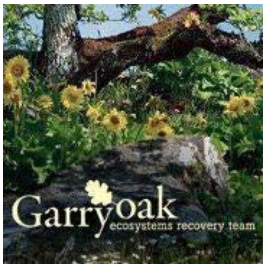
GOERT 2016

12th Research Colloquium
Traditional Practices and New Imperatives

Proceedings

Photo by Chris Junck

November 18th 2016



University of Victoria

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Edited by
Valentin Schaefer and Siobhan Darlington

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Acknowledgements

The *Traditional Practices and New Imperatives Colloquium* was sponsored by the Garry Oak Ecosystem Recovery Team Society (GOERT) and the Restoration of Natural Systems (RNS) Program of the University of Victoria, a program offered jointly by the Division of Continuing Studies and the School of Environmental Studies. Additional funding for the Proceedings was provided by the School of Environmental Studies. Logistics for the event were arranged by Laura Biggs and Laura Anderson of the RNS Program in the Division of Continuing Studies. Registration was handled by Craig Elder of GOERT.

Speakers for the Colloquium were primarily recommended by the Garry Oak Ecosystem Recovery Team (GOERT). Descriptions of the presentations provided in the Proceedings were based on notes taken by Siobhan Darlington of Environmental Studies at the University of Victoria. PowerPoint slides in the Proceedings were taken from the presenters' talks.

Val Schaefer, GOERT Society Chair and Academic Administrator for the RNS Program, was the Coordinator of the Colloquium and was responsible for developing the program, corresponding with presenters, working with the event volunteers and overseeing the production of the Proceedings.

All of the presenters volunteered their own time and paid their own transportation costs to participate in the Colloquium, a major contribution for which we are thankful and without which the Colloquium would not have been possible.

The cover photo was taken by Chris Junck.

Background Information

Traditional Practices and New Imperatives in Garry Oak Ecosystems

The restoration of Garry Oak Ecosystems faces many new practical challenges. They include the importance of provenance, the population dynamics of translocations, assisted migration and prescribed burns. There are many new theoretical challenges as well that have a bearing on our understanding of Garry Oak Ecosystems and on our decisions on how they are best restored – developments in resilience theory, novel ecosystems and ecological thresholds to name a few. Added to these considerations are the impacts of changing biophysical conditions in temperature, precipitation, species ranges and phenology. There are many moving parts and functional responses are frequently not linear.

The restoration of Garry Oak Ecosystems today questions some traditional practices and raises some new imperatives. A local example on the gulf islands involves some restoration groups that advocate for the use of native seed stock from a wide geographic range to increase the potential adaptability of restoration plantings, while other groups advocate the use of local stock to preserve unique genetic profiles. Also, there is now concern that selecting just the healthiest seedlings in restoration projects can create genetic bottlenecks and reduce resilience – we may be better served by planting a greater diversity of individuals.

This year's GOERT Colloquium explores the uncertainty inherent in the restoration of Garry Oak Ecosystems and offers an opportunity for dialogue about options as we move forward.

About the Garry Oak Ecosystem Recovery Team (GOERT)

Based in Victoria, BC, we coordinate efforts to protect and restore Garry Oak and associated ecosystems and the species at risk that inhabit them.

In the rainshadow of the Vancouver Island Ranges, one of Canada's richest ecosystems is also one of its most endangered. Less than 5% of Garry Oak ecosystems remain in a near-natural condition. More than 100 species of plants, mammals, reptiles, birds, butterflies and other insects are currently officially listed as "at risk of extinction" in Garry Oak and associated ecosystems. Several species have already been eliminated.

The Garry Oak Ecosystems Recovery Team (GOERT) is working to save these endangered species and the habitats they need for survival. Your help is needed. You can play a valuable part in a comprehensive recovery program to protect this rare habitat and save the plant and animal species at risk of local or global extinction.

A National Treasure Garry Oak ecosystems are a unique national treasure. Thousands of plant and animal species inhabit Garry Oak ecosystems. They are the richest land-based ecosystems in coastal BC, they are a defining landscape characteristic of this region, and they are an integral part of the culture of this area. First Nations have harvested foods and medicines from Garry Oak ecosystems for hundreds of years, and in some areas, Garry Oak meadows were tended and deliberately burned to enhance the production of camas and other food sources.

Garry Oak Distribution In Canada, Garry Oak ecosystems are found on southeast Vancouver Island, the Gulf Islands, and in two locations in the Fraser Valley. They are also found in Washington, Oregon, and California (where the trees are often known as Oregon White Oaks). They exist nowhere else in the world.

Our Story - What We Do

GOERT was formed in 1999 to coordinate efforts to protect and restore endangered Garry Oak and associated ecosystems and the species at risk that inhabit them.

Our Recovery Implementation Groups (RIGs) are working to complete the science-based information necessary for ecosystem and species recovery, minimize ongoing site and species losses, and motivate public and private protection and stewardship activities.

Only a concerted, long-term effort to conserve what is left of Garry Oak and associated ecosystems in Canada can halt the ever-increasing threat to their species at risk.

GOERT's recovery planning approach considers ecosystems as well as individual species at risk. Recovery planning in Canada has historically taken a species-by-species approach, but national initiatives now recognize the importance of incorporating a wider

scope in some circumstances. The ecosystem-based approach makes sense in this case, as so many species at risk occur in the same geographical area in Garry Oak and associated ecosystems.

Our Programs How We Do It

Bring Back the Bluebirds — the Western Bluebird Re-introduction Project. We are beginning year 3 of an ambitious 5-year project to re-introduce extirpated (locally extinct) bluebirds to Vancouver Island and the Gulf Islands.

Species at Risk Outreach — contacting private and public landholders who have species at risk on their land and helping them protect and restore the species at risk populations.

Local Government and First Nations Outreach — working with local governments and First Nations to provide resources needed for protection and recovery of species at risk in Garry Oak habitat.

Resources for protection and restoration of Garry Oak ecosystems — our popular *Garry Oak Gardener's Handbook*, comprehensive restoration manual, species at risk and invasive species field manuals, and much more.

What You Can Do

Through grants and donations the Garry Oak Ecosystems Recovery Team can continue to reach out to local governments and others who manage the remaining fragments of Garry Oak habitat in this region, the only place they exist in the world. Protection and restoration of habitat is needed to halt the decline of more than 100 species at risk. We are truly humbled by the dedication and hard work of so many partners working to save rare plants and animals and their habitat. With your support, we can continue this momentum.

Restoration Programs at the University of Victoria

Restoration of Natural Systems Diploma and Certificate

The Restoration of Natural Systems (RNS) program is an accredited program created to disseminate information about the emerging field of environmental restoration and to provide practical background knowledge, training, and skill development for those working in areas related to the restoration of natural systems. The program is offered by the School of Environmental Studies and the Division of Continuing Studies, and is guided by an advisory committee. This interdisciplinary program provides the theory and practice needed to conduct restoration activities. It takes a holistic approach that recognizes the importance of both the social and biophysical dimensions of environmental restoration. The courses have been designed to meet the needs of professionals and to suit the busy schedules of people who work full time. Courses are offered in either an on-campus five-day immersion format or semester-long distance format. The program is offered at the 3rd and 4th year undergraduate level and often attracts students who are concurrently working on an undergraduate degree.

The courses in the program are expected to contribute in varying degrees to the student's knowledge and skill areas in:

- Designing restoration projects that consider a broad range of subject areas and include consideration of human factors;
- Evaluating projects on an on-going basis and making adjustments;
- Using scientifically rigorous approaches to restoration projects;
- Reading and analyzing technical reports and scientific publications;
- Introducing students to the decision makers and policies governing restoration work;
- Dispute resolution, conducting consultative processes, and consensus building;
- Presenting ideas clearly electronically, orally and in writing;
- Recognizing personal values that affect individual's decisions;
- Use of current mapping and sampling technologies;
- Solving problems encountered in implementing restoration projects;
- Working in partnership with other professionals and stakeholders;
- Developing competency in the types of equipment and procedures used to sample the natural environment;
- Developing awareness of national and international restoration issues;
- Understanding human impacts;
- Including traditional ecological knowledge in restoration planning;
- Incorporating social and scientific knowledge in restoration planning.

Diploma students must be admitted into the program and accepted to the University of Victoria for credit study. Students must complete 12 courses (6 required courses and 6

electives) to obtain their diploma. A one- or two-term co-op placement option is available for diploma students.

Certificate students must also meet the admission requirements of the program but do not have to accepted for credit study at UVic. Students must complete 8 courses (6 required courses and 2 electives) to obtain their certificate.

The RNS Program has received both the Award of Excellence from the Canadian Association for University Continuing Education (2001) and the Ecostar Award for Environmental Education from the Capital Regional District (2005).

Ecological Restoration (ER) Professional Specialization Certificate

This non-credit ER post-baccalaureate certificate has been designed for professionals working in the field of ecological restoration, environmental practice, biology, landscape architecture, landscape design and management, forestry and agrology. The certificate builds on the success of the Restoration of Natural Systems program to offer more advanced training for working professionals. Courses in the certificate are offered in a distance format, appealing to professionals from across North America as a means to meet their annual professional development requirements or to update their skills and understanding.

This program is intended for people who already hold a degree or diploma. The certificate is designed for practitioners working in restoration and related fields who see "problems" with current practices and want to investigate alternative and innovative solutions. This program develops critical thinking skills and asks challenging questions that deal with the uncertainty inherent with problems in ecological restoration.

Upon completion of this program, students will be able to conduct detailed site assessments and restoration projects that pay special attention to the unique conditions and challenges presented by built and otherwise highly altered environments. The program focuses on the following areas:

- re-establishing natural processes;
- balancing social and economic constraints with ecosystem functioning;
- exploring new approaches to creating functional landscapes; and
- challenging our current understanding of ecological restoration as it is applied to a wide range of conditions.

The program features four courses, which are only available online:

- ER501: Design Principles for Natural Processes
- ER502: Ecosystem Design through Propagation of Native Plants
- ER503: Natural Processes: Restoration Ecology
- ER504: Invasive Species and Novel Ecosystems
- ER 505: Climate Change and Ecological Restoration

Three courses are offered each year, one in the spring (January to April), one in summer (May-August) and one in the fall (September to December). Students can complete the program in as little as two years.

The program has five foundational areas of emphasis:

1. Using a systems approach to restoration that focuses on ecosystem function as well as structure. For example, the program focuses on the use of symbiotic relations such as mutualism, competition and predation as they can shape plant and animal communities, or using ecosystem engineers such as beavers to create wetlands, or taking advantage of natural succession to restore disturbed areas.

2. Restoration as a means to re-establishing natural processes. Whereas the re-establishment of species associations requires knowledge of species habitat, re-establishing processes requires all of this knowledge as well as in-depth knowledge of systems, of interdependencies and of ecological processes, For example, it involves understanding the mycrorrhizae and invertebrates which form the basis of soil ecosystems.

3. Site analysis on the micro and macro level that examines ecosystems at all scales, from ions in soil and water through unicellular organisms to the larger plants and animals that dominate nature's ecosystems. The site analysis also identifies social, political, legal and other non-biological factors that need to be considered and incorporated into a restoration project.

4. Using the latest theoretical constructs in formulating restoration plans. These include concepts such as adaptive cycles, panarchy, novel ecosystems and assembly rules.

5. Restoration in severely disturbed environments that provide their own unique challenges. Frequently all natural processes have been altered and systems have been removed. Restoration, therefore, involves re-establishing a natural system from scratch. Furthermore, a restoration biologist often only has a small patch of land to work with. And there are many on-going disturbances to the site such as noise and impervious surfaces.

1. Propagation of rare plants for translocation efforts at Fort Rodd Hill and in Gulf Islands National Parks Reserve

Nathan Fisk, Parks Canada

Introduction

Parks Canada staff member Nathan Fisk from the Coastal BC unit presents an update on the species at risk restoration and maintenance projects initiated by Fort Rodd Hill and Fisgard Lighthouse National Historic Site.

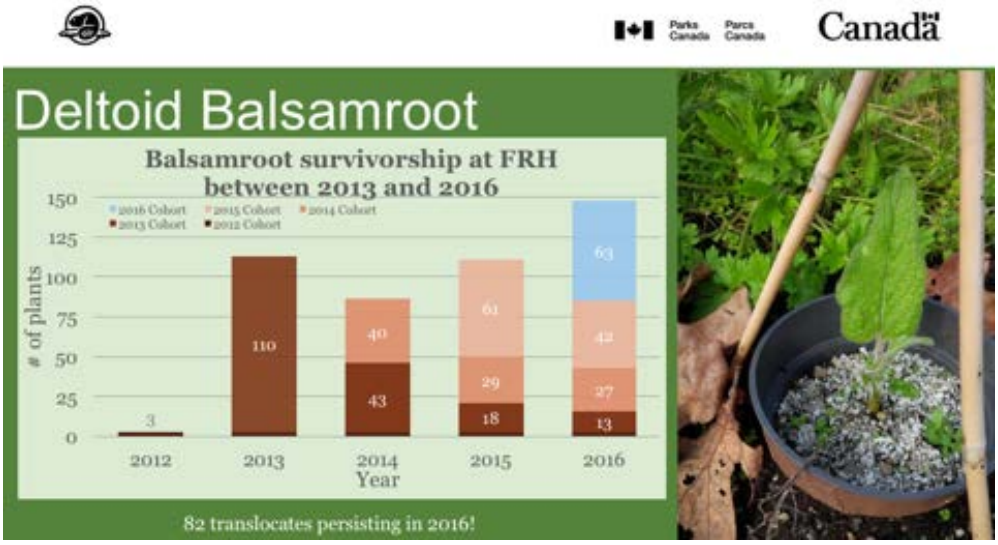
Garry Oak Learning Meadows Restoration

There have been a number of improvements to the nursery since the project began in 2012. Tall boxes were initially built for the growing flats however these frames were found to inhibit ventilation and the top halves were removed and filled with soil. In 2016 the nursery is growing successfully with camas growing faster than expected. Golden Paintbrush (*Castilleja levisecta*) are now protected by cages that prevent the flower heads and seed heads from being grazed. There is a high vole population in the meadows that attracts hawks and other birds of prey.

Species at Risk

There are many unique species at risk at Fort Rodd Hill that are currently being recovered. The Contorted-pod Evening Primrose (*Cammisonia contorta*) is listed as endangered under SARA Schedule 1. These plants are winter annual forbs that germinate in October and have taproots adapted to sandy ecosystems. Little care is required at the nursery as water run-off provides ample water supply and no fertilization is needed as wood and seashells are included in the boxes.

The Deltoid Balsamroot (*Balsamohiza deltoidea*) is listed as endangered under SARA Schedule 1. In 2013 there were 110 planted in the nursery. However, over half were unsuccessful in the first year. Soil mixtures and containers were improved including 4-inch copper collars installed for slug predation protection and a seeding drill that prevents soil compression and leaves the soil fluffy. In 2016 there were 63 planted and a total of 150 germinated plants with most blooming in 2 years. Seeds are currently collected from the Mill Hill and Thetis Lake area. However. the team is hoping that a self-sustaining population will establish soon.



