Environmental Change Institute

Analysing Change, Sustainability and Stewardship in Social-Ecological Systems through 3 Ecologies

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November 12, 2015
Characteristics of Systems Thinking (Capra and Luigi 2014)

• **Shift of perspective from parts to whole**
  Living systems are integrated wholes whose properties cannot be reduced to those of smaller parts. These properties are destroyed when a system is dissected... into isolated properties.

• **Inherent multidisciplinarity**
  All living systems share a set of common properties and principles of organisation. This means that. Systems thinking is inherently multidisciplinary.

• **From objects to relationships**
  At each level the living system is an integrated whole with smaller components, while at the same time being a part of a larger whole... the shift of perspective from the parts to the whole can also be seen as a shift from objects to relationships.

• **From measuring to mapping**
  In science, we have been told, things need to be measured and weighed. But relationships cannot be measured and weighed; relationships need to be mapped.

• **From quantities to qualities**
  Mapping relationships and studying patterns is not a quantitative but a qualitative approach.

• **From structures to processes**
  In systems science, every structure is seen as the manifestation of underlying processes.

• **From objective to epistemic science**
  "the method of questioning" - becomes an integral part of scientific theories.

• **From Cartesian certainty to approximate knowledge**
  ...of the endless web of interconnected phenomena.
Core Challenge for Sustainable Social-Ecological Systems (SES)

**Understanding:** A core challenge in diagnosing why some SESs are sustainable whereas others collapse is the identification and analysis of relationships among multiple levels of these complex systems at different spatial and temporal scales... Understanding a complex whole requires knowledge about specific variables and how their component parts are related... Thus, we must learn how to dissect and harness complexity [and diversity] rather than eliminate it from such systems ...This process is complicated, however, because entirely different frameworks, theories, and models are used by different disciplines to analyze their parts of the complex multilevel whole. A common, classificatory framework is needed to facilitate multidisciplinary efforts toward a better understanding of complex SESs. (Ostrom 2009:420)

**Responding:** Moving from extractive to regenerative systems through care for keystone species and critical land/seascapes.
Larger-scale governance systems may either enhance or destroy governance systems at the focal SES level (Ostrom 2009:422)

Each of these “units” and “systems” is subject to diversity of concept, relation, and practice within a particular cultural landscape.

**Fig. 1.** The core subsystems in a framework for analyzing social-ecological systems.
Key Terms

- **Adaptive Governance**: institutions (formal/informal), organizations, networks, and socio-political processes that change in response to new circumstances, problems, or opportunities.
  - Distributive dimension (decision-making, resources devolved to the most effective level)
  - Polycentric dimension (nested, small, medium, large-scale governance units) provide multi-scale, linked enforcement of decisions and rules.
  - Adaptive management (flexible and experimental in response to social-environmental change)

- **Local and Traditional Knowledge (LTK, or TEK)**: cumulative body of knowledge about ecological conditions and relationships handed down generationally.

- **Sustainability**: ability of a system of resource use (or social-ecological) system to persist indefinitely without decline in the resource base or the social wellbeing it delivers.

- **Shifting Baselines**: Generational change in acceptance of what constitutes “normal” in ecological conditions.
Key Terms

- **Maximum Sustained Yield (MSY):** highest production of a resource on a sustained basis year after year.

- **Ecosystem Management (classical):** systems as closed with feedbacks regulating toward equilibrium, homeostasis or a stable climax.

- **Ecological Stewardship:** a strategy to respond to and shape social–ecological systems under conditions of uncertainty and change to sustain the supply and opportunities for use of ecosystem services to support human well-being (Chapin et al 2009). Examples: Mayan Milpa and Tlingit herring fishery.

- **Resilience:** capacity of a social–ecological system to absorb a spectrum of shocks or perturbations and to sustain and develop its fundamental function, structure, identity and feedbacks as a result of recovery or reorganization in a new context.
Importance of Sustainable and Adaptive Coastal Ecosystems (CES)

Encouraging coastal adaptation through research and restoration:

_Our coasts are high energy environments, subjected to marine, terrestrial and meteorological forces. This makes them incredibly productive - over 150 million Americans live and work within our coastal areas, contributing $7.9 trillion to the U.S. economy. It also makes them vulnerable to extreme climate events, variability, and change._

--National Centers for Coastal Ocean Science (NOAA, USA: http://coastalscience.noaa.gov/research/climate/)
Cultural Models of Sustainability in Keystone Cultural Resource Systems

- How people conceptualize nature is linked with how they act in relation to it. ...Cultural differences in mental models and associated values play an important role in creating intergroup conflict and, therefore, may hold the key to addressing these conflicts. (Atran, et al 2005)

- Hierarchy of Cultural Models & “Myths”
  1. Guiding Myth of “Herring Rock” → “Cultivated Abundance” of sentient beings (Pacific herring, *Clupea pallasii*).

