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Methods and approach to the interdisciplinary and cross-cultural *Arctic Alaska Salmon Workshop*: critical self-reflections from fisheries scientists

Elizabeth D. Lindley and Peter A.H. Westley

College of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Fairbanks, Alaska

Corresponding authors: **Elizabeth D. Lindley** (email: edlindley@alaska.edu); **Peter A.H. Westley** (email: pwestley@alaska.edu)

Abstract

Redistribution and shifting habitat envelopes are impacting organisms across many taxa, which in turn are impacting Indigenous ways of life. In Arctic Alaska, Pacific salmon are known to have occurred for at least a century, but in recent years appear to be increasingly common. With the goal of holistically understanding and describing these changes in a way that equitably considers Indigenous, local, and western knowledge, we share our experience and methodologies in facilitating the Arctic Alaska Salmon Workshop. We share our perspective, approach, and methods as fisheries natural scientists convening this workshop, which included community-based knowledge holders from the Iñupiat communities of Kotzebue, Point Hope, Utqiaġvik, and Kaktovik, and western scientists and researchers from universities, fishery management agencies, and local community government. After briefly discussing some of the workshop highlights, we conclude with four key takeaways: (1) that the process of co-production of knowledge is an ideal towards, which we must strive, but acknowledge we may rarely, if ever, fully achieve, (2) pursuit of the "good science" should guide our work, (3) examination and assessment of assumptions should occur early and often, and (4) Anglanikina! Make sure you have a good time, (Yup'ik).

Key words: Arctic, climate change, Pacific salmon, cross-cultural approaches, collaborative research

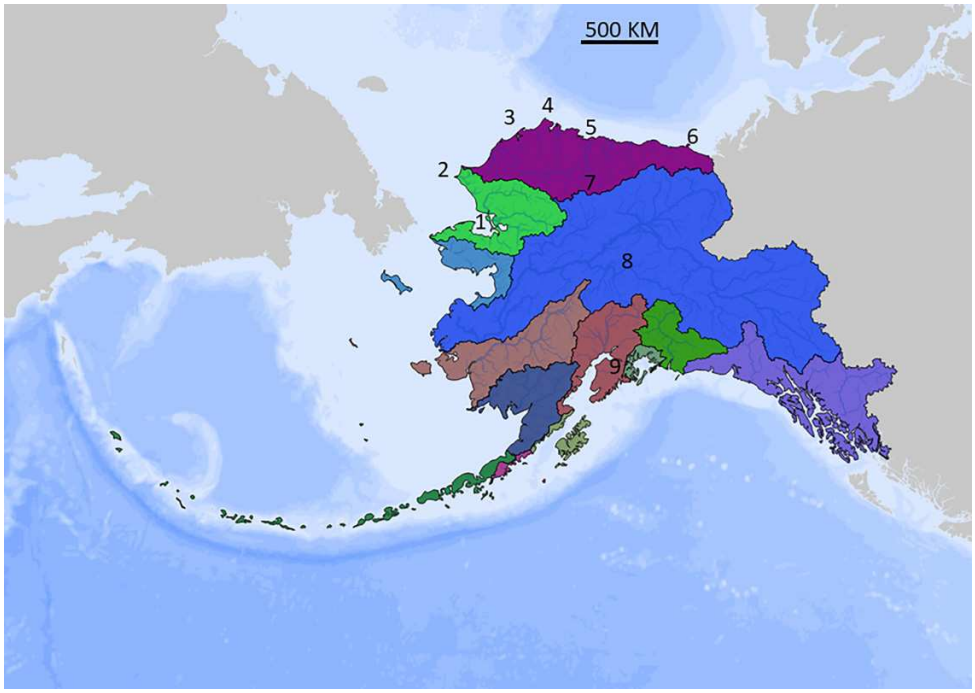
Positionality statement

We begin with intense gratitude and appreciation to everyone who inspired and participated in the Alaska Arctic Salmon Workshop, held on Dena'ina lands of Dgheyey Kaq' in what is now called Anchorage. We have chosen to begin this article with a positionality statement to put a personhood to the paper by sharing who the authors are in the context of their research. The workshop was envisioned and facilitated by the two authors on this paper. Elizabeth "Mik'aq" Lindley is Yup'ik, born and raised on the Kuskokwim River in southwest Alaska whose deep ties to salmon only exist because the Yup'ik people have had reciprocal relationships with salmon for thousands of years. The relationship between people and fish in Elizabeth's region is not something that can be described in words, but lives within each person and is uniquely experienced—a facet of existence shared among all Indigenous ways of life in Alaska. This understanding of the intricate and intrinsic links between people and place paired with a genuine enjoyment of the natural sciences is how she approaches the work described in this article. Peter Westley is the descendant of white settlers with cultural ties to Western Europe, who has called Alaska home his entire life, and for inexplicable reasons has been fascinated and drawn to salmon for as long as he can recall. He currently balances roles as father, husband, and associate professor of fisheries (including as graduate advisor to Mik'aq), where he explores questions about ecology and evolution of fishes and teaches to students in his classrooms and to those as part of the research team he leads, the importance of maintaining biodiversity, and focusing on sustaining the relationships between fish, people, and place. Both Elizabeth and Peter are trained as western natural scientists but increasingly work at the interface of natural, social, and Indigenous science, and are conscious of treading carefully and intentionally in these intersections. This paper, part of Elizabeth's pursuit of a Ph.D. in fisheries, is meant to share our collective experiences and critical self-reflections of doing collaborative work across disciplines, knowledge systems, and cultures with the hope it may serve as a model and inspiration to others.

