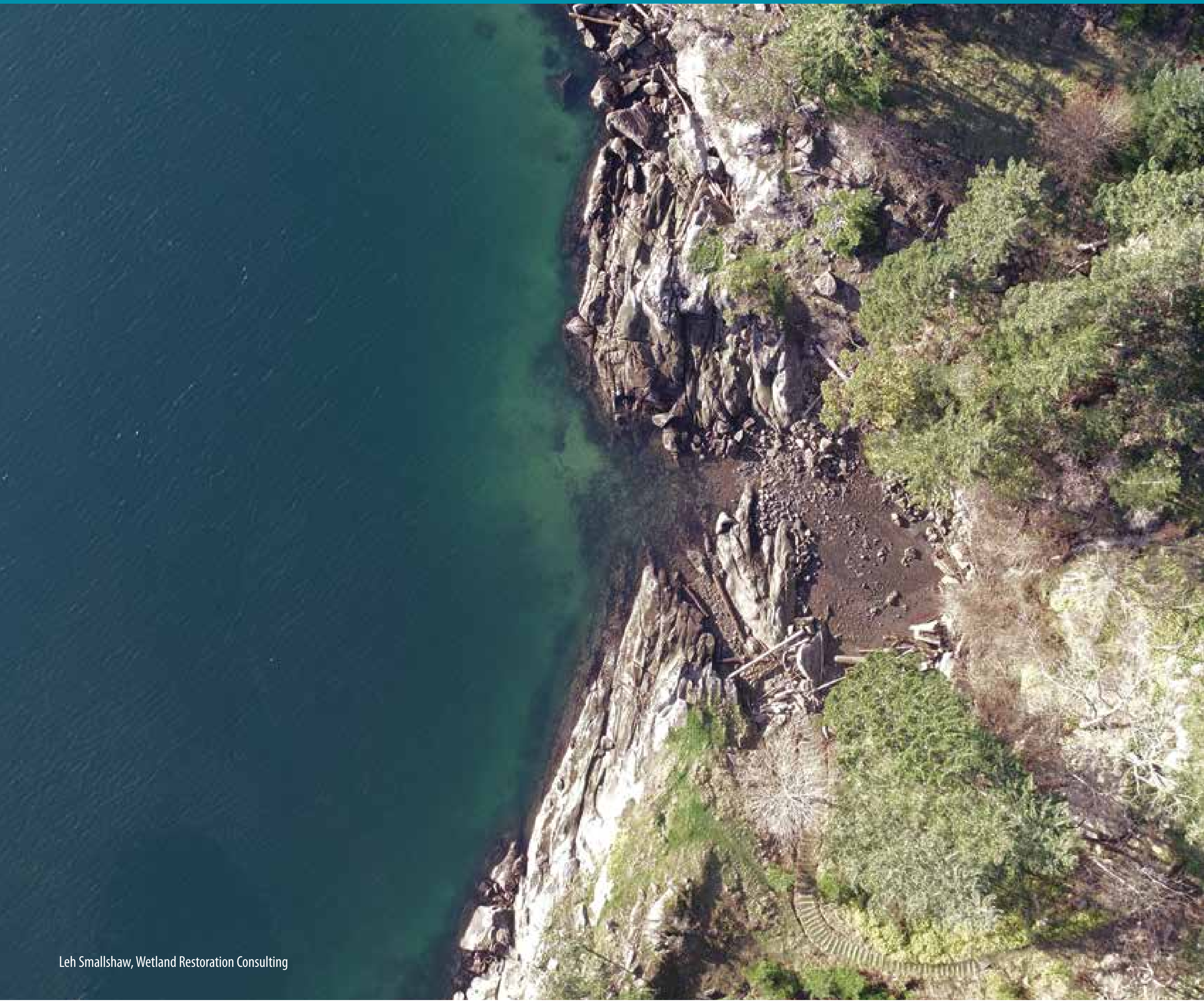
SUMMER 2020

The Galiano Island Stewardship News

A newsletter of the Galiano Conservancy Association, where the people of Galiano Island can share ideas, stories and perspectives on stewarding the land.



Leh Smallshaw, Wetland Restoration Consulting

Galiano Conservancy Association

In this Issue :

Climate, Water and the Southern Salish Sea Islands

By Dr. Dan Moore, Professor in the Department of Geography at UBC, and Forest Renewal BC Chair of Forest Hydrology

Climatic conditions have varied throughout earth's history. About 17,000 years ago, the Salish Sea was covered by glacial ice as a result of globally cooler conditions.[1] In addition to the longer-scale processes associated with past glacial cycles, the climate system includes shorter-time-scale phenomena such as El Niño events (in which a band of warmer-than-average water in the equatorial Pacific develops about every two to seven years[2]), which are usually associated with warmer-than-average winter conditions in south coastal BC.[3] Beginning in the 19th century, a long-term global warming trend has been added to the other types of climatic cycles and variability, associated with increases in greenhouse gases, especially carbon dioxide, which absorb heat emitted by the earth's surface and re-emit it back to the surface.

The southern Salish Sea Islands (here referring to the San Juan and southern Gulf Islands) experience a mediterranean climate, with mild, wet winters and warm, dry summers. Soils remain near "field capacity" (saturated) through winter, then dry out through spring, summer and early fall. The return of the wet season, typically in October, recharges soil moisture, bringing it back up to field capacity in November.

Seasonal variations in precipitation and soil moisture influence both surface water and groundwater. When soils are wet in winter, almost all of the rain reaching the surface either drains downslope through or over the soil toward surface water bodies (lakes, ponds, wetlands and streams), or percolates deeply to recharge groundwater. When soils are dry, particularly in late summer, any rain that falls and percolates into the soil is retained in the soil, where it can be lost by evaporation from the soil surface or taken up by plants through their roots and released to the atmosphere through openings on their leaves, a process called "transpiration." Through the spring and summer, the flow in many streams drops to a trickle or stops altogether, and water levels in ponds, lakes and wetlands decline. With reduced input via deep percolation from the soil, groundwater levels drop through the summer as aquifers continue to discharge directly into the Salish Sea or into surface water bodies. Groundwater use by pumping from wells during summer exacerbates this natural seasonal decline.