The Slender Popcorn Flower (*Plagiobothrys tenellus*) is listed as threatened under SARA Schedule 1. It is a fast-growing winter annual forb that germinates in the fall in varied soil mixtures. There is only one population recently observed in Canada. Therefore, the recovery team's objective is to establish a new population in 2017 or 2018.

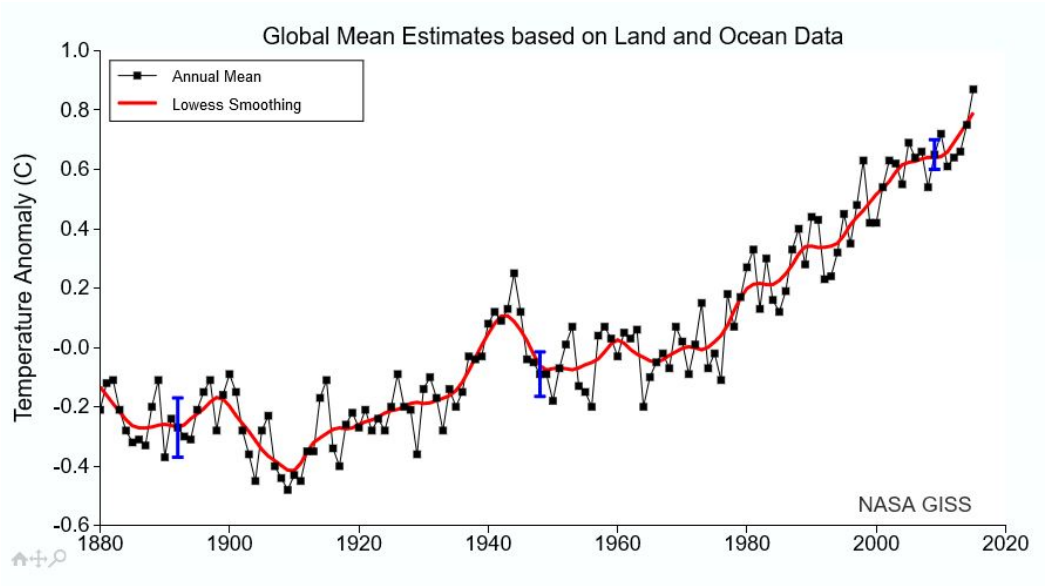
The Dense-flowered Lupine (*Lupinus Densiflorus)* is listed as endangered under SARA Schedule 1. There are three populations in Canada including Macauly Point, Beacon Hill Park and Trial Island. They are an annual taproot forb and respond positively to seed smoking as a method of increasing germination. Seed smoking in the nursery has increased the germination rate from 18 to 53%.

<u>Moving forward</u>

The recovery team aims to rotate out non-species at risk vascular plants and increase nursery production and diversity. Future translocations will include a greater diversity of sites including planting on the Gulf Islands. Finally, the team aims to share their knowledge of species at risk and improved techniques for restoration with the community.

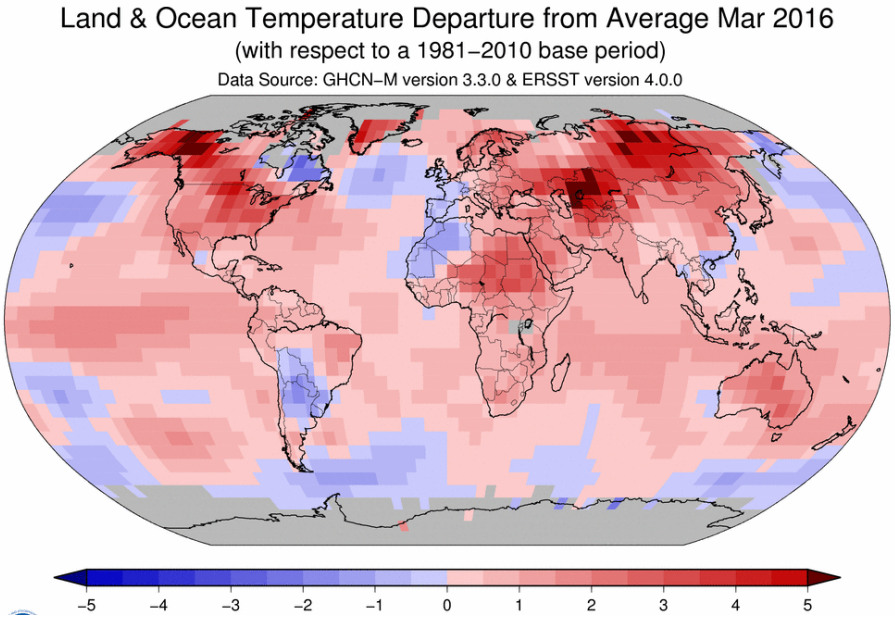
2. The Respective importance of genetic provenance, species selection and assisted migration in the light of climate change and increasing ecosystem fragmentation

Richard Hebda



Introduction

Richard Hebda is the Curator of Botany and Earth History at the Royal BC Museum and begins his talk by discussing the scale and rate of global temperature increases. Unprecedented rapid change is underway with record temperatures set globally in March of this year. Relative to the 1981- 2010 temperature base period, temperatures have increased by 5^{o}C in March 2016. This is the hottest year in recorded history.

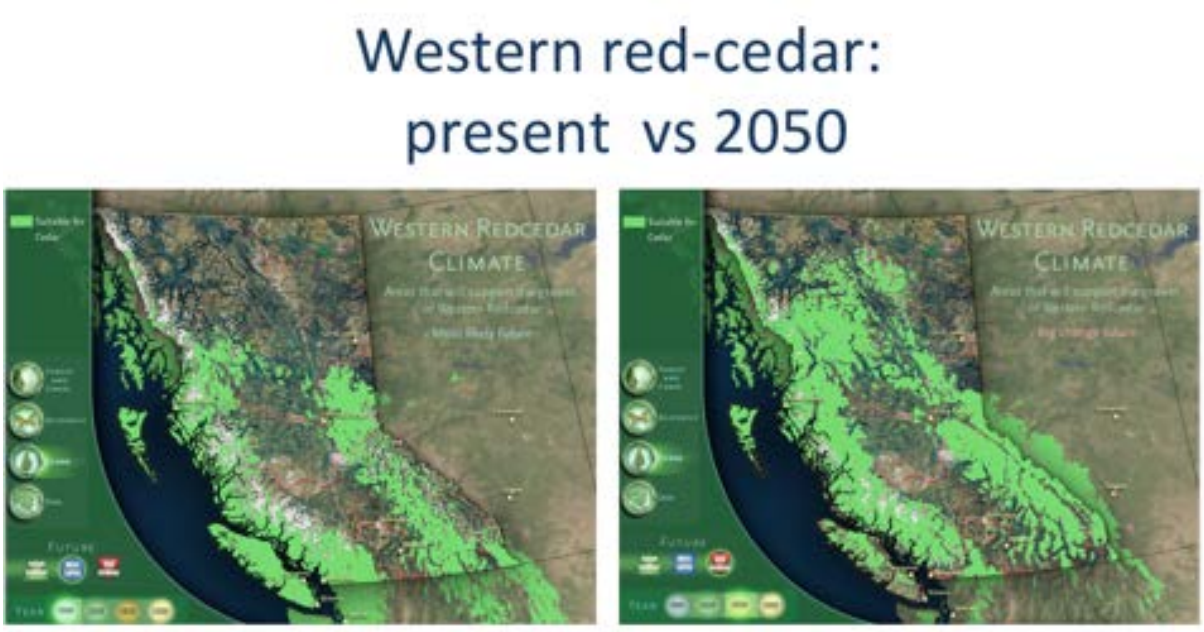


Carbon Dioxide on the rise

Carbon Dioxide (CO_2) exceeded 409 parts per million (ppm) in April this year for the first time in 800,000 years. Approximately 30% of this rise has occurred in the last 12 years. We've had exceptional increases in 2016 with 3.5 ppm compared to previous annual increases of 2.5 ppm or less.

Effects on Western Redcedar

The consequences of increased temperatures will invariably reach Vancouver Island's Western Redcedar (*Thuja plicata)* population. This species is in decline as the overstorey and understorey are affected by shifts in temperature with warmer summers and less precipitation occurring in the summer months. Pine death and cedar death are occurring on the Sunshine Coast and hemlocks have been observed dropping needles in this area. Cedars are projected to grow less in the southern range and expand their northern range as the climate envelope shifts. Projections of their future range show expansion into northern BC by 2050 with approximately 50% loss on Vancouver Island. More extreme projections show total absence of cedars on Vancouver Island and range expansion into the Yukon Territory by the year 2080. We are currently on track to meet the worst-case scenario.



Past warming periods (sobering thoughts)

During the Pliocene era approximately 2-5 million years ago (mya) the arctic temperature was 19°C warmer than today at only 390 ppm. Boreal forests grew on Ellesmere Island at the northern tip of the Nunavut Territory during this period. At just a 1-2°C increase sea levels were 5-7 m higher during the last interglacial period. Hebda asserts that it is unrealistic to limit global warming to 1.5-2°C because the impacts of CO_2 increases are lagging behind current conditions. We can expect an increase in temperature closer to 4-5°C at the rate we are currently experiencing.

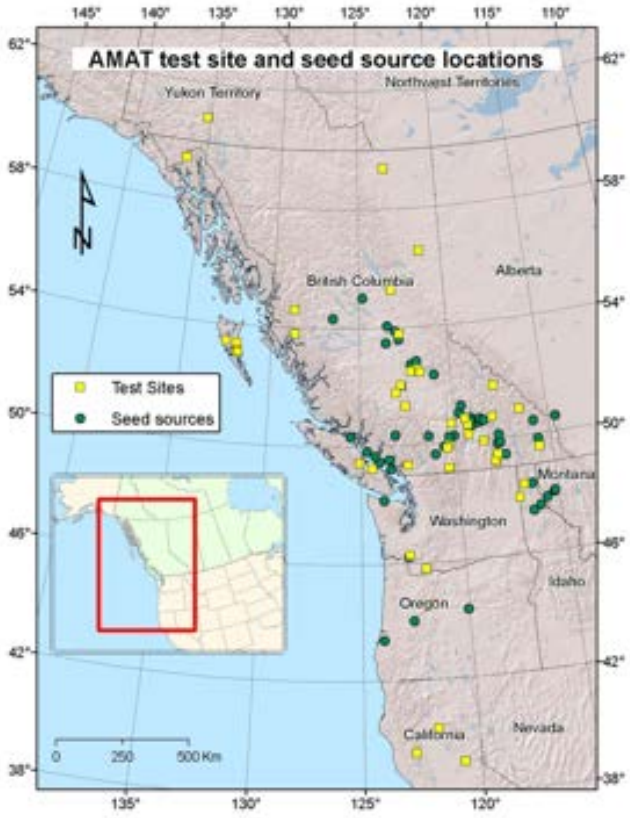
Adaptation

We must adapt to the conditions arising from global warming and be selective about what we can accomplish. Large-scale translocations of species are not possible because we do not have the capacity to manually shift species and test their success. Hebda suggests we put our ethical worries aside and step up to face the challenge or understand that we may be facing these worst-case scenarios within our lifetime.

Genetic provenance, species selection and assisted migration

Some actions can be taken in the BC forestry industry such as moving seeds slightly farther north (~200 m higher) from where they are currently growing; however, this is not enough. In Quebec local seed mixes are used in reforestation with other sources to create a more diverse seed base.

The province of BC implemented the Assisted Migration Adaptation Trial (AMAT) a few years ago with 15 tree species across 48 sites and today the consequences of the program are observed. In the figure below, green points represent seed sources and yellow points represent where seeds are moved to. Plants were not all planted at the same time due to funding constraints. Most of the sources were equally successful in terms of height achieved and germination rate. Some species were more successful than others like Ponderosa Pine (*Pinus ponderosa*). The important take-away message is that many of these species can grow far beyond their realized niches. Significant range changes may not be as devastating ecologically than expected because many of these species have grown together in the past.



Trials of species and seed sources beyond their range
MFLNRO,
G. O'Neill source

Translocation models

Woolly Sunflower can be used as an indicator species of open and dry sunny sites and act as a range model for Garry Oak Ecosystems. We can use Woolly Sunflower to select sites to move other species in assisted migration schemes and essentially create a species expansion model for species with smaller ranges. There are some risks associated with translocations such as introducing invasive species therefore it can be difficult to determine which species to move.

Key Points

Plant species will not be able to disperse at the rate of climate change therefore assisted migration is unavoidable as an adaptation strategy. It is important to begin with species and sites with the highest sensitivity, avoid drastic transformations, and sustain natural populations as sources. Finally, monitoring and reporting the results of assisted migration will improve future efforts.

3. Coastal Bluff Ecosystem Restoration in Helliwell Provincial Park

Erica McClaren

Project Team

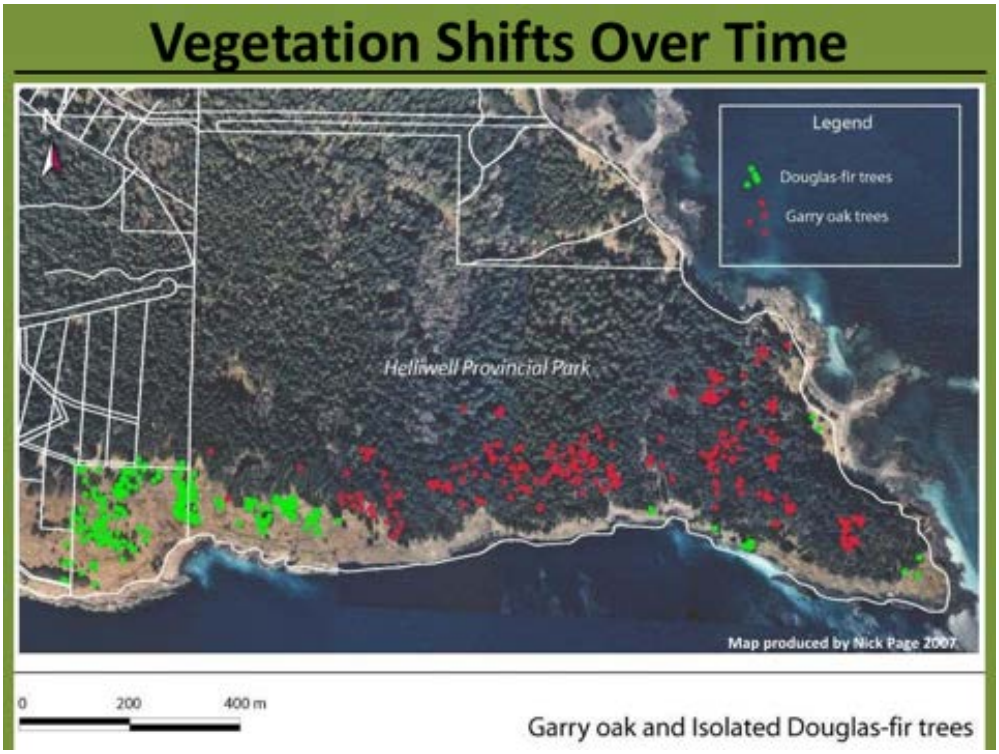
The Coastal Bluff Ecosystem Restoration Project is located within Helliwell Provincial Park on Hornby Island. The project is led by Erica McClaren, Jennifer Heron and Derek Moore in collaboration with Kristen and James Miskelly, Chris Junck, Parks Canada, BC Parks and Ministry of Environment, GOERT, Hornby Island Provincial Parks Committee, Hornby Island Natural History Society, Hornby Island Conservancy, Salal Ranch, Hornby Island residents, Polster Environmental Services Ltd., and the Ministry of Forests, Lands and Natural Resource Operations.

