Bridging Knowledge Systems: Indigenous-Led Governance and Climate Policy in Alaska

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Abstract

As climate change accelerates environmental shifts across the Arctic, the integration of Traditional Ecological Knowledge into environmental policy has become critically urgent. This research examines the incorporation of TEK within conservation and climate governance frameworks in both Alaska and U.S. federal policy, using a comparative lens informed by policy approaches in Finland and Sweden. While Indigenous communities have long stewarded Arctic ecosystems through holistic and intergenerational knowledge systems, their inclusion in formal decision-making remains uneven across federal, state, and Indigenous-led policies. Using a multi-method approach combining policy analysis, case studies, cultural impact assessments, and surveys, this study evaluates over twenty policy instruments across four dimensions: explicit mention of TEK, Indigenous consultation requirements, legal enforceability, and funding mechanisms. Findings reveal that Alaska demonstrates stronger integration of TEK than EU-level governance, particularly through co-management structures such as the Marine Mammal Protection Act and the Alaska Wildlife Action Plan. However, gaps persist, especially in legal enforceability and sustainable funding for TEK-based initiatives. This paper argues that effective environmental governance in the Arctic must center Indigenous autonomy, knowledge sovereignty, and community-driven adaptation. By identifying best practices and persistent barriers, this research offers actionable recommendations for advancing equitable, culturally grounded environmental policy in Alaska and beyond.

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Introduction

The Indigenous peoples of Alaska have cultivated complex, place-based knowledge systems over thousands of years, grounded in sustained interaction with Arctic and sub-Arctic ecosystems. These systems, known as Traditional Ecological Knowledge, or TEK, represent cumulative, intergenerational understandings of ecological rhythms, animal behavior, climate variability, and sustainable land use. In regions where rapid environmental change threatens biodiversity and human livelihood, TEK serves not only as a cultural legacy but also as a vital instrument for ecological stewardship and climate adaptation.

Alaska is home to over 200 federally recognized tribes, encompassing Iñupiat, Yup'ik, Tlingit, Haida, Aleut, and many other Indigenous groups, each with distinct cultural and ecological traditions. These communities have long practiced sustainable management of marine and terrestrial resources, guided by spiritual values, seasonal indicators, and oral histories. From whale migration patterns tracked through ancestral memory to berry harvesting calendars rooted in generations of observation, TEK continues to inform daily life, cultural identity, and subsistence practices. As environmental change accelerates across the circumpolar North, this knowledge has become essential for understanding and responding to ecological disruptions.

Despite its recognized value, the inclusion of TEK in environmental governance across Alaska and U.S. federal policy remains inconsistent. Although agencies such as NOAA and the U.S. Fish and Wildlife Service have made efforts to consult with Indigenous communities, these processes often fall short of genuine co-management or power-sharing. Structural barriers – including fragmented legal frameworks, limited funding, and epistemological bias – continue to hinder full integration. Moreover, TEK is frequently treated as anecdotal or supplementary rather than as a legitimate and sophisticated system of ecological understanding equal in rigor to Western science.

This research examines the role of TEK in Arctic environmental policy, with a specific focus on Alaskan Indigenous communities. It investigates both the challenges and opportunities associated with integrating this knowledge into formal conservation efforts, particularly within the contexts of climate adaptation and biodiversity protection. Drawing on policy analysis, surveys, and case studies, this project identifies where TEK has been successfully incorporated and where gaps remain, paying special attention to marine co-management systems, tribal conservation programs, and federal environmental assessments involving Indigenous leadership.

By building on comparative research previously conducted on Sámi communities in Finland and Sweden, this study establishes a framework that highlights shared challenges and distinct local dynamics. In both settings, Indigenous peoples navigate institutions that often undervalue their knowledge while facing acute climate vulnerability. This paper argues that meaningful integration requires more than consultation; it demands structural mechanisms for co-governance, cultural respect, and legal recognition. Understanding how TEK functions in Alaskan policy contributes to broader discussions on equity, sustainability, and climate resilience in the Arctic, offering insights into how Indigenous knowledge systems can inform more adaptive and inclusive forms of environmental governance.

Literature Review

Environmental governance in the United States Arctic is shaped by a complex network of federal, state, tribal, and international institutions with overlapping mandates. Key actors include the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, and the Bureau of Indian Affairs, alongside regional Alaska Native organizations, tribal governments, and co-management councils. While the United States lacks a formal national Arctic strategy comparable to those of other circumpolar nations, recent federal initiatives – such as the 2022 Arctic Strategy and the White House Memorandum on Indigenous Knowledge – have signaled growing recognition of Indigenous perspectives in Arctic policy (OSTP and CEQ 2022).

Even with these commitments, implementation remains fragmented. Environmental assessments and policy documents often acknowledge the need for tribal consultation, but Indigenous authority varies widely across agencies and contexts. TEK is frequently treated as supplementary to scientific data rather than as an equal epistemological framework. As Raymond-Yakoubian et al. (2017, 138) note, "Traditional knowledge (TK), TK holders, and the social science of TK have by and large not been incorporated into science, policy, and management initiatives... The broad scope, utility, and applicability of TK should be properly recognized, rather than viewed as simply supplemental to Western science."

The role and scope of TEK in Alaska extend far beyond environmental observation. It represents a dynamic knowledge–practice–belief system that integrates empirical understanding, cultural identity, ethics, and spirituality. TEK has long guided subsistence practices, navigation, weather forecasting, and seasonal land use. As Berkes (2012, 3) explains, it must be understood "as process, rather than as content," evolving through adaptive learning grounded in experience.

Case studies demonstrate how Alaska Native communities employ TEK to sustain community-based conservation and ecological resilience. The Alaska Eskimo Whaling Commission and the Alaska Beluga Whale Committee, for example, incorporate Indigenous observations of marine mammal migration and behavior into co-management systems, improving both population estimates and management practices (Huntington 2000). TEK also informs the management of salmon stocks and adaptation strategies for sea ice loss and permafrost thaw, offering insights that often surpass the spatial and temporal resolution of scientific models. These systems contribute longitudinal and fine-grained information essential for anticipating ecosystem changes and guiding management decisions (Behe and Daniel 2018; Raymond-Yakoubian and Daniel 2018).