The longest available weather record in the southern Salish Sea islands is from the "Olga 2 SE" station on Orcas Island in Washington State. The general long-term trends at that station should be reasonably representative of those experienced throughout the San Juan and southern Gulf Islands. The graphs in Figure 1 show air temperature (T) and precipitation (P) as recorded at Olga 2 SE for winter (November to April) and summer (May to September).[4]

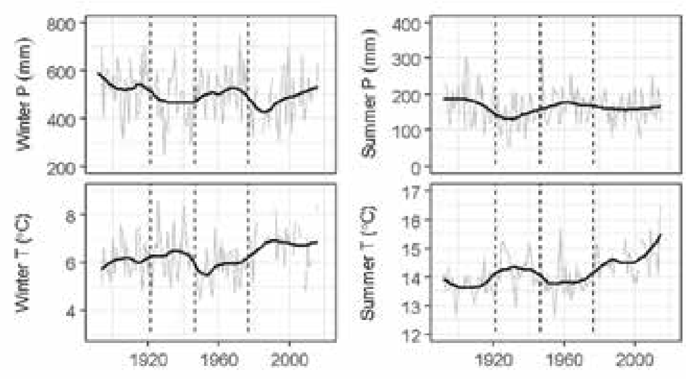


Figure 1. Time series of total precipitation and average maximum daily air temperature at the Olga 2 SE weather station on Orcas Island for winter (November to April) and summer (May to September). The vertical dashed lines indicate the timing of shifts in the Pacific Decadal Oscillation.

The grey lines in Figure 1 illustrate the substantial year-to-year variability of climatic conditions, while the black lines indicate smoothed trends. The smoothed trends include the effect of the Pacific Decadal Oscillation, or PDO, which involved large-scale changes in sea surface temperatures and wind patterns in the North Pacific Ocean around the years 1922, 1947 and 1977.[5] In southwestern BC, there was a tendency to cooler, wetter weather from the late 1940s to the late 1970s. One notable feature of the graphs is the trend to warmer summers beginning in about the 1970s.

To understand how climatic conditions may change in the future, research teams around the world run global climate models. Projections of future conditions based on these models are subject to uncertainties because all models have inherent limitations, and it is uncertain how future human activity will influence the emission of greenhouse gases. Scientists and planners therefore consider outputs from a range of models run with a range of future scenarios about human activity.

Table 1. Summary of projected climate changes for the 2050s, relative to conditions in 1971-2000, for the Capital Regional District.

Season	Precipitation change (%)	Daily maximum air temperature change (°C)
Winter (DJF)	-3 to 11	1.3 to 3.3
Spring (MAM)	-5 to 14	1.6 to 4.5
Summer (JJA)	-41 to 4	2.1 to 4.2
Autumn (SON)	-4 to 26	1.4 to 3.8

A report published by the Capital Regional District presented a synthesis of climate scenarios for the region.[6] Table 1 summarizes the projected changes in total seasonal precipitation and average daily maximum air temperature for the 2050s under a "business-as-usual" emissions scenario. The changes shown are relative to conditions in the period 1971-2000, and the ranges represent uncertainty associated with the variability among climate models as well as natural climatic variability.

There is a strong consensus among models that air temperatures will increase in all seasons and that summers will likely be drier and autumns wetter. Changes in overall precipitation in winter and spring are less clear. These projected climatic changes could have a range of impacts on water and associated values in the Salish Sea Islands.

Groundwater provides the dominant source of water for domestic, agricultural and industrial uses on most Salish Sea islands. A study of projected groundwater response to future climate change on Gabriola Island found that there would be an overall increase in annual precipitation and an associated increase in groundwater recharge by the 2050s.[7] However, the increase in recharge did not necessarily translate into higher groundwater levels, because much of the increased winter recharge was balanced by increased discharge from the aquifer.

Increasing air temperatures and reduced precipitation during the growing season would increase the need for irrigation for agriculture and landscaping. Where groundwater is used for irrigation, this increased demand would put more pressure on groundwater resources. Where surface water is used (e.g, in the form of storage ponds), increasing air temperature would likely result in increased evaporation losses at the same time as reduced precipitation would reduce inflows.

Warmer, drier summers would create higher drought stress, with implications for forest health. For example, since the 1990s, western red cedar have been exhibiting signs of drought stress, and many trees have died, as reported by CBC News (May 14, 2019).[8] The warming trend could also result in higher forest fire hazard that begins earlier in the spring and extends later into the fall. An increase in standing dead trees could exacerbate fire hazard by adding to the fuel load.

Available evidence from historical climatic data and projections from global climate models indicate that the southern Salish Sea Islands will likely experience warming in all seasons and reduced summer rainfall, with implications for water availability and ecosystems. Other articles in this issue of Stewardship News explore the connections between water conservation and climate, as well as a range of innovative solutions to current and future challenges.

[1] John J. Clague and Brent Ward, "Pleistocene glaciation of British Columbia." In J. Ehlers, P.L. Gibbard and P.D. Hughes, editors: *Developments in Quaternary Science*, Vol. 15, Amsterdam, The Netherlands, pp. 563-573, 2011.

[2] https://oceanservice.noaa.gov/facts/ninonina.html

[3] R.D. Moore, D.L. Spittlehouse, P.H. Whitfield, P.H. and K. Stahl, "Weather and climate." Chapter 3 in: R.G. Pike, T.E. Redding, R.D. Moore, R.D. Winkler and K.D. Bladon (editors). *Compendium of forest hydrology and geomorphology in British Columbia*. B.C. Ministry of Forest and Range, Forest Science Program, Victoria, B.C. and FORREX Forum for Research and Extension in Natural Resources, Kamloops, B.C. Land Management Handbook 66, pp. 47-84, 2010.

[4] Data are available via the following link: https://www.ncdc.noaa.gov/cdo-web/

[5] See P.H. Whitfield, R.D. Moore, S.W. Fleming, and A. Zawadski, "Pacific Decadal Oscillation and the hydroclimatology of Western Canada - review and prospects." *Canadian Water Resources Journal* Vol. 35, pp. 1-28, 2010.

[6] Capital Regional District, "Climate Projections for the Capital Region." Victoria, 59 pp., 2017.

[7] R. Burgess, "Characterizing recharge to fractured bedrock in a temperate climate." MSc thesis, Simon Fraser University, Burnaby, Canada, 2017.

[8] https://www.cbc.ca/news/canada/british-columbia/western-red-cedars-death-dry-climate-change-1.5134262

Growing More Food with Less Water

by Adam Huggins, GCA Restoration Coordinator

For many of us on Galiano, limited water supplies present a challenge for growing food. This is due in part to our Mediterranean climate of wet winters and dry summers, and in part because only about 20% of winter rainfall infiltrates our rugged topography.