Introduction

Helliwell Provincial Park was established in 1966 protecting 63 ha of terrestrial habitat and in 1992 a marine protected area was included totalling 2803 ha. An ecosystem plan was drafted in 2001 identifying threats to coastal bluff and Garry Oak ecosystems from conifer encroachment. Aerial imagery from 1931 to present shows conifers such as Douglas-fir increasingly growing into open areas on the island within the provincial park boundaries.

Project Goals

This project aims to contribute to the national recovery of coastal bluff and Garry Oak ecosystems, the species that inhabit them, and the ecological processes that maintain them for future generations to enjoy. Goals of the project include decreasing the abundance and diversity of invasive species and increasing the abundance and diversity of native species within Helliwell Provincial Park. The team aims to re-establish a self-sustaining population of the Taylor's Checkerspot Butterfly within the park.



Restoration actions

The first tree removal activity was completed in late March of 2015 with 280 conifer trees removed from the site. Following removal 754 plants of 14 native species were planted in the restoration areas. The restoration efforts are managed adaptively using a trial and error approach to determine which plants are better for growing and withstanding deer browse. In September 2015 Bull and Canada Thistle, Hairy Cat's Ear and Orchard Grass were growing in the restoration sites and a weeding session and fall planting occurred. In the fall of 2015 a round of tree removal and limbing occurred with dense bottom layers of trees removed to allow more light to reach the understorey species. In the spring of 2016 another 331 plants of 11 native species were planted in the restoration areas. In the summer of 2016 invasive plant removal were recommenced for each site as well as another session of native species planting and tree removal and limbing. In the fall of 2016 there are more native plants successfully coming in and some bull thistles and browse remaining. As of the fall of 2016, the restoration areas are becoming well established with native plant species, although invasive species and browse continue to be ongoing challenges.

Monitoring

Two types of monitoring have been occurring on the sites. The first is small-scale periodic monitoring of the restoration areas for plant diversity for outplanting survival and native plant diversity and abundance relative to non-native plants. The second is large-scale monitoring for plant community changes within and outside of the restoration areas. This entails placing transects adjacent to the first restoration area for baseline monitoring.

First Nations Involvement

The K'omoks First Nation is actively involved in the Helliwell Restoration Project. In March 2015 the team provided a background presentation on the project and the K'omoks First Nation were invited to the sites to observe restoration efforts and discuss which plants would be suitable to plant on the site.

Public Involvement

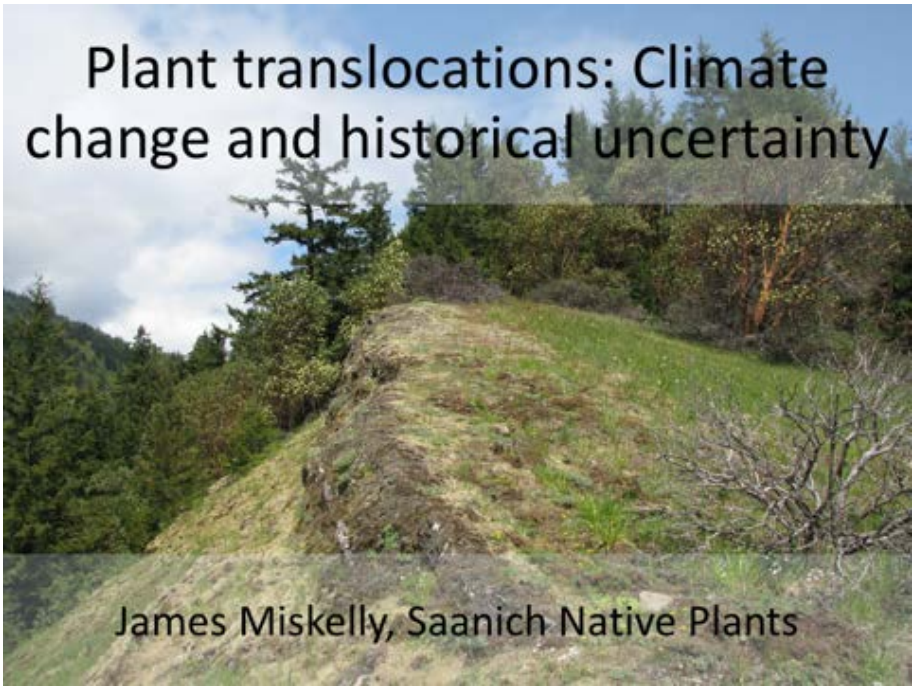
Clear and continued communication with the public has been essential to ensure this project is successful. The project has used public information sessions, online surveys, local farmer's market outreach and local advisory group meetings as ways to continue to keep the public involved and informed in this work.

Lessons learned

Over the past two years of adaptive management a few lessons have been learned. The costs of planting, seeding, and conducting invasive plant removal were higher than expected and a larger budget should be considered. After tree removal plants should be planted at high densities of 5-10 plants/m^2 to help outcompete invasive species. In addition, conifer needles should be left onsite as mulch to reduce invasives. Trees and limbs should be removed quickly from the worksite. The team has learned how essential it is to work with local advisory groups to help liaise with the community about this project.

4. Plant Translocations: Climate change and historical uncertainty

James Miskelly, Saanich Native Plants

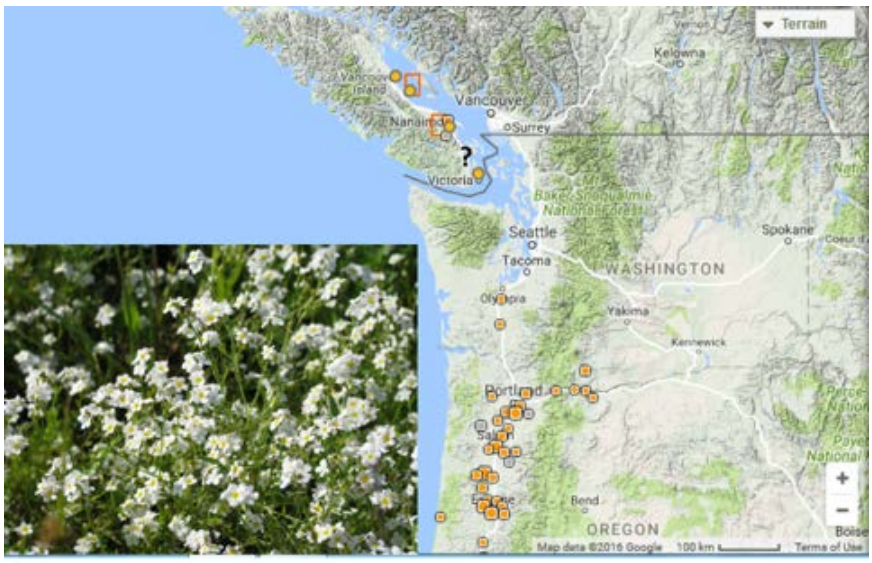


Introduction

James Miskelly discusses how climate change and rainfall in particular is driving shifts in vegetation composition and range. Garry Oak ecosystems occur in the Willamette Valley, from the Puget Sound through Georgia Basin. Victoria area is dryer than much of the range, with the Georgia Basin being dryer than most places to the south. Translocations are needed for the recovery and restoration of many native plants throughout this range that are vulnerable to the impacts of climate change.

Local arid plants

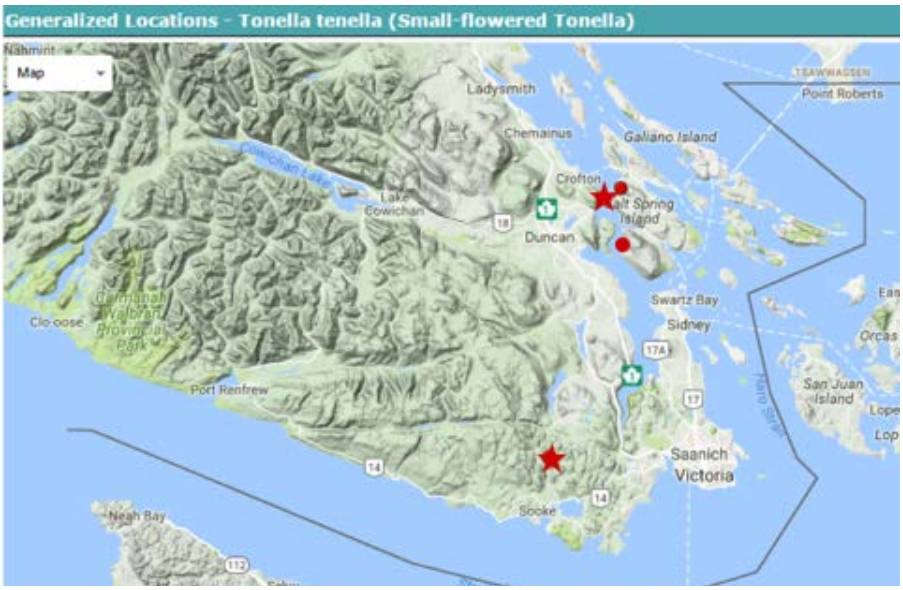
Prickly Pear, Silver Puffs and Grey Eye are arid land species with most of their range occurring in the interior and Garry Oak ecosystems limited to the Strait of Georgia. Recovery efforts should be focused on recovering arid land species that already occur in our region, including endangered species and protected the whole range of Garry Oak ecosystems.



Plagiobothrys figuratus

Recovery and restoration

Existing recovery strategies are based on recovering rare species in known historical locations. In the Cowichan valley, plant specimens are extending far back in the historical record but are not the best indicators for determining where species used to be. For example, there are no historic records for Popcorn Flower, Water Plantain and many other species. Recovery documents suggest that these plants were never there, therefore these plants should not be growing here. However, this is not precise. The Sooke Hills were never considered a suitable habitat for species like Small-flowered Tonella; populations were said to be historically limited to Salt Spring Island.



Rare and listed species are tracked and observed more today than previously, therefore historical occurrences may have been missed. Unlisted species common elsewhere in the province are found within Garry Oak ecosystems at a few sites but are overlooked or dismissed in regard to protection. It is likely that 90% of these populations have probably disappeared within Garry Oak ecosystems as habitat is lost.

Missing Species

Most of our protected areas, particularly urban parks, are missing species today. Beacon Hill and Uplands Park both have lost at least 5 species that were historically present. There are a few instances of rare species occurrences nearly being missed. *Lupinus oreganus* was found a few times in the 1920s but much of its habitat is now gone. *Lasthenia glabberima* was unnoticed until 2003 when most of its habitat was already mostly gone. There is little way of knowing how many species have been lost before they could be recorded.

Lasthenia glaberrima

Conclusions

The Strait of Georgia and Victoria area are currently drier than most Garry Oak ecosystems to the south. Some of the plants found in our region are arid-land species that do not occur in GOEs to the south. Many locations have a very poor historical plant record, and many species at risk and oddballs were more likely widespread than collection records indicate. Translocating plants from Washington and Oregon to prepare for climate change adaptation is not a good plan for the long term because it is not logistically feasible. Recovery planning should consider all available suitable habitat, and including previously undocumented plants in restoration projects will promote diversity.

5. Traditional Coastal Salish Food Production Techniques in Garry Oak Ecosystems

Darcy Mathews

Introduction

Dr. Mathews's research at the School of Environmental Studies, University of Victoria occurs within the Lekwungen and W'SANEC peoples territory and focuses on ecosystem management practices that pertain to food production, and particularly to Blue Camas (*Camassia quamash*) cultivation. Archaeological clues point to Garry Oak acorns being consumed as food, and the distribution of Lekwungen burial cairns are tightly linked to Blue Camas meadows. Dr. Mathews aims to explore these historical relationships in Lekwungen culture.

Gathering or incipient Agriculture

Simple gathering or agriculture? What is clear is that across British Columbia there are a variety of root foods that were harvested as carbohydrate food sources. Ethnographic, archaeological and historical sources indicate that the quantities involved were very large. The eatable bulbs of Blue Camas are a staple food, nutritionally important in an otherwise protein-rich diet. Blue Camas was prepared in earth ovens and there are probably hundreds around the Lekwungen territory. One earth oven was found near Esquimalt lagoon and is dated to be at least 3,000 years old.

The economic importance of Blue Camas

Blue Camas was a valuable asset where surpluses were grown and traded in kin-based exchange networks throughout the region with exchange networks dating back 10,000 years. These were owned by high status Lekwungen families who tended plots behind winter village sites. Land tenure over camas plots was an inherited right, the care and harvesting of which was often directed by specialists within households.

Annual camas harvest:

- Gunnysack = about a bushel of the bulbs
- 10,000 camas bulbs per family per year
- Assume 1000 people in a community and 10 people per family: annual harvest > 1,000,000 bulbs!

Blue camas management

The Coast Salish are active managers of plant resources, creating and maintaining plant communities. They ensured reliable, predictable and abundant supplies of food, materials and medicines. One of their most important resources was camas (*Camassia quamash* and *C. leichtlinii*). They employed a suite of different practices including selective/partial harvesting, burning, tending, tilling, weeding, ownership, stewardship, ritual, and ancestral presence. The Lekwungen people have specialized roles, division of labour, task groups, proprietary rights, and optimal accessibility to critical resources for high class Coast Salish families.

1 square meter of ground in Garry oak meadow, Cowichan; Kate Proctor's Masters research

Role of fire in GO ecosystems

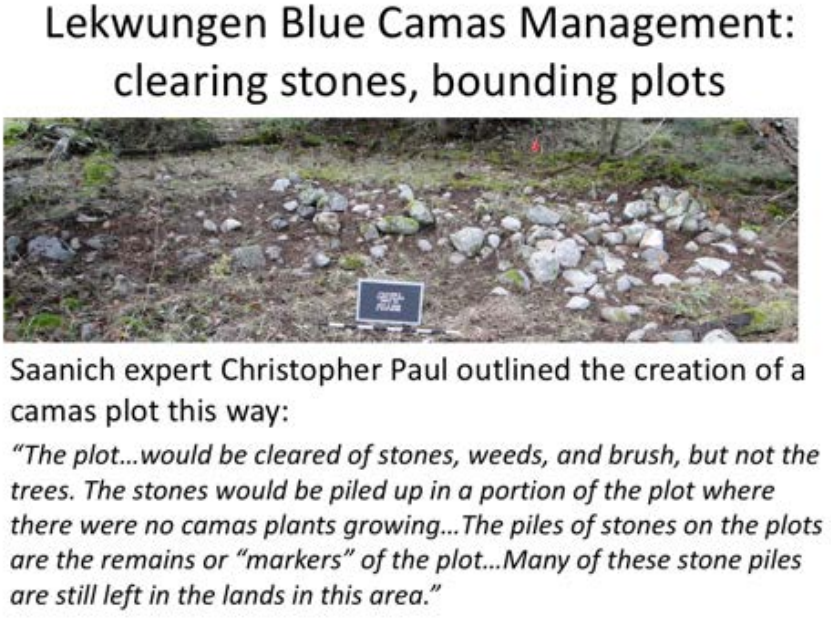
Burning is the best known and widely applied Tradition Ecosystem Management practice, with some form of fire management occurring worldwide. Large scale and small scale burning create a patchwork of biodiversity. Large scale fires occurring over many square miles drive game and renew the country. Dr. Matthew aims to understand more broadly about fire history, its timing, extent, intensity and time depth of burning.