Introduction

Intact, functioning ecosystems are the bedrock of biodiversity, Indigenous lifeways, and food security across the Arctic. Indigenous stewards are rightly considered the first ecologists and conservationists, where Native ways of life have long exemplified ecological conservation through relationality, reciprocity, and equal valuation of the land and all living beings (Barnhardt and Kawagley 2005). As unprecedented

Fig. 1. Map of Alaska showing salmon-producing regions (https://alaskasalmonandpeople.org/regions/) and approximate location of communities that were invited to/participated in the Alaska Arctic Salmon Workshop (AASW). From the northwest in clockwise order, (1) Qikiqtaġruk/Kotzebue, (2) Tikiġaq/Point Hope and near Cape Lisburne, which is the oft assumed northern limit of established salmon populations, (3) Ulġuniq/Wainwright, (4) Utqiaġvik/Barrow, (5) Nuiqsut, (6) Kaktovik/Barter Island, (7) Anaktuvuk Pass, (8) Tanana/Fairbanks, (9) Dgheyey Kaq' (Anchorage). See supplemental material for list of participants and home community of origin.



rates of climate change accelerate the threat to traditional ways of life for Alaska Native Peoples (Hauser et al. 2023), the opportunity to move towards equitably contextualizing ecological change at the intersection of western sciences and Indigenous Knowledge systems is particularly needed (e.g., Reid et al. 2021). Here, we describe the process and methods to bring together knowledge bearers of diverse backgrounds to better understand what Alaska Arctic salmon[1] might portend for the fish, the people, and the broader ecosystem.

One of the clearest harbingers of climate change is the poleward redistributions of marine taxa (Pinsky et al. 2013). Evidenced through both lifeways and western scientific methods, shifts in presence of all five species of sea-going Pacific salmon (*Oncorhynchus* spp., hereafter referred to as salmon) across Arctic Alaska are thought to be changing in relative abundance of species-specific encounters and observations (George et al. 2009; Brown et al. 2016; Mikow et al. 2016; Carothers et al. 2019). Salmon are a group of species that spawn and rear in freshwater, migrate to the ocean where they spend the majority of their life and obtain the vast majority of their growth, before migrating to the ocean to mature before returning to their natal streams to spawn and die. The current distribution of high-latitude habitat that supports self-sustaining salmon populations was discovered and established by individual salmon who strayed from their home-streams into newly available freshwater systems following the last glacial epoch (Hendry 2004). This process is termed "colonization" in the western scientific discipline and is used frequently in the salmon literature lexicon. In Alaska, the temporal extent of colonization and establishment of self-sustaining populations in the fringes of salmon habitat north of Cape Lisburne (located near #2 in Fig. 1) is not well articulated (Craig and Haldorson 1986; Nielsen et al. 2013). However, all five species of Pacific salmon have been periodically observed in subsistence fisheries and biological surveys across Arctic Alaska (George et al. 2009; Brown et al. 2016; Carothers et al. 2019; Giefer and Graziano 2023), with some species such as pink salmon (*O. gorbuscha*) and chum salmon (*O. keta*) being regularly encountered in North Slope rivers over the last century (Bockstoce 2011; Carothers et al. 2019), which may suggest the maintenance of small populations of these species in Arctic Ocean draining rivers (Craig and Haldorson 1986; Nielsen et al. 2013). Consistent with this, juvenile chum salmon have been observed in nearshore and freshwater systems, suggesting that successful spawning by this species in Arctic Alaska is possible at least in some locations (Moulton 2001; Dunmall et al. 2022). The perceived increases of salmon across the North American Arctic more broadly is thought to be a manifestation of increased marine thermal accessibility and range expansion to this region, and is well documented in places like Arctic Canada (Irvine et al. 2009; Dunmall et al. 2013; Logerwell et al. 2015; Bilous and

[1] Here, we distinguish "Alaska Arctic salmon" from the Canadian-based research program called "Arctic Salmon". For more information on that fascinating program see https://www.arcticsalmon.ca/.

Dunmall 2020; Farley et al. 2020) and Europe (Nielsen et al. 2020). In contrast, there is not clear consensus across Arctic Alaska that salmon at rapidly increasing at similar levels to those in Canada and beyond. That being said, no formal monitoring of salmon abundance exists in Arctic Alaska, limiting the ability to detect change quantitatively, and only one research project in the last decade explore changes qualitatively (Carothers et al. 2019). Observations and deep knowledge of salmon changes in Arctic Alaska in recent years do, however, exist, and has been a topic of discussion in informal settings for decades—of which both authors of this paper have participated in. The geographically expansive Arctic region is a place that is best known by the people who steward it, which is why any efforts to articulate change necessitates inclusion of local and Indigenous Knowledge systems.