While the climate crisis will intensify our annual drought, Galiano has always been on the dry side: according to the 2017 Southern Gulf Islands Food and Agriculture Strategy, "Early settlers [on Galiano] found the soil unfriendly and water scarce and turned their attention to fishing, hunting, sheep and fruit growing to make ends meet. Galiano was generally regarded as the least arable of all of the Southern Gulf Islands."

Our budding Food Forest at the Millard Learning Centre is no different - water is scarce, and the soils are poor. Below are some time-tested strategies we're using to grow food with less water.

HÜGELKULTUR: PUTTING WOOD TO WORK

We may not have much 'friendly soil' on Galiano, but we do have lots of wood! Hügelkultur is German for 'mound culture', and refers to the practice of building large raised garden beds on a mixture of coarse woody debris, organic detritus, and compost. The woody debris breaks down slowly over time under the mound, contributing micronutrients, encouraging beneficial fungi and soil microbes, and - importantly - acting as a woody sponge to retain water during drought. The GCA Food Forest is designed around five large Hügelkultur beds, which play an important role in helping our fruiting trees and shrubs endure dry summers. One year, we discovered that our automatic drip irrigation system had been turned off accidentally for most of July, but none of our perennial plants showed any signs of stress!

OLLAS: CLAY POT IRRIGATION

We live in the "Pacific Northwest," but we may have more in common with the "Desert Southwest." There, farmers have been employing clay pot irrigation for generations. The idea is simple: unglazed clay pots are partially buried, and then plants are established around them. These clay pots - or 'ollas' - can be periodically filled with water, which then slowly seeps out through the porous clay body to water the plants as needed. Clay pot irrigation saves time and labour, has been shown to be much more efficient than commercial drip irrigation, and can be achieved using handmade ceramics or standard terra cotta garden pots. This year, we're establishing an olla demonstration garden at the GCA Food Forest, using custom ollas from IF Ceramics.

Hand-made ollas produced for the GCA by If Ceramics (www.if-ceramics.com).

Creating a Hügelkultur bed in the Food Forest in 2015 - a machine is helpful, but not necessary.

The same bed in 2019.

RAINWATER CATCHMENT: WHERE THERE'S A ROOF, THERE'S A WAY

On your next visit to the GCA Food Forest, you might notice what looks like a concrete yurt. Don't worry - this isn't our new intern accommodations: it's actually a ferrocement rainwater cistern. "Ferrocement" refers to thin-walled concrete on a rebar and wire frame, and it is used widely in parts of the world where labour is less costly than materials. This cistern can hold over 45,000 litres of rainwater! While ferrocement is labour intensive to build (it took 30+ volunteers and GCA staff over 400 hours to complete this cistern), it has several advantages over HDPE plastic cisterns: it can be built in situ in remote areas without roads it is cheaper in terms of material costs and it has been shown to use 40% less embodied energy and produce less than half the carbon emissions of a similarly sized HDPE cistern.

Regardless of the size or what materials you use, harvesting and storing rainwater is a key strategy to reduce our reliance on groundwater for growing food.

Want to learn more? Come visit the Millard Learning Centre, and check out the GCA library - we have a great selection of books on applied water conservation.

Volunteers and staff establish olla garden at the GCA Food Forest.

Ferrocement cistern, mid-construction in summer 2019.

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :

Environment and Climate Change Canada   Environnement et Changement climatique Canada

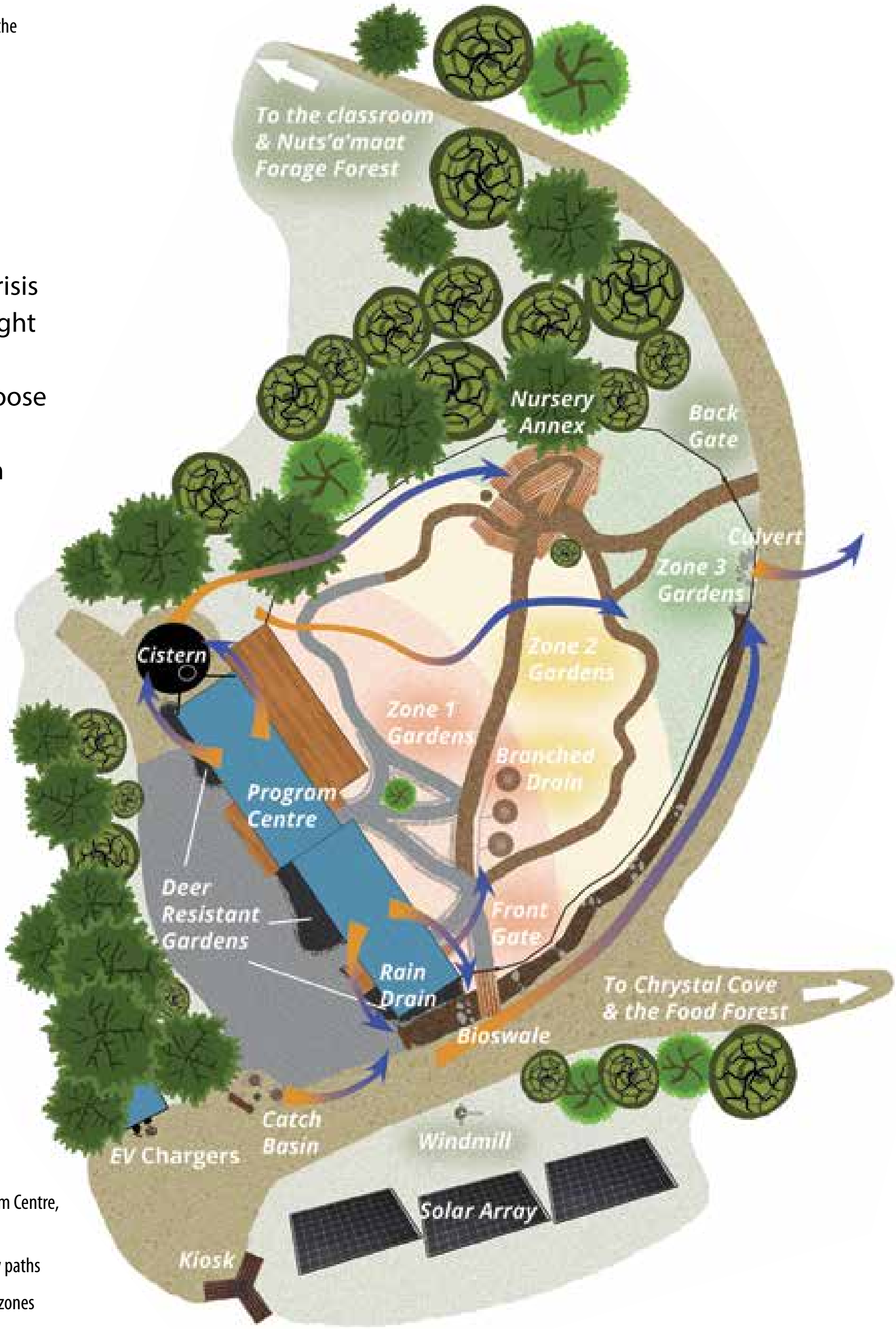
Climate Resilience at Home:
A Virtual Tour of the GCA's Program Centre

Students with UBC's School of Forestry helping to establish the demonstration gardens at the Program Centre in February 2020.