Benefits of Burning to Lekwungen Food Production

There are a number of benefits of burning for Lekwungen communities. Burning discourages pests and weed growth while accelerating nutrient cycling by releasing nutrients in ash. The blackened ground encourages spring growth and promotes early successional vegetation which attracts browsing animals like Roosevelt Elk (*Cervus canadensis roosevelti*). Burning allows selection for annuals and perennials of which many are pre-adapted to fire to increase production of berries, tubers, leafy greens and medicines.

Fire and looking after the Camas beds

Camas beds were owned through matrilineal line in which they are passed down to the next female in the chain of descent. Historically the managing person is responsible for burning. One of Wayne Suttles' consultants stated that she was responsible for burning the camas area that belonged to her grandmother once they had finished harvesting for the season. Other people were allowed to harvest from this site, but responsibility for managing the resource site through landscape burning was clearly delegated to ensure that the resource would be available in following years.



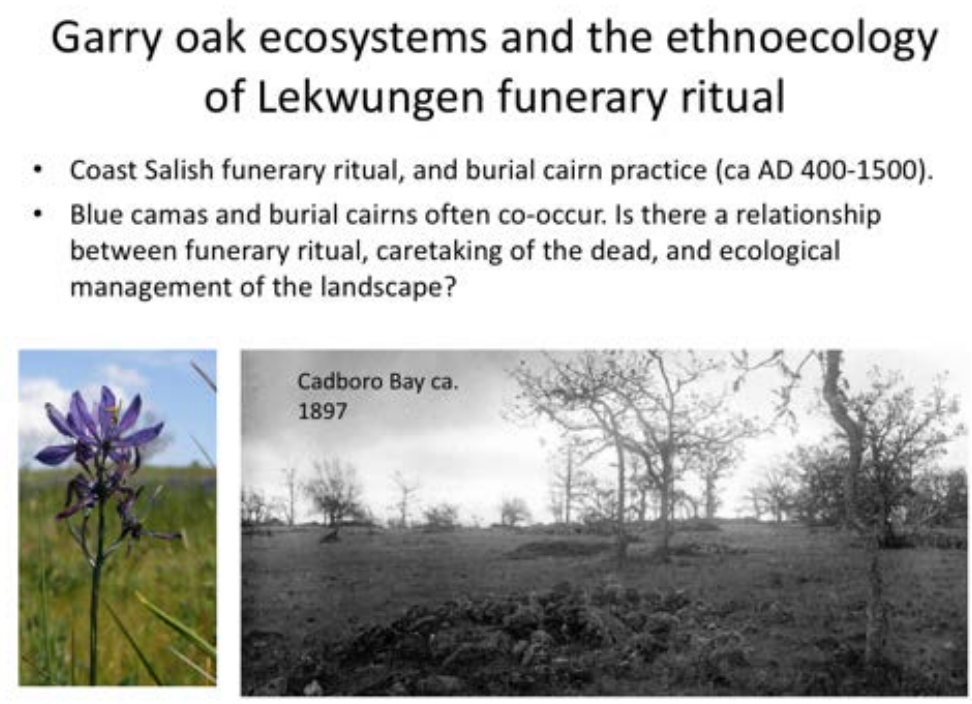
Clearing of stones and bounding of plots

Within camas gardens stones and brush are cleared from the area however trees are kept within the plots. Stones would be piled up in a portion of the plot where there were no camas plants growing. These are the remains of markers of the plots.

Burial cairns

Burial cairns have been found dating form 400-1500 AD. Interestingly, blue camas and burial cairns often co-occur suggesting a relationship between the two where the mourner becomes the inheritor. There have been 88 burial cairns mapped in 13.74 ha survey area in Uplands Park which occur around the edges of the camas blooming. Burial cairns are within 10 m of the

current edge of camas 64% of the time. Camas gardens created history and were an unbroken chain until European settlers arrived.

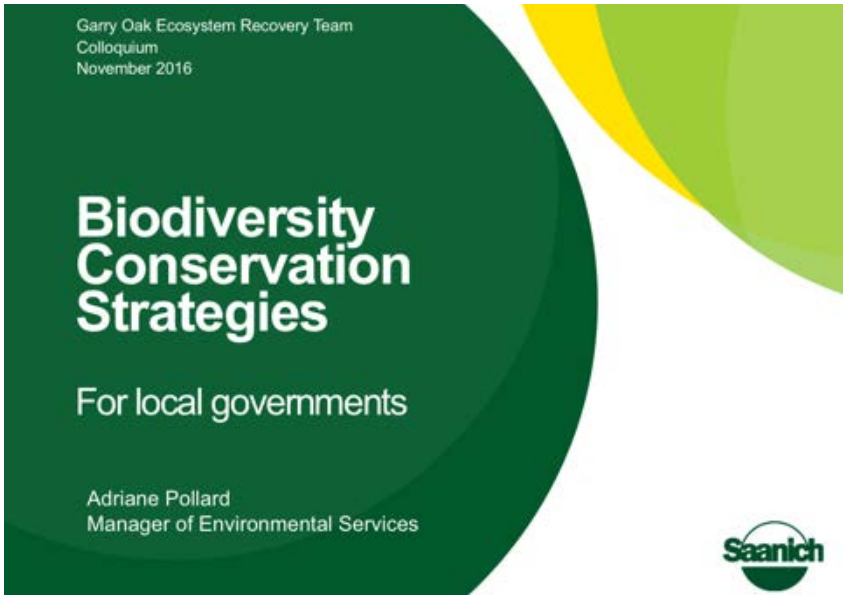


Garry Oak acorns as food

There is some ethnographic evidence that acorns were eaten by the Coast Salish people. On Sauvi Island, Oregon, there have been acorn storage and processing sites discovered suggesting large scale consumption. Acorns must have their bitter tannins removed before being consumed. Approximately 100 Western Hemlock-lined acorn leaching pits were found radiocarbon dated to AD 1760-1880. Various handstone and grinding slabs were found which are unique on the North Pacific Coast to this time period and were possibly used for grinding Garry Oak acorns.

6. Biodiversity Conservation Strategies for Local Governments

Adriane Pollard, Manager of Environmental Services, District of Saanich



Introduction

What are biodiversity conservation strategies? Adriane Pollard walked us through some examples and criteria for local governments to conserve biodiversity by increasing knowledge and understanding, identifying incentives and tools, providing strategic direction, creating partnerships, and mapping and planning.

Green infrastructure: is a strategically planned "natural" network that is actively managed and provides ecosystem services

Ecosystem Services: are functions and processes that provide benefits from air, water, land, and vegetation to our health, livelihoods, property, and community.

South Okanagan Similkameen Conservation Program

The 2012 biodiversity conservation strategy for the SOSCP was led by a steering committee in collaboration with governmental and non-governmental organizations. This strategy contains a baseline and current status for nature and biodiversity in the study area, suggestions on expanding conservation beyond municipal boundaries, strategic directions and opportunities for action by local government and implementation guidelines.

Nature Without Borders

The Comox Valley Conservation Strategy Community Partnership engaged local government in the development of their plan with a first edition completed in 2008 and a more extensive second edition in 2013. This newest version includes guiding principles with an overall objective to stop the loss of biodiversity with emphasis on landscape connectivity and access to nature, trails and freshwater systems. The visions, goals and objectives are clearly stated and priority conservation

areas are outlined with strategies for implementation. Policies and government are not included in the strategy document.

City of Surrey

This biodiversity conservation strategy emphasises the development of green infrastructure networks that reflect Surrey's more urbanized environment. This plan includes the biodiversity within the city, policy, education, and long-term monitoring using indicator species.

European Union

In the European Union, cities include biodiversity indices in collaboration with universities by mapping hot spots of biodiverse areas. Key considerations are the characteristics of high biodiverse areas, how large these areas must be to support diversity, and the extent of fragmentation and habitat connectivity. An environmental master plan is created to provide background data for conservation strategies; these identify main natural areas and anchor corridors including beaches, agriculture, and urban parks. These plans are combined with green infrastructure planning to meet targets.

Adriane illustrated these green infrastructure networks in a walk-through of Almada Portugal and Victoria-Gasteiz, Spain. Native plants are used to create green walls and rail lines are covered in grass to help with storm water management and to promote urban green space. Community gardens are planted with a perimeter of lavender to attract more pollinators. Beach restoration projects bring more dune grass habitat back to the beach and hold more sand in place. The city transit link allows access to wetlands and natural parks within 15 minutes of downtown. The municipality takes the lead on wildlife management and initiated a deer reintroduction to wetland areas. Few municipalities in Canada are involved at this level of species management.


ICLEI – Biodiversities: a primer of nature in cities

The International Council for Local Environmental Initiatives provides strategies for local governments to improve sustainability and calls for five steps:

1. Building a biodiversity team
2. Biodiversity assessment
3. Biodiversity planning
4. Implementation strategy
5. Monitor and review

Some weaknesses are that there is little focus on critical habitat and conservation takes a general approach. These plans are not always led by government and usually take a partnerships approach. Some common threads are that they are future looking, biodiversity plans are based on inventory mapping, promote connectivity, formulate partnerships, reporting is limited, and a policy framework is provided.

7. Ministry of Forests, Lands, and Natural Resource Operations Coastal Douglas Fir Breeding Program

Michael Stoehr – forest genetics section, tree improvement branch, Victoria BC

Introduction

Micheal Stoehr from the Ministry of Forests, Lands and Natural Resource Operations provided an update on the eight year Coastal Douglas-fir breeding program in BC and plans for the team to manage breeding and seed transfer with the implications of climate change.

Key definitions

Provenance test: evaluation of genetic variation due to seed source and response in new environment

Progeny test: evaluation of parents based on performance of offspring. Can also be used to make selections of good individuals (forward selections vs. backward selections)

Family: if only one parent is known ie. Wing pollinated or open pollinated cones = half siblings

Full siblings: both parents are known (controlled crosses)

Heritability: amount of genetic control over a trait

= the additive genetic variance/phenotypic variance

Breeding Value (BV): expression of genetic quality of parent:

BV = 20 means 20% more volume gain at rotation age

N_e: the effective population size, is an indication of inbreeding where selection and genetic diversity go in opposite directions

Breeding

Breeding is controlled crossing of genes. In Douglas-fir cross breeding paper bags are used to protect female cones and to control for natural pollination. The goal is to produce pedigree seeds for future testing and selection.

History of Coastal Douglas-fir Breeding Program in BC

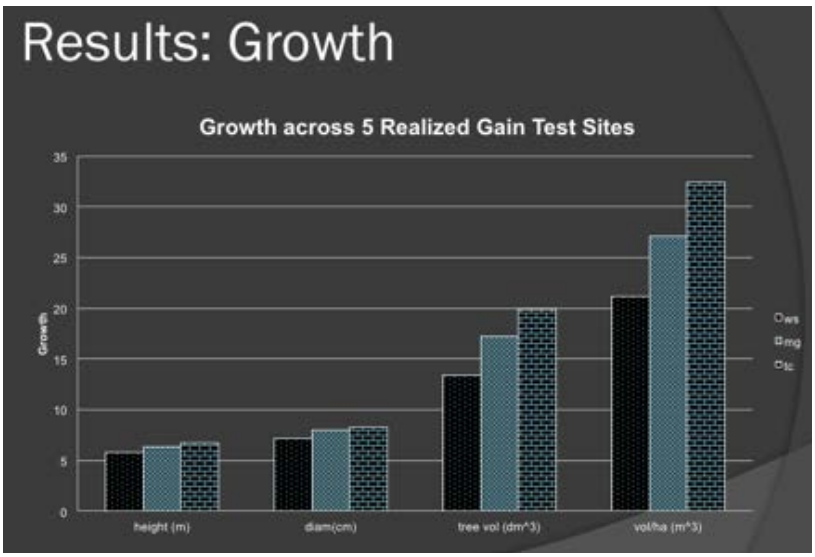
The breeding program in BC began with Allan Orr-Ewing who studied inbreeding since 1955 and began racial cross experiments in 1963. In 1976 Chris Heaman initiated the first EP708 diallel crosses. EP708 entails crosses with 6 genetically diverse parents in which some parents are only used as males or females, and some are used as both. Conifers possess both male and female cones on the same tree. Each diallel creates 15 full-sibling families. In 1990 Jack Woods began forward selections with 3000 series trees. In the last eight years the Coastal Douglas-fir breeding program has produced 62 diallels with 372 parents creating 930 full-sibling families across 88 total sites. Each test site is randomized complete blocks with four blocks per site and four trees per family. The total number of trees tested is 163, 680.

Coastal Douglas-fir Breeding Update:

Primary selection goals were volume at rotation secondary criteria: wood quality, stem form Third generation achieved 25% genetic gain with 100% orchard seed use in 2014 with over 15 million seedlings. With climate change there is more emphasis on disease and pest resistance. The team is looking into a climate-based seed transfer for next year that is strictly based on climate data. Approximately 10 million m^3 of Coastal Douglas-fir is harvested, generating $800 million dollars per year of which the team is responsible for 25% of this revenue.

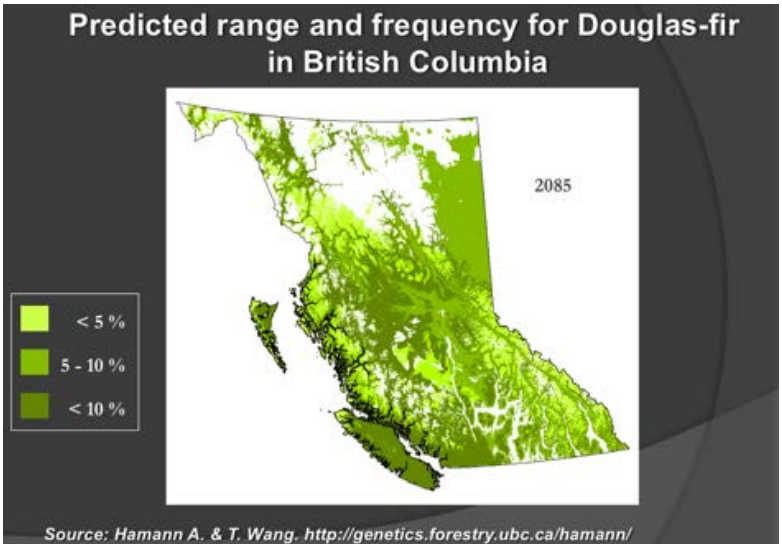
Realized genetic gain trials:

Genetic gain trials allow the team of verify estimated breeding values and to determine how their selections compare to other winners. Future production is estimated on an area basis and tree growth and yield trajectories are measured.



