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“Everything revolves around the herring”: the Heiltsuk–herring relationship through time

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ABSTRACT. Pacific herring (*Clupea pallasii*) is foundational to many social-ecological systems of the North American coast. The indigenous people of Heiltsuk First Nation on the central coast of British Columbia, Canada have depended on this forage fish for food, social, ceremonial, and economic purposes for millennia. Our research documents social, ecological, and cultural aspects of Heiltsuk First Nation’s relationship with Pacific herring and how this relationship has changed over time. We describe and discuss (1) how Heiltsuk social institutions, local and traditional ecological knowledge, and worldview have informed herring management strategies from pre-contact times until present, and (2) how post-contact changes in state-led herring management and other social and institutional developments in British Columbia have affected the role and transmission of Heiltsuk local knowledge and management of herring. By working in close partnership with Heiltsuk decision-makers, and by conducting interviews with Heiltsuk knowledge holders, we ensured that the data gathered would be relevant, applicable, and valuable to the Heiltsuk community. Our research therefore serves as an example of how state fisheries agencies could improve relationships with indigenous communities by engaging in more collaborative data collection, and our results suggest the potential for joint learning and improvement in fisheries management through collaboration during the design of management and harvesting plans. Our research has relevance at the global level because we identify some of the steps that may be taken to help overcome institutionalized inertia and attain more equitable power relationships for sustainable fisheries management.

Key Words: *fisheries management; governance; indigenous fisheries; herring; Northwest Coast; traditional ecological knowledge*

INTRODUCTION

Indigenous people around the world are working to regain control of fisheries resources in their traditional territories in order to retain and reinvigorate food security, governance, social relations, and economies (Berkes 2015). Recent global declines of fish stocks, and of forage fish in particular (Pinsky et al. 2011, Pikitch et al. 2012), are a driving force for many of these initiatives. For many coastal peoples, forage fish are a foundation of both their cultures and ecosystems (e.g., Morita 1985, Barrett et al. 2004, Pikitch et al. 2012, McKechnie et al. 2014). Indigenous peoples, in particular, have developed unique, place-based knowledge of forage and other valued fish species and transmitted this knowledge intergenerationally through oral narratives, songs, systems of rules, and communication about landscape features (Okey and Pauly 1999, Huntington 2000, Thornton et al. 2010, Huntington et al. 2013). This evolving body of knowledge, called traditional ecological knowledge, informed fisheries management systems for generations (Menziés 2006, Berkes 2015). Traditional ecological knowledge, combined with more recent ecological observations by local indigenous and nonindigenous community members (“local knowledge”), has the potential to inform and improve contemporary fisheries conservation, management, and policy (Berkes et al. 2007, Murray et al. 2011).

On the Northwest Coast of North America, Pacific herring (*Clupea pallasii*) is a forage fish and cultural keystone species that has played a foundational role in coastal social-ecological systems for millennia (Thornton et al. 2010, McKechnie et al. 2014, McKechnie and Moss 2016). In the past, and in many areas today, herring and herring eggs were harvested in coastal waters during the spring spawning season when millions of fish come to shore to spawn. Herring were also harvested throughout the year, often

in immense schools known as herring balls. Archaeological and ethnographic evidence indicates the extent to which coastal First Nations and Native North Americans harvested herring with nets, rakes, and fish traps, and harvested herring eggs (roe) spawned on branches or kelp laid out for this purpose (Lane 1990, McKechnie et al. 2014). Herring and herring eggs were and are still eaten fresh, or smoked, or dried for later consumption. For coastal indigenous peoples, herring harvest, processing, consumption, and exchange has been guided by local knowledge and traditional ecological knowledge (LTEK), nested within social and cultural institutions that incorporate management systems, rights, and responsibilities (cf. Trosper 2002).

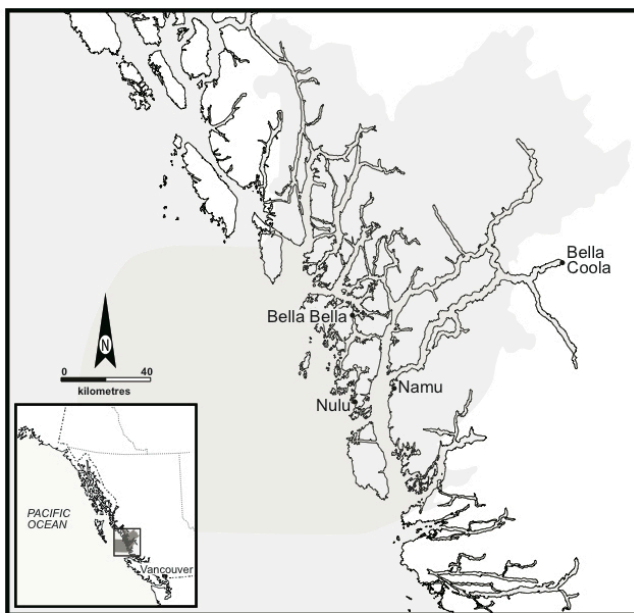
Over the last 140 years, Fisheries and Oceans Canada (formerly the Department of Fisheries and Oceans, and still known as “DFO”) has exercised regulatory authority over herring fisheries management in Canada, under powers vested in the federal government by the *Constitution Act, 1867* ((UK), 30 & 31 Victoria, c. 3). In the last 50 years, herring biomass on the Pacific coast has severely declined in many areas, which has disrupted ecological systems and affected human communities that are closely connected to the fish (Cleary et al. 2009, DFO 2011, Moss 2015). Declines in herring biomass have been attributed to habitat degradation, pollution, predators, climate change, poor management strategies, and overharvesting (Parsons and Lear 1993, Harris 2000, Benson et al. 2011, Powell 2012, Keeling et al. 2017). Archaeological evidence documented by McKechnie et al. (2014) demonstrates that herring were consistently abundant for many coastal indigenous communities for thousands of years prior to the industrial harvesting of the last century. These authors conclude that “The most parsimonious explanation for the difference between the modern pattern of variability in herring

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abundance and the long-term archaeological record is the onset of industrial-scale commercial fishing” (McKechnie et al. 2014:813).