THE FORECAST FOR THE SALISH SEA

It is becoming increasingly clear that the climate crisis isn't just a future threat - we're living it, together, right now. Responding to climate change is no longer a question of if, or when, but a matter of how we choose to act, day to day, individually and collectively. Many impacts are still uncertain, and there is much we can still do. Nevertheless, the forecast for the Salish Sea is already manifesting itself: we can count on hotter, drier summers; stormy, unpredictable winters; increased risk of wildfire and wildfire smoke during the dry season; and more pressure on limited freshwater supplies. As we work together to adapt to these conditions, we should remember that our ecosystems are doing the same, and that we must also protect and assist them during these uncertain times.

The GCA's new Program Centre facility has been designed to demonstrate simple, low-cost strategies to creatively address these challenges. Read on to learn more!



Map of the GCA's new Program Centre, showing features of interest:

WATER

Water is life, and water protection starts at home. Here's how we're approaching water conservation at the Program Centre:

REDUCING WATER NEEDS

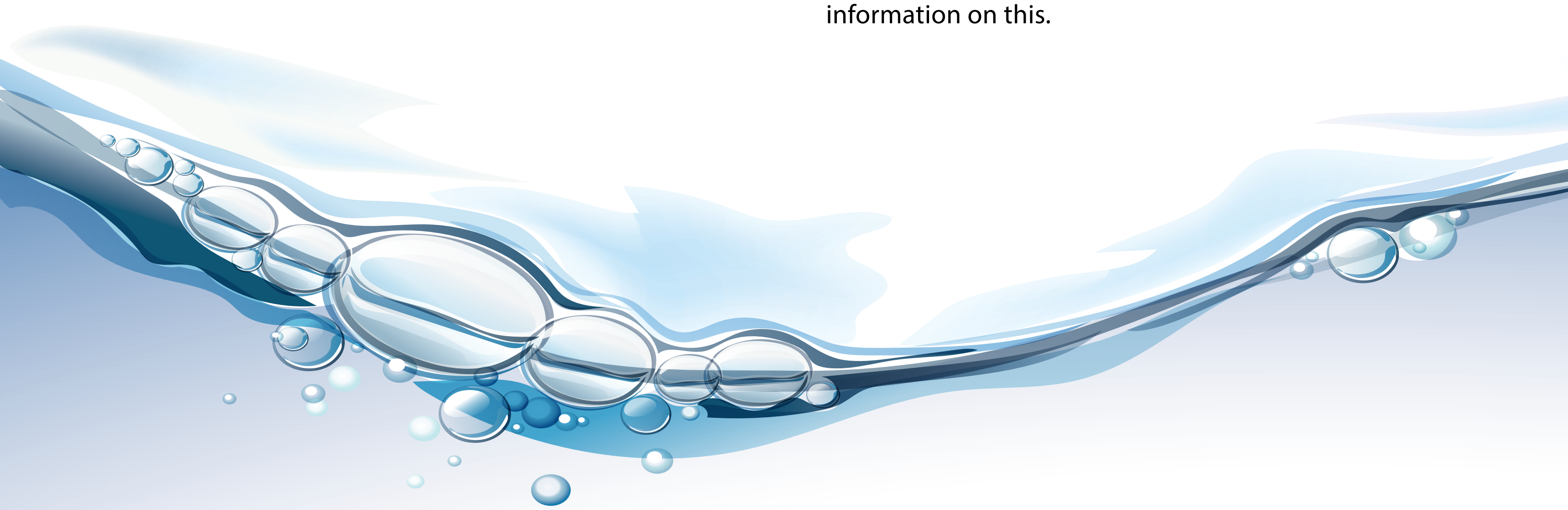
The most powerful way to reduce our impact on groundwater and local aquifers is to reduce our overall water use. Bathing, flushing, washing cars, and doing laundry less frequently and more efficiently is a great place to start. From there, installing more efficient appliances, shower heads, and faucets is a no-brainer.

- The Program Centre is equipped with water-efficient appliances and fixtures.
- Composting toilets are being installed at the Millard Learning Centre, and can reduce up to 40% of household water use.

HARVESTING RAINWATER

One way to capture and store rainwater is to harvest it from rooftops for later use in the home or landscape. Depending on the intended use of the water - potable or non-potable - careful consideration must be given to the materials of the roof; design of gutters, filters, and conveyance piping; and size, location, and type of storage container. For pressurized potable systems, professional plumbers and permitting will be involved. For non-potable uses, it is possible to design and install simple rainwater harvesting systems yourself, without a permit.

- The Program Centre features a 20,000 litre HDPE cistern which captures rainwater from the roof for later, non-potable gardening use in our Nursery Annex.
- The Food Forest features a 50,000 litre ferrocement cistern, constructed by volunteers and GCA staff, to store rainwater for use in the garden. Ferrocement construction takes some skill, but has been shown to require 40% less embodied energy and carbon than similar-sized plastic tanks. See the previous article, *Growing More Food with Less Water*, for more information on this.



Former Executive Director Keith Erickson (left) poses with current Executive Director Chessi Miltner at the Program Centre in front of our newly installed 20,000 liter rainwater cistern, donated by Twin Maple Industrial Tanks.

twin maple INDUSTRIAL TANKS

STORING WATER IN THE LANDSCAPE

Cisterns aren't the only way to capture and store rainwater. Wetlands, ponds, bioswales, rain gardens, and coarse woody debris can all capture rainwater, creating important habitat for aquatic and semi-aquatic species, aiding in groundwater recharge, and making more water available to plants and animals during summer drought. In fact, your yard may already be storing water - before imagining something new, it is always best to observe what is already working, and then consider how best to aid in that process. When designing a pond or wetland, don't forget to let it be natural: avoid clean lines or a 'tidy' aesthetic. Curves, irregularities, rocks, and woody debris provide habitats for many important species. Sometimes, the best contractor is a beaver!