Equally important, TEK embodies an ethic of reciprocity and restraint that shapes stewardship values emphasizing interdependence between humans and ecosystems. Rooted in oral traditions, ceremonial practices, and land-based learning, these relational frameworks inform holistic climate adaptation strategies. As the Indigenous Climate Hub (2024) observes, Indigenous approaches to environmental change reflect "a deep understanding of wildlife behavior patterns and plant–habitat associations, enabling sustainable stewardship of the land."

Regardless of its strengths, TEK faces persistent obstacles to formal policy integration. The most significant include legal ambiguity, institutional inconsistency, and epistemological bias. Although statutes such as the National Environmental Policy Act require consultation with Indigenous communities,

no comprehensive federal mandate defines how TEK should be incorporated into decision-making. Implementation thus varies widely among agencies. Bang and Marin (2015) emphasize that "despite the growing awareness for the need to change socio-ecological systems, making serious shifts has been slow... consequently minimizing transformative possibilities."

Scholars have also critiqued how TEK is framed within policy documents. Nadasdy (1999) argues that by translating TEK into the language of science, the state decontextualizes it, stripping it of political, cultural, and spiritual significance. Similarly, Raymond-Yakoubian et al. (2022) observe that Western science remains privileged in research and policy, often resulting in extractive rather than collaborative relationships. Recent federal guidance has urged agencies to move beyond extractive models, recognizing Indigenous Knowledge as a system that must be engaged through consent and collaboration (OSTP and CEQ 2022).

In the face of these challenges, Alaska provides examples of successful collaboration. Co-management frameworks for marine mammals and fisheries have created shared platforms for authority and learning. Organizations such as the Alaska Eskimo Whaling Commission, the Indigenous Peoples' Council for Marine Mammals, and the Sitka Tribe's fisheries monitoring programs demonstrate how TEK can be embedded in decision-making processes that shape harvest quotas, seasonal timing, and conservation strategies. As Huntington (2000) argues, "TEK should be promoted on its merits, scrutinized as other information is scrutinized, and applied in those instances where it makes a difference in the quality of research, the effectiveness of management, and the involvement of resource users in decisions that affect them."

Recent federal developments have also created new opportunities. The 2022 White House guidance on Indigenous Knowledge directs agencies to recognize, respect, and include Indigenous Knowledge as an equal and complementary system, marking a shift toward more pluralistic and inclusive governance (OSTP and CEQ 2022). Comparative studies further highlight promising alternatives. Canada's 2019 Impact Assessment Act mandates the integration of TEK in environmental assessments and protects Indigenous intellectual property, while co-management boards such as the Nunavut Wildlife Management Board and the Gwich'in Renewable Resources Board institutionalize Indigenous authority (Government of Canada 2019; Ferguson and Messier 1997).

The Arctic Council has similarly sought to incorporate TEK through its Traditional Knowledge Principles and declarations such as the 2013 Kiruna Declaration. Yet as Sidorova (2020) argues, these efforts often remain symbolic, with limited mechanisms for shared governance. In response, Indigenous organizations such as the Inuit Circumpolar Council have issued their own protocols for ethical engagement and knowledge sovereignty (ICC 2022).

Comparative and multi-method approaches to Indigenous environmental policy have been increasingly used to assess how knowledge systems intersect with governance. Researchers such as Koivurova (2019) and Allard (2021) have applied cross-national policy comparisons to evaluate the implementation of Indigenous rights in Arctic law, while others, including Ens et al. (2022) and Malek and Cornish (2019), have combined qualitative policy coding with case studies to identify best practices in co-management and consultation frameworks. These studies demonstrate that mixed-method designs – integrating document analysis, interviews, and stakeholder surveys – provide a more nuanced

understanding of how Indigenous Knowledge is operationalized across governance contexts. Building on this foundation, the present research employs a similar comparative, multi-layered approach to evaluate how TEK is embedded in environmental governance in Alaska and how these findings parallel broader circumpolar patterns.

Overall, the literature reveals both the potential and the limitations of TEK integration in environmental governance. While TEK offers vital ecological insight and community-led frameworks for sustainability, it remains underrepresented in policymaking structures. Bridging this gap requires not only consultation but also structural change, legal recognition, and epistemological humility. By analyzing the institutional landscape, case studies, and emerging collaborations in Alaska, this research contributes to a growing field that views Indigenous leadership and knowledge as central to environmental resilience in the Arctic.

Methodology

This study uses a qualitative, comparative approach to evaluate how Traditional Ecological Knowledge, or TEK, is integrated into Arctic environmental policy, focusing primarily on Alaska while drawing comparative insights from Finland and Sweden. The research design combines policy analysis, comparative evaluation, and visualization techniques to assess the inclusion of TEK within environmental governance frameworks. This structure allows for both cross-regional comparison and detailed attention to institutional mechanisms that enable or inhibit TEK integration.

Policy Analysis

The first stage of analysis involves a qualitative review of policy and legal documents related to environmental governance in Alaska. The study adapts a policy-mapping method previously applied in research on TEK integration among Sámi communities in the Nordic region. A total of sixteen policy instruments were selected based on their relevance to environmental governance, their potential impact on Indigenous communities, and their explicit mention of TEK or Indigenous consultation. These include federal laws such as the National Environmental Policy Act, the Marine Mammal Protection Act, and the Magnuson–Stevens Fishery Conservation and Management Act, as well as Indigenous-led frameworks such as the Ethical and Equitable Engagement Protocols and international declarations including the United Nations Declaration on the Rights of Indigenous Peoples and the Arctic Council's Kiruna Declaration.