In British Columbia’s (B.C.’s) unique situation, where many First Nations have not entered into treaties with colonial or Canadian governments, several First Nation groups have looked to the courts to affirm and enforce their Aboriginal rights in herring and other fisheries and to revitalize LTEK and associated management strategies (see, for example, the decisions of the Supreme Court of Canada in *R. v. Sparrow* (1990), *R. v. Van der Peet* (1996), *Delgamuukw v. British Columbia* (1997), and the British Columbia Court of Appeal in *Ahousaht Indian Band and Nation v. Canada (Attorney General)* (2013). In one such case, *R. v. Gladstone* (1996), the Supreme Court of Canada specifically affirmed the rights of Heiltsuk First Nation to harvest Pacific herring (*wá'nái*) spawn for food, social, ceremonial, and economic purposes within the boundaries of their traditional territory (Fig. 1). This landmark decision reflects the fact that the right and ability to fish and steward herring is tightly linked to Heiltsuk worldview, history, social relations, economies, and physical well-being (Lane 1990, HTC 2005). Twenty years after the Heiltsuk established their rights in the *R. v. Gladstone* decision, DFO and Heiltsuk leaders are still engaged in a reconciliation process in which they are negotiating accommodation options with regard to Heiltsuk loss of access to this fishery under DFO management. The Heiltsuk Tribal Council (HTC) and the Gladstone Reconciliation Society are dissatisfied with what they see as an antiquated approach to consultation and negotiation, and DFO’s reluctance to share power, which has stalled reconciliation (HTC 2011).

Fig. 1. Location of Bella Bella, and the ancient settlement sites, Nulu and Namu, on the central coast of British Columbia, Canada. Map prepared by Shannon Wood.



Our research is situated within the context of the desire of the HTC, Heiltsuk fisheries resource managers, and hereditary chiefs (Hemas) to reclaim power, authority, and managerial rights over the herring fisheries in their traditional territories (HTC 2005). The primary goal of this study is to examine the long-term history of the Heiltsuk–herring relationship and identify how the various components of the relationship have evolved and transformed over time. This aim is born from the recognition that locally specific rules of herring management cannot be decoupled from views about the right way to interact with the environment, about social systems and oral narratives, and indeed about worldviews (cf. Lertzman 2009). We adapted Berkes (2012a) “knowledge–practice–belief” conceptual framework to organize information about Heiltsuk LTEK and their systems of herring management into four domains of human–herring relationships: (1) worldview, (2) social institutions and agents, (3) land and resource management strategies, and (4) LTEK. We focus on LTEK and management strategies but also discuss the roles of Heiltsuk social institutions and worldview.

We begin by summarizing the major socio-political events that have shaped the Heiltsuk–herring relationship over time, and contextualize this information within Heiltsuk worldviews. We represent these events in a timeline that is divided into three categorical columns: Heiltsuk Institutions and Knowledge, Colonial Institutions and Impacts, and Resistance and Protest. We then describe Heiltsuk LTEK and management strategies for Pacific herring, based on the data obtained through our interviews with Heiltsuk knowledge holders. Our results highlight how traditional social institutions, LTEK, and aspects of Heiltsuk worldview informed herring management strategies in the past, and how changes introduced by state-led herring management have affected the role and transmission of LTEK-based strategies today.

METHODS

Our research is part of the coast-wide Herring School research initiative (www.pacificherring.org) and is founded on the tenets of community-based participatory research (Castleden et al. 2012). We collaborated with the HTC and Heiltsuk Integrated Resource Management Department (HIRMD) to design the research. Members of HIRMD assisted with the identification of individuals within the Heiltsuk community who could provide expert information about Heiltsuk herring management strategies, LTEK, and the broader Heiltsuk social system and worldview. From spring 2011 until fall 2014, Gauvreau conducted 25 semistructured interviews with 22 Heiltsuk First Nation herring resource users, including elders and hereditary chiefs. All interviews were conducted in accordance with the ethics protocol approved by Simon Fraser University and HIRMD. The participants included leaders, decision-makers, and key knowledge holders across three generations of herring resource users, ranging in age from 27 to 86 years old. Although the views of these individuals do not necessarily represent the full range of views, opinions, and knowledge of the broader Heiltsuk community, this sample of community members was selected because of their particular knowledge, expertise, and experience with the traditional and industrial herring fisheries as well as their knowledge of the broader Heiltsuk social system and worldview. Gauvreau (2015) provides further details concerning the selection of interviewees.

The interview questions were open-ended and followed a general guide to cover topics identified in consultation with HIRMD and HTC. The topics were selected to capture the time and spatial scale of each person's observations and to record their knowledge about LTEK, community-based management strategies, and local opinions. General topics included timing of harvest, stock monitoring procedures and techniques, technologies used for harvesting and processing, rules and ancestral laws surrounding the traditional fishery, impacts of the state-sanctioned fishery on the traditional fishery, and conservation initiatives. Interviews typically lasted 1–2 hours, and most interviews were conducted in Bella Bella, B.C. (Fig. 1); two interviews were conducted in Vancouver, B.C. We also incorporated data from interviews conducted by others during 2004–2014, which are referred to and cited specifically in the results.

Our interview strategy was informed by the recognition that specific rules of herring and herring roe management are tied to broader Heiltsuk views about the environment, and to their social system, oral narratives, and worldview. Thus, we sought to understand the mechanisms that underpin the broader Heiltsuk social system and give meaning to the more specific rules, as well as the more specific aspects of management and ecological knowledge about herring (cf. Berkes 2012a).

In addition to the interviews, information about the broader Heiltsuk social system (worldview, social institutions, and agents) was gleaned from informal conversations with community members, participation in potlatches, and discussions of oral narratives about herring with elders and other knowledge keepers. Ethnographic works and oral narratives augmented the interview data about Heiltsuk LTEK (e.g., herring ecology, trophic level interactions, behavior). Additional data about Heiltsuk herring management strategies were obtained through the analysis of archaeological evidence, ethnographic works, and technical documents. Data for the historical background section and the timeline were derived from interviews, ethnographies, technical documents, media releases, historical documents, and court transcripts.