Changes in Temperature and Precipitation

The coast is not as severely affected by the mean coldest temperatures as in the BC interior. The predicted range and frequency of Douglas-fir is moving and gaining in importance with climate change. The figure below illustrates the predicted range of Douglas-fir in British Columbia by the year 2085. With assisted migration the best way to calculate climate-based seed transfer guidelines is by measuring the transfer distance by the test site climate minus the origin of the climate. The best growth is achieved by seed lots that come from further south.



The wood density in coastal Douglas-fir is expected to become lighter as spring rain increases with climate change. Wood quality assessments have been done on Douglas-fir near Nanaimo river where 100 trees were thinned and cut into 2x4 planks and tested for growth and traits such as wood strength, specific gravity, and elasticity. Wood is becoming more popular in the construction industry such as UBC's new 18 storey wood building with a concrete core completed this September. Ideally, Douglas-fir will be used for these types of projects in the future.

8. Update on development of federal recovery documents for species at risk in Garry Oak Ecosystems

Kella Sadler

Introduction

Kella Sadler from Environment and Climate Change Canada discussed the successes and shortcomings of federal species at risk recovery documents and stresses the importance of defining critical habitat. She explained the difference between a Recovery Strategy, an Action Plan, and a Management Plan and outlines priority activities for the 2016-17 year.

SARA Responsibilities by Federal Department

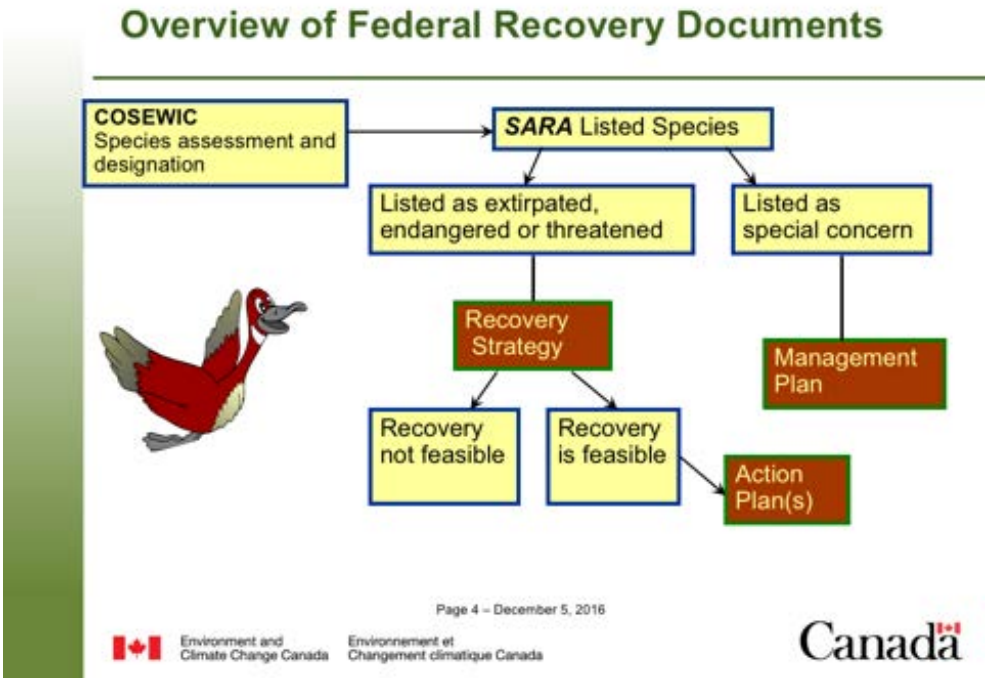
The responsibilities of the Species At Risk Act (SARA) are delegated to several departments within the Federal government. All aquatic species are under the jurisdiction of the Department of Fisheries and Oceans (DFO). All responsibilities regarding species within National Parks and Historic Sites fall to Parks Canada Agency, and all other species and overall administration falls to Environment and Climate Change Canada.

Overview of Federal Recovery Documents

Recovery Strategies (RS) are documents implemented for species listed as Extirpated, Endangered, or Threatened under SARA Schedule 1. This document sets the strategic direction to arrest or reverse the decline of species. The content requirements for an RS are listed in SARA schedule 41(1). Endangered species are the highest priority with a RS timeline of one year and two years for Threatened and Extirpated species.

Action Plans (AP) are documents implemented for species listed as Extirpated, Endangered or Threatened under SARA Schedule 1. The AP follows the production of an RS and can be a multi-species action plan; there can also be more than one action plan for a single species. The document outlines what needs to be done to achieve the population and distribution objectives identified in the recovery strategy. The content requirements are listed in SARA Schedule 49(1).

Management Plans (MP) are documents implemented for species listed as Special Concern under SARA Schedule 1. The document outlines what needs to be done to prevent the eventual listing of the species at a higher risk level. The content requirements are listed under SARA Schedule 65 and must include measures for the conservation of the species.

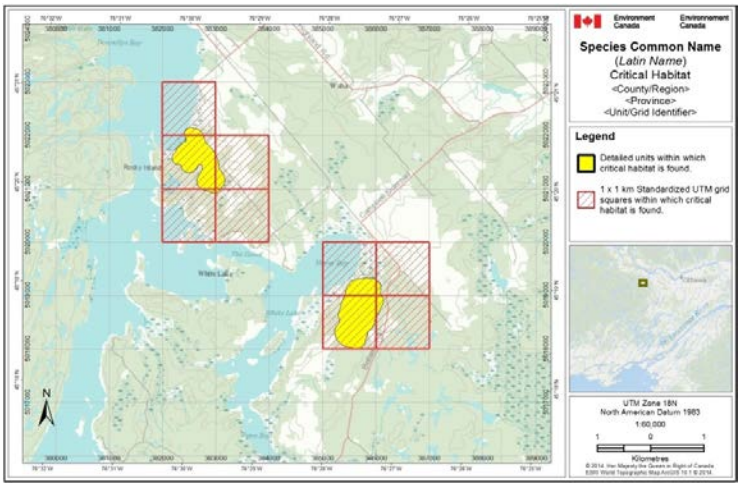


Format of federal recovery documents

SARA documents allow for the adoption of existing BC recovery plans and/or management plans. These documents may be published as a stand alone document or a two-part document that includes the BC recovery document and critical habitat identification.

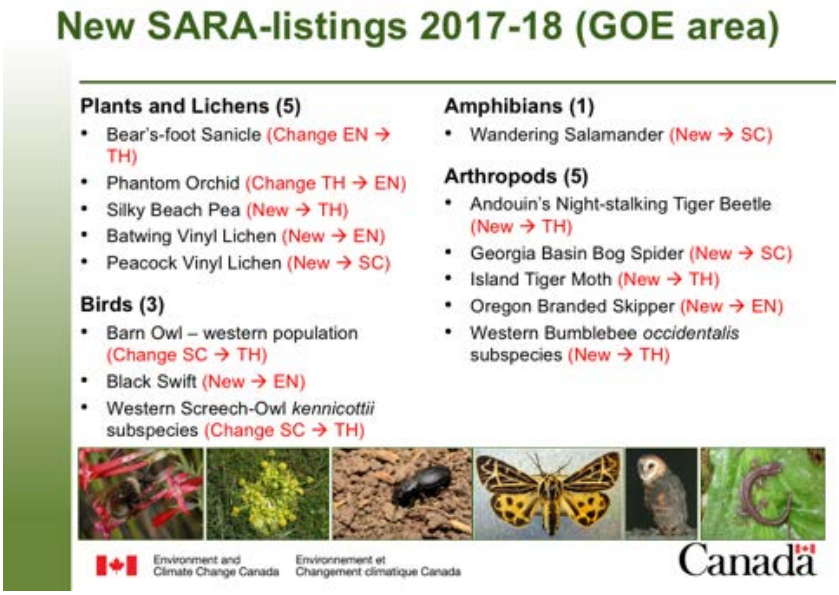
Critical Habitat Identification

Critical habitat is the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified in the recovery strategy or in an action plan for the species. Detailed polygons are used to define the boundaries of critical habitat; these shapefiles are available to the public in British Columbia. The critical habitat is determined based on important environmental variables or attributes for the species to survive such as the presence of wetlands or mature stands. Critical habitat must be based on the best available knowledge and identified to the greatest extent possible given the time constraints of SARA. The only times when critical habitat cannot be identified are when information is lacking or unavailable.



ECCC-CWS SAR priorities for 2016-17

Priorities for the upcoming year include completing the 3-year posting plan; there is a delay in finishing recovery documents and evaluating critical habitat must be standardized. Approximately 29 of 88 species still need to be transmitted and posted by March 2017. Recovery strategies and action plans for new listing species must also be developed to meet statutory timelines. There are five new SARA listings in the Garry Oak Ecosystem area including plants, lichens, birds, amphibians, and arthropods. Consultations and cooperation with aboriginal organizations must improve in the listing and recovery planning processes.



Transfer of SRA status (Parks Canada Agency to ECCC)

The ECCC will take on all future tasks as the SARA responsible agency for species that are not confined to Parks Canada Agency lands including Recovery Strategy and Management Plan updates and the modification of critical habitat identification. The ECCC will be responsible for ongoing consultation engagement and communication, protection of critical habitat, and the

development of action plans. This change will implicate 49 currently listed SARA species including Taylor's Checkerspot and the Northern Saw-whet Owl.

Funding Programs

The **Aboriginal funds for Species at Risk** supports aboriginal involvement in activities that protect or conserve habitats for Species At Risk. This includes a prevention stream for culturally important species.

The **National Wetlands Conservation Fund** provides funds to restore or enhance wetlands on non-federal lands.

The **Interdepartmental Recovery Fund** is intended for federal departments including INAC and departmental corporations.

Thank you!

Kella Sadler

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Conservation Planning Unit (Species at Risk)
Environment and Climate Change Canada –
Canadian Wildlife Service
Pacific Region
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9. Cowichan Valley Western Bluebird Reintroduction Project: Five years in Review and Looking ahead

Ryan Hetschko and Genevieve Singleton

Garryoak ecosystems recovery team

Bring Back the Bluebirds

Cowichan Valley Western Bluebird
Reintroduction Project

Five Years in Review & Looking Ahead

GOERT Colloquium 2016

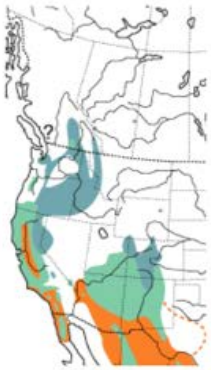
Ryan Hetschko & Genevieve Singleton

Introduction

Ryan Hetschko and Genevieve Singleton provide an update on the 5th year of the Bring Back the Bluebirds project. Western bluebirds disappeared 20-25 years ago in the Cowichan Valley and there were no signs of bluebirds until the reintroduction project began 5 years ago. The goal of the project is to achieve a self-sustaining population in their former range of southeastern Vancouver Island.

Translocation and Banding Program

Bluebirds were captured using mist nets and transported in bird cages from Washington State. The birds were placed in an aviary that resembles natural bluebird habitat for 1-3 weeks and were fed mealworms. Each translocated adult and juvenile was color banded to track who returns the following season.



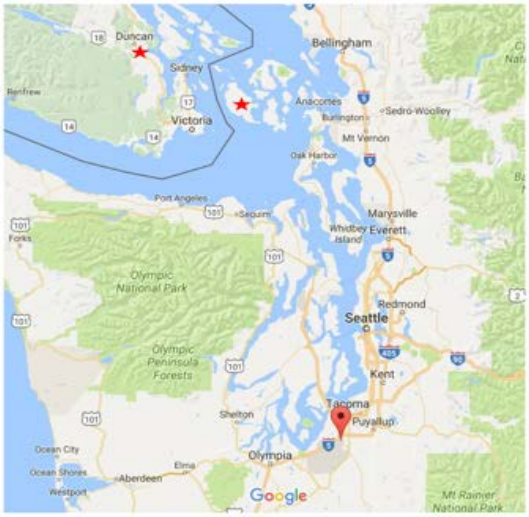
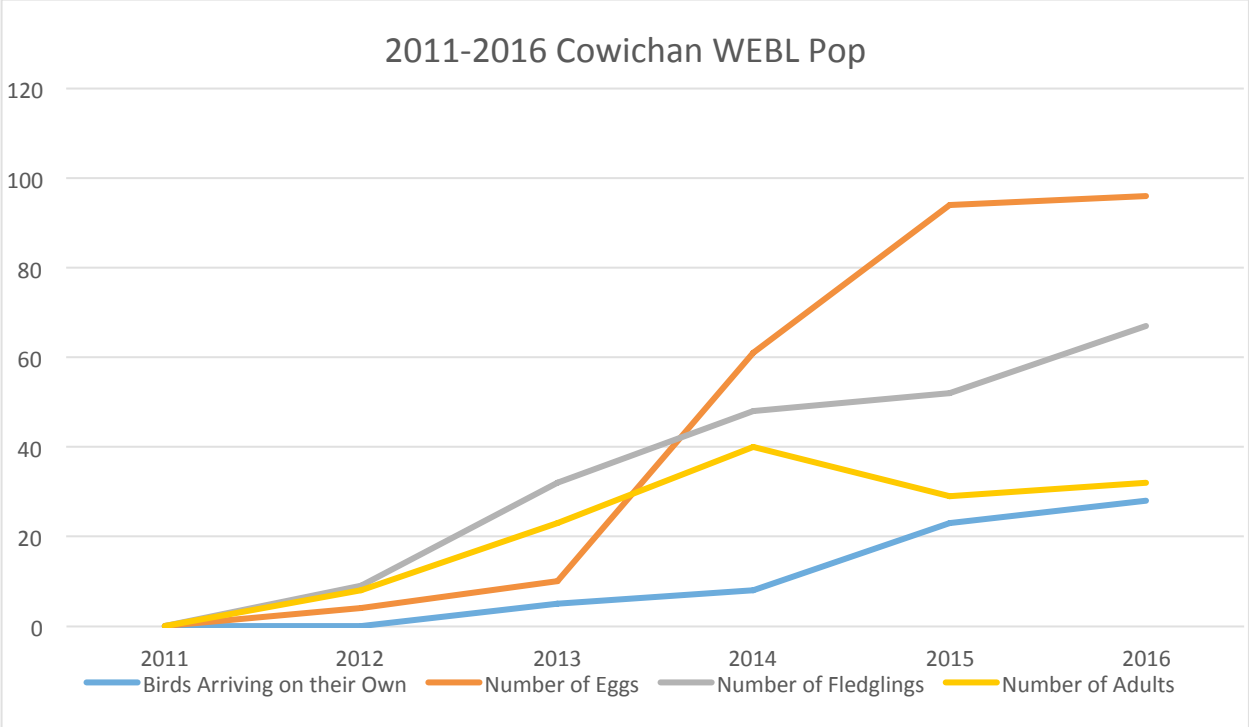


Photo: R. Hetschko

Program 5-year Review

In 2012 four breeding pairs and nine young were released into the Cowichan Valley; one pair decided to stay and establish a second nest and four eggs hatched. In 2013 five bluebirds arrived on their own and 28 were released. In 2014 eight arrive on their own, 32 were released including nine breeding pairs and 15 young. Eight nests successfully fledged. In 2015 there were 23 new arrivals, 20 released including three pairs and 14 young with 11 successfully fledged nests and 52 fledglings. In 2016 there were 28 arrivals, 96 eggs produced with 67 fledged, 11 breeding territories with 20 nest attempts of which 16 were successful. There is an upward trend of the number of eggs and fledglings succeeding on Vancouver Island.