- First model is dismissed while second is embraced as imperative (TINA) of “rational” economic policy.

![Herring Rock](image1.jpg)

![Commercial herring sac roe fishery](image2.jpg) → Subsistence → Herring egg fishery

![Sheet’ka Kiks.adi Clan’s Herring Rock](image3.jpg)

- The Sitka Kiks.adi (Raven/Feast Clan) first settled here approximately 10,000 years ago.
- The original Herring Rock is located on the waterfront of the Sitka Indian Village. This portion was removed in 1973, then moved and dedicated October 5, 2002.
- Each year, the herring return to this sacred rock to spawn, marking the beginning of the annual harvesting of our traditional foods.
Biological and Cultural Keystone Species

- Biological keystone/cornerstone/foundation species (structure of ecosystem)- “*feed for everything*”
- Indicator/bellwether species (health of ecosystem)
- Umbrella/flagship/charismatic species? (conservation of ecosystem)

I think [herring are]…really key to the different populations of fish here … [C]ompromise of the overall biomass, it’s definitely going to have a big effect on the salmon fisheries and the halibut fisheries and the marine mammals … [I]t’s the key to the ocean it seems like. *It’s our buffalo* (M.Miller).

Cultural keystone species (Garibaldi and Turner 2004):
1. intensity, cultivation, and multiplicity of use
2. rich linguistic associations
3. rich cultural associations (incl. with health/wellbeing)
4. persistence in memory and use despite cultural change
5. unique and irreplaceable role in the social-ecological system (ethics)
6. value in providing opportunities for resource acquisition beyond the home territory (e.g., through exchange).
<table>
<thead>
<tr>
<th>Management System Characteristic</th>
<th>Maximum Sustained Yield (MSY)</th>
<th>Ecosystem Management (Classical)</th>
<th>Ecosystem Stewardship (Incl. LTK and CM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference point</td>
<td>Industrial baseline (highest harvest)</td>
<td>Historical baseline (pre-degradation)</td>
<td>Trajectory of change</td>
</tr>
<tr>
<td>Central goal</td>
<td>Economic production in output</td>
<td>Ecological integrity biodiversity</td>
<td>Sustainable SES</td>
</tr>
<tr>
<td>Predominant approach</td>
<td>Single species models of “stocks”</td>
<td>Multi-species stocks</td>
<td>Manage stabilising and amplifying feedbacks to acceptable levels of risk</td>
</tr>
<tr>
<td>Role of uncertainty</td>
<td>Conservative toward maintaining harvest</td>
<td>Conservative toward maintaining species</td>
<td>Embraces uncertainty; flexibility to adapt</td>
</tr>
<tr>
<td>Role of research</td>
<td>Science emphasises productivity (biomass)</td>
<td>Science emphasises key ES indicators</td>
<td>Collaborative with stakeholders (+species?)</td>
</tr>
<tr>
<td>Role of Resource Manager</td>
<td>Optimise quota according to productivity models</td>
<td>Optimise according to baseline indicators</td>
<td>Support social-ecological resilience &amp; adaptation to conditions</td>
</tr>
<tr>
<td>Response to disturbance</td>
<td>Minimize disturbance</td>
<td>Productive v. minimise destructive</td>
<td>Disturbance cycles as window of opportunity</td>
</tr>
<tr>
<td>Resources of primary concern</td>
<td>Natural resource commodities (trees, fish)</td>
<td>Species composition, ecosystem structure</td>
<td>Ecosystem services and species wellbeing, adaptive capacity</td>
</tr>
</tbody>
</table>
Figure 1. The evolution of resource-management regimes observed in many western nations [11]. Arrows at show the management time course for selected locations. Dashed arrows show opportunities for developing nations to ‘leap frog’ from current management directly to ecosystem stewardship. The red-to-green gradient represents increased sustainability. (Chapin et al 2009)
From Tragedy of the Commons and MSY Commodification → Ecosystem-Based Management/Stewardship in Fisheries

Ecosystem-based fishery management is likely to contribute to increased abundance of those species that have been overfished. It may, however, require reduced harvest of species of critical importance to the ecosystem. We expect that ecosystem-based fishery management will contribute to the stability of employment and economic activity in the fishing industry and to the protection of marine biodiversity on which fisheries depend. As a society, we are recognizing the limits of the sea to provide resources and of our abilities to stay within those limits. What are acceptable levels of change in marine environments due to fishing?