Limited research focuses to better understand the ecology and history of salmon in Arctic Alaska, and ongoing changes in their abundance limits our ability to truly understand broadscale changes and impacts to local ecosystems and lifeways. The potentials for interactions with local, culturally important fishes, such as Dolly Varden (*Salvelinus malma*), broad whitefish (*Coregonus nasus*), Arctic grayling (*Thymallus arcticus*), and Arctic cisco (*C. autumnalis*) are largely unknown and emphasize the need to understand salmon changes in Arctic Alaska through culturally relevant approaches. While the literature is currently equivocal in describing patterns of abundance and range expansion, we can infer some commonalities across available data sources to suggest that salmon have been in the Arctic for at least a century and that occurrences and species diversity seems to be increasing (Carothers et al. 2019; Chila et al. 2022). As these trends in perception, catch composition, and perceived abundance evolve, there remains a clear need to bring together multiple disciplines and ways of knowing to learn about species-specific salmon presence across the vast Arctic region through community-engaged research methods that elevate Indigenous Knowledge systems and prioritize the maintenance of Indigenous lifeways.

Community-engaged western scientific research efforts with Arctic communities have a long history (Pearce et al. 2009; Hauser et al. 2023); however, evolving approaches and attitudes in this work are contributing to a paradigm shift where research and management recommendations are increasingly innovative and ethically responsible to local communities (Wong et al. 2020; Yua et al. 2022). Movement in the academic western sciences, including fisheries science and management, to work towards community-engaged and collaborative efforts in Alaska and beyond is in its infancy but has also had growing commitment in recent years from social, natural, and multi-disciplinary scientific contingencies (Ringer et al. 2018; Danielson et al. 2022; Silver et al. 2022; Hauser et al. 2023). The environmental investigation of cascading and diverse changes brought about by changing climates, such as salmon range expansion, are inherently multi-disciplinary, necessitating multi-disciplinary solutions from a diverse set of problem solvers across knowledge systems. This vision, however, can be challenged by classical disciplinary training conventions and siloed research methodologies. For instance, fisheries natural scientists interested in pursuing community-engaged work do not conventionally receive training to do so in the classic fisheries scientific training path (Moon and Blackman 2014). But fortunately, community-engaged research can take on a plethora of formats, comprised of various disciplines, practitioners, originations, networks, contingencies, and motivations.

A clear need to use new multi-disciplinary and cross-cultural approaches to research salmon in Arctic Alaska exists, which shaped the impetus for the Alaska Arctic Salmon Workshop (AASW), which was an event proposed to use a co-production of knowledge (CPK) framework to explore knowledge about salmon changes in Arctic Alaska. For the sake of this paper and the context of AASW, we will refer to Yua et al. (2022), who offers a conceptual framework for this approach and defines CPK as "a process that brings together Indigenous Peoples' knowledge systems and science to generate new knowledge and understandings of the world that would likely not be achieved through the application of only one knowledge system". AASW was an opportunity to contribute to the story of salmon in Arctic Alaska through a lens that equally valuates all forms of knowledge and perception in the form of a collaborative workshop, which was initially described in the funding proposal as follows.

> "Here we seek […] support to work authentically in collaboration with Arctic residents to better understand the potential impacts of increasing occurrences of Aqalugruaq [Iñupiaq], Pacific salmon, genus *Oncorhynchus* in the Alaska Arctic… Our specific objective is using a co-production [of knowledge] approach, plan and host community elders and youth, western and Indigenous knowledge bearers, members of agencies and academia at the inaugural Arctic Aqalugruaq Salmon Summit (AASS)…" Excerpt from funding proposal "*Pink Arctic: patterns, processes, and consequences of increasing Pacific salmon in the high north*"

AASW, a 2-day workshop hosted in Anchorage, Alaska, had two overarching goals set forth by the co-principal investigators, those being (1) advance and create knowledge about how salmon are changing in Arctic Alaska using a CPK approach, and to (2) identify priority research questions regarding salmon changes to help shape analysis priorities for Arctic salmon field research. Distinguishing with the goals of the AASW, the objective of this paper is to describe the process and design of the Alaska Arctic Salmon Workshop as a collaborative knowledge-spanning event hosted by natural scientists, from its inception to execution, the assumptions and considerations taken in the creations of this event, the outline of our convening, and the aspects of this work that might lend guidance to future work through a specialized example of our work exploring range expansion by salmon in Arctic Alaska. We intentionally do not discuss outcomes or "results" of the AASW, saving that for a collaborative companion paper that includes workshop participants as authors'. Said another way, Elizabeth and Peter as authors on this paper do not believe that the outcomes and products of the AASW are theirs alone to share and must include those who helped generate the results. The overarching aim of this paper is to share a practical example represented by the AASW that was created with the best intentions by natural scientists to conduct community-engaged collaborative research.