Our organization of this information is modeled after Berkes' (2012a) "knowledge–practice–belief" framework. In this framework, "worldview" encompasses the perception, identity, and ethos of the Heiltsuk. Influenced by the Heiltsuk worldview are Heiltsuk "social institutions and agents" that guide Heiltsuk resource management throughout their territory. At a more specific level of the Heiltsuk–herring relationship are Heiltsuk "land and resource management strategies" that comprise the practices, tools, and techniques that the Heiltsuk employ to manage herring in their traditional territory. Finally, at the core of the framework is Heiltsuk LTEK about herring, including herring ecology, trophic level interactions, and behavior.

RESULTS

The Heiltsuk–herring relationship: amid troubled waters

Heiltsuk people have shared a relationship with Pacific herring since time immemorial (HTC 2005, Housty et al. 2014). The multidimensional aspects of the Heiltsuk–herring relationship have evolved in the context of major shifts in Heiltsuk social-ecological systems, especially over the last two centuries (Fig. 2). We present a summary of the major social-political events that

have shaped the Heiltsuk–herring relationship over time and present the historical context in which these transformations occurred. Heiltsuk institutions and knowledge serve as the foundation of the evolving relationship. Indigenous institutions were affected by the instatement of colonial law and regulations, and these state-sanctioned impositions were met with Heiltsuk and other indigenous resistance and protest.

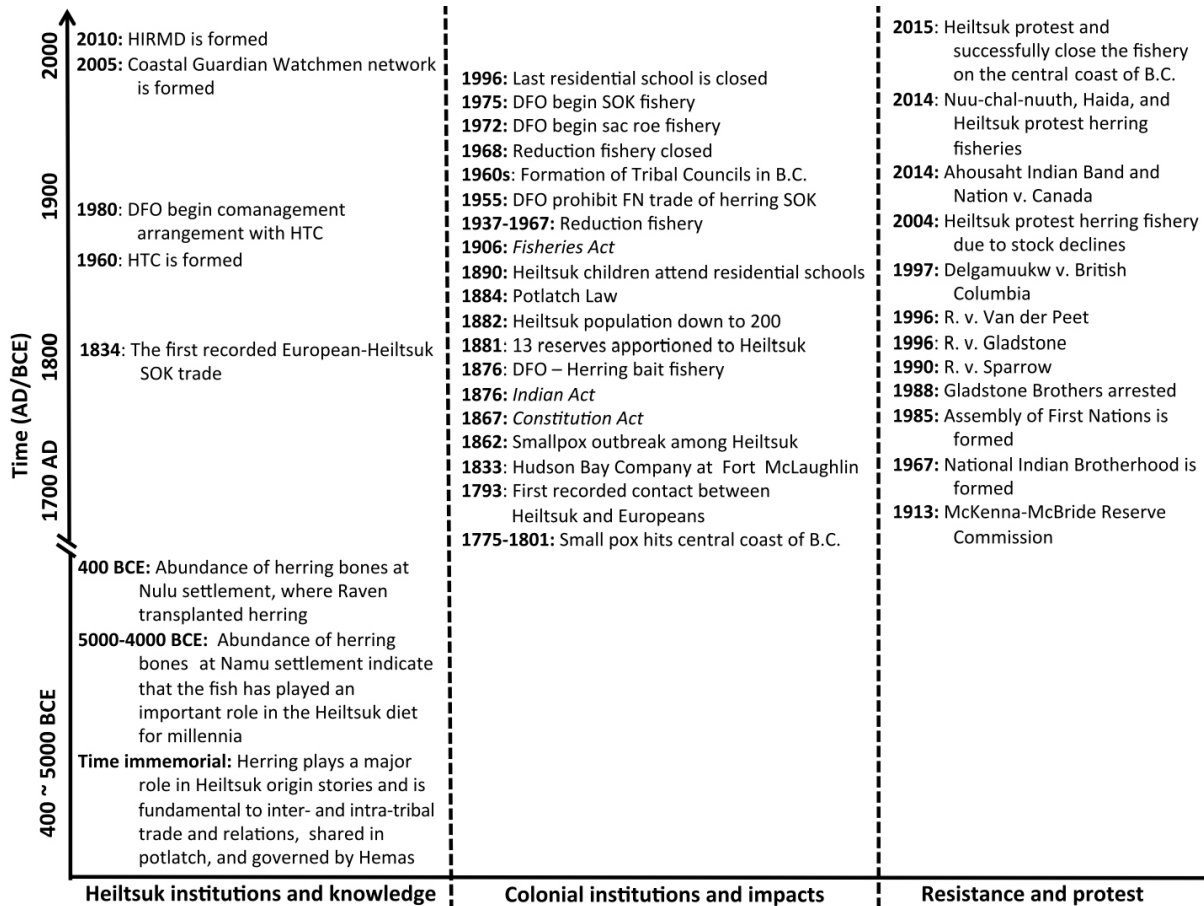
Colonial institutions and effects: disruptions to the Heiltsuk–herring relationship

Prior to European contact, Heiltsuk developed a thriving relationship with herring that was and is immersed in systems of traditional ecological knowledge, land tenure, *gvi'ilas*, worldview, and other knowledge, customs, and traditions. "Gvi'ilas" (pronounced "gwee-ee-las") is a complex set of orally transmitted customary laws, values, beliefs, teachings, principles, and practices; its source is ancestral, mythical, and inherited (Harkin 1996, HTC 2005). The laws and nature of *gvi'ilas* are discussed and lived both formally and informally. Formal discussion of *gvi'ilas* occurs during the potlatch, a millennia-old practice and occasion during which laws are reviewed, revised, and then agreed upon by the hereditary chiefs (Cole and Chaikin 1990, Harkin 1996, HTC 2005). Traditional names, rank, or hereditary privileges (e.g., access rights and ownership of specific herring harvesting sites) are also claimed through dances, speeches, and the distribution of property to those involved in the potlatch (Cole and Chaikin 1990, Harkin 1996, HTC 2005). The potlatch is a complex institution that is fundamental to the Heiltsuk social system. Outside of the potlatch, informal discussions of *gvi'ilas* occur among family and friends (William Housty, *personal communication*, September 2014), and include discussions of how to properly interact with herring.