— David Fluharty, Chair, Ecosystem Principles Advisory Panel (1998)

• In systems thinking today, we speak not of merely of “limits” but of Resilience Thresholds and Safe Operating Space with biophysical boundaries.
3 Ecologies for Examining SESs

- **Historical Ecology** (Balée and Erickson 2006)
  - Humans have had an effect on nearly all environments on earth → *landscapes*
  - Humans as morally neutral: they are not inherently bad or good conservationists.
  - Different types of societies influence their landscapes in different ways
  - Co-evolutionary relationships between people & land/seascapes should be examined holistically.

- **Event Ecology** (Vayda and Walters 1999; Walters and Vayda 2009; aka ACE)
  - Causes of environmental change are best understood by analysing events
  - Don’t assume political-economic or environmental “drivers” or “systems.”
  - Explain environmental change beginning with effects (e.g., disturbances), working outward (space) and back (time) to determine causal links.
  - Abductive reasoning: ask open-ended questions, address counterfactuals; gain causal insight through “progressive contextualization.”

- **Political Ecology** (Robbins 2004; Peet, Robbins, and Watts 2011, Biersack and Greenberg 2005, etc.) Study of power relationships among actors in understanding and responding to environmental issues and changes.
  - Who competes for environmental resources and how (‘rules of the game’, dominant cultural models)?
  - What resources are conserved/exploited, and by/for whom?
  - What effects do unequal access to and distribution and consumption of environmental resources have on human groups and ecosystems?
  - How do these relationships contribute to S-E stress and sustainability?
Sustainability/Stewardship of Pacific Herring in Marine Ecosystems


- Can we get from MSY to Ecological Stewardship involving LTK, science, resource users and managers in sustaining productive marine ecosystems? How?

- Using the 3 ecologies, can we understand the processes of change from pre-industrial “superabundance” to the “shifted baseline” of MSY in order to support restoration and improved resilience in Pacific herring SES?
Political Ecology of MSY

• Foreign Policy Tool: Policymakers saw that restricting fishing had the potential to compromise the longstanding territorial claims ... With the development of marine refrigeration during the 1930s, boats had begun to fish farther from home and stay longer at sea, drawing a host of complaints. [Leads to increased territoriality] (Finley 2011)

• Claims to optimise production through agricultural/forest governance model .... Thinning out the old population through intense fishing replaced the old, slow-growing fish with younger, fast-growing individuals, increasing the weight of the crop, just as thinning trees increased the yield in a forest. Fishing produced the conditions that allowed the population to respond; scientists could predict the maximum number of fish that could be taken on a sustained basis, year after year. Or so they thought. (Finley 2011)

• Policy disaster or disconnect? 60-80% of world’s fish stocks fully or overexploited (Myers and Worm 2003; Hilborn & Hilborn 2012); A large number of fish stocks ..have been reduced below levels that produce [MSY]. In the process of adapting to harvesting limits such as MSY, harvesting capacities have often been built to more than twice the optimal capacity. (Quenton et al 2010:592). This has resulted in collapses, depressed stocks, and shifting baselines.
The Maximum Sustained Yield curve, as published in the *Bulletin of the U.S. State Department* in 1949. Although the concept drove fisheries management for decades, it was a theoretical construction with no experimental or observational backing and no differentiation of target species’ role in the marine ecosystem. (see Finley 2011)
Case Study: Historical, Event, Political Ecology of Pacific Herring
Local and Traditional Knowledge (LTK) identifies Shifting Baseline Problem

Sitka Tlingit (Alaska)
- The herring stock is being depleted
- Spawning areas are shrinking
- Spawning periods are shorter
- Herring spawners are smaller.
- Too much of the spawning stock is taken by sac roe fishery in Sitka Sound.
- Subsistence harvesters unable to meet needs

Haida Gwaii (Canada): “In the past decade, stocks have been depleted because of low recruitment and excessive exploitation by commercial fisheries.” “The present harvest policy, established in the mid-1980s does not take account of Haida traditional knowledge.” (Jones 2007)
HERRING SYNTHESIS: DOCUMENTING AND MODELING HERRING SPAWNING AREAS WITHIN SOCIO-ECOLOGICAL SYSTEMS OVER TIME IN THE SOUTHEASTERN GULF OF ALASKA

