2010

Local and Traditional Knowledge and the Historical Ecology of Pacific Herring in Alaska

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Citation Details

Thornton, T. F., Moss, M. L., Butler, V. L., Hebert, J., & Funk, F. (2010). Local and Traditional Knowledge and the Historical Ecology of Pacific Herring in Alaska. Journal Of Ecological Anthropology, 14(1), 81-88.

Data Notes

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A HEARING ON HERRING

Pacific herring (*Clupea pallasii*) have long been a critical resource in the marine food web of the Gulf of Alaska. While the Exxon Valdez oil spill of 1989 wreaked havoc on Prince William Sound herring populations in the northern Gulf, the southern Gulf also has been impacted, if less severely, by commercial fishing, habitat degradation, and environmental changes over the past century. Just how much Southeast Alaska's herring have been affected is a historical-ecological question. But debate around this question is being carried out in a political-ecological environment between commercial sac roe fishers (who since the 1970s have harvested roe primarily to supply Asian markets because Japan overfished its own herring stocks), subsistence fishers (largely Alaska Natives), and other stakeholders concerned about the effect of herring declines on the marine ecosystem.

On February 10, 2009, the Alaska Legislature's House special committee on fisheries held a hearing on herring in which experts from local fishers to biologists to anthropologists (Thornton 2009) presented testimony on the status and management of herring in Southeast Alaska. Most of the testimony concerned perceived declines of herring and a lack of proper precautionary management principles on the part of state managers, but Alaska State Fish and Game officials and commercial fishers insisted the fisheries were being managed conservatively. This debate was a key impetus for our "Herring Synthesis" (Thornton et al. 2010) study, launched in 2008, in which we sought to test the hypothesis, derived from Local and Traditional Knowledge (LTK) bearers, that—while herring might now be managed conservatively—herring are being managed in a significantly depleted state. This is the familiar shifting baseline syndrome (Pauly 1995) in fisheries management wherein a degraded sea comes to be seen as normal because, as Callum Roberts puts it in *The Unnatural History of the Sea* (2007:xiv-xv), "A collective amnesia surrounds changes that happened more than a few decades ago, as hardly anyone reads old books or reports." At the Alaska hearing on Pacific herring, the elder Tlingit fishermen, like Clarence Jackson of Kake, were having none of the collective amnesia. "The herring have disappeared in my lifetime," Mr. Jackson told the House committee (Golden 2009).

SYNTHESIZING INFORMATION ON HERRING

Despite their foundational and bellwether role for North Pacific marine ecosystems, the Pacific herring's historical ecology in the region is not well understood. Salmon, halibut, cod, seals, sea lions, whales, and sea birds all rely on herring for a critical portion of their diet. Alaska Natives for millennia have fished herring as part of their seasonal rounds of subsistence—cooking and smoking the meat, rendering oil from the flesh, and harvesting eggs after spring spawning on natural (kelp) and introduced (hemlock boughs) substrates. Natives are intimately familiar with some aspects of the herring life cycle, especially the spawning stage, which they monitor carefully. But herring themselves are migratory and to date studies have not been able to conclusively track their ranges, seasonal movements, and level of fidelity to spawning areas (Carls et al. 2008). Herring life cycles, in turn, are affected by many factors ranging from habitat and water quality to levels of prey availability (e.g., krill) and predation. It is hypothesized that a herring meta-population exists in Southeast Alaska into which juveniles from various areas are recruited and entrained. As such, there are no separate genetic stocks but, rather, only "regulatory stocks" based on their shared life histories in particular spawning environments—though geographic populations may exhibit unique chemical signatures in their otolith bones (Carls et al. 2008; Meuret-Woody et al. n.d.).

In all, 86 individuals, both Native and non-Native, from ten different Southeast communities, 66 archaeological site reports, and thousands of pages of testimony, reports, and historical, ethnographic, and biological studies were consulted for information on herring ecology. We synthesized and mapped these data using a GIS database to locate observations in both space and time, where possible. The results provide a robust picture of what has happened to herring over the past 4,000 years in Southeast Alaska, but especially in the past century.

For the past century or so herring have been heavily exploited by non-Natives in Southeast Alaska beginning with the opening of the first herring reduction plant—a converted whaling station—at Killisnoo, near Angoon in 1882. This intensive commercial harvest of herring to produce oil and fertilizer continued until the mid 1960s, when it was undercut by the Peruvian anchovy industry. The peak reduction harvest of 78,749 tons came in 1929 and was shared by 18 reduction plants in the region. Between 1920 and 1950 more than one million tons of herring were removed from Southeast Alaskan waters. As early as the 1930s Southeast herring were identified as overfished on the basis of stock assessments by biologists (Rounsfell 1930, 1931), but the first harvest quotas were not put in place until the early 1940s after catches had declined precipitously. Still, seine boats continued to target masses of herring for another twenty-five years until the last reduction plant, at Washington Bay on Kuiu Island, closed in 1966.

