protection Act in 1972.

Present residents of Yakutat harvest about 120 different subsistence foods, totaling close to 300 kg per household in 2015 (Sill et al., 2017). Harbor seals, now taken solely for subsistence use, comprised about 20% of total community harvest weight. A survey in 2008 found that 57% of Yakutat Native households engaged in subsistence sealing and 100% consumed seal products; annual consumption (0.3 seals per person) was the highest in Southeast Alaska and the second highest in the state (Wolfe et al., 2009). The combined annual harvest for the Prince William Sound stock, including the Yakutat take, was 387 seals in 2014—well below the PBR for this stock (1,342)—indicating a sustainable modern level of hunting.

## Oral documentation of conservation practices

Possessory rights to land and resources have been proposed as a necessary precondition for Indigenous conservation (Smith and Wishnie, 2000). At Yakutat, matrilineal clans owned bounded territories and maintained exclusive control over resources on those lands (De Laguna, 1972; Goldschmidt and Haas, 1998). George Ramos, Sr. emphasized that, “One thing about the Tlingit culture is land ownership is one of the first laws. Nobody comes into your land, until you give them permission” (G. Ramos, 13 June 2011, IN-8). Clan leaders “took care of the land” (De Laguna, 1972: 361) and

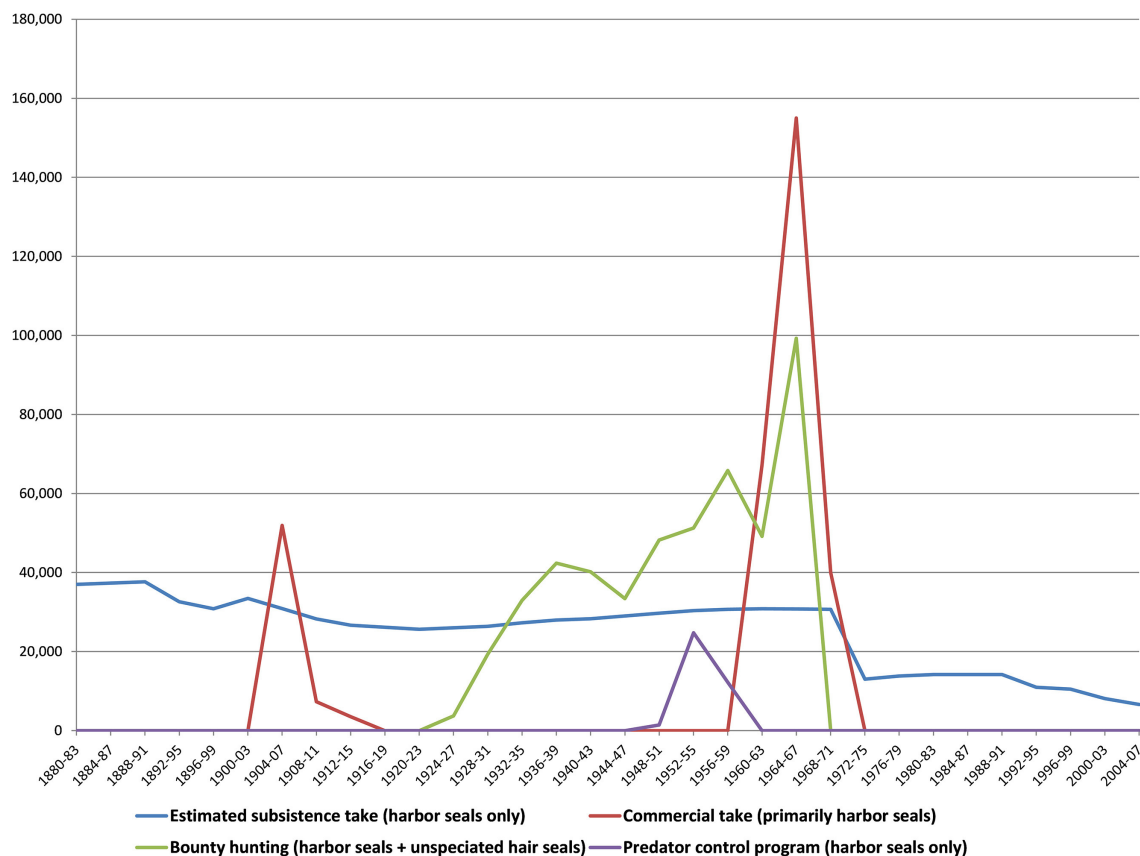


FIGURE 4

Estimated subsistence, commercial, bounty, and predator-control takes of Alaskan harbor seals, 1880–2007 (Crowell, 2020).

“made the regulations” (T. Valle, 12 June 2011, IN-7). According to community members interviewed by De Laguna:

He [the clan leader] not only determined when, where, and with what weapons his people and others might hunt or fish but might specify how many animals each man might take. Such rules were not simply to ensure a fair distribution to every man but were also to protect the animals during their breeding season. The chief had the power of life and death in enforcing these regulations and in dealing with unauthorized trespassers (De Laguna, 1972, p. 464).

Elaine Abraham said that “Yaa Xooda Keit [a Kwáashk'i K'wáan clan leader in the 1880s] would say, “These families can go. And they can take this many seals” (E. Abraham, 27 June 2013, IN-28). Leaders managed resources in cooperation with other clans; for example, permission given to the Teikweidi and L'uknaxádi by the Kwáashk'i K'wáan to hunt at the seal rookery was reciprocated by access to eulachon and salmon fishing sites owned by those clans on the Yakutat foreland (E. Abraham, 17 June 2012, IN-13B).

The Kwáashk'i K'wáan leader also determined the starting date of the rookery hunt. During the Russian colonial period when Tlingit hunters had little access to firearms and sealing was carried out using harpoons, he would authorize the hunt to begin in May as soon as the first newborn pups were visible on the ice floes (De

Laguna, 1972, p. 374–375; G. Ramos, 11 June 2011, IN-3). As we discuss below, the proportion of unweaned harbor seal pups in the Tlákwaan archaeofaunal assemblage suggests that this practice originated in the pre-contact period. After rifles came into use, the start of the hunt was delayed until mid or late June after the majority of pups had been born, although earlier hunting with harpoons was allowed (De Laguna, 1972, p. 360).

Yakutat community members interpret historical delay of the hunt until June as a conservation measure to protect the new generation of seals, allowing the pups time to become independent of their mothers and “to fend for themselves,” meaning they are weaned, able to catch their own food, and strong enough to escape hunters (E. Abraham, 27 June 2013, IN-28; D. Ramos, 10 June 2011, IN-1; G. Ramos, 18 June 2012, IN-15). However, because many seals are not born until early June and need to nurse for up to 6 weeks, relatively few would have survived if their mothers were killed at any point in June or even July. Kwáashk'i K'wáan elder Maggy Harry offered an alternative explanation—if hunting began too early in the season the herd would be frightened away by the noise of the guns, but once the pups were born the females would remain with them, even under hunting pressure (De Laguna, 1972, p. 373–376). This interpretation is consistent with the allowance of earlier harpoon-only hunting, which could be conducted in silence. We suggest that the delayed use of rifles ensured successful hunting but also had a conservation effect because it anchored the herd and

prevented the mass abandonment of pups, decreasing incidental mortality of this age class.