Each policy was evaluated using five criteria: (1) explicit mention or definition of TEK; (2) requirement for Indigenous consultation; (3) presence of co-governance mechanisms; (4) legal enforceability; and (5) funding or institutional support for TEK-related initiatives. These criteria were drawn from existing literature on Indigenous rights and knowledge systems in environmental policy. Policies were then coded using an ordinal scale: 0 for absence, 1 for partial inclusion, and 2 for strong or institutionalized presence. This scoring system was adapted from established approaches in comparative policy studies and Indigenous knowledge mapping.

Following the coding process, results were visualized through a comparative heatmap to illustrate the relative strength of TEK integration across different governance levels. The heatmap highlights where TEK is most effectively embedded – such as in co-management frameworks like the Marine Mammal Protection Act – and where implementation remains weak, particularly in policies that rely on non-binding consultation. This visual method provides a holistic understanding of structural patterns while allowing for clear identification of policy gaps.

This methodology prioritizes transparency and respect for Indigenous knowledge systems by incorporating Indigenous-led frameworks such as the EEE Protocols and acknowledging the role of Indigenous data sovereignty. While the analysis focuses on formal policy documents and avoids direct interviews or community engagement, care was taken to frame TEK as a living, culturally embedded knowledge system rather than as a dataset for extraction.

Comparative Analysis

This section builds on previous comparative research evaluating Sámi rights and Traditional Ecological Knowledge integration in Finnish, Swedish, and European Union policy. By applying the same criteria, explicit TEK references, Indigenous consultation, legal enforceability, funding mechanisms, and policy adaptability, this analysis contrasts how Alaskan and U.S. policies perform relative to Nordic frameworks.

Visual policy coding from prior research highlights distinct trends in how Indigenous knowledge systems are treated across these governance contexts. At the EU level, TEK is referenced only vaguely or indirectly in major frameworks, such as the EU Biodiversity Strategy 2030 and the European Green Deal, with minimal mention of Sámi participation or obligations for consultation (European Commission 2019). Even where Indigenous perspectives are acknowledged, mechanisms for co-governance or binding legal obligations remain weak.

By contrast, Finland's Nature Conservation (Act 2023) and Sweden's Reindeer Husbandry (Act 1971) embed explicit references to Sámi consultation and provide localized authority in land-use and conservation. According to Christina Allard, Sámi land rights and cultural practices in Sweden receive formal recognition in the law, but this recognition is rarely accompanied by robust resources or enforcement mechanisms (Allard 2021). Similarly, Timo Koivurova argues that Nordic environmental law remains uneven in its implementation, varying significantly between regions and sectors (Koivurova 2019). These frameworks offer comparatively stronger starting points than EU-level policies, but financial support for Sámi-led conservation remains inconsistent and fragmented, limiting long-term influence.

The Alaskan framework demonstrates a moderate degree of policy maturity in integrating TEK compared to its Nordic counterparts. As illustrated in the heatmap "Comparative Policy Integration of TEK," U.S. federal statutes such as the Marine Mammal Protection Act of 1972 and Executive Order 13175 (2000) perform relatively well in codifying consultation and co-management systems. Co-management structures allow Alaska Native Organizations to share authority over marine mammals and to integrate local ecological observations into population assessments and harvest guidelines (Malek and Cornish 2019). These legal mechanisms provide Indigenous communities with formal influence over subsistence resources, a dimension that in some respects parallels Nordic Sámi reindeer governance. However, similar to Finland and Sweden, dedicated and predictable funding for TEK programs is limited, often subject to short-term agency discretion rather than a sustained legislative mandate.

While Finland and Sweden benefit from centralized Sámi Parliaments with advisory and consultative powers at the national level, the United States relies on a government-to-government consultation model rooted in tribal sovereignty. The strength of these consultations depends heavily on agency leadership and political will. At the state level, Alaska's Draft Wildlife Action Plan of 2025 represents a significant step forward by embedding TEK references and outlining partnerships with tribal co-managers, placing it ahead of EU-wide frameworks in terms of community engagement.

Across all three regions, the most persistent gaps involve funding stability, enforcement capacity, and legal clarity. While Nordic states increasingly recognize Sámi involvement, these measures are undermined by uneven application in land and forestry policy. Alaska's co-management institutions and the federal OSTP Indigenous Knowledge offer promising models for integrating Indigenous leadership

and knowledge into decision-making (Guidance 2022). Nevertheless, structural barriers, particularly inconsistent funding and a lack of enforceable obligations, continue to constrain widespread adoption across U.S. federal and state systems.

The heatmaps and content analysis together suggest that while no system has fully realized the equitable integration of Indigenous knowledge into environmental policy, localized national frameworks, such as Alaska's co-management regimes or Finland's Indigenous consultation mandates, outperform supranational governance structures like the EU. These findings underscore the need for both legal clarity and institutional support to ensure Indigenous knowledge systems are valued not merely in theory but in active governance.

Case Studies

To ground the policy analysis in real-world applications, this section examines how Traditional Ecological Knowledge has been integrated through Indigenous-led stewardship, co-management of marine mammals, and land governance initiatives in Alaska. These cases demonstrate both the promise and persistent challenges of embedding TEK within conservation Structures.

Indigenous Marine Mammal Co-Management

Co-management agreements between Alaska Native Organizations and federal agencies stand as some of the clearest examples of TEK-based collaboration. Under Section 119 of the Marine Mammal Protection Act, ANOs such as the Alaska Eskimo Whaling Commission and the Ice Seal Committee work directly with NOAA and the U.S. Fish and Wildlife Service. These arrangements give Indigenous communities a formal role in setting harvest guidelines, sharing monitoring responsibilities, and incorporating Indigenous observations on habitat change and species behavior into federal assessments. The MMC's 2019 review underscores that trust, adequate funding, and regular communication are essential for these partnerships to function effectively (Marine Mammal Commission 2019). While these agreements respect Indigenous harvesting rights and create pathways for power-sharing, resource and capacity limitations remain consistent obstacles.