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June 2010

North Pacific Research Board Project #728

http://herringsynthesis.research.pdx.edu/
Herring Synthesis Project Aims

• Synthesize information on the historical ecology of Pacific herring

• Use existing records, interviews and community focus groups to build an historical and spatial (GIS) database to:
  1) identify herring spawning and massing areas in time and space;
  2) link changes in herring spawn extent and intensity to environmental and human factors in the socio-ecological system; and
  3) identify sensitive areas for protection and potential restoration of herring spawning.
Working Hypotheses

• Alaska/British Columbia are managing depleted Pacific herring stocks in some areas. Contemporary factors are preventing herring stocks from rebounding to healthy levels and adversely impacting subsistence herring egg fisheries & other species dependent on herring.

• Herring were depleted in many areas by the mid 20th century. It is from this “shifted baseline” that the state measures success under present MSY paradigm. Discrete spawning populations now managed as a single stock.

• Maintenance of diverse spawning locations is critical to conserving spawning populations and intra-specific biodiversity.
It’s mind boggling to think how herring survive. From the time they spawn, the crows, the ravens, the seagulls, the eagles, sculpins, the trout, you know. You name it, they’re all feeding on it. And when they hatch then the ducks and everything else are—you know it’s surprising how any can come back at all. They’re just so important to the total food chain . . . every animal . . . in the sea. They feed everything. They feed everything. They’re important to everything. . . We didn’t like the idea of commercial fishermen coming in and taking them on a large scale because they’re very important to our salmon and especially king salmon…And they feed our seals and stuff like that. Things that we’re depending on. -Harold Martin (Tlingit Elder, Kake)

50-70% of herring fall to predation. Oil rich, food for many species.
Factors in the Herring Declines

- Overfishing (esp. spawning areas)
- Climate change
- Climate cycles (Pacific oscillations, El Nino)
- Predation (esp. marine mammals)
- Salmon hatcheries
- Habitat alteration
- Noise
- Contaminants & disease
- Population fragmentation & trophic “traps”
Miles of Spawn Identified by Alaska Department of Fish and Game (c.1970 - 2007) Compared to LTK* Data (c.1915 - present)

Linear miles of spawn identified by Alaska Department of Fish and Game (c.1970 - 2007). The data was presented as an image of aggregate data without a specific time span. Using this image, spawning locations were georeferenced using GIS software. The linear miles of spawn was calculated using a function of this software that sums the total miles of coastline identified as spawning locations. Note that some spawning areas are more frequented than others from year to year according to local conditions. For example, Middle Island, in Sitka Sound, has supported significant spawn nearly every year documented, while other areas have supported spawn irregularly or become barren.

Focus Group (LTK) Herring Spawn Observations
Approximate Miles of Spawn: 2,759

Linear miles of spawn identified by consultants who participated in the Herring Synthesis Project (c. 1915 - present). At every focus group and individual interview, maps were provided and consultants were encouraged to identify, and mark herring spawning areas. This data was transferred into a GIS database and miles of linear spawn were calculated using a function of this software. According to these observations, herring spawning areas have covered extensive areas historically and greatly exceed those monitored by the Alaska Department of Fish and Game.

*LTK data do not include Yakutat, Haines, Klukwan, Hydaburg or Metlakatla; limited data were collected from Wrangell.
Historical Ecology of Atlantic Herring

BC--North Atlantic & Baltic: Bronze Age villagers netted them from canoes; Romans sold them pickled; Swedes dried them on the SW Coast where the Olaus Magnus found the odor so strong it was a navigational aid.

1000 AD—Christian Lenten (*Fish on Friday*) traditions & military demand led to exhaustion of inshore fisheries made “superabundant” herring attractive as religious and everyday food for the poor. Experts could gut 40 fish/minute.

1300s—Scarborough Fair (Yorkshire) became a center for herring trade after the development of mass preservation (salting and barrel brining in 10th century) and transport (Hanse Cog) techniques in 14th century. Hanseatic League sought to control the trade.

1350-1400s—Declines due to 1) overfishing, 2) climate change, 3) low North Atlantic Oscillations. Conservation imposed: “By the end of the fourteenth century, the decline was so severe that the town limited drying, salting, and packaging of herring to long-term residents.” (Fagan 2006:110).

1800s—Recovery: ‘In value and renown the herring takes an unassailable position as Lord of the fishes’ (in Roberts 2007:115).