Yakutat community members recognize spiritual agency in seal conservation, including the traditional belief that the male spirit of Sít Tlein glacier “protects the seals” by packing the ice floes together to deny access by canoe until the pups are ready, then letting the pack be broken open by tidal currents to expose the herd (E. Abraham, 11 June 2011, IN-2; K. Monture, 29 July 2013, IN-32; D. Ramos, 10 June 2011, IN-1; G. Ramos 11 June 2011, IN-3). Prayers, offerings, and ritual proscriptions (for example, the prohibition of fires before the start of the hunt) demonstrate respect for Sít Tlein and elicit his cooperation (E. Abraham, 10 June 2011, IN-1; G. Ramos, 12 June 2011, IN-10; 18 June 2012, IN-15; 19 June 2012, IN-20). The seals themselves are believed to play a role; one elder of an earlier generation said, “How is it that the hair [harbor] seals make the ice gather together and block Disenchantment Bay when they are having their young?” (De Laguna, 1972, p. 374). Thus, the human decision about when to start the hunt was influenced by physical factors (currents and breakup of the ice pack), close observation and knowledge of seal behavior, the type of hunting weapons to be used, and relationships with animals and natural forces that are defined in spiritual terms.

Proscriptions against waste play an important role in seal conservation at Yakutat. The cultural value placed on using all parts of a seal is related to the concept of inter-conscious, reciprocal relationships among people and animals, including that seals willingly give themselves to hunters. Wasting this gift would be offensive and disrespectful, causing the seals to move away (R. Sensmeier, 12 June 2011, IN-6; G. Ramos, 18 June 2012, IN-15). Oral accounts describe the conservative use of resources at *Keik'uliyáa*, where seal meat, blubber, oil, organs, and flippers were cooked and eaten on site or cured with smoke and packed in barrels and bentwood boxes for winter consumption (Crowell, 2024, p. 80–81). The trade-off between surplus production for the market and avoiding food waste may have been a consideration in how clan leaders managed the hunt, although the large harvests of the commercial period likely exceeded what could be fully utilized.

## Sealing at Tlákw.aan before Western contact

Tlákw.aan (“old town”), an Ahtna-Eyak village site on the south shore of Knight Island in Yakutat Bay, includes remains of seven rectangular lineage houses, food storage caches, and mounds of cultural midden containing charcoal, fire-cracked rock, well-preserved faunal remains, and stone, bone, and copper artifacts (Figure 5). Frederica de Laguna excavated House 1, the largest dwelling (15 × 15 m), in 1949–1952 along with parts of the adjacent midden (Mound B) (De Laguna et al., 1964). We excavated a 1 × 4 m trench in Mound B on the north side of House 1 in 2014 to obtain an AMS radiocarbon date sequence and a complete faunal sample (Etnier, 2017; Crowell, 2024, p. 116–136). Freed and Lane’s analysis of fauna from another area of Mound B provides comparative data, although the sample was discarded in the field by the investigators and could not be reexamined (Freed and Lane, 1964).

Tightly clustered AMS dates from the 2014 trench (Kováčik and Cummings, 2015) indicate that the cultural levels (Strata 2,

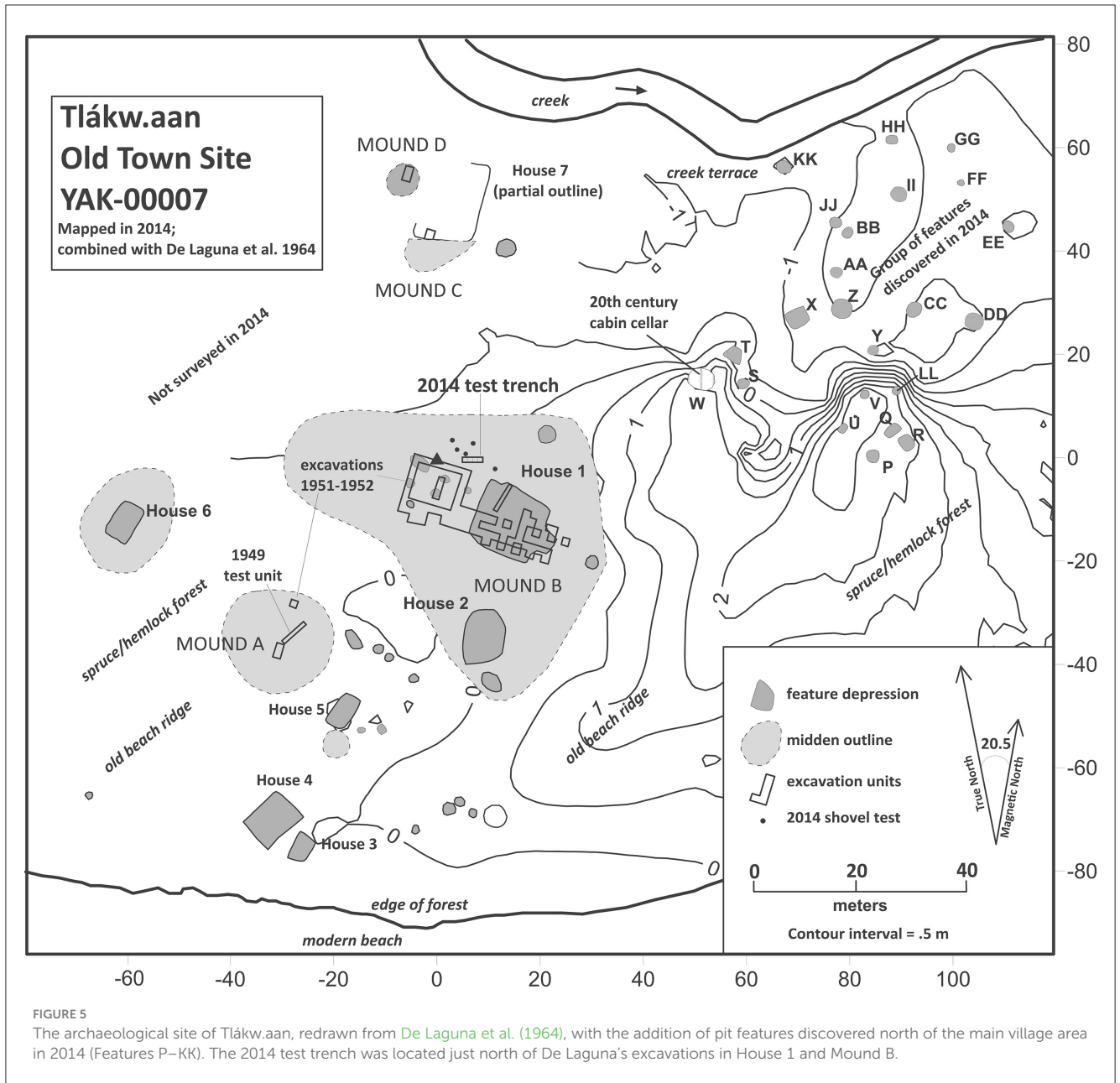
3, and 4) of Mound B (Figure 6) were deposited between 1454 (1509) 1631 cal. CE and 1461 (1561) 1635 cal. CE., a median 52-year period with a 95.4% confidence interval (2 SD) of 181 years (Table 2). The dates are on charcoal from long-lived species—spruce (*Picea*) up to 500 years and balsam poplar (*Populus*) up to 200 years—that pose the potential problem of significant age variation between inner and outer growth rings, yet the narrow spread of the AMS dates suggests that the wood samples were from young trees only recently established on post-glacial terrain. Knight Island was uncovered by glacial retreat in the mid-15th century (Barclay et al., 2001) and oral traditions describe a recently deglaciated landscape at the time of settlement (Crowell, 2022). No Russian trade items have been found at the site, consistent with its abandonment before 1780. Site occupation overlapped with the coldest interval of the Little Ice Age (1400–1530 CE) when seals were likely to have been abundant (Wiles et al., 2014; Crowell and Arimitsu, 2023). Hubbard Glacier was <20 km from the site during occupation and it is recorded in oral tradition that men of the village hunted “at the seals’ home” near the glacier (Swanton, 1909:347–368). Tlákw.aan artifacts related to sealing include barbed bone harpoon points, pecked stone oil lamps, semilunar slate knives, copper-edged flensing knives, and cobble spalls for cutting and scraping hides.