Methods

AASW overview

AASW was a part of a larger project awarded by Alaska SeaGrant to support graduate student-involved research on salmon in Arctic Alaska, which was granted to the lead author, Elizabeth. Funding dedicated to this event covered a large fraction of the costs of the convening itself, travel costs, and per diem for rural community-based participants, lodging, breakfast and lunch, one group dinner, and honoraria for participants sharing Indigenous knowledge. The workshop also had generous matching support from the Alaska Arctic Observatory and Knowledge Hub (AAOKH), a community-based monitoring program at the University of Alaska Fairbanks (see Hauser et al. 2023) and the SalmonNet project with support from the Gordon and Betty Moore Foundation (Sawyer et al. 2020). Many months of preparation was required for the 2-day event held in Anchorage, AK, that convened 18 experts spanning disciplines and knowledge systems. The workshop was structured to include large group conversation discussions, small break-out group discussions and activities, and opportunities to informally connect and build relationships (See Table 1 in the Supplementary material for additional details). All discussions and activities were designed and facilitated by co-authors Elizabeth and Peter.

Assumptions

Planning of the AASW included intense reflection on the motivations and articulation of our assumptions, both as they were written into the funding proposal and in proceeding with designing the workshop. There were three specific personal and research assumptions that we outlined, which helped in delineating the goals of the workshop, which was important for identifying the overarching research positionality of this event. First, we considered the guiding premise that motivated our workshop, spanning the proposal stage through the actual hosting of the workshop—which was that there is a clear need to move towards better understanding salmon in Arctic Alaska, specifically through more inclusive and equitable approaches. This was made evident through mere exploration of the western knowledge base and existing research on salmon in Arctic Alaska, as well as the long history of exclusive western natural scientific research practices in Alaska. This was a guiding principle that set the criterion for our invitation list, discussion topics, and plan moving forward. This guided the following assumptions, which were specific to the AASW. They were identified in planning stages and shared with workshop participants at the onset of the convening.

Assumption 1. A single part of an infinite system

The first assumption was that salmon are just one single part of a very highly connected social–ecological system. This assumption directs focus to an idea that is central to holistic and relational Indigenous worldviews (a system), but simultaneously highlights the contrasting linear and precise western approaches to knowing (a single organism). In the context of our convening, we had to assume that the place of salmon in a vastly intricate system will not always be the primary focus of the conversation, and that there is equal value in learning about other parts of the system. Whiting et al. (2011) describes the Iñupiat worldview of species interactions as highly complex, with changes in one species presence or availability stimulating changes in other aspects of the biotic community. This aspect of the Iñupiat worldview is fostered by a trained sensitivity to change, through generations of observing an environment that is more accurately characterized in the context of change, rather than stability (Whiting et al. 2011). This assumption became realized in our discussions as topics such as climate change, sea ice, whales, and other fishes became centralized and cannot be excluded from our future products.

Assumption 2. Salmon as a pattern and process

The second assumption was that through the study of salmon, we have an opportunity to learn about broadscale environmental changes occurring across the Arctic through community-relevant scales. This assumption situates our interest in salmon within the broader context of climate change, and the environmental dynamics that are facilitating changes in Arctic salmon abundance, and the impacts that shifts in abundance may have on local ecosystem functioning. In other words, one way we can learn about how the environment is changing is through the patterns of salmon changes, and thus the processes influencing these changes. Another important concept in ecological investigation of patterns and process is the matter of scale, which through Arctic community engagement can reflect scales that are relevant to community priority and perceptions. Framing this within our work: salmon are a way to track change, and they cannot change without impacting their surroundings—an important consideration that can become overlooked in highly focalized research activities.

Assumption 3. Salmon, people, and place

Our third and final assumption was that we all have different relationships with salmon, often nurtured by the places we come from. While we expected at least a general interest in salmon, we did not approach this workshop expecting that people have any level of value placed in, or relationships with, salmon. We expected that we would have participants with salmon relationships that ranged from deeply connected to non-existent. It would be inappropriate to enter this endeavor with the assumption everyone would care about salmon or this event on any specific level, but rather leaned on the presumption that salmon are one way to explore broadscale change and impacts to subsistence activities in the Arctic. By outlining this assumption during the workshop, we intended to create an environment that displaced pressure from the production in the natural scientific sense (e.g., identifying and outlining purpose-driven knowledge), to the production of conversations and opportunities

for co-learning that helped shape a more comprehensive story of salmon in Arctic Alaska.