1950s—tragedy of the commons/commodification due to overfishing

2000s—Resilience! herring coming back in the North Atlantic
## Pacific Herring Historical Ecology: Shifting Baselines

<table>
<thead>
<tr>
<th>Event</th>
<th>Year</th>
<th>Notes</th>
</tr>
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<tbody>
<tr>
<td>Aboriginal herring complex/cultivation</td>
<td>8-10kya</td>
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<tr>
<td>Commercial herring production begins (reduction, seines, gillnets)</td>
<td>1878</td>
<td></td>
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<tr>
<td>Bureau of Fisheries requires every individual and company to record annual statistics. Local shortages.</td>
<td>1904</td>
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<tr>
<td>Herring plants begin to record the quantity of fish being processed into meal or oil. 1929 peaks, ~80,000 tons.</td>
<td>1925-29</td>
<td></td>
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<tr>
<td>Because of evidence of severe depletion of herring, commercial fishing for herring other than bait is prohibited August 2.</td>
<td>1939</td>
<td></td>
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<tr>
<td>Herring reduction declines due to reduced market demand and declining herring populations.</td>
<td>1950s</td>
<td></td>
</tr>
<tr>
<td>The state of Alaska begins managing fisheries</td>
<td>1960</td>
<td></td>
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<tr>
<td>ADFG opens commercial herring sac roe fishery for Japanese market.</td>
<td>1976</td>
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<tr>
<td>Concerns over ‘collapse’ or lack of recovery of some localised herring ‘stocks.’ Objections to conduct of sac roe fishery.</td>
<td>1985-</td>
<td></td>
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<tr>
<td>The establishment of the Matsumae feudal domain</td>
<td>1604</td>
<td></td>
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<tr>
<td>Herring fishing expanded to Western Hokkaido</td>
<td>1716-1735</td>
<td></td>
</tr>
<tr>
<td>Dried herring and herring roe exported throughout Japan</td>
<td>1739</td>
<td></td>
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<tr>
<td>Herring fisheries expanded to Eastern Hokkaido</td>
<td>1772</td>
<td></td>
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<tr>
<td>Innovation of Mass-production set-nets</td>
<td>1772</td>
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<tr>
<td>Contract system fishing expanded throughout Hokkaido and Sakhalin I.</td>
<td>1793</td>
<td></td>
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<tr>
<td>Herring fishery opened to market</td>
<td>1876</td>
<td></td>
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<tr>
<td>Highest herring harvest record (976,000 tons)</td>
<td>1879</td>
<td></td>
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<tr>
<td>Herring fisheries collapsed in Western Hokkaido</td>
<td>1958</td>
<td></td>
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<tr>
<td>Herring fisheries collapsed in Eastern Hokkaido</td>
<td>1969</td>
<td></td>
</tr>
<tr>
<td>Increased import of herring sac roe; begin development herring enhancement techniques</td>
<td>1970s</td>
<td></td>
</tr>
<tr>
<td>Technoscience-based herring stock enhancement programs developed</td>
<td>1990s</td>
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</table>
“After they petitioned them out of the area [in early 1940s], it started building up. . .It took almost 30 years before the herring stock got pretty big in Sitka Sound again.” They used to have 3 salteries going 24 hours a day in the summertime. . .All of them went out of business when the herring was wiped out. (HK, Sitka)

[The big reduction plant seiners fished] all … along in here [Chatham Strait]. When I was a child, in the early 40s, there was herring boiling all the way across it seemed like: just nonstop. When they stopped the engine you could hear that boiling of the herring. From right here to straight up, and it looked like it touched the other shore. But they seined all the way up in here by Saginaw [Bay]. . . And one day I signed up at a Fisheries hearing. I said, “The herring stock is going down fast.” This was in ’58 or ’59. And I said, “I would like to see it closed from Point Gardner to Washington Bay.” And you know, it was just a passing remark, but they closed it. (CJ, Kake)
Subsistence Herring Egg Fishery

Up to 20,000 Natives each spring (19th century)

Today 97% Sitka Native HH use

Up to 278,299 lbs eggs taken on hemlock branches (177lbs HH)

Some use of meat and oil
Tragedy of the Commons or Commodification?