The 2014 archaeofaunal assemblage (NISP=10,638) included shellfish, fish (almost entirely salmon), land mammals (beaver, porcupine, black-tailed deer, dog, bear), and sea mammals (harbor seal, Northern fur seal, harbor porpoise), with harbor seal as the dominant mammalian species (NISP=1,044) (Etnier, 2017). Complete harbor seal bones from the 2014 archaeological sample were measured and aged using methods presented in Etnier (2002) and Ericson and Storå (1999) and measurements were compared with growth curves generated from 41 known-age reference skeletons collected in Puget Sound, Washington State.

To create growth curves, measurements for 32 young-of-the-year (YOY) seals in the Washington sample were plotted against age in tenths of a year. The graph for midline femur length (Figure 7) shows a typical degree of metric separation between newborns, transitional, and weaned animals. Based on where the Tlákw.aan specimens plotted relative to the known-age specimens, and whether or not they represented YOYs or older seals with more fully fused epiphyses, they were categorized as newborn pups, transitional pups, weaned pups, sub-adults, or adults. Subjective assignments to the categories of newborn, young-of-the-year, juvenile, and adult were made for Tlákw.aan specimens that could not easily be measured, based on the degree of osteological development, fusion state of the epiphyses, and size relative to known-age reference skeletons. Age estimates were made for a total of 173 Tlákw.aan harbor seal specimens, with 145 metrically determined (Table 3) and 28 subjectively determined (Table 4). Newborn pups made up 16% ( $n = 28$ ); transitional pups 16% ( $n = 27$ ); weaned pups 16% ( $n = 27$ ); sub-adults 30% ( $n = 52$ ); and adults 23% ( $n = 39$ ) of the assemblage.

The combined proportion of newborn and transitional pups (32%) is an unmistakable signal of ice floe rookery hunting beginning in May when the first pups were born, as reported for the early post-contact period. The proportional representation of skeletal elements in all ages of seals suggests that hunters accessed the rookery by canoe from Tlákw.aan and brought back entire carcasses to the village, as Freed and Lane (1964) also concluded.



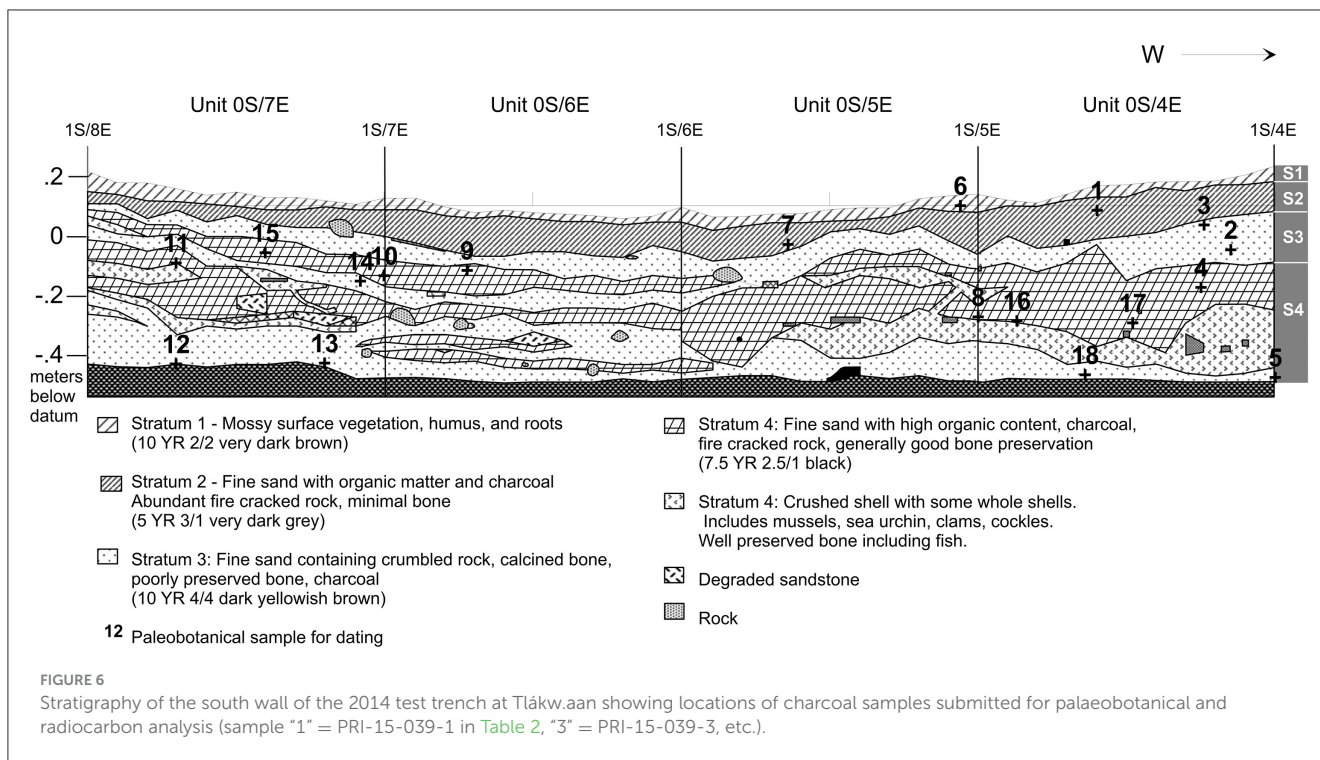


**FIGURE 5**  
The archaeological site of Tlákw.aan, redrawn from De Laguna et al. (1964), with the addition of pit features discovered north of the main village area in 2014 (Features P–KK). The 2014 test trench was located just north of De Laguna’s excavations in House 1 and Mound B.