Polar Bear Co-Management and the Alaska Nanuuq Commission

The Alaska Nanuuq Commission represents fifteen villages in northern and western Alaska and co-manages polar bear populations in the Chukchi Sea with the U.S. Fish and Wildlife Service. This co-management was formalized through the U.S.–Russia Bilateral, which emphasizes shared quotas and the integration of TEK into monitoring efforts (Agreement 2000). As Kanayurak (2016) explains, "traditional knowledge is an integral part in setting harvest regulations," particularly as sea ice loss alters bear behavior (Kanayurak 2016). Funding uncertainty and differing priorities between federal agencies and local communities, however, frequently threaten the stability of this arrangement.

Land and Water Stewardship by Alaska Native Corporations

Following the Alaska Native Claims Settlement Act of 1971, Alaska Native corporations received title to more than 44 million acres of land. Many corporations have since adopted stewardship programs

that draw directly on Indigenous knowledge. For example, the Bristol Bay Native Corporation has made salmon habitat protection a core priority, and Chugach Alaska Corporation has invested in environmental restoration programs. These instances, discussed in Ludwig and Poliseli, demonstrate that land governance rooted in TEK anchors environmental management within cultural obligations rather than external regulatory models (Ludwig and Poliseli 2018).

The inclusion or exclusion of TEK in policy frameworks has profound effects on cultural autonomy, sovereignty, and intergenerational knowledge transmission. Policies that meaningfully support TEK integration enable communities to sustain stewardship roles and affirm cultural identity. Conversely, policies that marginalize or tokenize TEK risk perpetuating epistemic injustice. These case studies reveal that TEK is more than a set of observations: it is a relational and political practice inseparable from the land, language, and governance systems that sustain Indigenous communities.

Surveys

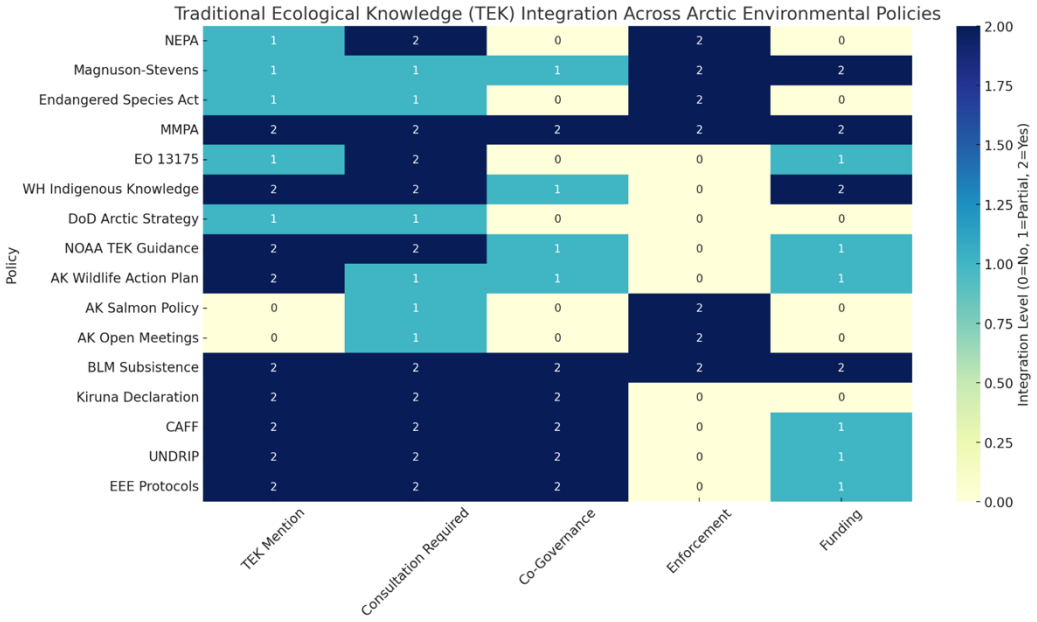

Figure 1. Integration of TEK across U.S. federal, Alaska state, and Indigenous-led policy documents. This heatmap evaluates selected policies using four criteria: explicit mention of TEK, Indigenous consultation requirements, legal enforceability, and presence of funding or support mechanisms. Policies are scored from 0 (no integration) to 4 (full integration). Results indicate that co-management frameworks like the Marine Mammal Protection Act and Alaska's Wildlife Action Plan score higher across all categories, while broader federal directives such as the Executive Order 13175 offer consultation mandates but lack robust implementation funding. The chart highlights the variability in how TEK is operationalized across governance levels in the U.S. context.

To supplement the policy analysis and case study research, a 12-question survey was distributed to a targeted group of Indigenous leaders, scientists, conservation NGOs, and policymakers involved in Arctic and Alaskan environmental governance. The goal was to better understand individual experiences with Traditional Ecological Knowledge in policy contexts, perceptions of systemic barriers, and attitudes toward the role of Indigenous knowledge in environmental decision-making. A total of 50 anonymized

responses were collected. Respondents represented a diverse spectrum of stakeholders, including Alaska Native individuals, scientists working in Indigenous communities, policy advisors, and NGO staff. As illustrated in Figure 1, a substantial proportion of respondents identified as Indigenous or as individuals working closely with Indigenous communities. This diversity was intentional, aiming to capture a wide range of experiences and perspectives on TEK integration.