- Commercial Sac Roe Fishing
- Commercial Winter Bait
- Commercial Pounds
- Kelp and roe high end products
Tens of thousands of tons from Sitka!
Managing the Fishery for MSY

- Aerial Survey
- Acoustical Survey
- Dive Survey (egg deposition)
- Biomass Estimates
- Harvest Quotas/ (20% of biomass estimate)
“Now the whole [Ketchikan] region is becoming an ocean desert”

(AR, Ketchikan)
Place name hotspots & Forage Fish: AFS streams containing Eulachon + Herring spawning areas (observed)

Indigenous and Historical Cultural Ecosystem Services Mapping for Southeast Alaska. This project, supported by the US Forest Service Pacific Research Station through a JV Agreement with Portland State University, uses indigenous place names collected from Haa Llik’w Haa Aami Saač’i: Our Grandparents’ Names on the Land (T. F. Thornton, 2012, University of Washington Press) and social-ecological data from other GIS sources to examine the relationships between place name ‘hotspots’ and ecosystem services, including cultural keystone species, subsistence use areas, and other biotic and abiotic variables. With verification, the results could be used to help guide forest and coastal zone management, including the protection and restoration of critical resources, habitats, and cultural landscapes. For more information, contact Thomas F. Thornton, University of Oxford; thomas.thornton@ouce.ox.ac.uk. The maps are for review only and not for reproduction. Simon Abee, University of Oxford, data preparation.
Sitka Sound Toponymic Density

From Haa Léelk'w Hás Aaní Saax'ú: Our Grandparents' Names on the Land
Sitka Sound: Toponymic Hotspot

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>392</td>
<td>Yaaw Teiyí</td>
<td>Herring Rock</td>
</tr>
<tr>
<td>418</td>
<td>Yaaw Kooq'k'</td>
<td>Little Herring Fish Hole</td>
</tr>
<tr>
<td>437</td>
<td>Yaaw X'aat'i</td>
<td>Herring Island</td>
</tr>
<tr>
<td>339</td>
<td>Táan Daa</td>
<td>Jumping Fish Surrounding</td>
</tr>
<tr>
<td>347</td>
<td>Néesh Sheeyí</td>
<td>Around the Sides of Táan</td>
</tr>
<tr>
<td>348</td>
<td>Táan Yadaa</td>
<td>Looking Milky Strait</td>
</tr>
<tr>
<td>460</td>
<td>Gall’óox’u</td>
<td></td>
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</tbody>
</table>

Proposed Core Area closed to commercial herring fishing.
Sitka Herring SES: Political Ecology of Shifting Baselines
Tlingit-Haida Herring Cultivation Complex

1. **Spawning initiation protocols** (e.g., to attract herring to spawn & quiet spawning areas)

2. **Habitat protection** (e.g., of spawning grounds to insure sustained reproduction)

3. **Habitat cultivation** (e.g., placing branches or other substrate to increase spawning in certain areas)

4. **Selective harvest and return of eggs** (e.g., placing thinner egg deposits back in the productive “band” of intertidal area to ensure hatching)

5. **Transplantation** (of eggs to new areas or to restore old areas)

*Cultivation activities enhanced habitat & egg production, reduced vulnerability, increased resilience, likely more than offsetting harvest*
“My dad says it was the seagulls that named that herring. “Yaaw” is the noise they make when the herring’s around [spawning]...that’s what the Tlingit call it: yaaw.”

(HK, Sitka)

“They say, ‘It’s got herring sound in its mouth. It sounds like it ate herring.’ So they start searching. Sure enough they see the herring moving in. That’s the sign of wealth coming in. “Yaaw.”

(CiP, Klawock)
Motioning the Herring In

• You have to lay it [the herring branches] a certain way. . . you’re respecting nature doing it the right way. And in Tlingit... you’re motioning it into a spawning area. And so that’s showing respect. Anything you eat... you respect.

– (CP, Klawock)
Targeting Non-Reproductive Eggs

“And according to the old Indians--my dad and some of my uncles that talk about it--6 feet above the low water line and almost three feet below, those are the only ones that swam away. Anything deeper than that or anything shallower than that died. …that’s why when we set our branches it’s 3 feet below the minus tide because it didn’t bother the stock at that point.” (HvK, Sitka)
Transplanting Herring

• We don’t see herring [in places we used to]. I’ve been trying to repopulate it. I take some of the branches up there and, some of the thinner ones I get, and put it up there…They claim that the herring will survive out of water for almost three days. As long as you get them back in the water they’ll, within three days, they’ll swim away. (HvK, Sitka)