Harbor seal consumption rates at Tlákw.aan can be approximated based on the minimum number of individuals (MNI). The most numerous element from the 2014 trench in Mound B for which body side can be determined is the humerus, with 19 left-side and 13 right-side specimens, suggesting an MNI of 19. Further consideration of the anatomical position (proximal vs. distal), ontogenetic stage of development, and chronostratigraphic provenience of the specimens confirms this estimate. Accumulation of these 19 harbor seals in the 4 m<sup>2</sup> trench occurred over at least 52 years based on median radiocarbon dates and up to 181 years at 2 SD. If we use the median span of 52 years and consider the total area of Mound B (~150 m<sup>2</sup>) and assume similar dating and stratigraphy over that area, then the total MNI for Mound B and its two households (Houses 1 and 2) would be 712 seals (150 m/4 m × 19), or 712/52 = 14 seals per year. This may be compared to results from the

Freed and Lane sample from a 200 ft.<sup>2</sup>/18.6 m<sup>2</sup> trench in a different area of Mound 1, which yielded 51 left side and 41 right-side harbor seal humeri for an approximate MNI of 51. The projected MNI for all of Mound B based on this sample would be 411 seals (150 m/18.6 m × 51), or 411/52 = 8 seals per year (Freed and Lane, 1964, p. 77–84). This lower MNI is likely due to rapid excavation and failure to record many of the bones; whereas we recovered 261 harbor seal bones per m<sup>2</sup> of excavation (1,044 NISP/4 m<sup>2</sup>) Freed and Lane reported only 33 per m<sup>2</sup> of excavation in midden of similar depth (627 NISP/18.6 m<sup>2</sup>).

Our MNI calculation of 14 seals per year for Mound B and previous estimate that House 1 and House 2 had a combined occupancy of 50 people (Crowell, 2022) yield a harbor seal consumption rate of 0.3 seals/person/yr., similar to modern subsistence consumption.



## Keik'uliyáa and the 19th century commercial sealing era

Keik'uliyáa was a large sealing camp on the east side of Disenchantment Bay used during the early commercial sealing era (1867–1915) (De Laguna, 1972; Crowell, 2024, p. 153–177). It was a “family camp” where women flensed and cut up seal carcasses, scraped and stretched seal hides, rendered oil from blubber, and prepared seal meat for winter consumption, reserving a large portion of the hides and oil for trade with the Alaska Commercial Company (Crowell, 2017). The men stayed overnight at hunting camps close to the rookery and returned to Keik'uliyáa with their catch. Almost the entire Yakutat population occupied the Disenchantment Bay camps from mid-June through early August.

On June 21, 1899, the Harriman Alaska Expedition photographed the main encampment at the mouth of Indian Camp Creek, which included a row of 18 canvas tents and a parallel row of six bark-covered smokehouses (Figure 8); a second, smaller encampment with eight tents and one smokehouse east of Aquadulce Creek (Figure 9); and a third location with six tents and one smokehouse at the mouth of Aquadulce Creek. The Harriman observers estimated that the population at all three subcamps was 300–400 people including Yakutat residents and visiting hunting parties from Juneau and Sitka.

Clusters of sleeping tents at the three subcamps, each associated with a smokehouse for processing meat, skins, and blubber, mirrored the socio-spatial arrangement of Tlingit winter villages. Kwáashk'i Kwáan, Teikweidí, and Galyáx Kaagwaantaan houses (*hít*) from Khantaak village at the mouth of the fiord, L'ukna<sub>x</sub>.ádi houses from Situk River Village on the Yakutat foreland and visiting lineages from Juneau and Sitka each appear to have established their own smokehouses and associated living areas at Keik'uliyáa,

although we were unable to learn the distribution of the different clans in 1899. The layout of the camp reflected sealing of this period as a large-scale, cooperative enterprise of socially linked matrilineal households, structurally comparable to sealing at pre-contact Tlákw.aan.

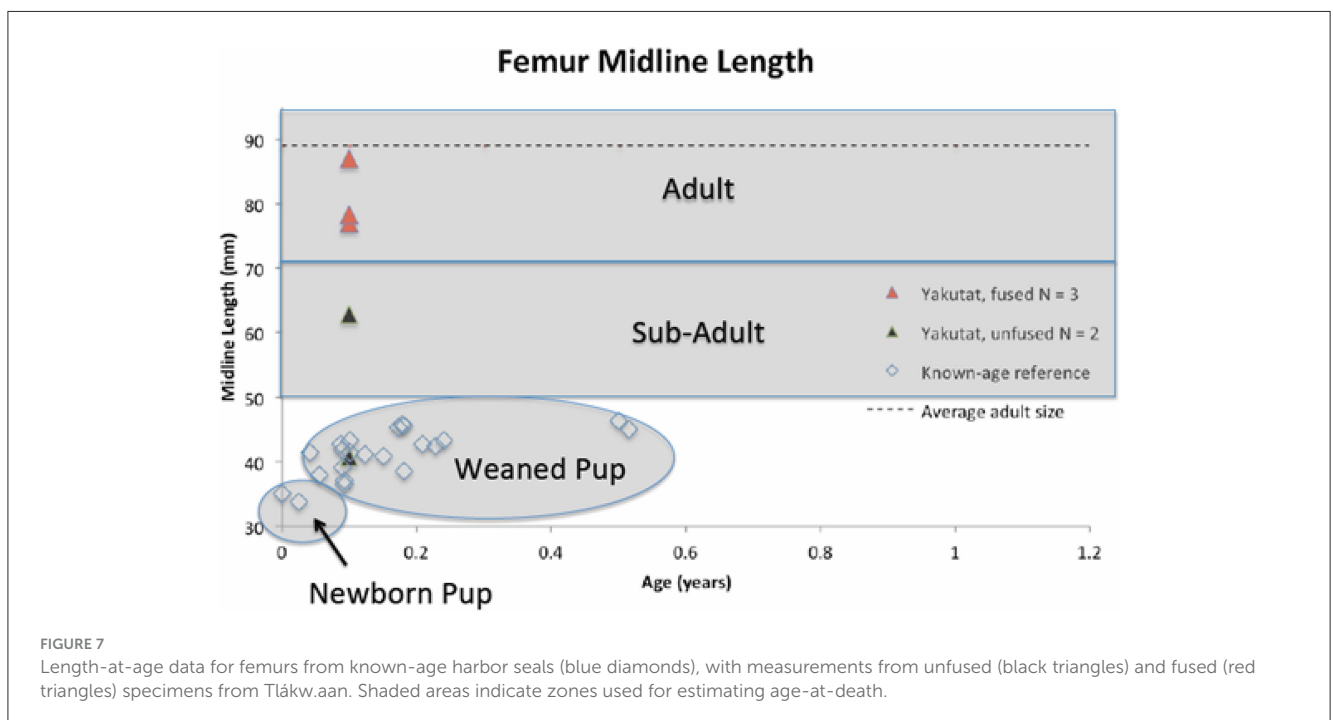
In September 1899 a series of strong earthquakes raised the land level of Keik'uliyáa by 3–3.5 m, and in subsequent seasons the camp was established along the post-earthquake shoreline. A central section of the uplifted and abandoned 1899 camp, including undisturbed rock outlines of the tents, was archaeologically preserved (Figure 10). Excavations of three tent outlines (Structures 1, 2, and 3) and a blubber-rendering hearth (Feature 1) yielded commercially-produced goods (glass beads, metal tools and fasteners, expended brass rifle cartridges, lead shot and primers, glass and ceramic vessel fragments, food cans, clothing, and personal items) dating from the 1870s to 1890s, reflecting hunting, domestic life, and trade with the Alaska Commercial Company.