Population Support

Future plans for the program are to provide population support rather than continuing translocations. Bluebird boxes are mounted with features that discourage predators like squirrels from reaching the nest. Supplemental feedings are also used to encourage bluebird survivorship.

Other Activities in 2016

For the remainder of the year the team aims to establish a Cowichan Valley Naturalist Society (CVNS) trail monitoring network and to improve relations with landowners and volunteers with CVNS. The CVNS will take the lead on monitoring the bluebird populations at the end of the year as part of their mandate. Other plans are to remove bird boxes that are placed in unsuitable habitat and to host a box monitoring workshop for volunteers. The team will focus on raising funds to continue supporting the project; so far a local pub in the Cowichan Valley has helped to raise over $3,000!

Thank You

Project Partners:

- Garry Oak Ecosystem Recovery Team
  - Kathryn Martell, Julia Daly, Jemma Green, Elizabeth Bailey, Reanna Shelling, Ryan Hetschko, Morgan Davies, Alina Fisher
- Cowichan Valley Naturalists' Society
- Ecostudies Institute (Gary Slater)
- Trudy Chatwin (FLNRO)
- Victoria Natural History Society
- Nature Conservancy of Canada
- And countless volunteers and other contributors...

Major financial partners:

- Habitat Conservation Trust Fund
- Canada Summer Jobs
- CleanTech
- Science Horizons
- TD Friends of the Environment Foundation
- And many other public and private donors...

Photo: R. Hetschko

10. An overview of, and lessons learned from, prescribed fire programs in North America Savannah Ecosystems

John Dick, Sustainable Visions Environmental Services, Victoria

NCC Cowichan Garry Oak Preserve Prescribed Burn

Introduction

John Dick from Sustainable Visions Environmental Consultants discussed the benefits and challenges of prescribed burning as applied to highly fragmented savannah ecosystems in the urban/wildland interface (UWI). He provides examples of successful prescribed fire programs in the Pacific Northwest and elsewhere and outlines the approach used in Garry Oak Ecosystems.

Prescribed Fire in Uplands Park

The Garry Oak meadows in Uplands Park have been deteriorating year by year through invasion by both native and exotic woody species. The resultant increase in fuel loadings means that a fire of significant intensity in the deep-soil meadows would harm many old-growth oaks, and pose a significant fire risk to adjacent residences. The gradual introduction of prescribed fire to Uplands Park is proposed as a management regeme, borrowing on experience from prescribed fire programs elsewhere in North America. .

Nature Conservancy of Canada, Duncan BC

In the early 2000s NCC implemented small-scale experimental burns on this 22 hectare Garry Oak Preserve. Following this early experimentation. several invasive species removals and fureductions on deep soil sites were carried out from 2001 to 2013 prior to the reintroduction of "landscape-level" burning. . In 2013 and 2014 the early experiments were scaled-up to the landscape-level with 1-2 ha burns on 4 separate areas, in cooperation with the B.C. Wildfire Management Branch. Burning is proposed to be repeated every 2 years. The burn proposed for 2016 was cancelled because of a rapidly-closing burn "window".

Seed Multiplication Beds, Puget Sound Ecological Fire Program

North and South Puget Sound Ecological Fire Program (NSPSEFP)

The NSPSEFP is a cooperative program of eight government agencies and non-government organizations coordinated by the Centre of Natural Land Management. The program involves GOE rehabilitation with prescribed burning and subsequent re-vegetation, from the BC border to the south of Tacoma. with a prescribed burning capability exceeding 1000 hectares per year since 2012. The large capacity is attributed to cooperative planning, pooled financial resources, and training of in-house staff as USFS-certified "burn bosses".

The Oregon Garden Prescribed Fire Program

The Oregon Garden is a 32 ha privately-owned urban park in Silverton, Oregon comprising a time-share resort and a large area of ornamental/water gardens. It also includes 25 ha of a native Garry oak grove. Fuel reduction and prescribed fire is used in the grove in partnership with park staff, the U.S. Forest Service, the Oregon Forest Service wildfire specialists, the Silverton Fire Department and the Oregon Forest Resources Institute. Pre-burning operations began in 2011 and have focused on fuel reductions to manage burn intensity. The first burn was carried out in 2014 and a second was planned for this year but cancelled because of an inadequate burn window. The program intends to burn on a 2-3 year return interval until control of invasive species is achieved, and thereafter for maintenance as often as necessary. In addition to prescribed fire for community fuel reduction, the park also includes a "fire-smart" demonstration for individual properties (see photo)

Fire Smart – House Modifications/Maintenance

Klamath National Forest

The Klamath National Forest straddles the Oregon and California border in an area of high relief with complex mixtures of oak and conifer savannah systems, open grasslands, small agricultural operations and scattered residential communities. Over the past two decades the U.S. Forest Service has pursued an aggressive program of forest restoration and fuel reduction using thinning and prescribed fire. The current burning programs have ranged between 3120-3960 ha per year.

California Department of Forestry and Fire Protection (CALFIRE)

California has the richest oak flora on the Pacific Coast with seven species in addition to Garry oak, all in savannah associations. Not surprisingly the state leads the rest of the region in Oak recovery programs. Since 1999 CALFIRE and partners have averaged about 5,265 ha per year of resource burns aimed at improving native biodiversitycontrolling invasive species and reducing fuel loadings around local human communities.

Redwood National and State Parks.

Native Americans managed prairie and oak woodlands that are now within the Redwood Park complex for thousands of years with regular fire. Early settlers continued the practice until 1930 when the state outlawed broadcast burning. Since then, California redwood forests and prairies have become encroached with thick stands of Douglas-fir and other conifers. Park management has utilized mechanical fuel reduction and prescribed fire as a management tool since the early 1980s. The annual area burned has varied from 300 to 500 ha. Fuel reduction programs are credited with preserving several of the "iconic" redwood stands during recent catastrophic wildfires.

The U.S. Forest Service, Fire and Fire Surrogate Study (FFSS).

FFSS, initiated in 1996, is a multi-disciplinary experiment to evaluate the costs and consequences of alternative fuel reduction treatments in savannah forests. The experimental design is replicated nationally across 12 major conifer and hardwood savannah forest formations and compares four treatments on 10-ac treatment plots: - prescribed fire only; mechanical

vegetation removal only; combined fire and mechanical removal; and untreated control. A 20-year review is expected to be published in 2017.

The B.C. Forest Service Ecosystem Rehabilitation Program (Rocky Mountain Trench).
This program was prompted by resource conflicts in the 1980's caused by decades of coniferous in-growth to open conifer savannahs. It was implemented in 1998 after five years of planning and the main focus was on domestic grazing lands, important wildlife habitats, and fire risk reduction in the wildland/urban interface. The total area treated to date is approximately 35,000 ha.. Both Cranbrook and Kimberly have included undeveloped municipal lands in the program and over the first three years of implementation Cranbrook officials have indicated the city is saving approximately $2 million per year in municipal fire insurance.

High Park, Metro Toronto
High Park is a 175 ha park in the heart of downtown Toronto, about 12 blocks from Toronto's main business district and managed by a private foundation. The park includes gardens, a small lake, historic and recreational facilities and 73 ha of white and black oak savannah forests and tall-grass prairies. The Park has carried out prescribed burning programs on the oak/prairie communities, with the full support of the Metro Toronto Fire Department, since 2000. The total area burned annually has averaged 17 ha, ranging from 11 to 27 ha.

High Park Toronto

Lessons Learned from Existing Recovery Programs
Fire history studies can give clues to the condition of Garry oak meadows and woodlands under First Nations management but ecological succession and public use demands have progressed too far to return to that state. Garry oak recovery in the urban/wildland interface should be guided by ecosystem templates to create a mosaic of habitats for multiple purposes and resource values, increased ecosystem resilience in the face of climate change., and fire risk reduction in urban communities. Low severity prescribed fire is recognized as the primary tool for hardwood and conifer savannah rehabilitation across North America. Results of a single burn are often

variable and transitory and burns must be carried out on regular return periods of 2-10 years to sustain the benefits.

A Sequenced Approach to the Introduction of Prescribed Fire in Local Garry Oak Ecosystems.

1. Obtain conceptual approval to proceed with program preparation from the responsible land manager.
2. Establish a collaborative partnership of organizations and individuals.
3. Assemble a technical steering group to guide the program and facilitate public consultation.
4. Consult with local residents, community associations and First Nations.
5. Set measurable ecosystem management objectives.
6. Establish a burn planning and approval protocol with local fire authorities.
7. Amend local government "open-burning" regulations where necessary.
8. Assemble committees to prepare plans for ecosystem mapping and monitoring programs
9. Develop a long-term, strategic adaptive management plan Develop a rehabilitation/protection program for non-Garry oak ecosystem

11. Field Screening of Whitebark Pine for Blister Rust Resistance

Charlie Cartwright

Introduction

Charlie Cartwright from the BC Ministry of Forests, Lands and Natural Resource Operations provided an update on Whitebark Pine screening for blister rust resistance in the BC interior. Whitebark Pine was listed as endangered by COSEWIC in 2010 due to mountain pine beetle (*Dendroctonus ponderosae*) infestations, fire suppression, climate change, and white Pine Blister Rust (*Cronartium ribicola*) affecting large stands.

Blister Rust

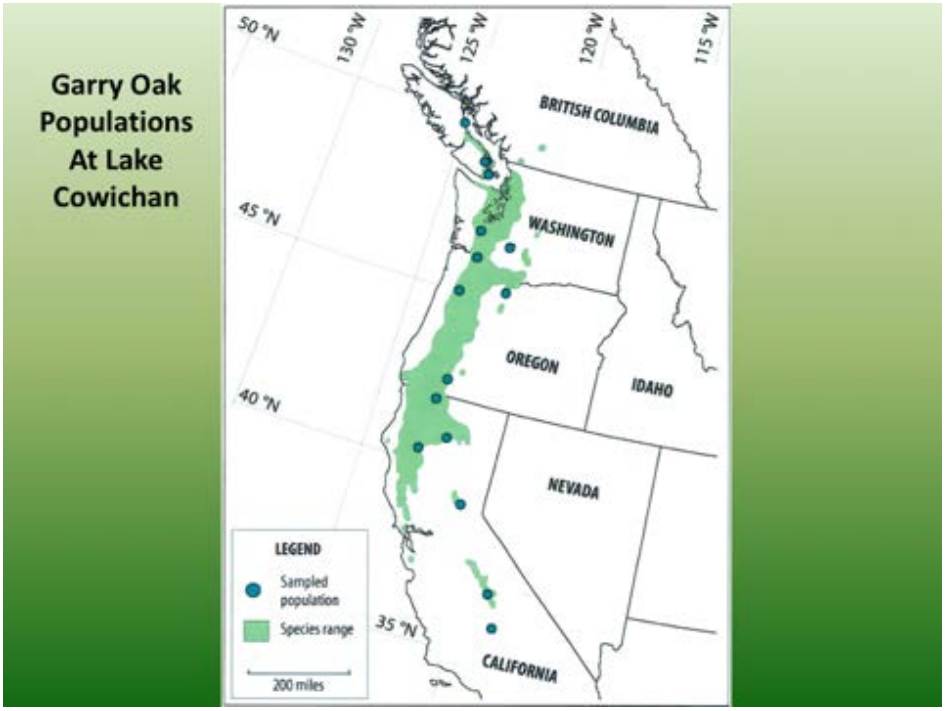
Blister rust was introduced to BC in 1911 as an Asian horticultural species. A proposal was developed in 2015 to restore Whitebark Pine stands by deploying rust resistant seedlings. This process entails exposing seedlings produced from resistant trees to blister rust spores and monitoring them for infection by the fungus. Blister rust screening has been implemented in the United States and other parts of Canada as a primary recovery strategy that enables pine species to co-exist with the fungus where attempts at eradication have been unsuccessful.

Climate-based seed transfer

Three field test sites for Whitebark pine are in effect across BC including Bamfield, Holdberg, and the Charlotte islands. The best growing material for seedlings is typically 200 km south of local stands.

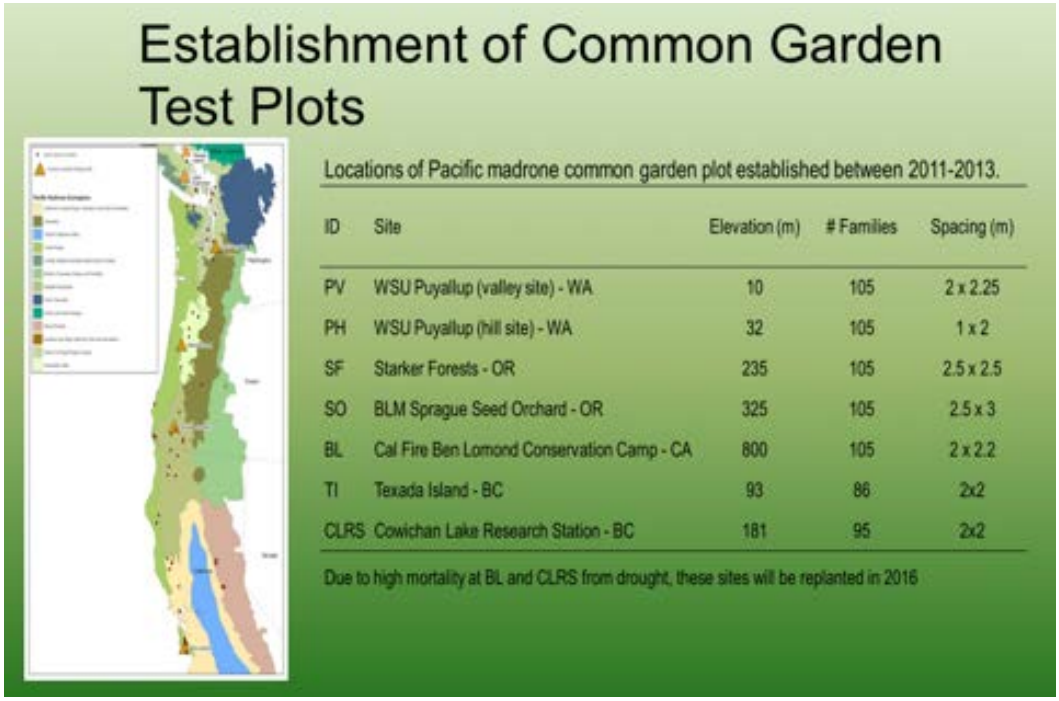
Gene Conservation

There are a number of ex-situ and in-situ gene banks for Whitebark pine in BC. There is an ex-situ seed centre in Surrey BC and many in-situ reserves in parks and ecological reserves, old growth management areas and caribou riparian areas. Collectively, these in-situ reserves make up 40% of the protected land base in BC. On Vancouver Island there is an ex-situ clone bank at Lake Cowichan growing Western yew overshadowed by Douglas-fir and similarly with Arbutus collected by Washington State University. The Genetic Conservation Technical Advisory Committee handles funds for gene conservation and divides funding between the province, the ex-situ seed bank and the UBC gene conservation center.