- The Program Centre includes a "bioswale" to collect and filter excess runoff from the parking lot and rooftop. A series of rock weirs (small, permeable dams made of rock) and the root systems of plants help to slow and filter the runoff, reducing erosion and increasing infiltration. During large storm events, the bioswale conveys water to a wet meadow, where water-loving native species make use of it before it passes through a culvert and down towards Chrystal Creek.
- The Food Forest features hugelkultur beds, drip irrigation, ollas, and mulching to retain water and reduce water needs. See the previous article, *Growing More Food with Less Water*, for more information on this.
- The Millard Learning Centre features both constructed and natural wetlands - can you tell which is which?

UVic students help establish native species to filter runoff in the Program Centre bioswale in February 2020.

Farewell-to-Spring blooming in the Nursery Annex at the GCA's Program Centre.

Visit the Nursery Annex at the Program Centre during business hours, and check out our nursery inventory at www.galianoconservancy.ca/nursery/

NATIVE SPECIES IN THE LANDSCAPE

Here on Galiano Island, a large variety of beautiful, edible, medicinal, and useful native species thrive in our mild winters and dry summers. There are native plants to suit every purpose and habitat niche; despite this, a great deal of damage has been done to native ecosystems in order to make them suitable for introduced ornamental or edible species. By fitting the right native plant to the right niche, it is possible to reduce landscape irrigation requirements to almost zero.

- Program Centre landscaping features a wide variety of native species with different moisture requirements, from very wet to very dry. The Nursery Annex at the Program Centre is open to the public for plant sales during business hours.

GREYWATER

Greywater systems allow us to safely re-use lightly soiled water from showers, baths, sinks, laundry machines, and dishwashers in the landscape or for toilet flushing. The design of the system depends on the source and end-use of the greywater. More sophisticated systems allow for better filtration and targeted irrigation, but can be expensive and prone to failure; simpler systems are less configurable but cheaper, easier to maintain, and less resource-intensive. The right design will incorporate your household patterns of water use, as well as your budget and maintenance abilities. Whether you re-use greywater or not, it is important to choose biodegradable detergents, personal care products, and cleaning agents.

- The Program Centre sports a simple, gravity-fed branched drain system. Light greywater is collected from the laundry machine and shower before flowing through buried pipes to feed a series of mulch basins and fruit trees. This system was cheap and easy to build, and should be easy to maintain over time.

The simple, gravity-fed branched drain system at the Program Centre irrigates three mulch basins that are ready to be planted with fruit trees.

FIRE

Fire is an essential ecosystem process, and we live in a fire ecology. While fire is natural, decades of artificial fire suppression, industrial forestry, and climate change have influenced the unprecedented scale and intensity of recent wildfires in BC. Here's how we're approaching fire at the Program Centre:

FIRESMART IN THE HOME

Half of homes that burn are ignited by sparks or embers; sometimes, the house will burn while leaving surrounding vegetation intact. A FireSmart home has a fire-resistant roof and siding, is located at least 10 meters from wood sheds or other wooden outbuildings, and receives regular maintenance, including cleaning the roof and gutters.

- The Program Centre is outfitted with a metal roof and siding, and heated using an energy-efficient air-to-air heat pump - no woodshed required. It does, however, have a wooden deck. The area under the deck must be kept clear of materials and vegetation.

FIRESMART IN THE LANDSCAPE

A resilient landscape conserves water, stores carbon, and provides habitat and food for a range of species - including people. It should also act as a fuel break, but employing FireSmart doesn't have to mean giving up these other values. FireSmart landscape design relies on four landscape 'zones'. It is possible to cultivate a beautiful, productive, ecological landscape while following FireSmart principles.

- The Demonstration Gardens next to the Program Centre were designed based on FireSmart zones, to minimize combustible material near the building.

COARSE WOODY DEBRIS

Coarse woody debris in various states of decomposition is an important component of our forested ecosystems, helping to store water, release nutrients, and provide habitat for many species. However, it is important to remove all coarse woody debris from around the home. Beyond a 10 metre radius, some coarse woody debris can (and should) be present on the ground, provided it is in contact with soil (to promote decomposition) and distributed evenly across the landscape (not in piles).

- At the Program Centre, coarse woody debris has been distributed away from the building.

ENERGY

The Millard Learning Centre is carbon neutral - meaning that over the course of a year, all of the energy we use is derived from renewable sources that do not emit greenhouse gases such as carbon dioxide and methane. This is achieved through energy efficiency and three inter-linked solar installations with a combined energy capacity of 21.6 kW:

GRID-TIED SOLAR

The Gulf Islands are poised to be a solar powerhouse, and the price and efficiency of the technology keeps improving - there has never been a better time to invest in solar energy for your home. In 2019, as part of a bulk buy organized by the Salish Sea Renewable Energy Coop (SSREC.org) and with financial help from the CRD and a generous donor, we installed a 48 module, 15.8 kW ground-mounted, grid-tied solar array that provides for

the electrical needs of the Program Centre, including a drilled well and two electric car charging stations. Oriented to maximize summertime production, our grid-tie system overproduces during the longer days of the year, feeding the surplus electricity into the grid and making our meter spin backwards. During shorter, winter days, we draw from the grid to make up any deficit in solar production. The array has been live for a year and, to everyone's delight, has exceeded our wildest expectations: in the first year of operation, our solar array produced more electricity than the two buildings, our staff, volunteers, course participants, instructors and the two public charging stations for electrical vehicles have consumed. Put another way, the MLC is now 'Net Zero', producing more solar energy than we consume. Free electricity now and for the foreseeable future!

- The Program Centre is equipped with a 15.8 kW solar array. To further offset greenhouse gas emissions in the construction of the solar array we specifically chose earth anchors, rather than concrete pads, for mounting the panels to avoid the significant greenhouse gas emissions created during the production of cement and concrete.
- Solar panels also power our classroom facility and a dug well used to irrigate the Food Forest

ENERGY EFFICIENCY

Besides producing our own solar energy, the key to becoming net zero is energy efficiency. The new Program Centre has 8-inch walls, an extremely well-insulated foundation built to new efficiency standards that minimize the use of concrete (the technical term is ICF – insulated concrete forms), and R65 ceiling insulation. Both the Program Centre and the Classroom facility are equipped with on-demand electric hot water heaters and modern air-to-air heat pumps - no inefficient baseboard heaters anywhere.