Rifle cartridges were from the 1892 .25-20 Winchester, the 1884 .30 Springfield military rifle, the 1886 .32-40 Winchester, the 1895 .35 Winchester lever-action rifle, and the 1884 .44 caliber Colt Lightening magazine rifle, all of higher caliber than weapons used by seal hunters today (Barnes, 2012). A 12-gauge brass shell was also found, probably for the Winchester Model 1887 shotgun (Kirkland, 2007). These weapons were significantly louder than modern guns; even from shore, “the crack of the Winchesters of the men could be heard out among the ice” (Burroughs et al., 1901, p. 60). However, seals remained at the rookery due to the presence of dependent pups (see “Conservation Practices” above).

Archaeofaunal remains were poorly preserved at Keik'uliyáa (NISP = 10 including harbor seal humeri, tarsals, femur, vertebrae) but an estimate of seals killed annually at Keik'uliyáa can

TABLE 2 Tlákw.aan (YAK-007) radiocarbon dates and palaeobotanical identifications.

Sample no.	Context	Botanical ID	AMS $^{14}\text{C}$ date	2-sigma calibrated date (95.4%)	Median	$\delta^{13}\text{C}$ (0/00)
TLÁKW.AAN (YAK-007)						
PRI-15-039-1	Trench, S2	<i>Picea</i> charcoal	351 ± 24	1461–1635 CE	1561 CE	−28.14
PRI-15-039-9	Trench, S4	<i>Populus</i> charcoal	357 ± 24	1458–1634 CE	1555 CE	−26.48
PRI-15-039-10	Trench, S4	<i>Picea</i> charcoal	324 ± 24	1490–1641 CE	1563 CE	−26.35
PRI-15-039-14	Trench, S4	<i>Picea</i> charcoal	310 ± 24	1497–1647 CE	1561 CE	−25.6
PRI-15-039-4	Trench, S4	<i>Picea</i> charcoal	366 ± 24	1456–1632 CE	1519 CE	−26.35
PRI-15-039-8	Trench, S4	<i>Picea</i> charcoal	371 ± 23	1454–1631 CE	1509 CE	−25.63
PRI-15-039-5	Trench, S4	<i>Picea</i> charcoal	366 ± 24	1456–1632 CE	1519 CE	−24.23



be reconstructed from historical reports. The Harriman Alaska Expedition recorded about 1,000 seal skins drying on stretchers at the camp on June 21, near the start of the hunting season (Burroughs et al., 1901, p. 165), and the total by the end of the season would likely have been at least two to three times higher. In 1886, it was reported that 1,500 seals were killed at Disenchantment Bay in just 3 days (Seton Karr, 1887, p. 71). We suggest 2,000–3,000 seals per year as a conservative estimate of the rookery harvest in the 1880s, consistent with the volume of Yakutat skins received by the Alaska Commercial Company (Crowell, 2017). This would have been up to 10 seals per person, more than 30 times higher than subsistence consumption at pre-contact Tlákw.aan, demonstrating the large surplus generated for the skin and oil trade.

This level of hunting would have extirpated the present-day rookery, but harbor seals were almost certainly far more abundant during the 1840–1923 cold PDO phase, supported by Seton Karr's observation of "large numbers in the sea" at Yakutat in 1886 (Seton Karr, 1887, p. 71). Although harbor seal stocks in the Gulf of Alaska reportedly declined by the end of the 19th century (Morris et al., 1898), market sealing was conducted at Keik'uliyáa for almost five

decades without local depletion of the resource, suggesting that the quotas set by Kwáashk'i Kwáan clan leaders were effectively adjusted to prevailing conditions.

## Mid-20th century sealing at Woogaani Yé

Woogaani Yé, located in Disenchantment Bay just north of Keik'uliyáa (Figure 1), was the site of a Teikweidi stone-walled fort and sealing camp, abandoned after a L'uknaḡ.ádi attack in about 1805 (De Laguna, 1972:67–68). In the mid-20<sup>th</sup> century, it was a small camp used by Tlingit sealers and bear hunters (E. Abraham, 16 June 2012, IN-13A).

While no remains of the earlier occupation were found, the modern camp was rediscovered in 2013 on a beach terrace behind the storm berm (Figure 11). Surface features included a charcoal-filled hearth ring (Feature 1); four tent rings (Features 2, 6, 7, and 8), a rock pavement (Feature 3), a meat cache (Feature 5), other rock groupings (Features 4, 9, and 10), and a collapsed wooden cabin. Rifle cartridges found on the surface and in Feature

TABLE 3 Summary of metrically-determined harbor seal age estimates, by element and specific measurement.

Element	Measurement	Pup	Trans.	Weaned	Subadult	Adult	Total
Mandible	Short Length	2	0	0	1	0	3
Bulla	Length	4	9	0	1	1	15
Pelvis	Acetabulum Ht.	2	0	1	0	5	8
Femur	Length	0	1	0	1	3	5
Fibula	Length	0	2	0	0	0	2
Astragalus	Length	1	0	0	3	0	4
Calcaneus	Length	0	0	0	2	0	2
1st metatarsal	Length	1	1	1	6	1	10
2nd metatarsal	Length	0	1	0	2	3	6
3rd metatarsal	Length	0	1	0	3	1	5
4th metatarsal	Length	1	0	0	1	0	2
5th metatarsal	Length	0	2	0	0	1	3
1st phalanx (rear)	Length	0	0	0	5	1	6
Scapula	Glenoid height	2	0	1	1	6	10
Humerus	Length	4	0	1	0	1	6
Humerus	Head Width	1	3	0	1	0	5
Humerus	Distal thickness	2	4	0	1	1	8
Radius	Length	0	1	0	0	0	1
Radius	Proximal height	0	1	2	0	6	9
Ulna	Length	0	0	0	2	0	2
1st metacarpal	Length	1	0	1	5	0	7
2nd metacarpal	Length	1	0	0	4	1	6
3rd metacarpal	Length	0	0	1	6	1	8
4th metacarpal	Length	0	0	0	3	0	3
5th metacarpal	Length	0	0	1	2	0	3
1st phalanx (front)	Length	5	1	0	0	0	6
Total		27	27	9	50	32	145

“Pup” refers to individuals inferred to be unweaned newborns ~1 month or younger; “trans” refers to individuals that are transitional and could not be distinguished between newborn pups vs. weaned young-of-the-year. “Weaned” refers to individuals inferred to be weaned, older than approximately 6 weeks. Sample from the 2014 Tlákw.aan test trench.