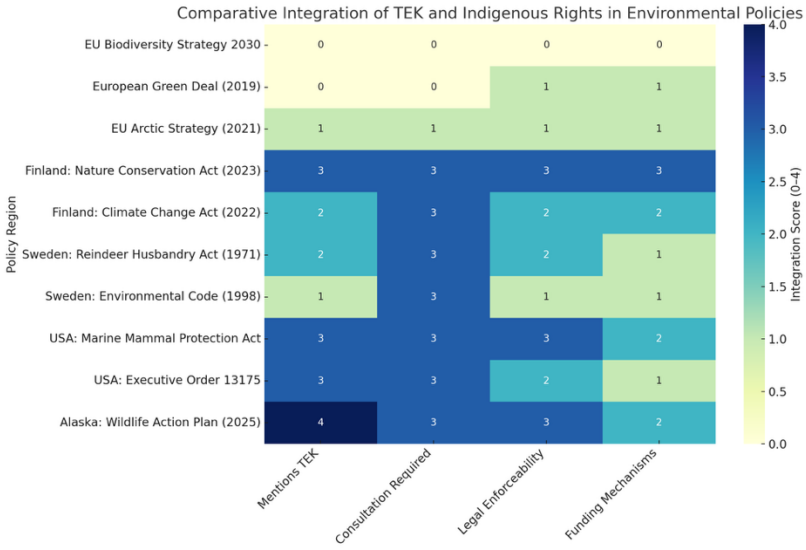

Figure 2. Comparative integration of Traditional Ecological Knowledge and Indigenous rights across selected environmental policies from the European Union, Finland, Sweden, the United States, and Alaska. The heatmap visualizes the degree of policy inclusion across four criteria: explicit references to TEK, requirements for Indigenous consultation, legal enforceability, and funding mechanisms. Values are coded from 0 (no inclusion) to 4 (strong inclusion), illustrating how policy integration varies by region and governance level. Alaska state policies and U.S. federal co-management frameworks show higher levels of TEK integration compared to EU-wide initiatives, while Finnish and Swedish legislation demonstrate moderate inclusion with regional variation.

Geographically, the majority of respondents lived or worked in Alaska's central and southeastern regions, while several reported statewide or interregional engagement, particularly those affiliated with tribal consortia and conservation NGOs (Figure 2). This distribution reinforces the relevance of the findings to Alaskan policy contexts and Indigenous governance networks across the state.

When asked about involvement in environmental policy processes at the local, state, federal, or international levels, participants reported a spectrum of engagement. Most indicated participation at tribal and local levels, with fewer involved in state and federal processes and only a small number at the international level (Figure 3). These findings point to a broader issue: while TEK is increasingly discussed in policy literature, formal channels for Indigenous participation remain limited, particularly beyond local governance structures ((Raymond-Yakoubian 2024); Arctic Council 2021).

A key focus of the survey was identifying perceived barriers to the meaningful inclusion of TEK in environmental policy. Respondents selected from a list of known obstacles and were invited to contribute additional insights. The most commonly cited barriers included institutional bias toward Western science, lack of consultation requirements, insufficient funding, and epistemological incompatibilities (Figure 4). These align with existing research indicating that TEK is often sidelined due

to deeply embedded structural inequities and limited recognition in formal governance mechanisms (Ludwig & Poliseli 2018; Ens et al., 2022; National Park Service 2024).

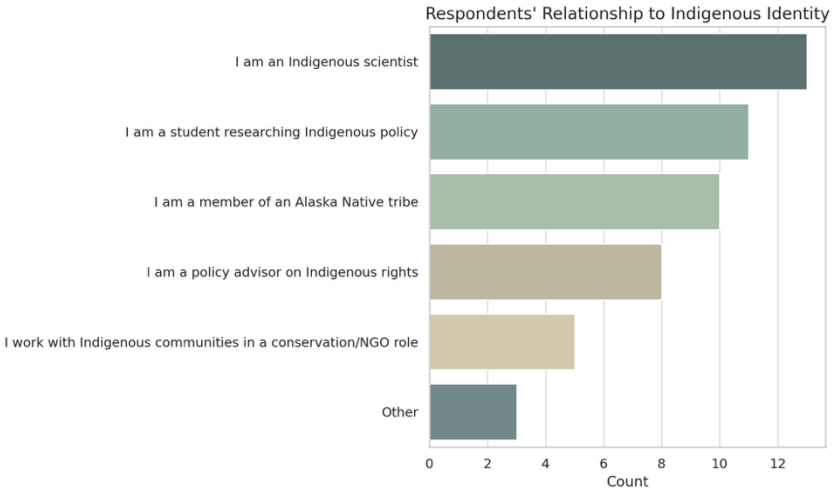

Figure 3. Respondents' self-identified relationship to Indigenous identity. This question helped contextualize participant perspectives by distinguishing between Alaska Native individuals, Indigenous-affiliated professionals, and non-Indigenous allies engaged in environmental or policy work. The majority of responses came from Indigenous-identifying individuals or those working closely with Indigenous communities.

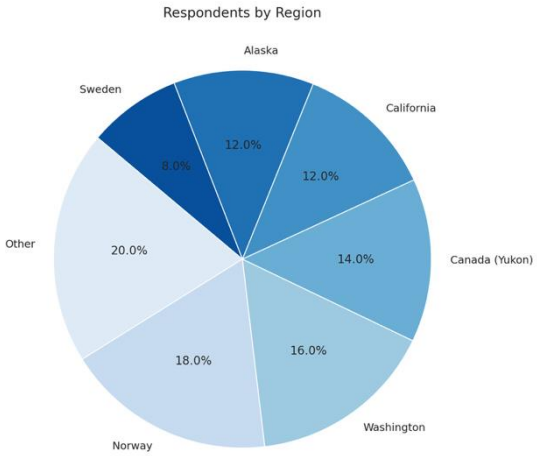

Figure 4. Geographic distribution of respondents across Alaska. While most participants work or live in the central and southeastern regions of Alaska, others represent tribal organizations and NGOs with statewide or cross-regional reach. This regional diversity reflects the breadth of environmental policy experiences captured in the survey.

Additionally, many respondents emphasized the need for long-term relationships built on trust and co-development rather than extractive consultation practices. A significant number expressed frustration with "check-the-box" inclusion models, in which TEK is acknowledged rhetorically but not substantively incorporated into policy outcomes.