For generations, Heiltsuk have been connected to herring in a myriad of tangible and intangible ways; these connections cannot be separated from the social systems in which they are embedded. Herring roe on hemlock branches and kelp (stringy kelp [*Egregia menziesii*], flat kelp [*Macrocystis pyrifera*]) has always been a significant component of people's seasonal diet, ceremonial and potlatch feasts, and economy. Thus, when European contact and colonization in the 18th and 19th centuries precipitated a multitude of social and environmental transformations among Heiltsuk communities (Fig. 2) (Harkin 1996, Hobbler 2000), these events had cascading effects on the Heiltsuk relationships with herring.

Between 1775 and 1889, roughly 80% of the Heiltsuk population died as a result of pandemic diseases, notably smallpox, influenza, measles, and tuberculosis (Tolmie 1963, Boyd 1999). Most of the survivors amalgamated at the village of Bella Bella (Waglisla) on Campbell Island, B.C. in the late 1800s (Hobbler 2000). A wealth of traditional knowledge about herring and the land tenure system was disrupted by the dramatic declines in the Heiltsuk population (Harkin 1996, Hobbler 2000). The implementation of the *Indian Act* by the Canadian federal government in 1876 (dealing with "Indian Reserves," status, and rules of governance) and the federal ban on potlatches enacted in 1884, resulted in additional disruption and dissonance with the social systems of coastal First Nations (Haig-Brown 1988, Cole and Chaikin 1990, Simpson 2004). For the Heiltsuk, the *Indian Act* and associated laws challenged paradigms of authority, land tenure, and most

Fig. 2. Events that have shaped the Heiltsuk–herring relationship through time (HIRMD = Heiltsuk Integrated Resource Management Department; DFO = Fisheries and Oceans Canada; HTC = Heiltsuk Tribal Council; SOK = spawn on kelp fishery; B.C. = British Columbia; FN = First Nations).



importantly, gv'ilas. By 1890, many Heiltsuk children were forced by the Canadian government to leave Bella Bella to attend residential schools across the Pacific coast, where they were isolated from Heiltsuk social and cultural traditions and were penalized for speaking the Heiltsuk language (Harkin 1993). The transmission of herring LTEK acquired over millennia (e.g., seasonality, spawning locations, harvesting technologies, and ecological indicators) was hindered by these social disruptions.

In 1876, the Canadian federal government authorized the first commercial harvest of herring as a bait fishery, where herring were caught en masse for the primary purpose of being used to catch other, larger fish (Powell 2012). By 1906, DFO had established the *Fisheries Act*, which created more regulations for the fisheries and changed the structure of the licensing system, intentionally excluding many First Nation fishers, including members of Heiltsuk First Nation (Parsons and Lear 1993, Harris 2000). In the early to mid 20th century, a DFO-managed reduction fishery (for fishmeal and oil) was instituted and subsequently collapsed due to depleted herring stocks (Parsons and Lear 1993, DFO 2011). DFO closed the reduction fishery from 1968 until the early 1970s to allow herring stocks to rebuild (DFO 2011).

Following a partial recovery of stocks, DFO initiated the commercial sac roe fisheries in 1972. The sac roe fisheries use large seine nets or gill nets to target unfertilized “pre-spawn” egg sacs that are removed from the female herring and shipped overseas; the carcasses are processed into fishmeal (DFO 2013). In 1975, DFO appropriated and commercialized traditional indigenous fisheries techniques by establishing and implementing the commercial spawn on kelp fisheries (SOK) (Harris 2000, DFO 2011). Building on indigenous knowledge, SOK fisheries target the eggs that spawning herring have deposited on kelp suspended in the water column (Harris 2000, DFO 2013). This method allows the adult herring to survive because only the roe is harvested. Both the sac roe and SOK fisheries remain in operation today (DFO 2013). The sac roe fishery typically occurs each year from late February to early March when the herring gather to spawn (DFO 2013). The SOK fishery opens after the sac roe fishery, and typically runs until late April (DFO 2013). Thus, the sac roe fishery harvests fish that would otherwise contribute to the SOK fishery, and this creates conflict because Aboriginal rights in the SOK fishery are entitled to priority over other users (the “doctrine of priority” articulated by the Supreme Court of Canada).

Table 1. Deep-time traditional ecological knowledge of Pacific herring.

Topic no.	Observations	Sources
1	Raven (chief/himaskas'u) transplanted herring to the village site of Nulu from Gildith.	Raven Obtains Herring (Bella Bella Tales – Franz Boas)
2	Black ducks dive underwater to harvest and consume kelp fronds that are laden with herring roe, and this is how some of the Heiltsuk ancestors learned how to harvest herring roe on kelp and hemlock boughs.	“Golden-Eye Duck” (owned by Beatrice Brown) shared by E.W. September 2014
3	The full moon (nusi) in February represents the beginning of the herring season and the Heiltsuk new year. When the crescent moon starts to tip over, herring begin to spawn, and it is the time to set trees/kelp.	Brown and Brown 2009; Interview data: E.W. September 2014; P.W. September 2014
4	For people living around Rivers Inlet, alder trees turning from brown to green marked the time to head to the more coastal fish camps to prepare for the herring spawn.	Interview data: E.W. September 2014
5	Bird life, whale, and other animal activity indicate where herring are massing and spawning.	Interview data: E.W. September 2014; W.H. May 2013; J.B. March 2011; G.W. May 2013
6	Seagulls will mass and dive around herring balls and herring spawning sites.	Interview data: E.W. September 2014; W.H. May 2013; J.B. March 2011; G.W. May 2013
7	Spawning herring are sensitive to noise and disturbances. Disruptions can cause herring to disperse and stop spawning.	Interview data: G.H. May 2012; R.B. May 2013; F.R. May 2013; A.P. March 2011; G.W. May 2013
8	Herring will repeatedly spawn on branches and kelp that are suspended in the water column; if too many layers of roe are deposited, it will cause egg die off and rot.	Interview data: W.H. June 2014; S.C. October 2012

By the early 1980s, the SOK fishery was becoming increasingly economically viable. However, many Heiltsuk fishers were excluded from participating in the fishery because DFO allocated a limited number of licenses to HTC for distribution. As a result, many Heiltsuk fishers became “deckhands” for other non-Heiltsuk companies (e.g., BC Packers Limited) (Steve Carpenter, *personal communication*, September 2011). This created a particularly dire situation for Heiltsuk community members that relied on their access to the fish for sustenance and their local economy. HTC requested more SOK licenses during the 1980s to help the fishers of their community escape poverty, but the requests were denied by DFO (Harkin 1997, Harris 2000). By the late 1990s, as a result of the *R. v. Gladstone* decision, DFO began allocating additional SOK licenses to the HTC, and HTC was responsible for allocating these licenses to Heiltsuk herring fishers. Unfortunately, resource allocation remained extremely difficult with competing demands and fewer fish to go around (Harris 2000).