• We put a tarp on the bottom [of the boat] so no oil gets to them. [and cover them] And then, when I come to the right place I’ll break them up in small—I’ll take a couple hours and make sure they all go down and I put them where I don’t think the bullheads and the flounders will get at them… I give them the best opportunity to make it. I used to put them in the harbor, and I started getting a little crafty and start moving them around … About four or five years went by and then they showed up. And the guys told me, “Your herring came back”. . . (CJ, Kake)

• You take the live herring and have an eagle [claw] transport them to the area where you want them to spawn and then you release the herring, in an eagle’s grip. And I guarantee that that transplant works. It’s a known fact and that’s how our Tlingit people transplanted most of the spawning areas. It’s not by accident we got the herring chosen to spawn. They done this for subsistence use. They done it because it was for easy access: that was the thought behind it… (AM, Hoonah)
Event Ecology at Kah Shakes
(with Jamie Hebert, M.A. Thesis)

1. Identify an event
2. Ask open-ended questions
3. Consult multiple data sources
4. Explain environmental change beginning with effects
   - Outward in space
   - Backward in time
   - Progressive contextualization
   - Consideration of counterfactuals
5. Arrive at better understanding of causes.

1. Disappearance of herring at Kah Shakes
2. Do not assume only political causal factors
3. Consult historical documents, scientific literature and ethnographic data
4. Begin with Kah Shakes boundary change in 1991
   - Extend analysis outward in space beyond the Kah Shakes management boundary
   - Extend analysis backward in time to include historical documentation
The Kah Shakes Event

Prehistory = Settlements and subsistence camps for herring production

1976  First commercial sac roe fishery at Kah Shakes.

1990  Kah Shakes failed to open

1991  ADF&G expands management boundary at Kah Shakes

1993  The Herring Coalition files injunction to close fishery at Kah Shakes

1994  The Herring Coalition and the Metlakatla Community file a lawsuit to close the fishery at Kah Shakes.

1995  Court case dismissed.

1998  Final closure (collapse?) of Kah Shakes commercial herring sac roe fishery.
Conflicting Voices

Collapsed Herring Stock Caused by Commercial Overharvesting

Kah Shakes is past tense. And so they asked this guy, when you’re fishing herring around Kah Shakes, does the herring move? ...“Yep, they move ... They move in boxes to Japan.” . . . They move by boxes to Japan. They didn’t move to Cat Island. (Franklin James, Sr. 2008).

Not too long ago they [commercial fishermen] wiped out Kah Shakes.... All the gillnetters came in there ... four hours later ... they [the herring] were all gone, tenders were all gone, boats were all gone, and we only see one herring jump after that. And then they can’t figure out what’s happening to the herring (Marvin Charles, Sr. 2008).

Movement away from Traditional Spawning Grounds

I know that probably within my lifetime, those herring will move back out of Annette Island and then we’ll have fisheries again [at Kah Shakes]. But right now, they have that stock is predominately spawning in Annette Island waters (Scott Walker 2008).

“If you actually look at the overall return of herring to that area down there and if you add Kah Shakes, Cat Island and then add on the spawning biomass that happened over on Annette Island, the returning herring to the area was pretty much what the state [ADFG] had forecasted,” he said. “It actually wasn’t a decline in herring stocks. It was just another movement of fish” (Friedel 2000).
Coincident Data

• Data that is similar between and within the LTK and scientific discourses
  – Environmental discourse
    1. Herring no longer spawn at Kah Shakes in amounts sufficient to open a commercial sac roe fishery
    2. In 1990 and 1991 there was a northeasterly wind that delayed spawning
    3. Herring exhibit “skittish” behavior when spawning
    4. An increased whale population may be influencing herring populations in ways yet to be determined

The significance of these findings therefore lies not in what is known about herring, but what is not known
Dissident Data: Conclusions

• Dissident data of Kah Shakes
  ○ Number of herring stocks (single or mixed)
  ○ Measures of herring abundance (measures of “pristine”)

• Determine source of dissidence
  ○ Arbitrary management boundaries (framing)
  ○ Shifting baseline syndrome

• Conclusions
  ➢ The expansive re-framing of the Kah Shakes fishery after the localized “collapse event” at Kah Shakes spawning area was based on limited data and understanding of herring behaviour and the relationship of spawning “stocks.”
  ➢ A precautionary approach (fishery closure) followed by appropriate studies of local spawning herring behaviour would have been a more appropriate response.
  ➢ Learning from this event could lead to better research questions and adaptive management policy in the future.
1. Herring are under-valued for their ecosystem service functions (supporting, provisioning, and cultural ecosystem services)

2. Herring are being managed in a “shifted baseline” status from former abundance and distribution.

3. Herring become more vulnerable to overfishing, spawning disturbance, and other stress when spawning areas decline.

4. Aboriginal cultivation and stewardship of spawning herring (“servicing ecosystems”) was significant, enhancing ecosystem conservation and resilience, mitigating impacts.