The survey findings reinforce the urgent need for policy mechanisms that go beyond symbolic inclusion. Respondents called for enforceable consultation requirements, Indigenous-led research funding, and governance models that formally recognize TEK as a valid and authoritative system of knowledge. These recommendations are echoed in recent federal initiatives such as the White House's 2022 guidance on Indigenous Knowledge, but implementation remains inconsistent (White House OSTP 2022). Moreover, several respondents expressed concern over the intergenerational impacts of policy exclusion. Without formal recognition, TEK transmission to youth is jeopardized, along with opportunities for future Indigenous leadership in environmental stewardship (Berkes 2018). The survey data complements the paper's broader argument: for environmental policy in Alaska to be effective, equitable, and sustainable, TEK must be integrated not just as an informational tool, but as a governance framework rooted in Indigenous rights and self-determination.

Cultural Impact Assessment

The integration, or exclusion, of Traditional Ecological Knowledge in environmental policy has direct consequences on the cultural survival, autonomy, and governance capacity of Indigenous communities in Alaska. TEK is more than a body of environmental observations; it is a dynamic system of knowledge embedded in language, ceremony, and reciprocal relationships with the land. As Berkes notes, "Traditional ecological knowledge is not static; it is a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission" (Berkes 2018).

Policies that acknowledge and actively support TEK do more than inform ecological management; they affirm Indigenous identity, safeguard intergenerational learning, and promote self-determination. Research on Indigenous-led conservation consistently shows that when indigenous governance and knowledge are respected, outcomes are both ecologically and culturally robust: "Integrating Indigenous knowledge and management practices into conservation has proven to strengthen community resilience and reinforce Indigenous governance systems" (Ens et al., 2022, 110).

When policy frameworks include Indigenous consultation and respect for TEK, they strengthen community sovereignty. For example, co-management regimes such as those established under the Marine Mammal Protection Act allow Alaska Native Organizations to retain control over subsistence practices while participating in federal conservation planning (Malek and Cornish 2019). These arrangements create formal pathways for Indigenous knowledge holders to influence decision-making, sustaining not only environmental outcomes but also the relational governance systems that support autonomy.

Conversely, policy environments that marginalize TEK risk significant cultural harm. Exclusion from governance processes contributes to epistemic injustice, where Indigenous worldviews are sidelined in favor of Western scientific paradigms. As Ludwig and Poliseli argue, reducing traditional ecological knowledge to a source of data strips it of its epistemological and cultural context, undermining Indigenous sovereignty over their knowledge systems (Biology & Philosophy 2018).

Funding is another key dimension of cultural impact. Policies that provide financial resources for TEK-based research, stewardship, and education, such as those supported through NOAA initiatives or Alaska Native corporations, directly support the continuation of traditional knowledge systems. These

investments empower communities to maintain control over how knowledge is documented, shared, and applied, reinforcing Indigenous data sovereignty and long-term cultural resilience. The Indigenous Climate emphasizes that funding and resources must flow to Indigenous-led initiatives to ensure that knowledge systems are not co-opted, but instead strengthen community-led adaptation and conservation (Climate Hub 2024).

Ultimately, cultural impact is not a secondary concern but a central outcome of environmental governance. Policies that integrate TEK must do so with care, co-design, and accountability, ensuring that Indigenous communities are not only heard but have genuine power in shaping environmental futures. As the Arctic continues to face ecological and political challenges, culturally responsive policy will be critical for sustaining the knowledge, leadership, and self-governance of Indigenous peoples across Alaska.

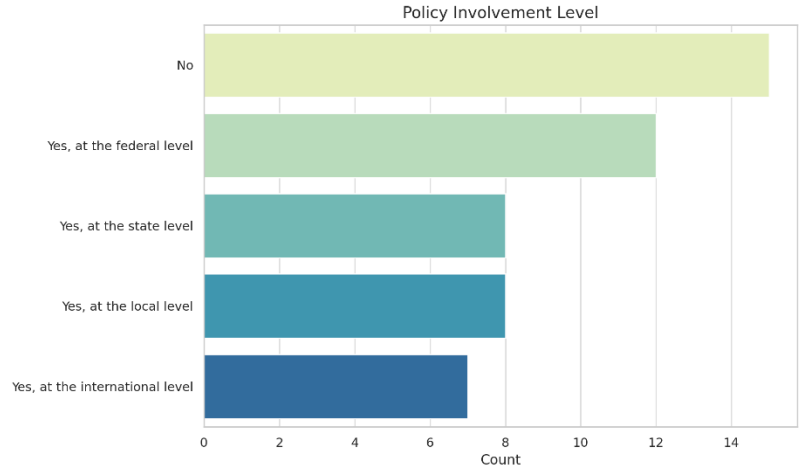

Figure 5. Respondents' involvement in environmental policy-making at different scales. While some participants reported engagement at local or tribal levels, fewer reported involvement in international forums. The results highlight a need to increase formal inclusion pathways for Indigenous leaders across all levels of environmental governance.

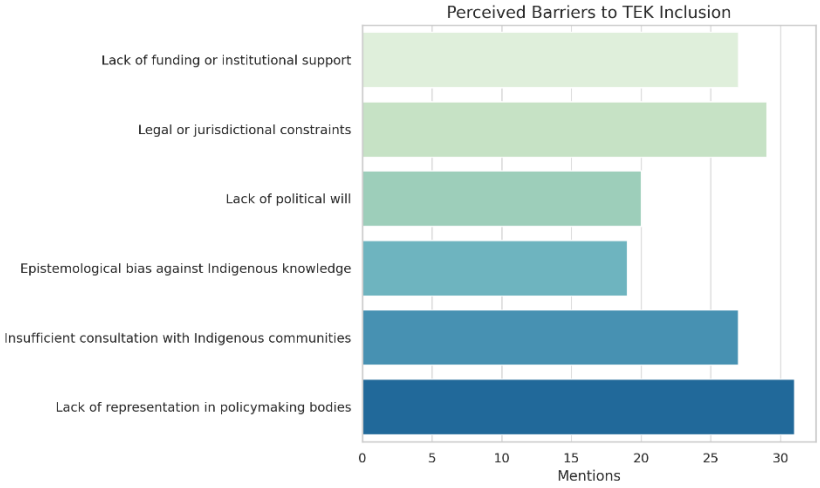

Figure 6. Reported barriers to the integration of Traditional Ecological Knowledge in environmental policy. Respondents most frequently cited institutional bias, lack of consultation mechanisms, and knowledge hierarchies that privilege Western science. The findings underscore structural challenges that must be addressed to create equitable, TEK-inclusive policy Frameworks.

