Marine Ecology: Forage Fish and Salmonids in the Esquimalt Lagoon

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Introduction:

Along coastal British Columbia marine ecosystems and their vitality lend heavily to how people, both as a community and as individuals, identify themselves in reference to where and how we live. Whether this connection is through food sources, through industry, through cultural significance, or through recreation, the west coast of British Columbia is teeming with direct and indirect human connections to place.

These connections are particularly apparent in an area like the Esquimalt Lagoon. Located near Colwood, the lagoon is a mosaic of valuable ecosystems and culturally significant areas. Having access to the numerous different habitat types and their various ecological processes helps to establish attachment to the lagoon within the surrounding community. As such, these habitats are hotspots for human use and enjoyment. Coastal formations such as the Esquimalt Lagoon and the sandy spit provide the community with destination tourism, recreational areas, wildlife and bird viewing opportunities, and increased sport fishing potentials. The Esquimalt Lagoon is an area that can provide a functional ecosystem for both salmonids and small pelagic forage fish. These fish have been important to coastal communities historically and remain of vital importance today. In any populated urban area, balancing human utilization and healthy ecosystem function is a struggle; however, by instilling a long-term sense of stewardship, marine ecosystem restoration and protection within an urban context can be met. To make informed choices we must understand the ecological and cultural importance of the fish species and habitats in Esquimalt Lagoon, as well as what the various threats to the area mean to its future.

Our group focused on the lagoon habitat and the surrounding riparian system as a means of supporting aquatic life that could be used to connect people more deeply to the ecosystems in which they commute through, visit, live in, or go to school near.

Coho salmon and cutthroat trout use the creeks, streams, rivers, and lagoon habitat as potential spawning grounds and as a safe haven during development. These salmonids rely on a sustained and healthy source of forage fish. The protection of forage fish will in turn support salmonids. Forage fish not only provide a main source of nourishment for the salmon and cutthroat within the area but also provide a livelihood to the migratory birds. Establishing a sense of place within the community relating to the fish stocks of the Esquimalt Lagoon is important to fostering environmental stewardship. Finding and creating connections between people and these aquatic ecosystems through education and community involvement can help to improve the quality of habitat accessible to these valuable fish species.

Informing the community and Esquimalt Lagoon visitors of the forage fish and salmonid populations that reside in the area aims to increase and foster a communal sense of stewardship. Protecting fish spawning grounds, habitat, and ecosystem function should be a priority as well as something to be proud of culturally within the community. It is rare and remarkable that the urban marine ecosystem, regardless of development, use, and various threats has managed to maintain a relatively healthy ecosystem function; this needs to be recognized and protected within the Esquimalt Lagoon in hopes of maintaining a sense of place amongst future inhabitants, community members, and visitors.

Forage fish – *Ira Webb and Hannah Thorlak*

Introduction

Forage fish refers to small pelagic fish that are preyed upon by fish at higher trophic levels. Forage fish feed on zooplankton, and as such are integral to the transferring of energy and biomass through the marine food web (Hannesson, 2013). In the waters off of southern Vancouver Island, species such as Pacific herring (Clupea pallasii), Pacific sand lance (Ammodytes hexapterus), and surf smelt (Hypomesus pretiosus) are the trophic link between zooplankton and many secondary predators including salmon, lingcod, and rockfish. These secondary predators are in turn prey for large predators such as pinnipeds and orcas (de Graaf, 2010). Because of their dependence on fluctuating plankton biomass, these species are subject to more severe biomass fluctuations than most other fish (Alder et al., 2008). Forage fish are important for the recovery of at least 13 marine species at risk (de Graaf, 2010). Salmon, cutthroat trout, rockfish, and other marine fishes depend on these species for a significant amount of their food intake (e.g. Coho diet is more than 50% sand lance), while some seabird species have diets consisting of 80% sand lance (de Graaf, 2010). Because of their influence on our fisheries, our bird populations (very pertinent as Esquimalt Lagoon is a migratory bird sanctuary) and our connections to charismatic megafauna, these small fish represent a tremendous contribution to the things that are celebrated on this coast. Cultural significance of forage fish populations.