Heiltsuk resistance and protest

By the beginning of the 21st century, Heiltsuk and other coastal communities had witnessed multiple declines in herring biomass and repeated regional fisheries closures (DFO 2013, HTC 2014). Despite Heiltsuk opposition, DFO re-opened a commercial sac roe fishery in Heiltsuk traditional territory in 2004. Out of concern for the dwindling stocks, Heiltsuk community members took to their boats and occupied the waters in an attempt to protest and block the commercial fish boats. Heiltsuk efforts to protest the sac roe fishery were publicized in the media and acknowledged by DFO, yet the Heiltsuk protestors were unable to stop the commercial fishers from obtaining most of their quota. The herring stocks in Heiltsuk territory crashed to an all-time low in 2007, despite Heiltsuk efforts to stop the fishery. At this time, similar events were unfolding between Nuu-chah-nulth First Nation and DFO on the west coast of Vancouver Island, B.C. First Nation advocacy of rights and title gained increasing momentum in the courts following these protests, yet DFO's

institutionalized inertia and the federal government's unwillingness to share decision-making power continued.

DFO officials announced in the spring of 2015 that the agency was once again planning to open the commercial herring fisheries on the central coast despite Heiltsuk opposition. Members of the Heiltsuk community occupied the federal agency's office on Denny Island, B.C. for several days, and were eventually successful in having the fishery closed (CBC 2015). However, the commercial sac roe fishery was still in operation in the traditional territories of several neighboring First Nations communities. Ultimately, the vessels were displaced from Heiltsuk territory, but the commercial allocation for the region was still achieved in nearby KITASOO Bay and elsewhere. Thus, the governance issues described here are part of a much larger regional issue, with implications for many coastal First Nations in British Columbia. Members of the Gladstone Reconciliation Society, HTC, and HIRMD remain in ongoing discussions with DFO and industry, in which the Heiltsuk are seeking a joint-management arrangement that will integrate aspects of Heiltsuk local and traditional ecological knowledge of herring and the pre-existing Heiltsuk management strategies for herring (HTC 2016).

The Heiltsuk–herring relationship: evolving knowledge and management strategies

Over millennia, Heiltsuk fishers and stewards developed extensive knowledge about herring that evolved in shifting social-ecological contexts. Deep-time and more recent (within the last 80 years) Heiltsuk LTEK (Tables 1 and 2) are some of the core components of the Heiltsuk–herring relationship and the foundation of Heiltsuk management strategies for herring (Tables 3 and 4). Compilations of this knowledge and practice highlight how herring has played an important food, social, and ceremonial role as well as being a major staple of Heiltsuk economies for millennia.

Table 2. Recent observations about Pacific herring.

Topic no.	Observations	Sources
1	Herring spawn later than they did historically, occasionally not until late spring and early summer. There used to be snow on the ground when herring spawned; the air and oceanic temperatures are now much warmer.	Gerrard 2014; Interview data: E.N. March 2011; C.R. April 2011; P. W. September 2014; E.R. and T.R. November 2013
2	Herring size has decreased over time. Many people have noticed a decline since the 1980s.	Interview data: W.H. May 2011; K.G. March 2011; G.W. May 2013; M.R. March 2011
3	The duration of spawning events has decreased since the early 1940s. Herring used to spawn for 7–8 days consecutively. They now spawn for about 2–3 days.	Interview data: H.H. May 2013; W.H. May 2013; Gerrard 2014; Interview data: H.H. May 2013; W.H. May 2013
4	The predictability and quantity of herring spawning locations have declined over time.	Gerrard 2014; Interview data: H.H. May 2013; W.H. May 2013
5	Herring now spawn deeper in the water column.	Interview data: F.R. May 2013; G.W. 2013

Heiltsuk local and traditional ecological knowledge of herring

Traditional ecological knowledge represents cumulative bodies of observations transmitted across generations via a myriad of cultural processes (cf. Gadgil et al. 1993, Turner et al. 2000, Berkes 2012a); oral narratives are one of many cultural processes for transmitting ecological information (Turner et al. 2000, Jones and Russel 2012). In the case of Heiltsuk and herring, oral narratives include knowledge about seasonality, spawning locations, harvesting technologies, and other aspects of herring ecology. Heiltsuk have two narratives in which herring are prominently featured (Table 1, Topics 1 and 2). “Raven Obtains Herring,” from the Namu settlement, and “The Golden-Eye Duck,” from the Nulu settlement, document the antiquity of the Heiltsuk–herring relationship and offer some of the first examples of herring management recorded in Heiltsuk traditions. These narratives are complemented by the archaeology of the settlement sites from which they originate; Namu (Fig. 1) has been a consistently important location for harvesting large quantities of herring since at least 7000 years ago, while Nulu’s (Fig. 1) record of the same extends to at least 2400 years ago (Cannon et al. 2011, McKechnie et al. 2014).

Heiltsuk stewards monitored celestial, environmental, and ecological indicators to know when the herring season was approaching (Table 1, Topics 3 and 4). In the spring, the arrival of herring was central to the renewal of the cycle of the Heiltsuk people (Brown and Brown 2009). Herring attracted groundfish, birds, and other animals closer to shore, which facilitated hunting and fishing of other species both before and after the spawn (Table 1, Topics 5 and 6). The arrival of herring therefore marked the beginning of the Heiltsuk new year. Herring were the first fresh fish to arrive in February after the stormy winter when people historically relied on dry-stored goods. Close attention was paid to the behavioral characteristics of herring while they spawned, and it was understood that certain behaviors affected the quality of the roe harvested, as well as the overall well-being of the fish (Table 1, Topics 7 and 8). The Heiltsuk knew that herring are particularly sensitive to disturbances and potential threats while spawning, and would respond quickly to predators and loud noises by fleeing the spawning site, balling together, or going deeper in the water column.