Results

Analysis of sixteen policy frameworks reveals that the integration of Traditional Ecological Knowledge in Alaska and Arctic environmental governance is highly uneven, with substantial variation across governance levels, policy instruments, and the extent of co-management mechanisms. The policy coding results (Figure 1) indicate that co-management frameworks, such as the Marine Mammal Protection Act and Alaska's Wildlife Action Plan, demonstrate the strongest integration of TEK. These policies consistently scored high across all five criteria, explicit mention of TEK, consultation requirements, co-governance, enforceability, and funding support. Their success stems from the formal embedding of Indigenous consultation processes and the establishment of shared authority between federal agencies and Alaska Native Organizations. In contrast, broader federal directives, including the National Environmental Policy Act and Executive Order 13175, require consultation but lack clear funding mechanisms and enforceable structures. Other instruments, such as the Magnuson-Stevens Act and the Department of Defense Arctic Strategy, acknowledge TEK but remain limited in terms of meaningful Indigenous co-governance. International and Indigenous-led agreements, including the Ethical and Equitable Engagement Protocols, the United Nations Declaration on the Rights of Indigenous Peoples, and the Arctic Council's Kiruna Declaration, perform well on explicit recognition and consultation but do not provide direct enforcement mechanisms, leaving implementation dependent on national or local bodies.

The comparative analysis with Nordic frameworks (Figure 2) highlights key differences. EU-wide strategies such as the European Green Deal and Biodiversity Strategy 2030 make only vague references to Indigenous perspectives and lack binding consultation requirements. Finland's Nature Conservation Act of 2023 and Sweden's Reindeer Husbandry Act of 1971, by contrast, explicitly embed Indigenous consultation and confer localized authority to Sámi parliaments. These frameworks provide a stronger starting point than EU-level approaches, but they remain constrained by insufficient funding and inconsistent application. In this respect, Alaska falls between these models. Co-management bodies in the Alaskan system provide strong opportunities for Indigenous participation in marine and wildlife governance, yet the absence of centralized, stable funding structures limits the durability of these programs. While Finland and Sweden benefit from the institutional presence of Sámi parliaments, Alaska's government-to-government consultation model depends heavily on agency leadership and political will.

Case studies offer grounded evidence of how TEK functions in practice. Marine mammal co-management partnerships between federal agencies and groups such as the Alaska Eskimo Whaling Commission and the Ice Seal Committee integrate Indigenous observations into quota-setting, seasonal guidelines, and species monitoring. These collaborations have enhanced conservation outcomes, though they continue to face resource constraints. Polar bear management in the Chukchi Sea, carried out by the Alaska Nanuuq Commission in collaboration with the U.S. Fish and Wildlife Service under a bilateral agreement with Russia, similarly relies on TEK to track population changes linked to sea ice loss. Land and water stewardship programs established by Alaska Native corporations following the Alaska Native Claims Settlement Act of 1971 extend the role of TEK into forest, fishery, and restoration projects. These

initiatives reflect how TEK, when embedded at the local level, produces management practices that are both ecologically effective and culturally rooted.

The survey findings complement these document-based insights. Most respondents, who included Alaska Native leaders, scientists, and conservation professionals, reported participating in decision-making processes primarily at local or tribal levels, with far fewer engaged in state, federal, or international forums. When asked about the barriers to TEK inclusion, respondents most frequently identified institutional bias toward Western science, insufficient funding, and the absence of enforceable consultation mechanisms. Several also noted frustration with procedural consultation models that acknowledge TEK rhetorically without substantive integration. Many emphasized the importance of sustained relationship-building, legally binding consultation requirements, and dedicated support for Indigenous-led research and stewardship. These responses suggest that despite growing policy attention to TEK, formal avenues for meaningful Indigenous participation in governance remain limited.

Across policy documents, comparative coding, and survey findings, three consistent themes emerge. Co-management systems, where they exist, provide the highest degree of TEK integration and cultural responsiveness. Funding and enforcement mechanisms remain the weakest elements across all governance levels. Finally, there is a persistent gap between the rhetoric of policy frameworks that acknowledge Indigenous knowledge and the reality of their implementation. These results underscore that policies which treat TEK as a governance framework, rather than as supplemental data, produce stronger ecological outcomes while enhancing Indigenous self-determination.

Policy Recommendations

The findings of this research, including federal and state policy analysis, case studies, and stakeholder survey responses, point to the critical need for more robust and equitable integration of Traditional Ecological Knowledge into Alaskan environmental governance. While progress has been made through co-management models and recognition frameworks, persistent structural and epistemological barriers continue to marginalize Indigenous voices. The following recommendations are divided into short-term, actionable steps and long-term structural changes, offering a roadmap toward more inclusive, culturally responsive environmental policy.

Short Term Actions

Increase Indigenous leadership in conservation agencies To foster genuine representation, conservation agencies at all levels – federal, state, and local – should proactively recruit and elevate Indigenous professionals into decision-making roles. This includes roles within NOAA, the U.S. Fish and Wildlife Service, and Alaska's Department of Fish and Game. Leadership should not be symbolic; Indigenous leaders must be empowered to shape research agendas, enforcement strategies, and funding priorities. Institutional partnerships with tribal colleges and Alaska Native organizations can support pipeline programs and leadership development.