7 were of mid-20th century vintage including small rounds for seals (0.22 Magnum, 0.22 Hornet, 0.222 Remington) and larger rounds suitable for bear (0.32 Remington, 0.30-30 Remington UMC, 0.44 Remington Magnum) (Barnes, 2012). Wire nails, machine-molded bottle glass, a 1976 U. S. Bicentennial Mason jar, and a 1959 State of Alaska license plate were found. Six harbor seal bones (a vertebra, humerus, tarsal, femur, and unidentifiable fragments) were recovered from Feature 7.

Mid-20th century hunters used flat-bottomed canvas-covered canoes with small outboard motors to enter leads in the ice pack, shooting seals with quiet, small-bore rifles that could scarcely be heard above the sounds of moving ice. They killed groups of seals one by one after first “picking off the watchman”, a male sentinel that scanned for danger while others slept on the ice floes (T. Valle, 12 June 2011, IN-7; G. Ramos, 11 June 2011, IN-3).

The site is consistent with orally attested patterns of small family units staying briefly at Keik’uliyáa, Woogaani Yé, Daak Léin,

and other camps in Disenchantment Bay for spring subsistence sealing from the 1930s through 1970s (E. Abraham, 27 June 2013, IN-28) and of individuals or small groups of men who undertook high production commercial sealing using the same camps during the price boom of the 1960s (G. Ramos, 18 June 2012, IN-15). These patterns contrast socially with the months-long, clan-structured community effort at 19th century Keik’uliyáa, and technically with earlier sealing because of superior weapons and motorized canoes and skiffs that enabled rapid transport to and from Yakutat village, eliminating the need for the whole community to relocate to Disenchantment Bay.

As discussed above, traditional conservation measures were not observed during this period. Commercial hunters shot hundreds of seals and took the fleshed skins and seal noses or faces—used to claim state bounties—back to Yakutat, leaving most of the meat behind to waste. They typically hunted in April and May before the salmon fishing season began (De Laguna,



TABLE 4 Summary of subjectively-determined age estimates, by element and specific measurement.

Element	Measurement	Pup	YOY	Juvenile	Adult	Total
Femur	Fusion	0	2	0	2	4
Tibia	Development	1	1	0	0	1
Fibula	Fusion	0	1	1	0	2
Mandible	Development	0	3	0	0	3
Tooth	Development	0	1	0	1	2
Scapula	Fusion	0	0	0	2	2
Humerus	Fusion	0	3	0	1	4
Radius	Fusion	0	2	1	1	4
Ulna	Development	0	1	0	0	1
Pelvis	Fusion	0	1	0	0	1
Sternabra	Development	0	3	0	0	3
Total		1	18	2	7	28

Sample from the 2014 Tlákw.aaan test trench.

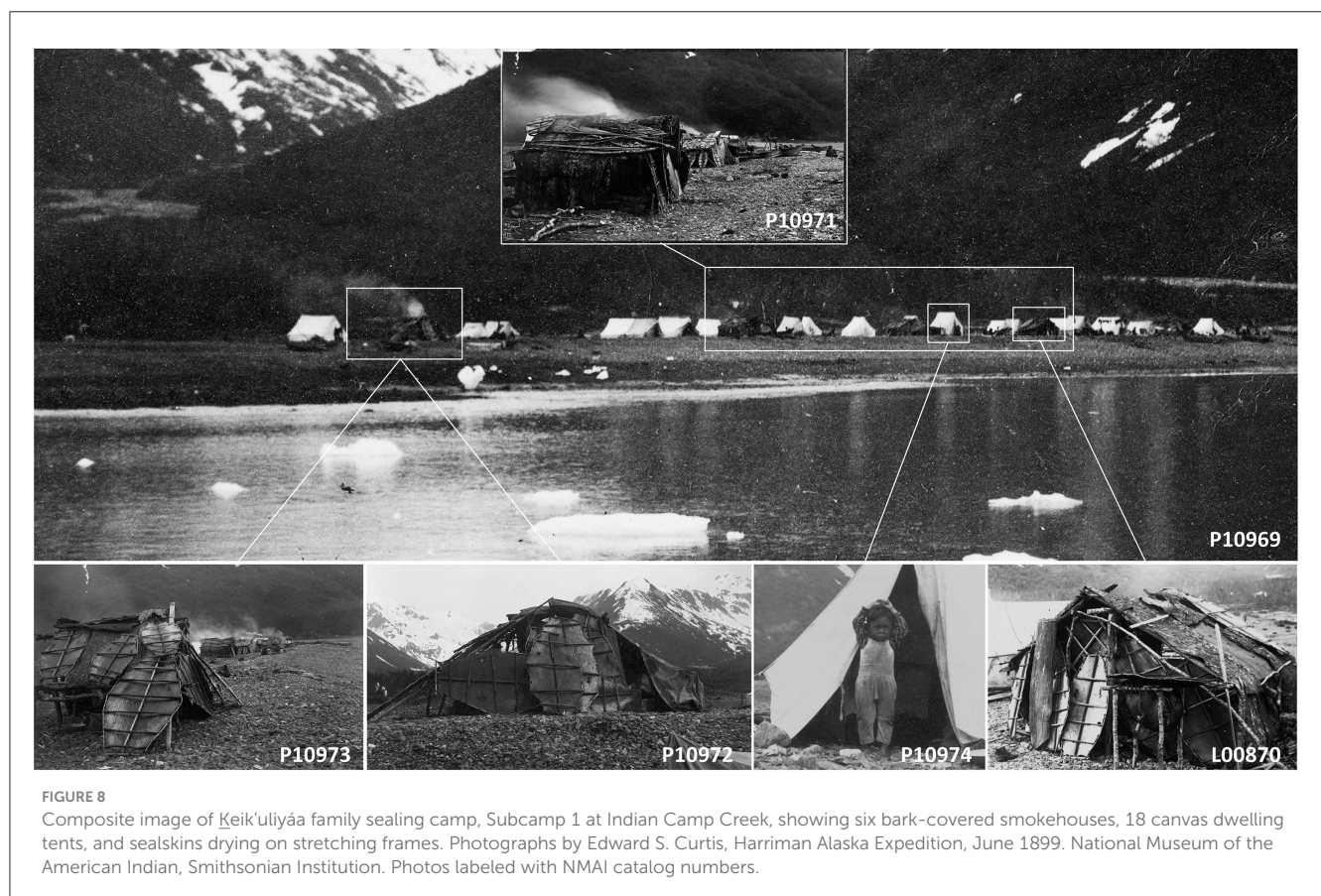


FIGURE 8 Composite image of Keik'uliyáa family sealing camp, Subcamp 1 at Indian Camp Creek, showing six bark-covered smokehouses, 18 canvas dwelling tents, and sealskins drying on stretching frames. Photographs by Edward S. Curtis, Harriman Alaska Expedition, June 1899. National Museum of the American Indian, Smithsonian Institution. Photos labeled with NMAI catalog numbers.

1972, p. 374), resulting in the killing of female seals with unborn young.