Participant invitation

Iñupiat harvesters and environmental experts

Formal inquiries to predominantly Iñupiat communities to gauge interest and identify potential invitees took place largely after the proposal was written and funding was acquired, but an existing network of relationships by proposal investigators and authors here greatly facilitated a process that would likely have been exceedingly difficult or impossible otherwise. Respecting tribal sovereignty, we began by reaching out to tribal governments and proposing our plans and desire to invite and support the attendance of 1–2 knowledgeable fishers to AASW. Outreach began 6 months and ended 1 month before the event and took place in the form of phone calls followed up with written invitations. Informational fliers were also created by Elizabeth and distributed through e-mail. In addition to connections with tribes, connections were also made with local city governments, village corporations, and the regional North Slope Borough. A project description and invitation was also shared in a presentation at the Indigenous People's Commission for Marine Mammals in October 2022. Invitations and outreach efforts were extended to the northwest Arctic and North Slope communities of Kotzebue, Point Hope, Wainwright, Utqiaġvik, Anaktuvuk Pass, Nuiqsut, and Kaktovik, Alaska (Fig. 1). In attendance: one Iñupiaq elder from Kotzebue with lifelong fishing experience, one active fisher and hunter from Point Hope, two whalers and harvesters from Utqiaġvik, one Iñupiaq elder from Kaktovik, and one environmental observer and subsistence specialist from Kaktovik joined the AASW. All participants, with the exception of the elder from Kaktovik, are all local observers in the AAOKH (see Hauser et al. 2023). Expertise of Iñupiat participants truly reflected the dominant harvesting practices of each community, and more so the harvest practices of each person. In the context of salmon in Arctic Alaska, this ranged substantially—for instance, the participant from Kotzebue was a lifelong commercial and subsistence salmon fisher as this region is heavily reliant on salmon, another participant was a whaling captain who no longer actively participates in fishing activities. Linking back to our third assumption, the diversity of fish relationships among participants only enriched the discussions in which holistic connections describing change spanned many species, geographies, and seasons.

Western scientists

Invitations were emailed to scientists with expertise in western natural sciences who are recognized as knowledgeable of North Slope fisheries, effective research practices, fisheries management, or cultural anthropology. Each invitee has exhibited commitment to participating in more equitable research activities in their work. Disciplinary expertise of the western scientific contingency included oceanography, Arctic marine and freshwater ecology, North Slope freshwater fish biology and behavior, fisheries social sciences, salmon ecology and evolution, behavior and movement ecology, and North Slope fisheries management, including members of State and Federal management agencies. Invitations were intentionally distributed through e-mail and were not transferable; however, recommendations for additional participants were considered.

Approach to workshop discussions and activities

Dialogue agreements

Setting the tone at the onset of our convening, we created a set of dialogue agreements, outlining a set of expectations with the intention of creating a comfortable sharing environment (see Table 1 in the Supplementary material). Agreements were adapted from the First Alaskans Institute, an Alaska Native non-profit charitable organization that among many other resources, hosts Alaska Native Dialogues on Racial Equity (ANDORE) and has created a set of dialogue agreements to set the tone for sensitive discussions such as the potential consequences of changing life ways in the face of rapid warming (see https://www.firstalaskans.org/dialogues-hostings-trainings for more information about ANDORE and other training opportunities). Both authors have previously participated in this training opportunity, and we chose to include dialogue agreements to collectively agree to create a space that was empowering and respectful.

Semi-structured discussions

All discussions and activities were semi-structured, open, and voluntary opportunities to share. Group sizes of discussions ranged from three to four individuals to the entire group, with the room modular in design to accommodate small groups (at least three people) as well as joined large circles (up to the full group). Discussion topics were thoughtfully designed by co-authors to address the objectives of our gathering in a way that all participants had equal opportunity to participate conversationally. We did not want to facilitate discussions that might be exclusive to a single expertise, community, or life experience. We also used multiple levels of group size engagement opportunities. Table 1 in the Supplementary material outlines discussions and activities included in our agenda and the rationale behind each session. Despite the workshop being held over a short few days period, we also wanted to ensure that there were built-in opportunities for all participants to visit informally and build relationships beyond the scope of our professional convening. Examples of this included allotting 2 h for introductions on the first day before beginning any workshop content, providing lunch so that participants could stay and visit, many coffee and tea breaks throughout the day, and hosting an optional project-funded group dinner at a local restaurant.

Reporting and workshop products

In the final conversation held during the workshop, we agreed to collaboratively author a synthesis of existing data

and knowledge generated during the workshop with all participants as invited co-authors on the manuscript. In fulfillment of this requirement and to address objective one of AASW, this synthesis will be led by Elizabeth, bringing together existing peer-reviewed and gray literature, and conversations held during the workshop to describe salmon changes in Arctic Alaska. The second objective of AASW was intended to create a list of research priorities and considerations more broadly, which will also be outlined in the synthesis paper. In addition to formal reporting in the form of literature, a summary of workshop findings was published in the AAOKH newsletter, which is distributed to all boxholders of AAOKH communities (Kotzebue, Point Hope, Utqiaġvik, Wainwright, and Kaktovik, Alaska; see https://arctic-aok.org/2023/02/21/hot-off-the-press-check-out-our-winter-2023-newsletter/?fbclid=IwAR1bQx1pr3yaOZ7VSp6f5VD1h4Djc0I1Do2gVA7Z6Q2XJHoPkD600bxLIrU).