OTHER APPROACHES TO ENERGY

Eagle-eyed visitors to the Program Centre may also notice a small wind turbine spinning happily and rather intermittently near the solar array. The wind turbine is mounted there as a learning tool for renewable energy programs only—a proof of concept—and is not connected to the grid. In addition to solar, we use the many facilities at the Millard Learning Centre to demonstrate micro-wind, micro-hydro (water wheels), energy interconversions, air-to-air heat pumps, and more. Check out our education programs in renewable energy online or email energy@galianoconservancy.ca to learn more.

Participants in the TETACES Climate Action program learn about solar and micro-wind at the Program Centre.

Pacific Herring:
The Cornerstone of Salish Sea Food Webs

by Elias del Valle, GCA Marine Technician

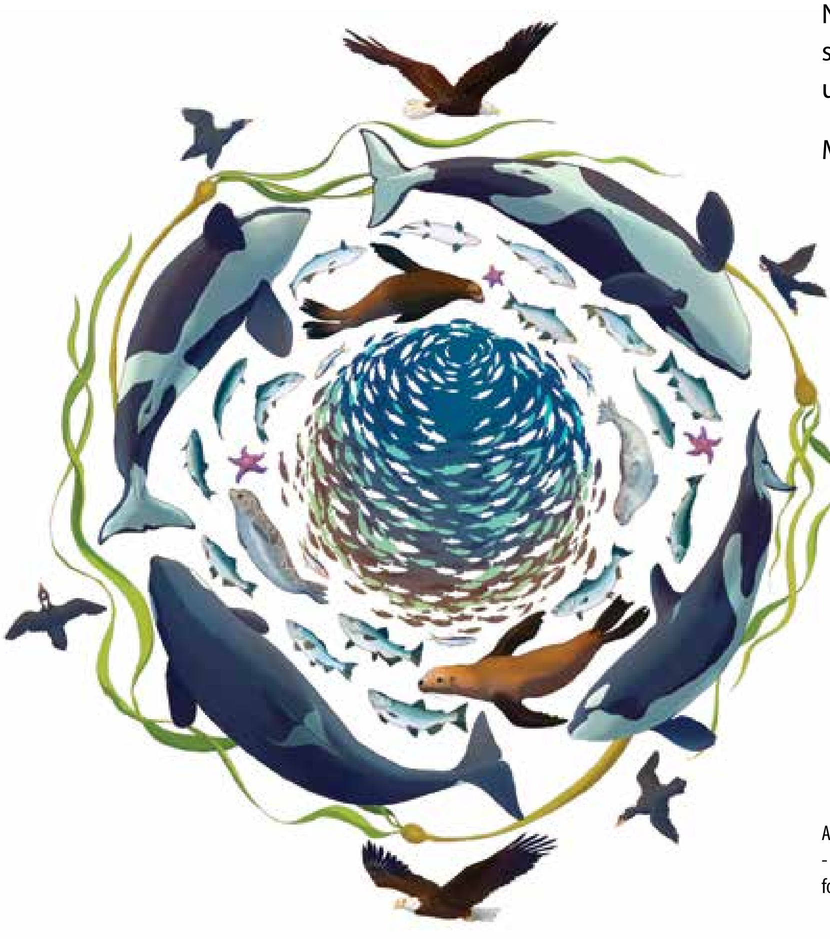
In early spring, when days are getting longer, Pacific herring (*Clupea pallasii*) return to the west coast to spawn in sheltered bays and estuaries. Herring schools spawn together, with each female laying 10,000 to 50,000 sticky eggs on kelp, eelgrass, and other marine vegetation in shallow areas.

Spawn events are recognizable by the milky white milt that turns the water turquoise as males fertilize the deposited eggs. A few weeks later, millions of those little herring hatch and start a new life cycle in the Pacific Ocean. Estimates suggest that only one of every 10,000 eggs laid will return as an adult to spawn; the rest become food for other species.[1]

Known as a 'forage fish'- a term that includes other schooling species, such as smelt, sandlance, eulachon, and capelin - herring provide an essential food source for a broad range of marine and terrestrial predators, such as salmon, rockfish, seals, sea lions, sea birds, cetaceans (whales, dolphins, and porpoises), coastal wolves, and even bears. In fact, the Salish Sea's endangered southern resident orcas (*Orcinus orca*), are indirectly dependent on herring, as they provide a central food source for resident orca's focal prey, Chinook salmon (*Oncorhynchus tshawytscha*)[2,3]. In other words, herring feed the salmon that feed our resident orcas.

Herring have also played and continue to play a critical role in supporting First Nations communities across the Pacific Northwest. Through archaeological faunal analysis, research led by the University of Victoria's Dr. Iain McKechnie demonstrated that over the past 10,000 years, herring have been found in roughly 99% of Pacific Northwest Coast archaeological sites. In several individual sites, most notably in the Salish Sea, Pacific herring made up 80% or more of the total fish consumed.

McKechnie's work also highlights the existence of a problematic 'shifting baseline' in BC's herring fishery. A shifting baseline can be described as a measurement error that occurs when a system is measured and compared against a previous reference point or baseline that is assumed to represent the 'normal' or 'natural' state of the system, when in fact, the previous reference point or baseline is also an altered state. For example, when herring abundance first began to be measured quantitatively in the mid-1900s, it had already been impacted by intensive settler-driven overfishing; therefore, the 'baseline' herring population that is employed is likely significantly lower than historical herring populations under First Nations management. McKechnie's findings demonstrate that over the last 10,000 years, herring catch remained incredibly high and



Artwork by Tasli Shaw for Conservancy Hornby Island - visit https://www.conservancyhornbyisland.org/herring for information about their herring campaign.

consistent across most archaeological sites; therefore, it is likely that the low herring populations, which are currently deemed as natural or normal, are a very recent phenomenon, and a striking cause for concern[4].

Declines in herring and other forage fish populations have cascading impacts on numerous predators higher up in the coastal food web. Chinook salmon, already suffering from the impacts of overharvesting, habitat loss and degradation, as well as diseases and parasites spread by farmed salmon, are now subject to a greatly reduced food supply. The resulting scarcity of Chinook salmon is considered to be the primary stressor on the dwindling southern resident orca population.[5] Thus, the long-term health and survival of southern resident orcas is linked not only to the abundance of their preferred prey, Chinook salmon, but also to the stability of Pacific herring populations.