## Discussion

Oral, archaeological, and documentary data provide a longitudinal record of Yakutat Tlingit use and conservation of

harbor seals from a pre-contact baseline to the present. The study demonstrates that Indigenous conservation—as suggested by Hames (2007)—may be situationally adopted or discontinued in response to changing environmental, societal, technological, and economic circumstances.

At 16th century Tlákw.aaan, an ample harbor seal resource was matched with relatively low Indigenous demand, resulting in





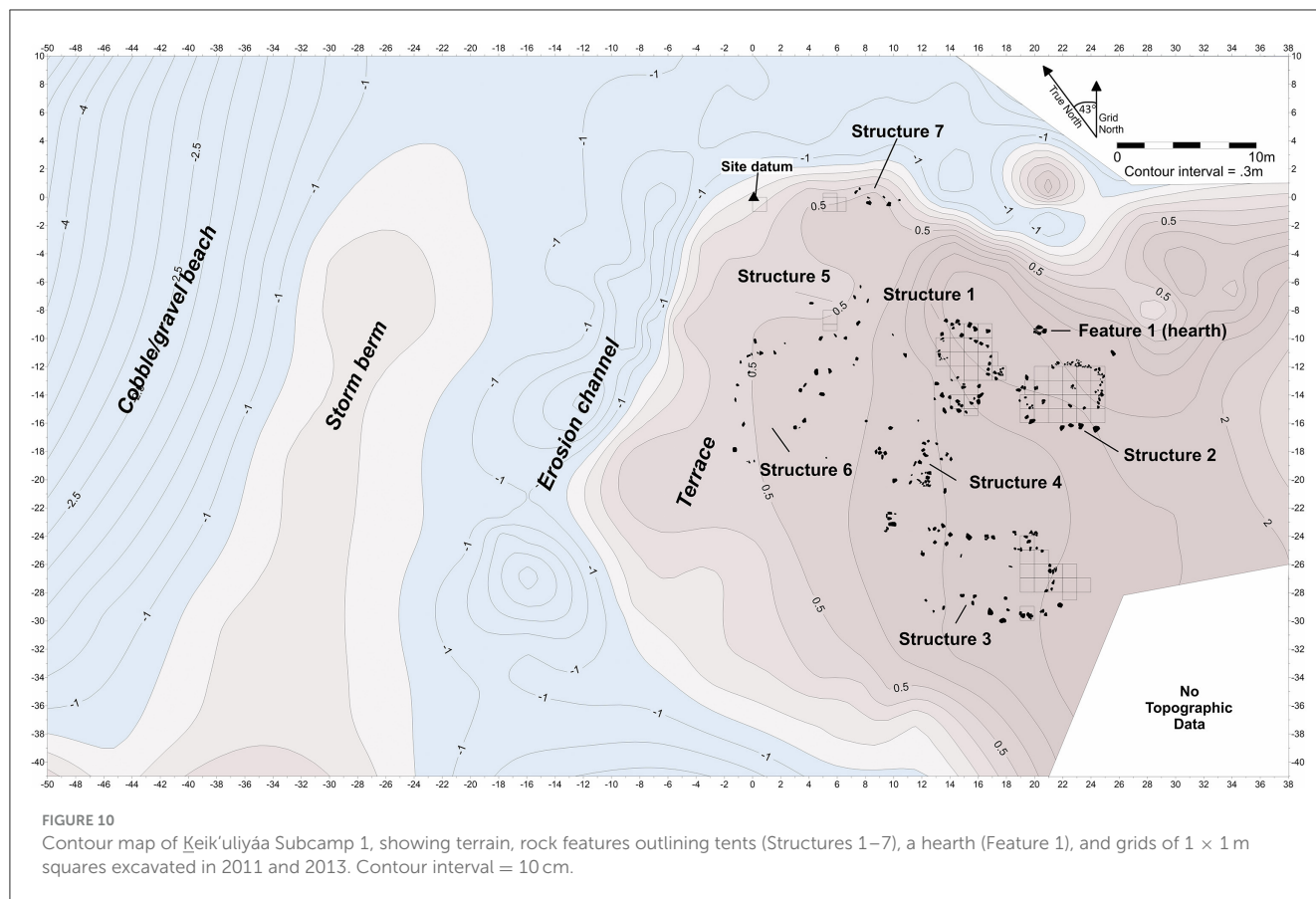
epiphenomenal sustainability. We project that the seal population of Yakutat fiord—elevated by cool ocean waters of the middle Little Ice Age and abundant forage fish that thrive under those conditions—far exceeded the subsistence needs and hunting capacity of the human population, which numbered about 120 at Tlákw.aan. Large numbers of bones from unweaned seal pups indicate that residents were hunting at the rookery starting in May, with no evidence of the seasonal shift instituted as a conservation measure following the switch from harpoons to rifles in the late 19th century.

Harbor seals were the most commonly consumed sea mammal at Tlákw.aan but were far from an exclusive focus, and total consumption (fewer than 40 seals per year) was only a small fraction of annual harvests during the later commercial era. The lack of external demand—other than small volumes of seal products that may have been traded to Alaska Native communities in the interior or along the coast (De Laguna, 1972:346-351)—represents a significant contrast to the colonial period.

We have no evidence of harbor seal conservation under Russian colonial rule, when Yakutat residents continued to carry out subsistence sealing using traditional methods and weapons. Oral historical accounts describe seal conservation after the transfer of

Alaska to U. S. control in 1867, when the Alaska Commercial Company (ACC) instituted commodity trade for harbor seal hides and oil and Yakutat hunters armed with rifles intensified the rookery harvest (Crowell, 2017). ACC market sealing occurred during the 1840–1923 PDO cold phase when seals would have been abundant, and despite a reported decline in the meta-population by the end of the 19th century the volume of skins produced for the market by Yakutat and other Gulf of Alaska communities continued to increase, reaching its apparent peak in 1904–1907.

Measures initiated during this period to manage the Yakutat rookery harvest, including control by the Kwáashk'i Kwáan of access by other clans and outside groups, strict harvest quotas, and delay of the hunt to prevent excessive losses of dependent pups, clearly meet the standard and definition of conservation; that is, intentional moderation in the exploitation of a resource to prevent its depletion (Hames, 2007). Factors generally conducive to Indigenous conservation (Smith and Wishnie, 2000) applied in the Yakutat context including: (1) controlled or exclusive access to a resource, reflected in ownership of the seal rookery by the Kwáashk'i Kwáan; (2) a distinct or confined resource population, i.e., the seasonal concentration of harbor seals at the glacier; (3) a resilient or rapidly renewing resource, consistent



with ocean temperatures that bolstered seal recruitment in excess of losses; (4) a low discount rate, meaning that the value of a sustained yield over decades exceeded the perceived value of higher immediate returns; and (5) small group size with stable membership and effective social control, which aptly characterizes the clan-based social organization at Yakutat under which sealing was conducted.