In recent times, Heiltsuk fishers have noticed changes in herring seasonality, biology, abundance, distribution, and behavior (Table 2). Pacific herring now begin spawning in localized areas within Heiltsuk territory in March, and occasionally continue spawning until late April and into the summer. People remember, however, that spawning events used to occur around the time of the crescent moon in mid-February, and some Heiltsuk recall that there was still snow on the ground when herring would spawn (Table 2, Topic 1). These latter observations may be related to declining snow pack associated with climate change rather than, or in addition to, changes in spawn timing. People have also noted that the size of the mature herring has decreased over time, from an average of about 10–11 inches (25–27 cm) to 5–6 inches (12–15 cm) (Table 2, Topic 1). Some Heiltsuk believe that smaller juvenile herring now dominate herring populations as a result of the targeted removal of large, gravid females by the industrial sac roe fishery of the last few decades (Gary Wilson, *personal communication*, May 2013). Changes in spawning location and depth may be linked to the herring population being predominantly juveniles (Gary Wilson, *personal communication*, May 2013).

Heiltsuk have also observed that the duration of spawning events has noticeably shortened (Table 2, Topic 3), and the predictability, distribution, and abundance of sites where herring mass and spawn have also shifted over time (Table 2, Topic 4) (Gerrard 2014). Herring occasionally have “puff-spawns” or “spot-spawns” now, where they spawn for a day or so and then relocate to another bay. In the past, the Heiltsuk observed heavy spawns for 7–8 days straight in the same bay. It is now sometimes necessary for fishers to follow herring between sites and reset their kelp and branches to get a worthwhile harvest. Herring have also been observed spawning deeper in the water column than they did in the past (Table 2, Topic 5). This increased depth makes it more challenging to harvest the eggs, and may result in egg loss due to increased mortality caused by predation and habitat type (see Keeling et al. 2017). These recent observations are among the drivers of Heiltsuk demands for more localized management strategies for herring, and more control over herring management on the central coast of British Columbia.

The Heiltsuk management system for Pacific herring

The traditional Heiltsuk management system for Pacific herring created a strong foundation for the Heiltsuk economy and for

Table 3. Deep-time management strategies for Pacific herring.

Topic no.	Strategies	Sources
1	The Heiltsuk manage herring stocks in their traditional territory in accordance with the laws of <i>gvi'ilas</i> .	HTC 2005; Interview data: W.H. June 2014; H.H. May 2013; P.W. September 2014; F.R. May 2013
2	Heiltsuk hereditary chiefs (Hemas) and their right-hand men/women (Auuks) oversee the management of herring in their respective tribal areas; however, all Heiltsuk people are responsible for harvesting herring in accordance with the laws of <i>gvi'ilas</i> .	HTC 2005; Interview data: W.H. June 2013; H.H. May 2013; G.W. May 2013
3	Families inherit and hold access rights to specific herring harvesting sites and processing camps located within the tribal areas of their traditional territory.	Interview data: R.B. May 2013; H. H. May 2013; G.W. May 2013; E. W. September 2014; W.H. June 2014
4	If people want to harvest herring and herring roe at another family's site, they must ask the highest ranking person within the family for permission; this is typically a Heiltsuk hereditary chief (Hemas).	Interview data: R.B. May 2013; H. H. May 2013; G.W. May 2013; E. W. September 2014; W.H. June 2014
5	The right to harvest herring and its roe comes with the responsibility to maintain herring abundance, in its natural or ecological entirety.	Housty et al. 2014; Interview data: P.W. September 2014
6	Tidal weirs or fish traps allow for selective harvest of herring and are used to control spawning in bays for easy harvest. Herring can be harvested from the traps using open-lattice baskets, scoop-nets, or herring rakes.	Barnett 1939; Drucker 1963; Lane 1975; White 2006; Interview data: E.W. September 2014; D.V. 2004; C.H. September 2004
7	Leave some behind; the primary focus should be on what is left behind, not what is taken. Leave some branches with roe in the water so that herring can hatch.	Housty et al. 2014; Interview data: S.C. October 2012; G.W. May 2013; P.W. September 2014; W.H. June 2014
8	The best hemlock branches to set for harvesting herring roe have needles that fan out flat on two sides. Set branches earlier than kelp fronds, but harvest the roe-covered kelp first. Once the branches/kelp are set, leave them for 2–4 days so as not to disturb the herring.	Interview data: E.W. September 2014; S.C. October 2011
9	To avoid egg loss, harvest branches and kelp once they have 5–6 layers of roe deposited on them.	Interview data: W.H. June 2014; S. C. October 2012
10	Out of respect and understanding for herring behavior during spawning events, no noise can be made on the spawning grounds. Anchor away from the spawning grounds, and do not use motors as you approach – row in or coast in.	Brown and Brown 2009; Interview data: G.H. May 2012; R.B. May 2013; F.R. May 2013; A.P. March 2011; G.W. May 2013
11	People should not hunt or kill other animals on or around the spawning grounds during the spawn.	Interview data: G.W. May 2013
12	People should not harvest clams when herring are spawning.	Interview data: E.R. and T.R. November 2013
13	The trade of herring and herring roe is a Heiltsuk tradition that is integral for the maintenance of inter- and intra-tribal relations. Herring plays a fundamental role in the Heiltsuk economy.	Harris 2000; Lane 1990; Tolmie 1963; Interview data: R.B. May 2013; F.R. May 2013; H.H. May 2013; E.W. September 2014

their general well-being (Lane 1990, Harris 2000). Heiltsuk ancestors sustained a long-term relationship with herring by tending to, looking out for, and selectively harvesting the fish (Table 3). The strategies used in managing herring as a food fish and for roe were an embodiment of *gvi'ilas* (Table 3, Topics 1 and 2). The onus to harvest herring in alignment with *gvi'ilas* was the responsibility of all Heiltsuk, not just the Hemas (hereditary chiefs). In the past, resource ownership was regulated through the laws of *lhaxvai* (pronounced “lah-hay”) (Table 3, Topics 3 and 4). *Lhaxvai*, coupled with *gvi'ilas*, refers to the inherent authority held by the Hemas within their traditional territory (HTC 2005). Their “inherent authority” is derived from their millennia-old land tenure system comprised of access, title, and stewardship rights and responsibilities associated with family-owned harvesting locations (Table 3, Topic 4). Each family was given responsibility over specific lands and waters, and by following the laws of *gvi'ilas* and *lhaxvai*, implemented measures designed to ensure sustainable harvest of herring within those areas (HTC

2005). Sustainability was key to ensuring a continued relationship with herring (Table 3, Topic 5).