There was universal agreement among our consultants that the reduction fisheries overexploited herring, causing both local and regional impacts on herring populations. In communities like Angoon and Sitka, impacts were felt as early as the 1920s and 1930s. The Angoon-Killisnoo area was disproportionally affected due to the early reduction plant being placed at Killisnoo, which targeted local herring for decades during its early operations. Indeed our oldest consultant, 100 years of age in 2008, who worked in the Killisnoo reduction plant in the 1920s, observed that herring were no longer being caught near Angoon at this time; rather the big herring seiners were travelling up to 50 miles away to fish. This localized depletion also transformed the Native economy which had been producing significant quantities of herring meat and oil for millennia. Seven of nine archaeological sites excavated in the area by de Laguna (1960) and Moss (1989) contained herring bones, spanning a period of approximately 1,800 years. At one site, herring comprised 99 percent of fish remains and

was, according to de Laguna's (1960:46) informants, a "famous locality for herring" (likely fall oil production). Native herring oil production in Angoon virtually ceased after the 1930s.

At this same time, Sitka Sound—by far the most productive herring fishery in the Southeast region—was also being impacted to the extent that local organizations were calling for a prohibition on herring seining there. Such interventions may have helped the Sitka Sound population avoid collapse and rebound over time. But in many areas the cumulative impacts of herring removals have yet to be reversed. Fishermen we interviewed who plied the waters of central and southern Southeast Alaska in the first half of the twentieth century recall vividly when herring stretched "as far as the eye could see" and their roiling surfacing activities mimicked a mighty rain or wind. "Today, you don't see that anymore," was a frequent comment made by fishermen over the age of 60. By the time Alaskan statehood was achieved in 1959 and a modern fisheries management regime had been put in place in the 1960s, herring were already depleted in many areas—though just how much is difficult to quantify.

ADAPTING TO HERRING

Generally speaking, the ethnographic and archaeological data suggest that herring spawning and near-shore massing areas are coincidental with the establishment of long-term human settlements in Southeast Alaska. Oral histories and archaeological data synthesized for our project confirm the affinity of Tlingit and Haida populations for settlement sites proximal to high concentrations of herring or eulachon (*Thaleichthys pacificus,* a similarly oily, spring-spawning smelt fish), especially spawning areas. The most direct way to measure the relative importance of herring to ancient peoples comes from documenting archaeological fish remains. Herring remains are present as early as 8,000-9,300 years ago, but become particularly frequent after 4,000 years ago, when bones appear consistently in more than 75 percent of reported sites that were excavated with fine mesh screens. Human population would likely have been growing—resulting in more sites—but dependence on herring as a food resource likely evolved over time as human fishers were attracted to herring spawning areas with abundant substrates for egg deposition (such as macrocystis kelp, rockweed, and eelgrass); human fishers sought out herring along with competing predators (e.g., halibut, salmon, seals) (Monks 1987).

Historically recorded and on-going practices show that indigenous people enhanced herring production through the cultivation of marinescapes and the regulation of users. Key techniques to enhance herring supply include: habitat conservation (limiting disturbance of spawning areas); habitat cultivation (through placement of substrate, such as Western hemlock, *Tsuga heterophylla,* boughs for spawning); selective harvesting (e.g., of non-viable eggs lying too deep or shallow in the intertidal zone to survive); predator control; and transplantation of eggs to new habitats. On the demand side, practices contributing to the avoidance of overharvest included: territoriality and limits on access; time-specific prescriptions and prohibitions on interactions with herring; diversifying site; prey and substrate choices; and sanctioning of abusive harvesters (Emmons 1991; Thornton et al. 2010).

Tracking the ancient time depth of cultural practices which enhanced herring spawning habitat production or regulated harvest, while extremely worthwhile, is difficult to measure using archaeology (Caldwell 2011; Campbell and Butler 2010). Humans have been co-evolving with and adapting to herring for millennia and diverse spawning populations have been critical to the biocultural evolution and diversity of Southeast Alaska.