Factors that can discourage conservation (Smith and Wishnie, 2000) also applied, including (1) high demand from external markets; and (2) the acquisition of novel and more efficient hunting technologies, at Yakutat consisting of post-Civil War rifles with reasonable accuracy and rate of fire. Nonetheless, effective Yakutat conservation measures were employed, enabling sustainable harvests that were exponentially higher than in the pre-contact period.

The mid-20th century brought another turn in the relationship between Alaska Native people and seals. The harbor seal meta-population grew during the 1946–1976 cold PDO cycle but hunting increased to three times the early 20th century peak, driven by bounties and record high prices for skins. Social controls over hunting once exerted by Yakutat clan leaders were weakened; sealing was transformed into an individual, family, or small group activity rather than a coordinated enterprise involving the whole community; and income from bounties and sales of skins was critical in the mixed cash-subsistence economy of the modern village (Wolfe and Mishler, 1994; Wolfe et al., 2009; Sill et al.,

2017). Indigenous conservation practices that had maintained sustainability during the previous seal boom were abandoned and the resource was severely depleted as a result. The end of commercial hunting came in 1972 with passage of the Marine Mammal Protection Act, but the decimated harbor seal population has nonetheless failed to fully recover, due in part to warming ocean temperatures and the biological regime shift that accompanied the end of the 1946–1976 PDO cycle (Crowell, 2020).

The Yakutat people today are recommitting to principles of responsible care and regard for seals, seeking to ensure their survival and for the life-sustaining tradition of sealing to continue (Crowell and Ramos, 2024). Sealing today is solely for subsistence and little hunting is undertaken at the ice floe rookery, allowing the seals to raise their pups undisturbed (J. James, 22 May 2014, IN-44). The annual subsistence harvest from all parts of the fiord, which has declined in recent years, is similar to pre-contact levels at Tlakwaan on a per capita basis. The community cooperates with the Alaska Department of Fish and Game, National Oceanic and Atmospheric Administration, and Alaska Native Harbor Seal Commission to record subsistence hunting activities, monitor population and health trends, and mitigate threats including water pollution and disturbance of the Hubbard Glacier rookery by cruise ships (G. Ramos, 18 June 2012, IN-15; R. Sensmeier, 12 June 2011, IN-6; R. Sensmeier, 18 June 2012, IN-16; Jansen et al., 2014; Sill et al., 2017).

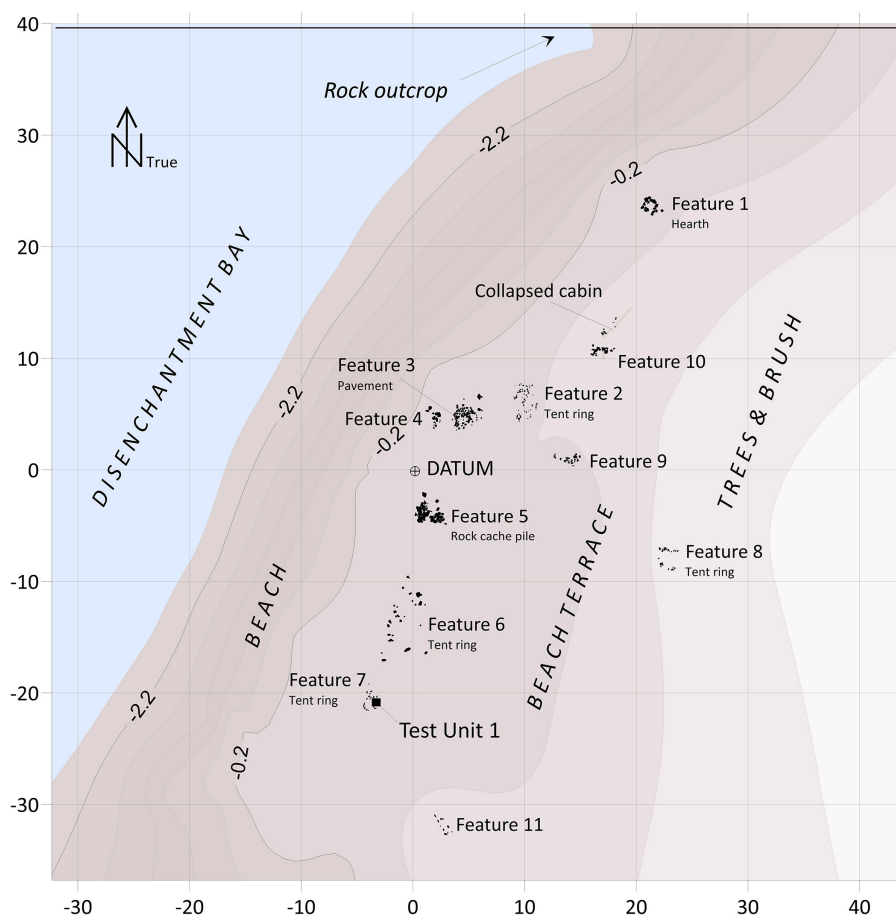


FIGURE 11  
Contour map of Woogaani Yé showing rock Features 1–11. Contour interval = 40 cm.

## Conclusion

De Laguna contended that Yakutat Tlingit conservation practices were conceptually misguided because of their foundation in an Indigenous worldview:

My informants spoke of their ancestors who “took care” of the hunting territories as if this involved conservation of the game. It is doubtful, however, whether conservation was formerly conceived in a realistic fashion since dead animals were thought to become reincarnated in new bodies. Rather, this care must have been directed primarily to avoid “angering” the animals or frightening them away from the hunting grounds (De Laguna, 1972, p. 362).

An alternative perspective is that while traditional Tlingit conceptions of human-animal relations are antithetical to precepts of Western science, Yakutat Tlingit seal conservation is the product of an empirical Indigenous science based on the long-term observation of environmental change and experiential knowledge of animal biology, behavior, ecology, and population trends. As one critic conceded:

American Indian comprehension of relationships between living organisms and their organic and inorganic environments is “ecological”—that is, it is systemic, relational, attentive to interdependencies, and shows the hallmarks of ecological thought. Because it is cultural, it is premised on, for example, theories of animal behavior (ethology), ideas about habitat locations or the presence of other-than-human beings, and definitions and metaphors specific to particular cultural systems (Krech, 2005, p. 79).

As demonstrated here, harbor seal conservation informed by Indigenous science was effective in sustaining a critical resource through a period of intensive exploitation, while damage to the seal population after conservation restraints were abandoned provides the negative case that affirms the validity of ancestral sealing knowledge.

Project data including interview transcripts, artifacts, archaeological records, photographs, and videography are archived at offices of the Smithsonian Arctic Studies Center (Anchorage), Sealaska Heritage Institute (Juneau), Yakutat Tlingit Tribe, Wrangell-St. Elias National Park (Glenallen), and Tongass National Forest (Juneau).



## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The involvement of Yakutat community members was approved by the Smithsonian Institution Human Subjects Institutional Review Board. The studies were conducted in accordance with local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

## Author contributions

AC: Conceptualization, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing. JR: Investigation, Writing – review & editing. ME: Formal analysis, Methodology, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author(s) declared that they were an editorial board member of *Frontiers*, at the time of submission. This had no impact on the peer review process and the final decision.

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