5. In contrast to the regenerative aboriginal system, herring management under single-species, MSY may contribute to the above blind spots (#s 1-3) and to adverse impacts on biocultural diversity and marine ecosystem resilience and health.
MSY as Managed Annihilation?

**Figure 2.2** Adapted Gordon-Schaefer model | Note: This model combines Gordon’s assumptions about the behaviour of fishermen with Schaefer’s population surplus production model and illustrates how a fish population will develop under different fishing intensities, given the assumption that each effort level results in a stable population size and a stable reproductive output. | Source: P. Holm, “Fisheries Management and the Domestication of Nature,” *Sociologia Ruris* 36, 3 (1996): 181.
From Maximum Sustained Yield to an Ecosystem Stewardship model based on “cultivated abundance”

- MSY not ideal for forage fish under stress
- Minimum to assure ‘superabundance’ for ES in a complex, dynamic system is hard to pinpoint
- Precautionary approach may lead to better productivity for fish and fishers.
- PA + cultivated abundance based on locally appropriate aboriginal techniques could best enhance the SES.

The Larkin Lecture

The little brown fish in your pizza and an ecosystem-based view of the world

Dr. Patricia Majluf
Director at Center for Environmental Sustainability - Cayetano Heredia University, Peru
Putting Fisheries Management Back into Places

Fisheries scientist Daniel Pauly (1997:126) has advocated for “Putting Fisheries Management Back into Places.”

Though sometimes tempted by pessimism, I believe that we humans will, in the next Millennium, find ways to match our numbers and our demands with what our planet can provide (this is not so for the time being). This will require that we abandon rape and pillage as our major mode of interaction with natural resources. For fisheries, it will require rediscovering places for fisheries management.

How can the 3 Ecologies help to do this? Do we need to add a 4th—Ethnoecology?
Restoring Indigenous Concepts within Marine Ecosystem Stewardship

• Haida Gwaii First Nation (BC, Canada) has encouraged the incorporation of Haida LTK and ethics in management and restoration of herring and other fisheries (Jones and Williams-Davidson 2000).

• A recent Haida Gwaii paper (2007) goes further, calling for the establishment of an oceans data centre and resource library on Haida Gwaii, that includes scientific, traditional and local knowledge, and specific conservation actions to “Protect and rebuild marine species and habitats around Haida Gwaii that are of known conservation concern, including herring, rockfish, wild salmon, northern abalone, and Pacific cod populations.”

• Management Units? Based on Indigenous cultural models of marinescapes?

• Management Strategies? Based on indigenous techniques (e.g., protection of core spawning zones, transplantation)?
### Ecosystem Services (ES)

#### Provisioning Services
- Food
- Fresh water
- Fuelwood
- Fiber
- Biochemicals
- Genetic resources

#### Regulating Services
- Climate regulation
- Disease regulation
- Water regulation
- Water purification
- Pollination

#### Cultural Services
- Spiritual & religious
- Recreational
- Ecotourism
- Aesthetic
- Inspirational
- Educational
- Sense of place
- Cultural heritage

### Services to Ecosystems (S2E)

#### Protecting Services
- Habitat protection
- Weeding/culling
- Ritual regulation
- Cultural prohibitions & prescriptions on species and habitats

#### Enhancing Services
- Cultivation
- Domestication
- Trait selection
- Translocation, range spreading
- Pruning
- Fertilizing
- Nutrient (re)cycling

#### Restoring Services
- Improving soil/water/air quality
- Habitat/niche (re)construction
- Nutrient release (burning)
- Planting, sowing
- Revitalisation of eco-cultural harvesting

#### Supporting Services
- Ecosystem functions
- Nutrient cycling - Evolution - Soil formation - Spatial structure - Primary production

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From Comberti, Thornton, et al. 2015
New Management Paradigms?


http://thetyee.ca/News/2015/04/02/Heiltsuk-Herring-Dispute-Ends/

Managed Annihilation

From Bavington (2010)

Properly managed, this species can make a complete recovery.

Figure 5.1 This cartoon by political cartoonist Peter Pickersgill appeared in The Express, a weekly St John’s newspaper, in 2003.