So, what might we do to help protect herring, salmon, and orcas? Understanding threats to critical habitat is a great place to start. Without sufficient habitat, populations will be subject to growth limitations. One thing herring and salmon have in common is a reliance upon eelgrass meadows and kelp forests as critical habitat. These habitat types are structured, offering shelter from rough ocean conditions, and a place to hide from predators, while also hosting plentiful prey for herring and young salmon such as zooplankton and smaller fish. In addition to their pivotal role in maintaining and enhancing fish populations, kelp forests and eelgrass meadows are significant carbon sinks and coastal buffers, making their protection more critical in the era of climate change and rising seas.

Eelgrass meadows grow in shallow waters from the intertidal down to 7 m depth, while kelp beds lie somewhat deeper, down to 17 m. As coastal ecosystems, both are very susceptible to negative human impacts such as coastal development, excess sedimentation, pollution, and climate change. Eelgrass can also be damaged through trampling and dragging of boat anchors, and kelp is susceptible to threats of its own, including propeller damage, over-harvesting, and sea urchin overgrazing (typically a consequence of human removal of sea otters, a primary urchin predator, which were extirpated from BC coastal ecosystems through over-hunting during the 1800's).

By providing a means of protection for these habitats, we can ensure that both herring and salmon retain adequate habitat to support population recoveries. Abundant fish populations will in turn support the continued viability of our iconic southern resident orcas, and the health of the Salish Sea as a whole.

The Galiano Conservancy Association (GCA) is collaborating with the Mayne Island Conservancy Society (MICS) to map eelgrass meadows throughout the Gulf Islands and initiate a long-term kelp bed monitoring program with partner conservancies on Pender, Saturna, and Valdes Islands. Baseline data on eelgrass and kelp bed locations and extent are essential for assessing how these habitats are changing through time. The habitat mapping program is one half of a larger Cetacean Conservation Project, which also focuses on public outreach, promoting whale-safe boating and cetacean conservation as a whole. The long-term kelp bed monitoring initiative is made possible through the help of volunteers on each island involved. We are currently seeking volunteers to monitor kelp beds by kayak with us in 2020! Surveys will take place during low tides in August, when annual kelp stands have reached full length and are visible at the surface.

If you are interested in volunteering with our 'Kelp Squad', or donating to the Cetacean Conservation project, please email: oceans@galianoconservancy.ca. In the meantime, there are several steps that you can take to keep our eelgrass, kelp, herring, salmon, and orcas healthy. For boaters, these include only anchoring deeper than 7 m (23ft) to protect fragile eelgrass meadows in shallower waters, avoiding kelp forests when motoring and anchoring, and staying up to date on marine mammal regulations, such as the new requirement to stay at least 400 m from all orcas in Southern BC coastal waters as of June 1st, 2020. Non-boaters can also make a difference by joining your local streamkeepers chapter to help protect and enhance salmon habitat, taking part in shoreline clean-ups, and reporting boating infractions to 1-800-465-4336. Together we can rejuvenate the productivity and biodiversity of the Salish Sea!

[1] Capital Regional District. See https://www.crd.bc.ca/education/our-environment/wildlife-plants/marine-species/pacific-herring

[2] Ford, J., & Ellis, G., "Selective foraging by fish-eating killer whales (Orcinus orca) in British Columbia." In Marine Ecology Progress Series, 316, pp.185-199, 2006. doi:10.3354/meps316185

[3] Ford, J., Wright, B., Ellis, G., & Candy, J., "Chinook salmon predation by resident killer whales: Seasonal and regional selectivity, stock identity of prey, and consumption rates." DFO Can. Sci. Advis. Sec. Res. Doc. 2009/101. iv + 43 p.

[4] McKechnie, I., Lepofsky, D., Moss, M., Butler, V., Orchard, T., Coupland, G., . . . Lertzman, K., "Archaeological data provide alternative hypotheses on Pacific herring (Clupea pallasii) distribution, abundance, and variability". In Proceedings of the National Academy of Sciences, 111(9), pp. 807-816, 2014. doi:10.1073/pnas.1316072111

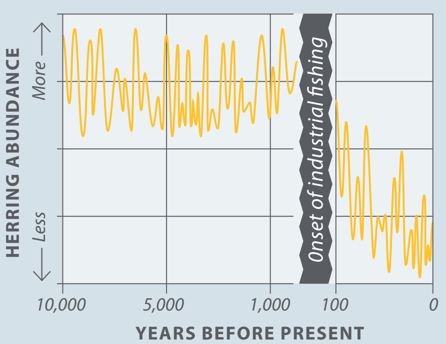
[5] Ayres, K., Booth, R., Hempelmann, J., Koski, K., Emmons, C., Baird, R., . . . Wasser, S. "Distinguishing the impacts of inadequate prey and vessel traffic on an endangered killer whale (Orcinus orca) population." In PloS One, 7(6), e36842, 2012. doi:10.1371/journal.pone.0036842

PACIFIC WILD'S TOP 10 ARGUMENTS

Against the Strait of Georgia Commercial Seine & Gill Net Herring Fishery

The wrong population baseline is used to set quotas

Current population estimates are compared to data from 1951, even though herring populations were already depleted by industrial fishing at that point. This **conceals the declines caused by the early fishery and limits the scope of recovery** for B.C. herring populations.



For thousands of years, herring were abundant on the B.C. coast

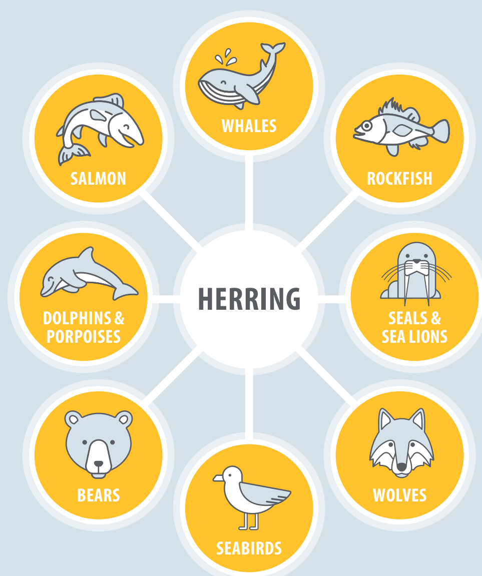
First Nations fished Pacific herring sustainably for thousands of years before industrial fishing. Archeological records from up to **10,700 years ago show that herring were more abundant than they are today** - they may even have been a more important food source than Pacific salmon in the Gulf Islands.