Nursery bed trials

Families of trees are planted in different areas to determine how genotype acts in different environments. This interaction is important in determining the value of genotypes and the durability of the trait. One of the key questions being examined is whether resistance to blister rust holds up over time. Seed dormancy is hard to break and germination is typically low without extra effort. Germination success increases from 20% to 60% with increased effort such as cutting off the ends of seeds and soaking seeds in hydrogen peroxide to kill threats. Nursery bed trials and field sites are distributed in BC, Washington and Oregon for Whitebark Pine. As as alpine species, they establish roots first and do not grow fast. The next round of seed collection is in California for transfer to BC. The field sites occur within each Biogeoclimatic zone that the species occurs in.

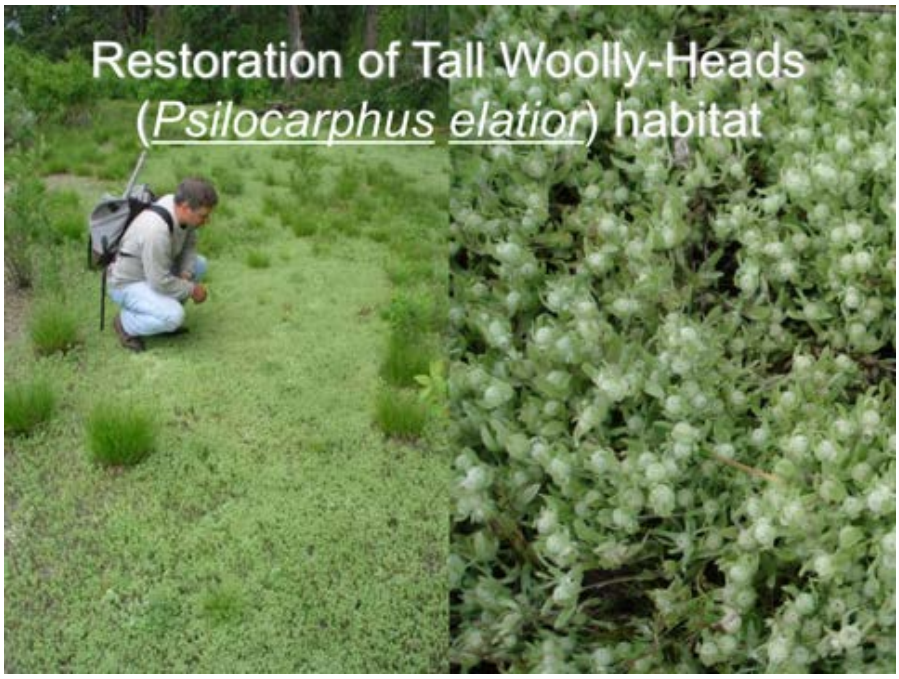


Species At Risk

Preventing blister rust in Whitebark Pine is the most important step to conserve stands. Critical habitat availability is what the federal action plan is predicated on however new habitat is opening up all the time. Other concerns regarding the loss of Whitebark Pine are the effects on species that depend upon it such as the Clark's Nutcracker who forage on cones. The project aims to create ample regeneration of resistant stands across the field sites moving forward.

12. Restoration of Tall-Woolly Heads (*Psilocarphus elatior*) habitat

Dave Polster



Introduction

Dave Polster provides an update on the restoration of Tall-Woolly heads in Duncan, BC. Tall-Woolly Heads (*Psilocarphus elatior)* used to grow in millions, however the municipality dredged Somenos creek in 2004 preventing flooding of the habitat and replaced the woolly heads with a dense thicket of willows and reed canary grass. A proposal was developed in 2013 to restore the woolly heads in this area.

Restoration actions

In 2013 the affected area in Somenos creek was aggressively cut to reduce willows and grasses. Further issues arose as suckers grew up in the place of willows and the berm was still there. In October the area was excavated to breach the berm in a few locations to allow flooding in the winter time down to the elevation of the creek. In January 2014 the area was flooded and stumps of willows were visible. Vegetation started up in the spring after the flooding dissipated and species that precluded the woolly heads returned. The locations of the remaining woolly heads were identified. Mowing of the area was initiated when the offending plants had reached the low point of their energy reserves to prevent photosynthesis in the summer time. Raking and removal of stumps occurred every few weeks after mowing. In the spring of 2015 grasses grew up after flooding subsided and mowing treatments recommenced. In the spring of 2016 woolly heads started to appear and barer ground was visible on site by September.

How can we restore habitat and bring back species at risk?

Expanding habitat into a big open area is a good strategy for getting other species back. In the case of Somenos creek, flooding and getting rid of the willows and Reed Canary Grass was critical for recovering the woolly heads.

13. ER 505: Climate Change and Restoration

Hilary Harrop Archibald

Introduction

Course developer Hillary Harrop Archibald presents a blueprint of a new post-graduate level online course ER 505: Climate Change and Restoration. The course is currently in review as Hillary presents an overview of the course modules and assignments.

Module 1. Introduction to physical climate change science

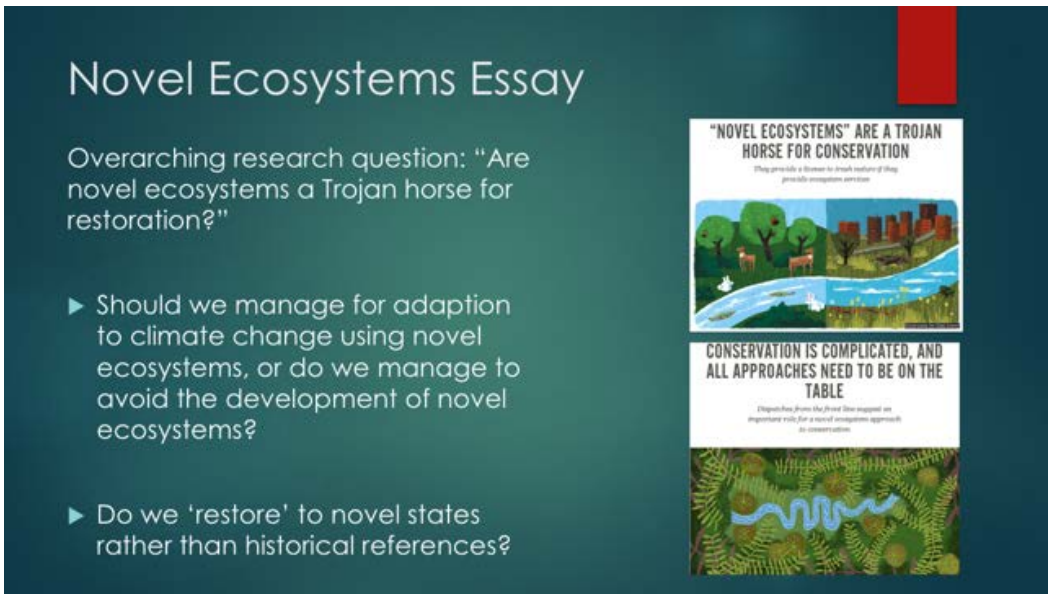
The foundation module is designed to provide students with a background on physical climate change science including the drivers of climate change and how the scientific community differentiates between natural variability and anthropogenic influence. The majority of information will come from the Intergovernmental Panel on Climate Change (IPCC) and the USDA Climate hubs.

Module 2. Species specific responses to climate change

The second module will be on species-specific responses to climate change, and available forecasting approaches in the restoration process. Species distributions are expected to shift and evolutionary changes are expected to occur. Students will compare bioclimatic envelope models in their first assignment and discuss their usefulness and limitations in restoration planning.

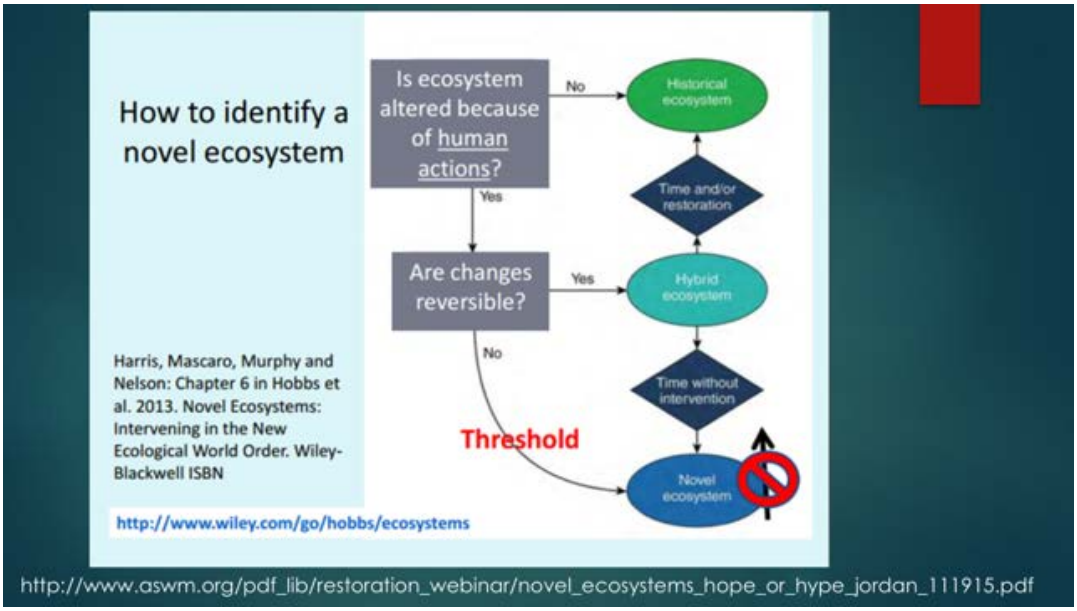
Module 3. Community responses to climate change

The third module is on community responses to climate change and how individual responses lead to changes in biotic interactions and destruction of community dynamics. One example of this is a mismatch between the pied flycatcher and its caterpillar food supply where a change in temporal and spatial overlap between species results in a decoupled relationship. A phenological shift in the caterpillars causes them to come out earlier resulting in a shortage of food supply during the pied flycatcher's breeding season. This module will focus on the challenges associated with making multi-species community and ecosystem level predictions and reviews important foundation concepts such as scale, bottom up and top-down effects, and thresholds for novel ecosystems.



Module 4. Restoration in the 21st century: novel ecosystems

This module focuses on restoration in the 21st century and specifically novel ecosystems. *Novel ecosystems* emerge when abiotic and biotic thresholds have been passed and the ecosystems can no longer be restored to its previous state. Climate change by definition results in altered abiotic conditions and in many cases will result in novel ecosystem assemblages. Students will discuss the management implications of working with ecosystems that we have never seen before and critique the refocusing of restoration efforts from species assemblages to ecosystem function. The second assignment of the course will be a novel ecosystems essay in which students must answer the question "are novel ecosystems a Trojan horse for restoration"?

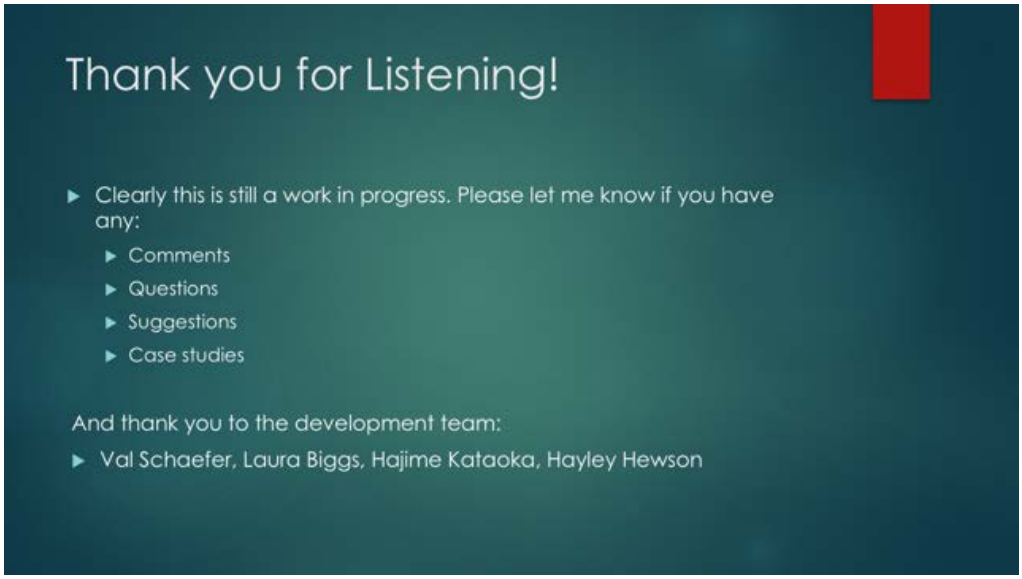


Module 5. Restoration response to climate change: migration
The learning objectives of this module are to understand the factors affecting migration rates and spatial habitat configuration. Assisted migration is a climate change adaptation strategy but is still a contentious topic in conservation and restoration communities because it can conflict with other management objectives. Students will discuss the risks and benefits of this management approach and the factors that determine which species are the most suitable candidates for assisted migration such as species at risk and successional species. An online debate will be designed for students to discuss whether restoration plantings should include species that are projected to be but are not currently in the range of a restoration site.

Module 6. Adaptation
Local provenance is largely discussed in this module. Communities advocate for locally sourced seeds but this is changing in the face of climate change. A second online debate will be available for students to explore whether local provenance matters and if the use of non local stock causes loss of local genetic variation, outbreeding depression, or genetic rescue of depauperated gene pools.