Today, spawning and rearing habitats throughout the Southeast region are threatened. As Figure 1 shows, historical spawning areas documented by consultants in our study (from c. 1915-present) outnumber those documented by the Department of Fish and Game

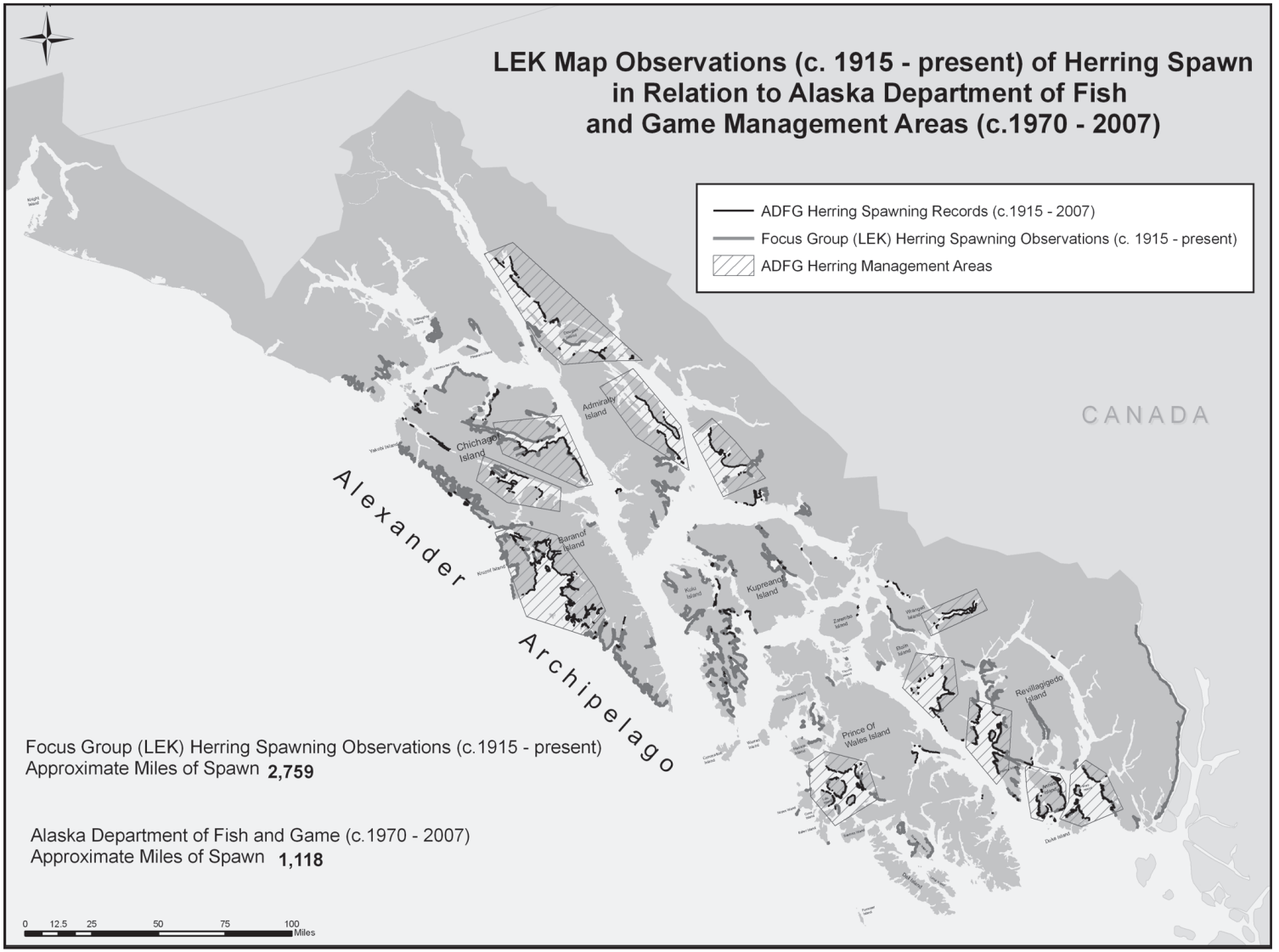

FIGURE 1: This GIS map displays miles of herring spawn recorded through interviews and focus groups with local and traditional knowledge (LTK or LEK) bearers versus that recorded in government (Fish & Game) records for the Southeast Alaska coast. The LTK documents more than twice as many miles of coast used for spawning, even though our survey did not include all Southeast communities. This disparity is a function of greater time depth of observations and closer monitoring of herring spawning areas by local fishers. Local fishers also gave details on spawning reliability, environmental changes and impacts, and specific herring harvest and cultivation techniques in various geographic locales.

since 1970 by a ratio of 2.5 to 1. Some of this habitat has been lost due to degradation, while other areas have been overfished and remain depleted. Even during the so-called conservative management era of Alaska's Department of Fish and Game beginning in 1980, nearly half of Southeast Alaska's herring sac roe fisheries have had to be closed because the spawning populations on which they depend can no longer support them.