Reflections

AASW was truly created with the best of intentions by fisheries natural scientists and delving into a format that is not conventionally used in fisheries science. From an organizers perspective, the AASW required some creativity in tooling methods unfamiliar to us as natural scientists. Since hindsight perspective always allows for opportunities to reflect on potential changes, strengths, and recommendations for any other iterations that may follow. In this section, we share some aspects of the project that changed from the time the proposal was written for funding and the actual event, aspects that worked well, and areas that could be improved in the future.

Names and the Power of Words

Clear points of evolution occurred from the inception of the project idea to the actual carrying out of AASW. Evident even its name, which was originally proposed as the "Alaska Aqalugruaq Salmon Summit".

> "Here we seek […] support to work authentically in collaboration with Arctic residents to better understand the potential impacts of increasing occurrences of Aqalugruaq [Inupiaq], Pacific salmon, genus *Oncorhynchus* in the Alaska Arctic…" Excerpt from funding proposal, Westley 2020 "*Pink Arctic: patterns, processes, and consequences of increasing Pacific salmon in the high north*"

During the workshop, we learned that Aqalugruaq is the name for chum salmon used in the Iñupiaq dialect of the Kotzebue region and is not a word used in the Iñupiaq dialect of the North Slope region. Iqalugruaq, the word used for chum and all other large-bodied salmon occasionally encountered in far north Arctic Alaska, such as sockeye (*O. nerka*) and Chinook salmon (*O. tshawytscha*), is the word that may have more accurately described the regional intention behind the use of the word in the initial stages. Or perhaps the inclusion of both dialects. During AASW, iqalugruaq was said to translate to quite literally "big fish" and to be used to describe more than one salmon species as was identified through photographs shared during the workshop discussion, *Power of Words*.

The *Power of Words* discussion shared during the workshop became a highly interactive and exciting conversation that gave everyone an opportunity to learn together (See Table 1 in the Supplementary material). All participants excitedly discussed ways in which the different salmon species can be identified and differentiated, and ways in which culturally important North Slope subsistence species Iqalukpik (Iñupiaq, used for both species of char), Dolly Varden, and Arctic char (*S. aplinus*), can be visually differentiated from pink salmon, and the names used for different salmon (Fig. 2). The range of relationships to salmon held within our group was truly reflected in this discussion and allowed for true lateral exchange of experiential and professional knowledge alike, and highlighted the importance of names, something shared among different knowledge systems represented by our group. While the goal in all our discussions and breakout groups was to create opportunities to advance knowledge through implicit co-learning, the workshop may have benefitted from creating explicit co-learning opportunities. From the standpoint of observing the co-learning opportunity as an organizer, it seemed to strip any semblance of knowledge power imbalances that may persist in mixed-knowledge spaces such as AASW. For instance, the practice of co-learning built into collaborative and co-productive efforts in research has been identified as critical to effective and equitable decolonizing research practices (Khan et al. 2022), and a key characteristic of the guiding principles of Two-Eyed Seeing (TES) (Bartlett et al. 2012). As the analyses of this workshop will be led by Elizabeth, as an Indigenous scholar, TES is integral to the framing and synthesis of bringing together multiple knowledge types from a multi-worldview perspective. Given these two points, and the reception observed in workshop participants during specific co-learning opportunities, one key takeaway here would be designing more opportunities specific to this form of production.

Co-production of knowledge or collaboration

Another point of evolution was the verbiage used to describe AASW in the proposal stage and the chosen descriptors to use for the event. The event was proposed as using a CPK framework; however, this labeling was increasingly inappropriate as it evolved from its inception to completion. As the AASW was just a single part of a larger research project that was identified and outlined within a single knowledge system, which, holistically, does not reflect a CPK framework. Specifically, in that both knowledge systems were not reflected in the proposal and planning stages of this work, and only in the convening itself. We must admit that the AASW was a preconceived research activity with objectives and intention set by principal investigators, whom all identify as western scientific researchers, without contribution from communities at the earliest stages of inception, where the problem was identified, questions developed, methods outlined, and then community participation initiated. Elizabeth being an Indigenous scholar, however, brought her whole self to contributing to this work. Had communities

Fig. 2. Alaska Arctic Salmon Workshop (AASW) participants excitedly share information on identification of salmon species caught during customary and traditional harvest for Dolly Varden shared by fishers from Kaktovik. For more, see text in section on *the Power of Words*.

been equitably involved from inception and contributed to the motivation, priorities, and approach to this work from the onset, the AASW may have been more closely aligned with the CPK research process. For this reason, we chose to describe the AASW as a collaborative, rather than CPK, event. Certain stages and aspects of the AASW itself, however, reflect some tools and guiding principles set forth by a CPK framework (e.g., Yua et al. 2022). The intention behind AASW was to move towards a more equitable research practice, which was the goal in the design of the workshop discussions. And while this stage was not necessarily co-produced, it aimed to capture conceptual equity building tools outlined by Yua et al. (2022) such as cultivating trust and respect, encouraging relationship building, striving to conduct the work ethically, and creating an empowering environment for all participants.