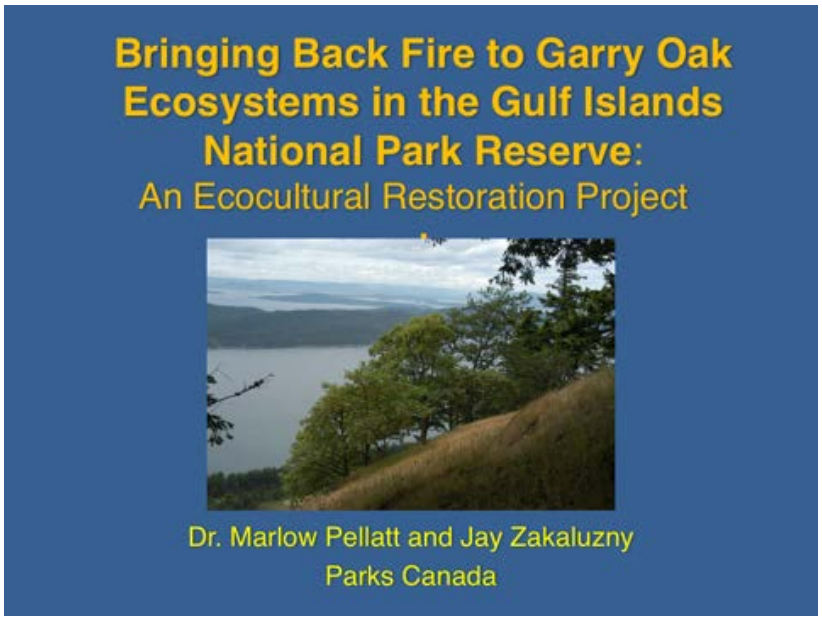
Module 7. Restoration as a climate change mitigation strategy: Carbon sequestration
Notably there is scepticism in our ability to mitigate climate change impacts through restoration. Students should have a basic understanding of the carbon cycle, carbon budged and carbon sinks, and how restoration affects carbon pools. Students will be looking at IPCC documents and the Canadian carbon budget for our forest sector.

Module 8. Experimentation
This module is still in progress including the development of a final project. In general, this module will focus on incorporating climate change adaptation research and design into restoration plans and projects.



14. A prescribed burn at Tumbo Island in the Gulf Islands National Park Reserve

Dr. Marlow Pellatt and Jay Zakaluzny – Parks Canada



Introduction

Dr. Marlow Pellatt is a National ecological recreation ecologist with Parks Canada and Jay Zakaluny is a fire operations specialist. They provide an update on prescribed burning in Garry Oak ecosystems on Tumbo Island, a part of the Gulf Islands National Park Reserve.

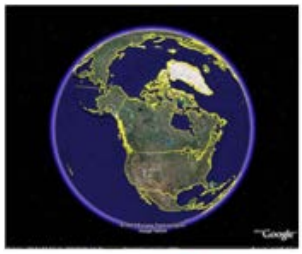
This project is a collaboration between many players from the science side to implementing a safe and effective natural fire. They would like to thank Ze'ev Gedalof, Marian McCoy, Shvanne Smith, Jenny McCune, Rob Walker, Celeste Barlow, Mark Vellend, Andrew MacDougal, and Nathan Cardinal for their efforts.

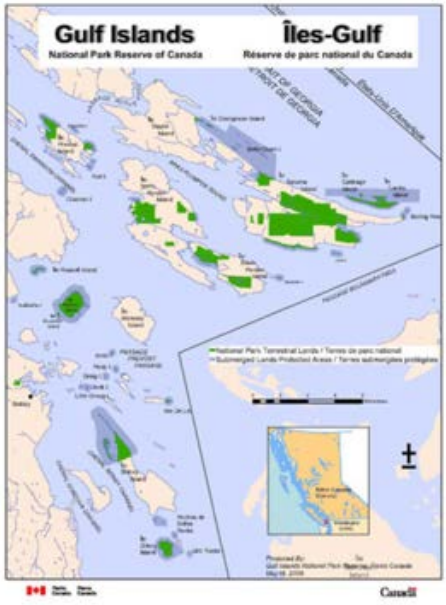
Terra Nullius

Throughout the world colonialism resulted in the suppression of aboriginal land management practices abetted by the concept of terra nullius, belonging to no one, the belief that aboriginal people had little influence on the land. Until recently, this ideology was entrenched in resource management and policy. Aboriginal people know this is not true. Their knowledge is supported by archeological and palaeoecological and anthropological studies.

Brief history

Fire on the landscape is not a myth. It's been documented in palaeoecological records from the mid-1800s in Garry Oak ecosystems and has been suppressed by the government through the Bush Fire Act of 1874 in British Columbia.





Project Objective

The objective of this project is to take a multi-disciplinary approach to understand the role of climate and fire in the formation of eco-cultural landscapes and to translate research into action. This is achieved by re-introducing First Nation land management practices into eco-cultural restoration projects.

Lessons from the past

We can use pollen and charcoal as indices of how vegetation has changed over time. Pollen analysis shows that in the early Holocene 10,000-12,000 years ago temperatures were 2 – 4C warmer than present on a landscape comprising of open savannah with more Douglas fir and fires. Garry oak expanded about 8000 years ago, and although at lower values, oak and grass remained constant for 5000 years when shade-tolerant conifers such as cedar, western hemlock, and spruce were increasing in a more temperate climate.

Charcoal and tree-ring analysis reveal climate driven patterns of fire occurrence on the landscape. Continuous and frequent prescribed burning events are found in the historical record with severe fires occurring every 26-41 years in southwestern British Columbia throughout the Anthropocene which comprises the last 250 years. These results are consistent with stand age reconstructions showing Garry oak establishment in 1850 AD which corresponds with modern fire exclusion, aboriginal population decline and the end of the Little Ice Age. Fire suppression is shown to change ecosystem structure and Garry oak ecosystems have been strongly influenced by eco-cultural practices. It is highly evident that Garry oak ecosystems are dependent on prescribed fires for their open structure.

Palaeoecology is the study of how ecosystems change over time. The dynamic nature of ecosystems can be observed relative to time in a seasonal to millennial scale in order to understand ecological integrity.

Tumbo Island Prescribed Burn

The goal on Tumbo island is to re-introduce fire following 150 years of fire suppression and to measure the changes in plant communities. Most restoration in this area has been done tackling invasive species and thinning conifers however the Parks Canada team aims to get a handle on more prescribed fire as a restoration action. The team takes an adaptive approach to managing Tumbo with deer exclusion areas as control sites in the prescribed burn experiment. Pre-burn data was collected in 2010, 2012 and 2015 on the plant communities and the prescribed burn occurred in September 2016. The burn site included many on-site firefighters, representatives from the Capital Regional District (CRD), media, fire crew from the BC forest service, First Nations crew, Coast Salish elders, youth and other Parks Canada staff. Each plot was 50 square meters and every second plot was burned with a total of 4 fires across one hectare in area.

Keys to successfully implementing prescribed fire

Important things to consider when implementing prescribed fire are allowing enough time to build the capacity for safe and effective burns and obtaining the right expertise. Patience, perseverance and risk management are all vital for successful burns. Burns should be low risk and low in complexity to facilitate planning and management. It is also important to note who is taking the risk as burn plans and protocols reach many community members and stakeholders. Engaging with the public and media about prescribed burns helps to increase support for this restoration technique.

Next steps

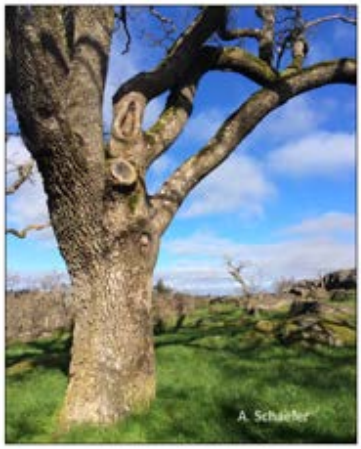
The team was able to create a more open forest floor using prescribed burns on Tumbo Island, removing approximately 150 years of fuel on the ground. Garry Oaks were not affected by the burns though Douglas-firs were highly flammable and some large trees burned at the roots and fell. The next steps include monitoring, adding selected plants, expanding plots for conifer removal, add new prescribed burn sites and repeat the burning process. After 15 years of planning the first phase of the project is complete.

15. Friends and foes of the GOE Impacts of climate change on symbiotic relationships with GOE species

Dr. Val Schaefer, School of Environmental Studies, UVic

Friends and Foes of Garry Oak Ecosystems

Val Schaefer, PhD RPBio
Restoration of Natural Systems Program
University of Victoria
May 14, 2016.



Introduction

Dr. Valentin Schaefer is the GOERT Society Chair and Academic Administrator for the RNS Program at the University of Victoria's School of Environmental Studies. As an active member of the restoration community in Victoria he discusses how conserving Garry Oak ecosystems isn't just about the oaks, and how restoration actions and attitudes have changed over time.

It's not just about the oaks

There are many other species that have an impact on the Garry Oaks and wildflowers that are not often the focus of restoration efforts. Ecological memory, community thresholds, and novel ecosystems have indirect effects on the oaks.

Ecological Memory

In terms of each ecological memory, one of the factors is raising the nitrogren levels in the soil. Many of the wildflowers are adapted to low nitrogen levels and many of the invasive species that are removed are nitrogen fixers such as the scotch broom and red alder. Elevated nitrogen levels are considered a foe of Garry Oak ecosystems and they are a part of ecological memory. Allelopaths such as Scotch Broom (*Cytisus scoparius*) and Garlic Mustard (*Alliaria petiolata*) keep out many of the wildflowers however it is important to work with the life history of these species in restoration actions. For example, Garlic Mustard produces more of an allelopath early on in invasion compared to ten years later.

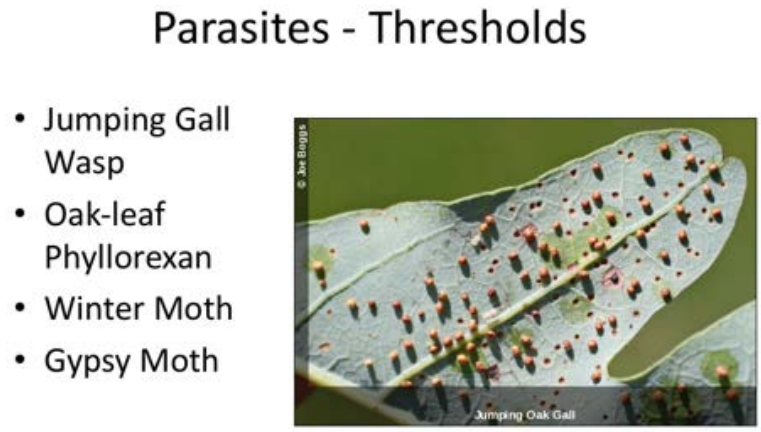
Provenance – Salt Spring Uniform Stand

On Salt Spring Island there are large even-aged stands of Douglas-fir that were planted instead of being naturally regenerated. The origin of tree plugs is difficult to source as there are more than 1,300 strains of Douglas-fir. These trees could have come from interior instead of coast and from different slopes and elevation; these factors may be important to consider with provenance.

Community thresholds

One example of community thresholds is in the Mountain Pine Beetle. Their larvae winter under bark and their northern range is typically limited by cold winter temperatures and cool summers. Trees possess few defences against the Mountain pine beetle and only at low populations. An outbreak in British Columbia in the early 1990s has lead to a reduction in 50% of total volume of commercial Lodgepole Pine; these outbreaks are difficult to anticipate but the risks can be managed by increasing stand biodiversity

Another example is in English Oaks. Tim Spark's article in the Guardian examined how warmer weather leads to smaller crops of acorns and how the trees are flowering in less synchronous fashion. Acorns today are ripening 13 days earlier than 10 years ago and trees are losing their leaves 1 week later than 30 years ago. These factors could be thresholds for other species in the ecosystem. This is also true for parasites. For example, the Lawson cypress canopy in Victoria is thinning out from root rot which affects nesting habitat for the Great Blue Heron.



Sudden Oak Death

Phytophthrora ramorum is an alien invasive pathogen that affects oaks and is expected to increase as a result of climate change. Various mycorrhizae are truffles and are eaten and dispersed by voles, deer mice, and harvest mice. The California vole is expected to be affected by climate change which will in turn affect mycorrhizae that benefit oaks.

Rudolph Effect – Allelic Spectrum in Restoration

A genetic bottleneck can develop if we only choose the healthiest plants for plantings and translocations. It is better to have more genetic variability to promote resistance. Val drew the

analogy with Rudolph the red-nosed reindeer as an example of a phenotype that was viewed as odd and undesirable under normal circumstance and was exactly what was needed when there was a change in the environment.

Restoration actions over time

One key example of the change in restoration action through time is how stream restoration used to entail the removal of woody debris in the 1950's and 1960's; however, we have since learned that woody debris is important to stream ecosystems and especially to salmon therefore we now add debris to streams instead.

Green Shores is a program in the Stewardship Center of BC that focuses on the restoration of shorelines from erosion. Originally the restoration strategy included putting in hard edges to protect shorelines and now this strategy has shifted to planting soft edges that absorb energy and prevent problems further down the shoreline.

Presenters

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Valentin Schaefer, University of Victoria, Schaefer@uvic.ca

Attendees

Individuals (Alphabetical by First Name)

Adrianne	Pollard
Agnes	Lynn
Aimee	Pelletier
Alanah	Nasadyk
Alex	Van Zyl
Alf	Birch
Andrea	Schiller
Andrew	Anderson
Becky	Miller
Beth	Burwash
Brenda	Costanzo
Caitlyn	Jimmo
Carolle	Rosell
Carrina	Maslovat
Charlie	Cartwright
Chris	Junck
Christine	Torgrimson
Christopher	Justice
Coco	Van Zyl
Colleen	O'Brien
Craig	Elder

Daniela	Toriola-Lafuente
Darcy	Mathews
Darren	Copely
Dave	Polster
Deanna	Mathewson
Emily	Doan
Erica	McLaren
Genevieve	Singleton
Hal	Gibbard
Hilary	Harrop-Archibald
Jake	Mentz
James	Miskelly
Jay	Zakaluzny
Jemma	Green
Jennifer	Medd
Jenny	Hebb
Jeremy	Gye
Joan	Looy
John	Dick
Jon	Dick
Judith	Carder
Kathleen	Mathews
Katie	Tribe
Kella	Sadler
Kersti	Vaino ?
Kevin	Moore
Kristen	Miskelly
Larry	White
Laura	Matthias
Lindsay	Kathrens
Loys	Maingon
Maija	Finvers
Margaret	Ferguson
Marilyn	Bell
Marion	Cumming
Marlo	Shaw
Marlow	Pellatt
Marta	Donovan
Martin	Perry
Matt	Fairbarns
Michael	Stoehr
Mike	Derochers
Morgan	Davies
Natasha	Bush
Nathan	Fisk
Nuala	Murphy

Paige	Erickson-McGee
Pat	Miller
Paul	Bishop
Peter	Woodward
Pippi	Lawn
Richard	Hebda
Rick	Marshall
Rick	Hatch
Rick	Marshall
Rick	Page
Rod	Walker
Ron	Carter
Ryan	Hetchko
Sandra	Hemstock
Serena	Soucy
Shane	Ford
Shay	Hinskens
Siobhan	Darling
Stuart	Prescott
Susan	Hannon
Susan	Fisher
Tara	Martin
TBA	U Vic Student
Thomas	Munson
Thomas	Witte
Tom	Macleod
Tom	Epplett
Tracy	Comforth
Trudy	Chatwin
Val	Schaefer
Wendy	Anthony
Wendy	Tyrell
Wylie	Thomas
Wynne	Miles