Herring are worth more in the water

Herring contribute more to B.C.'s economy by feeding other species than by being caught and processed. **Better management of herring populations is an investment in the B.C. economy.**

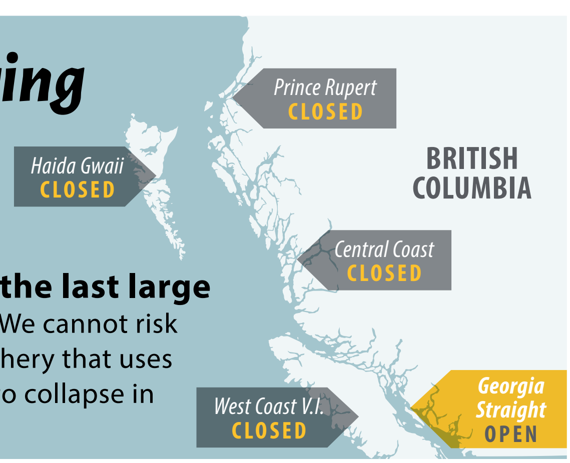
Herring feed the coast

Herring play a **key role in the coastal ecosystem,** transferring energy from plankton to bigger animals, from salmon to seabirds and even whales. A complete collapse of herring populations would cause ecosystem-wide changes.



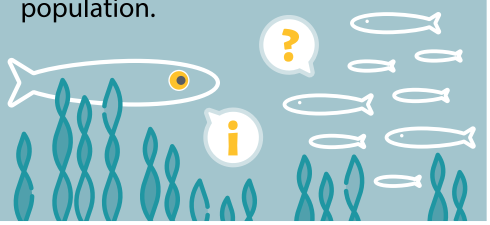
4 out of 5 herring populations have crashed

The Strait of Georgia is **home to the last large herring population in B.C.** We cannot risk our last herring population for a fishery that uses unreliable models which have led to collapse in the other four populations.

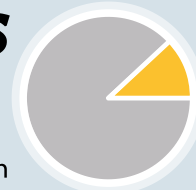


Young herring rely on older herring for knowledge

Older fish hold important hereditary knowledge, like where to spawn, and **they pass this knowledge down to younger fish.** The herring fishery catches the largest fish, which are the oldest, removing important knowledge from the population.



Only 12% of the catch feeds humans - in Japan



The roe is sold in Japan as kazunoka, a luxury food. The carcasses from the male and female herring are ground up and **turned into low-value products.**

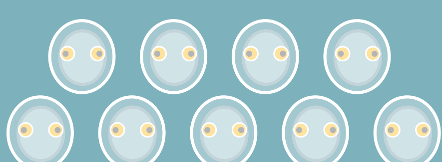
Help Us Map Herring Habitat

As part of our Cetacean Conservation project, we are looking for volunteers to help us monitor bull kelp beds! Kelp and eelgrass provide critical habitat for herring, salmon, and other small fish that support healthy cetaceans in the Salish Sea. To get involved, email oceans@galianoconservancy.ca.

Galiano Conservancy ASSOCIATION

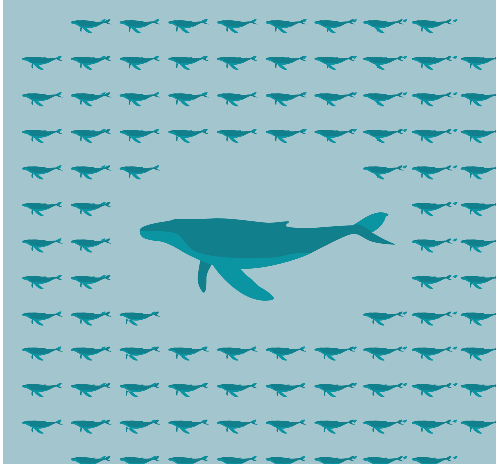
1 herring can spawn up to 9 times in a lifetime

Adult herring can **live up to fifteen-years-old,** and return to the same place to spawn, year after year. The roe fishery catches herring right before spawning, interrupting the production of billions of fertilized eggs.



130 million herring could feed a lot of animals

The quota for the 2019 Strait of Georgia roe fishery of over 20,000 tons translates to about 130 million herring - **enough to feed 100 humpback whales all summer.**



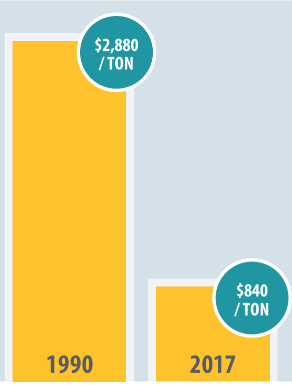
Learn more about how to help protect the herring

Go to https://pacificwild.org/campaign/protect-pacific-herring/

PACIFICWILD

Herring fishers make too little for their catch

Herring fishers are **making a fraction of what they made three decades ago** - for the same quantity of fish. As catch values decline, each boat must fish multiple licenses to make enough money to offset the costs of fishing.



Galiano Gratitude!

A heartfelt thank-you to our community for the continued support of all the work we do to help preserve and protect this island we all love so much!

POWERFUL WAYS TO CONTRIBUTE:

CREATE YOUR PERSONAL LEGACY FOR GALIANO

By leaving a bequest to the Galiano Conservancy, you can help secure the peace and beauty of our special island far into the future. Your legacy will help continue the work of the Galiano Conservancy for generations to come. For more information on Legacy Giving please visit www.galianoconservancy.ca/donate/

BECOME A MEMBER OF OUR GIVING CIRCLE

We are asking friends of the Conservancy to join us in building an Annual Giving Circle to provide a stable source of unrestricted funding. Your annual gift will help to ensure that the Conservancy can passionately pursue its mission to preserve and enhance the human and natural environment of Galiano Island. Every level of giving supports a strong foundation. We invite you to join at one of four levels:

ONE-TIME DONATIONS OR MONTHLY GIVING

Did you know that only two cents of every dollar donated in Canada goes to nature? Choose nature with a single or monthly donation! Making a pre-authorized monthly gift to the Conservancy from your bank account or credit card provides a steady, reliable source of conservation funds that will be put to immediate use.

To make a donation please visit www.galianoconservancy.ca/donate-online/ or contact Jennifer Stackhouse at 250-539-2424 or by email: development@galianoconservancy.ca

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