Engagement planning

A presumption made regarding community interest in the AASW was that communities and fishers across Arctic Alaska have been broadly interested in, or worried about, salmon in Arctic Alaska and are willing to travel to participate in a multi-day workshop. The engagement plan was generally laid out in the proposal and carried out by Elizabeth. This was challenged throughout the actual engagement process, which used multiple levels of outreach that ranged from phone calls and emails through personal networks to formal engagement with local and regional governments, and local corporations. Given 5 months of effort and countless phone calls and emails throughout the seven communities we reached out to, it is unclear what the challenge to greater interest and attendance may have been reflective of. We hoped to have 1–2 fishers in attendance from each of our invited communities. Of the seven communities we reached out to, we had one representative from three and two from one. There are many very pressing issues in communities across rural Alaska related to climate change that must take precedence over changes in salmon abundance, perhaps salmon is just not as big of a concern as previously thought (e.g., Huntington et al. 2019). Furthermore, we also acknowledge that it is a substantial request to make of someone to step away from their lives to travel on multiple flights during the work week to attend a workshop, and this is just not possible for some people. We intentionally avoided hosting the event during a timeframe that might conflict with subsistence schedules and consulted community connections to confirm our timeframe was appropriate in this regard. Interest expressed in attendance is also reflected in the shift from the AASW being an intended "elder and youth" opportunity to all ages, and only adults in attendance. We may have been able to enter this process with greater clarity regarding interest and approaches to engagement had community research infrastructure been involved during the earliest planning stages, such as the inception of the proposal.

During an outreach phone call with an individual from a North Slope community, we received feedback advising that

the community should have been involved from the onset of the project, rather than receiving an invitation to participate in a pre-planned research event. This sentiment has been expressed by multiple Arctic communities in formal publications, while also stating that communities are experiencing research fatigue with increasing attention from scientists (Brinkman et al. 2016; Kawerak INC. 2020). For this reason, another takeaway for future iterations of this work would be to engage with local community structures, such as individual tribal and city governments, at earlier stages of the planning process to share our interest and explore best approaches to community engagement. One example of this might include hosting community meetings through well-established networks of project partners, such as the North Slope Borough—with whom involvement was included from the onset of the larger funded project through which AASW was created. This would greatly enhance outreach, gauging community interest, and ensure that there is potential for the integration of community-relevant priorities and goals throughout our work. This would also more closely align with the CPK research framework. However, as we are natural scientists learning from an inaugural event, we have ample opportunity to approach this differently in future iterations.

Highlights

As described in this paper, AASW was a very special opportunity to host from an organizers perspective where scientists and Arctic community members connected and built research and personal relationships around a shared ecological interest. In reflection, it was a highly successful inaugural gathering that embodied productivity and relationship building, and hopefully there will be opportunities for future iterations. The benefit to collaborative processes being iterative was felt in this work, as it only just seemed like we were "getting to the good stuff" once it came time to conclude our convening and that we either needed to keep going or do it again. The "good stuff" being the discussions made possible by cultivating a level of comfort and familiarity within our group, which will be outlined in other formats in which participants' will be involved in their presentation and have explicit ownership over data shared. In our closing session and in some follow-up conversations with participants, many commented on how much they learned throughout the workshop and how innovative the design was. The majority of the 18 participants from both knowledge contingencies had never participated in anything like the AASW, where scientists and harvesters had an opportunity to talk and learn in semi-structured formats. The conversation and discussion-based format is not one commonly used in western natural scientific research processes, and it was noted to be a brand new experience for some scientists in the group. Unlike many science-based workshops, here were no conventional presentations shared by scientists, just conversations and discussions lead by the facilitators, which were aided by the use of slides when appropriate to help visually present ideas, photos, and discussion points. One participant reflected that they were surprised by the fact that community members in the Arctic could be displeased with the increasing presence of salmon. As so much of the state of Alaska deeply values and appreciates salmon, indifferent, and even negative, perceptions of salmon shared in discussion came as a surprise to many scientists—but an important perception to understand. Multiple Arctic community members shared how important and valuable it was that scientists were hearing and learning about the Iñupiaq perspective and values throughout the workshop, and that this was a format that should be more broadly used by co-productive processes such as co-management meetings. The open sharing of perspectives in research settings such as the AASW was said to be something needed more broadly by the natural scientific community to promote respectful and ethical community-oriented research conduct. In the context of salmon in Arctic Alaska, the AASW truly helped shape the Arctic salmon story and our perspectives as natural scientists. To summarize some themes regarding Arctic changes emphasized in our discussions, here we share some key themes:

- **Perception is highly variable across Arctic Alaska**. Communities in the Kotzebue region are deeply connected to salmon. Meanwhile salmon use varies widely in North Slope communities and perceptions range from appreciation to dislike. Regardless of perception, however, the treatment and reporting of salmon changes must support local governance and self-determination in subsistence rights.
- **Presence and harvest of salmon and other species are changing**. A shared observation among community representatives and scientists was a shift in species composition of salmon and other species increasingly encountered in the Arctic. Some of these changes included increased pink salmon in the Kotzebue region, increased observations of unusual fishes harvested and washing up on beaches in and around Point Hope, more salmon harvested and observed in and around Utqiagvik from 2014 to 2021, and an observed increase in Saffron cod (*Eleginus gracilis*) in conjunction with a decrease in culturally important char in and around Kaktovik.
- **Anomalous environmental conditions.** Increased occurrences of freeze–thaw event and severe uncharacteristic storms have unknown impacts to local organisms. Increasingly observed and highly unusual river seeps in Arctic draining systems are also greatly concerning for resident and migratory fishes that rely on freshwater habitat.

While this list is abridged, themes and data shared during the workshop will be jointly reported on in greater detail and be complemented by other existing data in the gray and peer-reviewed literature. Two salient questions that emerged as unanimously important in future research efforts were (1) where are these salmon coming from, and are they new (strays) or returning (homing)? and (2) in what ways might increasing salmon abundance and shifts in species composition impact culturally important subsistence species? An additional question raised was whether it is appropriate to study salmon in Arctic Alaska as a novel organism when much of the state is experiencing massive states of crisis in their salmon runs. Finally, a thoughtful question raised posed: in what ways can we describe salmon change that best supports

Indigenous governance and knowledge systems, and avoids erasing legacies of existing knowledge held by Indigenous peoples, or claiming first evidence/knowledge reporting?

Conclusions

- **Co-production as a process with endless opportunities for growth.** Throughout this process, we have learned a lot about ourselves as researchers and each of our unique positionalities doing collaborative work. In reflecting on striving for equity through our collaborative efforts, we believe that it is a continuum that we will always be striving to improve. By retrospectively comparing our approach to CPK frameworks, there were clearly stages that could have been approached differently to center equity. This is something, however, that we believe will always be the case. We suggest that CPK is an ideal towards, which research should strive, while acknowledging that perfection can often be an impediment to progress. For this reason, one of our key takeaways from the perspective of natural scientists is to continually be reflexive of positionality, research approaches, and intention—however, also give yourself grace to make errors, learn from them, and continue striving towards an ideal.
- **Centering perspectives in the pursuit of creating the "Good Science"**. A participant shared that the Iñupiat must use "the good science", that is science which fits within Iñupiat values and aligns with Iñupiat perspectives. The AASW was said to have been innovative and an unconventional research process, perhaps due to the fact that conversation and discussion was centered as a primary method. This allowed for the conveyance of knowledge and perspectives to flow freely, unbridled by a rigid set objective. This created a space where Indigenous participants felt their participation was valued through the elevation and reception of perspective, something that has long been excluded in western scientific research and is a primary facet of *moving toward equity*. For this reason, our second key takeaway is that collaborative approaches should be deliberate in the inclusion of perspective throughout the pursuit of knowledge and chosen methods should elevate this exchange.
- **Acknowledging assumptions early and reassessing often.** We have already reflected on the assumptions outlined specific to the AASW, as described earlier in this paper, but we have only more recently reflected on the implicit assumptions made prior to the workshop. We would have benefitted from identifying our assumption that there would be broad interest in attending the AASW, explicitly and earlier in the research process. While there was certainly large amounts of interest in the AASW, our assumption that interest would largely be universal was unfounded. To ensure that the most effective and relevant approaches to collaboration are being used, and to repeatedly situate our positionalities within our work, we would recommend that research assumptions be continuously reevaluated throughout the research process.
- **Anglanikina! Make sure you have a good time,** (Yup'ik). There is an expected level of seriousness when doing science. However, we must remember our fourth dialogue agreement "value our sense of humor", to not take yourself too seriously, and to not forget to have a good time. Teams play best when they are having fun on the field, and we believe research that is fun increases the probability of success. Collaborative research across knowledge systems can have so much opportunity for relationship building, and a really good way to build relationships is by having fun together. With relationality being an important aspect of Indigenous Knowledge systems and way of life, we found it to be important to integrate avenues for human relationality through this work—which is not something commonly used in scientific endeavors. A very valuable part of the AASW was the opportunities we created for informal visiting and gathering as just People.

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Data availability

Data associated with the research project associated described in our original manuscript are stored in a Google drive, which is approved for use by our institutional Internal Review Board. Drive is only accessible by those intimately involved with the project and workshop participants, as they remain intended for use.

Author information

Author ORCIDs

Elizabeth D. Lindley https://orcid.org/0000-0003-3556-1871

Author contributions

Conceptualization: EDL, PAHW
Data curation: EDL
Formal analysis: EDL, PAHW
Funding acquisition: PAHW
Investigation: EDL, PAHW
Methodology: EDL, PAHW
Project administration: EDL, PAHW
Supervision: PAHW
Validation: PAHW
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Competing interests

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Supplementary material

Supplementary data are available with the article at https://doi.org/10.1139/as-2023-0054.

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