Forage fish compose “37% of the global marine landings” and are used throughout the world to produce fishmeal or to be consumed, most often in preserved form, by humans (Alder & Pauly, 2006, p. viii). Although these fish have such a large global significance they are rarely acknowledged as a critical human and ecological resource. Aside from direct human consumption, they are highly important food source for larger marine species and bridge the trophic gap between plankton those larger species (De Gaaf, 2010).

We cannot say for certain how long forage fish have been spawning at the Esquimalt Lagoon, but there has been human use of the area for thousands of years making these fish a part of the place making identity of the lagoon. The Esquimalt Lagoon has long historical ties to both the Esquimalt and Songhees first nations and evidence of clam garden harvesting has been found, but there is little information about historical uses of forage fish (CRD, 2013). This is perhaps an area where while a direct connection may not be evident to the outside eye, there is an undeniable recognition of the importance of salmon populations to First Nations on Southern Vancouver Island, and forage fish are a key food source for salmon (de Graaf, 2010).

Although Forage fish are a "cornerstone [species] of the nearshore marine food web" at the Esquimalt Lagoon they are still not recognized for their invaluable ecological role (de Graaf, 2010, p. 6). The connection between these species and humans who use the lagoons needs to be made more visible through education, so that it will hold a greater level of social importance for the lagoon users and stakeholders.

Habitat at the Esquimalt Lagoon.

In 2009 the Esquimalt Lagoon Stewardship Initiative asked Ramona de Graaf, whom we interviewed for our research, to conduct a survey of forage fish spawning habitat at the lagoon. This report showed the presence of fall spawning forage fish such as Sand Lance and Surf Smelt (de Graaf, 2010). Both of these species require sandy-gravel beaches for the deposition and incubation of their spawn, and areas with mobile sediment as well as terrestrial shading are ideal for these fish (de Graaf, 2010). The long sandy beaches of the lagoon provide ideal spawning habitat throughout the fall and winter but lack enough of a terrestrial buffer for summer spawning populations.

The lagoon's terrestrial buffer is not sufficient enough to support different species of forage fish as well as salmonids as those species consume 50% or more terrestrial food for the first few weeks of their lives (de Graaf, 2010). However the lagoon is still a "fantastic spawning area" for both the Sand Lance and the Surf Smelt. It is dynamic, with erosion being an integral part of the spit land formation, and this means mobile sediments

that won't collect sulphides which, are bad for the embryos (de Graaf, personal communication).

This site in particular is especially important to Surf Smelt populations, as their spawning areas have noticeably diminished since 2002. De Graaf explained that she has seen stretches along the coastal Strait of Georgia where Surf Smelt used to spawn be eradicated thus these populations no longer exist. Therefore the Esquimalt Lagoon is an extremely important support for Surf Smelt populations throughout the entire Salish Sea (de Graaf, personal communication).

Threats and Conservation Issues

Biologist, educator and forage fish specialist with the BC Shore Spawners Alliance Ramona de Graaf highlighted some of the most pressing threats to this important habitat, particularly alterations to natural erosion rates and sediment transport, as well as sea level rise and the impervious surfaces footprint in the area. Impervious surfaces create runoff and fouling of the sediment, killing embryos (de Graaf, personal communication). What is needed is a long term approach to managing the spawning habitat, one that recognizes that eventually the landform will be underwater, and uses this foresight to better plan for the future (de Graaf, personal communication).

One possible restoration action that is already being implemented is the restoration of the dune habitat. Roots of dune plant species hold sand and soil together, which prevents erosion (Kwasnicia, 2008). Planting of metre high shrubs would assist in both securing sediments and insect prey for juvenile sand lance and surf smelt. Furthermore, this vegetation may provide sufficient overhanging shade to promote spawning of summer surf smelt (de Graaf, personal communication).

Several good ways to go about informing the public about the importance of Esquimalt Lagoon were touched on in our interview. First, the forage fish story must be better integrated into the ecological signage, particularly through connection of sand

lance and surf smelt with Pacific herring, whose importance is better recognized (de Graaf, personal communication). For example, sand lance and surf smelt ecology is not mentioned on the Capital Regional District website's Esquimalt Lagoon overview (CRD, 2013).