Where the cultural and physical landscape permitted, Heiltsuk fishers and their families built herring traps to facilitate selective harvest of adult herring and to “pen” herring while they spawned (Table 3, Topic 6). One type of trap was constructed of narrowly spaced lattice fencing anchored to rows of boulders arranged in the intertidal zones (White 2006). Herring and other fish would swarm the traps in the intertidal zone during high tide and become trapped in the curvature of the rock walls and the lattice of the fence when the tide receded. When herring were present in significant numbers, they could be scooped from the water using open-lattice baskets, scoop-nets, buckets, or herring rakes (Lane 1990, White 2006). The remnants of stone and stake fish traps are common in Heiltsuk territory, as they are elsewhere on the Northwest Coast (e.g., Moss et al. 1990, Caldwell et al. 2012). “Open-pens” built from logs and lines strung across bays were also used to “loosely” pen the fish so that they could spawn and

Table 4. Recent management strategies for Pacific herring.

Topic no.	Strategies	Sources
1	There should be no “kill-fisheries” in Heiltsuk traditional territory until the stocks have been allowed to rebuild; only food, social, and ceremonial harvest, and spawn on kelp harvest in designated areas.	Housty et al. 2014; Interview data: H.H. May 2013; Brown and Brown 2009
2	Out of an understanding of recent declines in herring abundance and distribution, certain ocean areas should be off-limits to some, or all, herring harvesting activities.	Housty et al. 2014; Interview data: G.W. May 2013; P.W. September 2014
3	Closed ponds result in higher mortality rates; only open-pond spawn on kelp systems should be used in Heiltsuk territory.	Interview data: G.W. May 2013
4	Conservation of herring is a high priority for the Heiltsuk. Herring must be sustained to maintain and safeguard Heiltsuk well-being and direct connection to their territory and resources.	HTC 2005; Interview data: P.W. September 2014; W.H. June 2014

leave (Evelyn Windsor, *personal communication*, September 2014).

When harvesting herring roe and fish, Heiltsuk applied a variety of strategies to ensure sustainable harvests. These included the selective placement and setting of branches, the removal of roe and herring from the fish traps, and the leaving behind of some branches that were laden with spawn so that those eggs could hatch (Table 3, Topics 7, 8, and 9). Furthermore, the more general philosophy of “leaving some behind” and remaining quiet while on the spawning grounds (Table 1, Topic 7; Table 3, Topic 10) were considered to be fundamental to the health of the herring populations. These strategies are in stark contrast to the modern industrial sac roe fishery that requires removing the egg sac whole from pregnant females, which results in the death of the adults as well as the roe, and does not have an ethic of being quiet while harvesting.

Additional strategies and restrictions were applied by Heiltsuk to herring harvests; these were part of a larger corpus of knowledge about the right way to behave around herring. For instance, Heiltsuk fishers observed that spawning herring were sensitive to the presence of blood in the water, and that the fish would stop spawning if an animal was killed at the fishing site. For this reason, hunting of ducks, seals, or other animals that were feeding on herring spawn was typically discouraged at spawning locations, although some exceptions were made (Table 3, Topic 11). Harvesting clams both during and after herring spawning was also discouraged because the clams were considered to be contaminated by the spawn, and/or to also be engaging in spawning at the same time (Table 3, Topic 12).

The ancient Heiltsuk tradition of trading whole herring and herring roe was integral to the maintenance of inter- and intra-group relations (Table 3, Topic 13). The earliest recorded European observation of Heiltsuk fishers trading herring was in 1793 when Alexander Mackenzie noted Heiltsuk people trading “cedar-bark, [herring] fish-spawn, copper, iron, and beads with the Nuxalk of Bella Coola” (Lane 1990). The fish and roe were, and remain, a valuable product for trade and sale (Harris 2000).

In recent times, members of the HTC and HIRMD have established new management strategies in response to the observed decline in herring abundance, distribution, and viable spawning habitats (Table 2). These strategies reflect the coupling of recent local observations of herring ecology with the deep-time

knowledge from Heiltsuk ancestors (Table 4). For HTC, contemporary Aboriginal stewardship embodies an integrated, ecosystem-based approach to fisheries resource management. In this approach, the manner, amount, and allocation of harvest should be regulated within the local community, in a geographically specific manner, and with reliance on the traditional ecological knowledge passed down from generation to generation (HTC 2005).

DISCUSSION

Over at least the last 7000 years, Heiltsuk fishers and stewards have developed specialized technologies, harvesting and management strategies, social organizations, and local economies related to Pacific herring (Fig. 2). All of this was perpetuated through time via memory carriers such as oral narratives, landscape features, and systems of rules (cf. Barthel et al. 2013). The deep-time LTEK and management strategies of the Heiltsuk that we have described incorporate many elements that are found to be important in the conservation strategies and ethics of other indigenous communities, including respect for nonhuman life, taking only what you need and avoiding waste, rules about appropriate harvesting behavior, and institutional restrictions on access and harvest (Turner and Berkes 2006, Turner 2014). Such indigenous social institutions and beliefs have also been identified as important factors in the sustainability and resilience of salmon–human interactions in the Pacific Northwest (Campbell and Butler 2010). Heiltsuk institutions for governance and management of the herring fishery also align well with the six governance principles that Trosper (2002) identifies as supporting sustainability and resilience for indigenous peoples of the Northwest Coast: property rights governing access and use, responsibility for proper management associated with these property rights, an ethical system governing use, reciprocity of economic exchange (through potlatching and other mechanisms), public accountability for reciprocity, and enforcement of rules by chiefs, who have the power to revise rules when called for by the circumstances.