LESSONS FROM HISTORICAL ECOLOGY AND LOCAL KNOWLEDGE

The Age-Structure-Assessment model currently used by fisheries managers to estimate herring biomass is treated with scepticism by many locals with long-term herring experience. But at the State House committee hearing on herring, the biometric model was also criticized by biologists, one of whom (Evelyn Brown) noted that Fish and Game does not "have the tools to deal with this [marine ecosystem] complexity," and that more field research is needed, including documenting the observations of local experts who are viewing herring over the course of their life cycles (Brown et al. 2002).

Al Wilson, an elder reared in Auke Bay but now living in Sitka, has witnessed collapses of local herring stocks already in his lifetime and admonishes:

> I'd just like to stress the importance of the herring as a food supply. The herring biomass is in danger of collapsing. The Fish and Game by their own reports say that the biomass has diminished in the last two years [2006-2008], yet their harvest increases...I was raised in a place called Auke Bay and they had a tremendous herring harvest there until they opened up the area to seining, harvesting the herring for roe—sac roe... It's never come back. I know places like West Behm Canal. The same thing has happened. I know the areas around Hydaburg…near Klawock has diminished tremendously. The herring roe that comes in there is very small…Even when you look at past spawn maps…there [were] substantially more miles of spawn then. It seemed to me that from that they could see that the herring biomass is getting smaller. I'm really concerned. That's my biggest concern—that the herring biomass [at Sitka] will collapse and I know that when that happens it will never come back. At least not in my lifetime.

The recently released "A Program for Improving Management and Research of Fisheries in the Southeast Region—Herring" (Hebert 2010) proposes a relatively comprehensive set of proposed biological studies, although it does not include a social scientific or Local and Traditional Knowledge component. Relatedly, the Canadian government is expanding partnerships with The Haida Nation and other First Nations in order to improve marine spatial planning and ecosystem management (Jones et al. 2010). However, the Alaska government recently (May 2009) chose to unilaterally terminate its 2002 Memorandum of Agreement with the Sitka Tribe of Alaska seemingly in order to reassert its exclusive managerial authority over the herring fisheries.

Although herring transplantation has been tested in limited scientific studies—apparently with little success (Hay and Marliave 1988)—these tests have not been based on local knowledge and techniques that our consultants judged successful. Perhaps restoration plans could be carried out in conjunction with local Alaska Native tribes, whose members are repositories of local knowledge about herring habitat and enhancement techniques. This should not be a substitute for conservative management of remaining herring populations, but could enhance depressed or defunct runs of herring. Such a program, however, would have to be launched at an appropriate scale (other techniques for herring enhancements are being piloted in Japan) and with corresponding commitments to long-term monitoring, so effectiveness could be evaluated over time and under different ecological conditions.

In addition, more monitoring of herring spawning areas should be carried out to reveal how climate and other environmental changes, such as increased predation by humpback whales (which, ironically, were hunted for their oil and depleted before the major shift to herring in the 20th century), are affecting local herring populations. Some monitoring

is already being conducted formally and informally by tribes and other associations, such as Sitka Tribe of Alaska, and individual fishers. This could be augmented and coordinated with other long-term monitoring efforts beyond the aerial and deposition surveys carried out by the Department of Fish and Game. Sites of increasing herring productivity (e.g., around Yakutat and perhaps Hoonah) and decreasing productivity (e.g., Kah Shakes Cove, Auke Bay, and areas of Sitka Sound) could be compared in terms of their ecosystem assets and constraints. Correlatively, otolith and ancient DNA studies could be carried out to further explore genetic and ecological relationships between different geographic spawning and massing populations of herring. In addition, impacts, like noise pollution and contamination from development could be monitored vis-à-vis key indicators of local herring population health and LTK observations over time, as documented in our study.

Finally, with respect to environmental change, it has been hypothesized (Planque et al. 2010) that the demographic effects of targeted fishing (e.g., removal of mature spawners by sac roe fishers) may have "substantial consequences on the capacity of populations to buffer climate variability through various pathways (direct demographic effects, effects on migration, parental effects)." Similarly, "selection of population sub-units within meta-populations may also lead to a reduction in the capacity of populations to withstand climate variability and change." How current herring fishing patterns might play out in relation to realized and anticipated climate change patterns would be greatly enhanced if the historical fishing and observational data could be more closely correlated with historical patterns of climate variability and herring spatiotemporal variability in Southeast Alaska and elsewhere in the North Pacific.

For more information on the "Herring Synthesis" project, see our project website: http://herringsynthesis.research.pdx.edu/ and the full report (Thornton et al. 2010).

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