Salmonids – *Carli Charbonneau and Christine Adams*

Introduction

Salmonids (Salmonidae) are a family of fish that are anadromous meaning that they are born in freshwater systems (creeks, rivers, streams), upon maturity enter the salt water systems (ocean) for 3-4 years, returning to spawn in the same fresh water systems from which they were born (Fisheries of Canada, 2013). Salmonids include Pacific and Atlantic salmon, trout, char, and, freshwater whitefish (Bovee, 1978). Within the Esquimalt Lagoon both Cutthroat Trout (Oncorhynchus clarki) and Coho Salmon (Oncorhynchus Kisutch) are the main salmonids that reside in the marine systems. Cutthroat Trout are abundant in both Bee Creek and Colwood Creek as has been documented during the trappings one both of these systems over the last decade. Coho Salmon have been trapped although far less frequently and in fewer numbers. The presence of Coho Salmon is inspiring and exciting as it deems these creeks as potential habitat for spawning beds. Although, to date, there has not been any documented sighting or finding of Coho salmon carcasses, which are often apparent along the shores of spawning beds.

Habitat

Colwood creek is one of the main freshwater creeks that exits into the lagoon. It is fed by Glen Lake, located on the boarder of Colwood and Langford, thus it remains flowing throughout the year although it is known to be "fast and deep in Winter, shallow and sluggish in summer" (Mithcell and Richardson, 2007). Colwood Creek, being a part

of the 850 ha Colwood Watershed, is subject to flash flooding, as are many urban streams, due to surface run off from increased impervious surface area, urban areas, agricultural lands, and golf courses all within the surrounding the lagoon. Colwood is far larger than the other small streams and creeks that run into the Esquimalt Lagoon. Beed Creek, is shorter than 500 m in length and is subject to flash flooding as well although it goes through less changes in flow patterns due to being spring fed than does Colwood Creek (Mitchell and Richardson, 2007).

Monitoring

The Esquimalt Lagoon Stewardship Initiative (ELSI) and its volunteers have done the trapping of fish, for monitoring purposes, within Bee Creek and Colwood creek for the last ten years. The trapping occurs seasonally, when rain and run-off water surges are at a low with the use of gee traps. Gee traps, a sort of trap with a funnel like entrance that allows fish in but hinders their ability to exit, are places in relatively slow moving deeper pockets along specific sections of the creek. ELSI uses smoked oysters or herring as bait to lure the salmonid fry into the traps. Once trapped the small fry are placed in buckets, individually removed, measured, identified, and carefully returned to the creek.

The Esquimalt Lagoon Stewardship Initiative (ELSI) works with various aspects of the ecosystem including dune restoration along the spit, the migratory bird sanctuary and its habitat, as well as the marine ecosystem vitality within the lagoon and riparian systems. Joe Richardson, an ELSI volunteer, has been doing monitoring work on Bee Creek and Colwood Creek for the past decade, describes the importance and reasoning behind protecting these habitats as being vital because these riparian ecosystems are the salmonids home and always have been; community members, volunteers, and ELSI coordinators should strive to maintain and protect these habitats to ensure that the fish have a home to return to in the future.

During the trapping over the past decade records show that in Colwood creek between 2006 and 2007 there were 14 coho fry trapped and identified and many cutthroat

and various other marine species (crayfish, sculpin, stickleback, perch) (Mitchell and Richardson). Bee Creek however had previously only yielded trappings and data that supported the presence of Cutthroat and the absence of Coho salmon. However, as informed by our interviewee Joe Richardson, more recently a small coho fry had been trapped and identified on Bee Creek (Richardson, Personal Communication May 23).

The salmonid presence and specifically the Coho is important as it indicates that these streams may in the future be able to house and support spawning salmon beds. There is evidence that supports the presences of these salmon in the past although information that we found was inconclusive. If salmon could be (re)introduced in the area the Canadian Department of Fisheries would have reason to take stands on protecting this valuable marine ecosystem and surrounding riparian area from development, degradation, or various other threats.

Ecosystem Services

The riparian and coastal ecosystems within the Esquimalt Lagoon offer a number of benefits to the surrounding urban landscape. Healthy aquatic ecosystems perform a number of ecosystem services such as nutrient transport and removal of waste (Meyer et al., 2005). Beyond physical services, these systems also provide the community with recreational opportunities and other social benefits (Meyer et al., 2005). As development in the area increase it will become increasingly important to engage with the community in maintaining these aquatic ecosystems.