Require TEK consultation in Alaska-specific environmental assessments While some federal agencies have guidelines for TEK inclusion, these practices are often voluntary and inconsistently applied. Mandating TEK consultation in environmental assessments—especially those concerning resource extraction, land management, or biodiversity conservation—would operationalize commitments made

under Executive Order 13175 and the White House's 2022 Indigenous Knowledge Guidance. Alaska's State Environmental Policy Act could be amended to explicitly require Indigenous consultation and documentation of TEK in all major assessments.

Long-Term Structural Changes

Institutionalize co-management models Co-management frameworks, such as those used for marine mammals under the Marine Mammal Protection Act, provide a legal basis for shared governance and knowledge integration. However, these models remain limited in scope and often depend on discretionary funding or administrative support. Future policy should expand co-management to terrestrial ecosystems and climate adaptation planning, embedding legal structures that ensure Indigenous authority is not contingent on external political will.

Bridge scientific and Indigenous epistemologies in law and practice Legal and scientific institutions must develop tools and language that respect the legitimacy of Indigenous knowledge systems without forcing assimilation into Western paradigms. This includes updating agency guidance documents, reforming evidentiary standards for environmental hearings, and creating shared research frameworks that allow for pluralistic approaches to knowledge. Educational and training programs for policymakers and scientists should incorporate decolonial methods, language revitalization, and cross-cultural research ethics.

Secure sustained funding for TEK-based programs Indigenous environmental programs often operate on short-term grants, limiting their stability and long-term impact. Policies at the federal and state levels should establish permanent funding streams for TEK-based stewardship, education, and monitoring initiatives. This may include tribal research endowments, inclusion of TEK in federal conservation grants, and state-level trust funds dedicated to Indigenous-led conservation. Stable funding empowers communities to document, transmit, and apply TEK on their own terms, preserving cultural autonomy and long-term resilience.

Effective TEK integration requires more than consultation: it demands a paradigm shift in how environmental governance defines knowledge, authority, and collaboration. By centering Indigenous leadership, embedding TEK into legal frameworks, and ensuring financial sustainability, Alaska can serve as a model for ethical, reciprocal environmental stewardship in a rapidly changing Arctic.

Limitations

This study has several limitations that should be acknowledged when interpreting its findings. First, the scope of the research is geographically and temporally constrained. While the analysis focuses on Alaska, Indigenous knowledge systems and governance models vary widely across the circumpolar Arctic, and the conclusions drawn here may not fully represent the diversity of approaches across other regions such as Canada, Greenland, or Russia. Similarly, the summer research timeframe limited the number of policies, case studies, and community perspectives that could be examined in depth.

Second, although surveys were employed to capture a range of perspectives from Indigenous leaders, scientists, conservation practitioners, and policymakers, the participant pool cannot be considered fully representative of Alaska's Indigenous communities. Responses reflect the insights of those individuals and organizations who were available and willing to participate during the data collection period.

A significant limitation lies in the inability to conduct interviews with tribal governments and community members. Ethical research involving tribal nations generally requires formal approval from each individual tribe or tribal council. Given that Alaska is home to hundreds of tribes and tribal organizations, securing the necessary permissions was beyond the scope of this single-season research project. As a result, this study relies more heavily on document analysis, existing literature, and secondary data than originally intended.

Finally, institutional opacity posed challenges in evaluating how Traditional Ecological Knowledge is operationalized in practice. While many policies reference TEK or consultation, documentation of implementation is often limited or inaccessible. Consequently, there is a gap between the language of policy and its practical outcomes that could only be partially addressed within this study. These limitations underscore the importance of continued research that incorporates long-term, community-driven collaboration and Indigenous-led methodologies to deepen understanding of how TEK can be meaningfully integrated into environmental governance.

Conclusion

This research examined the role of Traditional Ecological Knowledge in Alaskan environmental policy, with a focus on how Indigenous communities contribute to conservation, navigate policy frameworks, and assert cultural autonomy. Through a multi-method approach, encompassing policy analysis, case studies, stakeholder surveys, and comparative frameworks, this project identified both barriers to and opportunities for TEK integration across federal, state, and Indigenous-led governance models.

The analysis revealed significant inconsistencies in how TEK is acknowledged and applied across environmental policies. While certain federal statutes, such as the Marine Mammal Protection Act, offer successful models of co-management, others marginalize TEK by omitting Indigenous consultation or relegating it to non-binding recommendations. Survey results reinforced these findings, highlighting institutional bias, lack of consultation mechanisms, and Western-centric epistemologies as major barriers. Case studies of marine mammal co-management and Alaska Native corporations illustrated the transformative potential of Indigenous-led stewardship when supported by legal and institutional frameworks.

This study contributes to growing scholarship on Indigenous knowledge and environmental governance by offering a regionally grounded, policy-focused analysis of TEK integration in Alaska. It bridges environmental studies, political science, and Indigenous studies, demonstrating the value of interdisciplinary, decolonial approaches to climate and conservation research. Policy recommendations derived from this work propose short-term and long-term interventions aimed at institutional reform, epistemological inclusion, and equitable resource allocation, guidance that can inform lawmakers, conservation agencies, and tribal governments alike.

At its core, this research is rooted in the principles of environmental justice. It underscores the right of Indigenous communities to shape policies that affect their lands, waters, and futures. In doing so, it advances the conversation on cross-cultural governance—models that honor Indigenous sovereignty while fostering collaboration across knowledge systems. The incorporation of TEK not only affirms cultural identity and ecological stewardship but also offers time-tested strategies for climate resilience in the Arctic. As climate change accelerates, the need for locally grounded, culturally adaptive solutions has never been more urgent.

This project will be shared with Indigenous organizations, conservation practitioners, and policymakers through presentations, reports, and community briefings. Survey results and policy recommendations will be returned to participating organizations with an open invitation for feedback and continued dialogue. In the long term, this research will serve as a foundation for expanded comparative studies between Alaska, the Sámi regions of Northern Europe, and other Indigenous communities engaged in environmental governance. By continuing to build partnerships with Alaska Native organizations and transnational Indigenous networks, this work aspires not only to study policy but to support meaningful change.

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