Prior to the establishment of fisheries management institutions by the Canadian federal government, herring resource use and allocation within Heiltsuk territory operated solely through tribal governance systems (Lane 1990). The Canadian government disregarded the millennia-old indigenous herring-harvesting traditions and governance systems when it superimposed a command-and-control regulatory regime on these pre-existing

systems. DFO's mandate under this regime appears to have served the interests of the commercial fisheries at the expense of the long-term viability of the social-ecological system. The "pathology" of top-down command and control resource management has been well documented in other systems, with outcomes that include resource collapse and loss of biological diversity (Holling and Meffe 1996). Over the last 140 years, the centralized state-sanctioned management system has infringed on Heiltsuk Aboriginal rights, thereby affecting their food security, their governance systems, and the transmission and use of LTEK (Harris and Millerd 2010). Disease and declining human population levels, the *Indian Act*, the ban on potlaches, and the residential school system created additional disorder in the Heiltsuk relationship with herring.

Despite colonial attempts to sever the cultural systems that encompass and define traditional herring management, some aspects of LTEK remain at the core of the Heiltsuk–herring relationship (HTC 2005, Brown and Brown 2009, Housty et al. 2014). Deep-time knowledge and recent observations continue to provide valuable local insights about herring abundance, distribution, and other behaviors. Management strategies born from Heiltsuk knowledge prescribe regionally specific actions that could potentially remedy some of the current issues affecting the herring fisheries within the boundaries of their traditional territory.

Conceptualizing the Heiltsuk relationship to herring in terms of LTEK, management strategies, social institutions, and worldview enables us, as outsiders, to gain a better understanding of the multidimensionality of this relationship, including how Heiltsuk worldview relates to the vision of herring resource management now promoted by HTC and HIRMD (cf. Berkes 2012a). This vision, founded on LTEK, involves the application of tangible rules and sustainable fishing strategies for the management of the fish and their roe. Specifically, this vision for management involves the consideration of the fish as well as the ecosystems of which they are a part, including the effects of weather and climate change, predation, and competition with other species. Heiltsuk rules and management strategies for herring are consistent with global recommendations concerning forage fish. For example, the Lenfest forage fish report (Pikitch et al. 2012) recommends that fisheries management strategies should be founded on a three-tiered precautionary approach that considers not only forage fish stock dynamics but also trophic level interactions and dependencies between herring and other species (e.g., dependent predator populations), as well as how herring respond to shifting environmental conditions.

Conflicts persist in herring fisheries management in Heiltsuk territory, and members of the HTC, Gladstone Reconciliation Society, and DFO have been unable to reach agreement about reconciliation and appropriate management of the fishery (HTC 2016). Differences in perspectives about local control (e.g., consultation versus shared decision-making), the application of LTEK in operational decision-making, and the issue of Heiltsuk priority rights versus the rights of multiple stakeholders (e.g., DFO, commercial fishermen) remain at the heart of these conflicts. The herring management goals of the HTC, Gladstone Reconciliation Society, HIRMD, and DFO are unachievable if pursued in isolation (Harris 2000). The HTC argues that a true

joint-management arrangement—one in which Heiltsuk Aboriginal rights are honored and respected, decision-making power is shared, and management is transparent and effective—could remedy some of the current management issues in their territory (HTC 2005). This Heiltsuk vision is consistent with recommendations made by Von der Porten et al. (2016) in their comparison of Canadian federal marine policies with the indigenous governance systems of the Haida, Nuu-chah-nulth, and Heiltsuk Nations in British Columbia, namely, increase access of First Nations to herring fisheries and apply court rulings, allow for the co-existence of indigenous policies, provide for meaningful engagement and relinquish some decision-making power to First Nations, establish a framework for comanagement agreements, reflect new environmental threats and realities, and use LTEK and/or provide opportunities for knowledge holders to apply it.

Berkes (2012b) asserts that implementing ecosystem-based management in fisheries requires "cooperative, multilevel approaches involving partnerships, social learning, and knowledge co-production." In our research, we worked in close partnership with Heiltsuk decision-makers, and this helped ensure that the data we gathered would be relevant, applicable, and valuable to the Heiltsuk community. Thus, our study serves as an example of how state fisheries agencies in Canada and elsewhere in the world potentially could improve relationships with indigenous communities by engaging in more collaborative data collection. In addition, our results suggest the potential for joint learning and improvements in fisheries management through collaboration with indigenous communities during the design of management and harvesting plans. For example, a joint adaptive management strategy that integrates DFO management techniques with Heiltsuk community-based approaches to harvesting and monitoring herring could serve to build partnerships, trust, and community support. This could also allow Heiltsuk herring fishers the opportunity to critically evaluate scientific predictions and stewardship strategies on their own terms while all parties work toward sustainable management (cf. Walters and Holling 1990, Lertzman 2009, Gunton et al. 2010). The exact design of such a collaborative strategy will need to be worked out by the parties to suit their specific needs and the context, but several models have been proposed in the literature (e.g., Plummer 2009, Von der Porten et al. 2016). It is clear that for a herring management system to be legitimate and in accordance with Heiltsuk rights, LTEK must be incorporated, conservation must be prioritized, and decision-making power must be equitably shared.

Local Heiltsuk authorities continue to assert their rights in marine planning and management processes, and there have been some encouraging developments in the last year that suggest that DFO officials may be willing to entertain new approaches to herring management for the central coast. For example, last spring, Heiltsuk authorities worked alongside DFO to negotiate and set the herring harvest levels within some areas of their traditional territory (HTC 2016). Meanwhile, members of HIRMD continue to conduct community workshops and information sessions to help individuals feel more closely linked to their landscapes and associated resources, thereby reinforcing a sense of belonging and responsibility. These initiatives should increase the potential for future success of a collaborative management arrangement for herring on the central coast (cf. Gunton et al. 2010).

Members of the HTC, Gladstone Reconciliation Society, HIRMD, and the broader Heiltsuk community have shown that they will not await passively the demise of the herring in their traditional territory. Heiltsuk authorities say they are committed to working with scientists, researchers, and government officials to overcome the issues affecting their fisheries today (HTC 2014). As expressed by Heiltsuk Hemas Harvey Humchitt (*personal communication*, September 2014), “everything revolves around the herring.” For the Heiltsuk, this has been true for thousands of years, and should continue to be so in the future.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/issues/responses.php/9201>

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