Community

ELSI has already worked within the community to monitor and restore some of the creeks in the Esquimalt Lagoon system. As explained by Beth Mitchell (an ELSI coordinator and long time volunteer) these efforts have been volunteered based, relying on support for the community. Currently volunteers are mostly retirees but there is

potential to reach out to a diverse range of ages. ELSI has already reached out to Sangster Elementary, providing the outdoor kindergarten with the opportunity to observe fish trapping (Joe Richardson, personal communication, May 23, 2013). Allowing children to interact with the natural environment is an important part of fostering a sense of environmental stewardship form an early age. Engaging with the community to protect these ecosystems helps to establish and strengthen the connection to place. Not only will this increase environmental stewardship in the area but it will provide physiological and spiritual enlightenment (Newman & Jennings 2008).

Increasing public awareness of these ecosystems will help to improve stewardship within the community. One possible way to increase education would be to work with Royal Roads and surrounding landholders to create a series of interpretive trails along the creek systems and shoreline informing people about the presences of salmonids and forage fish within these ecosystems. These trails also offer the opportunity to showcase the interconnected nature of the ecosystems (Meyer et al. 2005). By having one long trail move from urban to riparian to coastal ecosystems the public can actively see the gradient of ecosystems as well as their integration into the human environment as a whole.

The Future

As urban development continues, green spaces such as the Esquimalt Lagoon will become less common. However, these ecosystems should be protected, not only for the fish and other species present but also for the benefits to the community. In a fully urbanized it can be difficult to remember the city's connection the surrounding landscape. Understanding this is an essential part of developing a sense of place, which in turn is an essential part of community wellbeing (Newman & Jennings 2008). The Esquimalt Lagoon, in part, shaped Colwood and the surrounding urban environment. Maintaining these ecosystems and educating the public on their importance will help to foster a sense of place within the community. A well-defined sense of place will benefit the fish, the community and the urban landscape as a whole.

Conclusion

West Coast residents and visitors are aware of and recognize the role that the marine ecosystem plays within how we shape the idea of home. The British Columbian coast is of high value and appreciation due to the myriad of marine species for tourism, industry, sustenance, and aesthetics. Without forage fish there would not be salmon, and without salmon our highly appreciated and revered coastal marine species such as otters, sea lions, orca whales etc. would not be present. West Coast place making is undeniably shaped and solidified within the context of coastal marine life.

Historically both forage fish and salmonids have played a major role culturally both in indigenous peoples of the area, such as the Songhees and the Esquimalt tribes, and within recent history for both sport and commercial anglers as a source of food. Forage fish, although less recognized, are a major cornerstone species within the near shore marine food web. They provide sustenance to the salmonid populations that were and still are harvest for human consumption. Without a steady and sustained population of forage fish the salmon population would diminish. Many people today as well as historically harvest Salmon for both sport and sustenance.

The Canadian Department of Fisheries holds salmon spawning grounds and refuge areas in high regard and places importance on supporting and protecting their habitat. If Esquimalt Lagoon is restored, supported, and protected it may in the future be used as a reintroduction site for salmonid species, specifically Coho salmon. As stated by de Graaf:

> *"Forage fish are the drivers of the productivity of the Salish Sea, which is the driver of fisheries, predatory fisheries on salmon, halibut…If you like killer whales you like chinook, and if you like chinook you gotta' like sand lance… If you don't make people understand why it's important to them, to their everyday lives, then it's just another cool fact about nature, and it doesn't get much attention after that."*

The critical role of forage fish in terms of support our BC salmonid populations needs to be acknowledged more broadly and more publically. ELSI and many community members recognize the fundamental role that these marine species play in shaping our meaning of home. Celebrating the past and present human links to the salmon and their supporting population of forage fish will help sustain the identity that British Columbians have claimed and been known for. The Esquimalt Lagoon and its surrounding riparian ecosystems are an ideal representation of what it means to be a part of a coastal ecosystem. Protection and celebration of the values of a place can only lead to more public awareness and investment in its sustained ecological prosperity. The Esquimalt Lagoon is a amazing opportunity for the community of Colwood and Esquimalt to protect and ecologically functioning marine ecosystem for the future.

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