Book of Abstracts

# SERWC

2018

# RESTORATION *for* RESILIENCE

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# PLENARY SESSIONS

## Resilience and Restoration

Katharine Suding

Resilience has long been championed in ecological restoration as a strategy to sustain biodiversity and ecosystem services in the face of a rapidly changing and uncertain future. By identifying components and dynamics that bolster the system's ability to resist, recover or adapt to environmental changes, restoration can ensure sustainability in the coming century. But how can we actually manage for resilience? I focus on three possible strategies: we can manage drivers of change to enable historic states to persist; we can enhance a system's ability to adapt to changing conditions; and – particularly when anticipating catastrophic collapse – we can enable transformation to an alternative desired state. A key consideration is that processes which allow for ecological novelty (e.g., evolution, composition turnover) are necessary for ecosystems to adapt to change but actions which introduce "anthropogenic" novelty may often reduce adaptive capacity. While it may be difficult to predict how novelty will "naturally" emerge from complex ecosystem processes, attempting to emulate nature's response to environmental change may best embrace innovations critical for managing unprecedented environmental change.

## Transformation ecology: the evolving field of restoration ecology

Emliy Gonzales

Restoration ecology is poised to address global environmental challenges and benefit ecosystems, people, and economies. International policy has embraced this promise by setting ambitious restoration targets such as the Bonn Challenge, the 20x20 Initiative in Latin America, and the Convention on Biological Diversity's Aichi Targets. Will these investments in restoration live up to the promise? What exactly are we promising? Among the sciences, restoration ecology is unusually value laden, context driven, and prone to disagreement. In recent years, the novel ecosystems concept has emerged as a focal point of conflict in the field. Novel ecosystems are self-assembled ecosystems that have irreversibly changed and are self-sustaining in this new state. Opponents suggest recognizing the existence of novel ecosystems threatens to lower restoration standards and diminish the potential and promise of restoration. Others see novel ecosystems as a pragmatic path forward for highly altered sites given that restoration resources are limited and there are still ecosystem services and other benefits to be gained. Ultimately, achieving the promise of restoration requires the clear articulation of restoration goals and predicting those outcomes requires an understanding of the natural variability of ecosystem properties. Restoration is an inherently human endeavour and inclusive and participatory approaches are considered crucial to sustainable restoration. As these collaborative processes strive for consensus on goals and prioritization efforts, dialogue among restoration participants will continue to evolve concepts in restoration ecology.

## Learning from Novel and Natural Ecosystems in Oil Sands Mine Reclamation

Brad Pinno

Oil sands mine reclamation sites in the boreal forest of northeastern Alberta are clearly novel ecosystems given the new landforms, soils, species composition, and disturbance regimes associated with these sites. This concept of novel ecosystems is reflected in the regulatory requirement that reclaimed ecosystems have "equivalent land capability" to pre-disturbance conditions rather than being replicas of natural forests. However, there is still a strong desire to have functioning forest landscapes that are at least similar to natural boreal forests. So, what can be learned from natural ecosystems to help improve reclamation practices? To help answer this question, we established a multi-disciplinary study looking at the ecological responses to a variety of reclamation practices, including the use of different cover soils, fertilization, woody debris applications, weed control, and site preparation, in comparison to nearby naturally disturbed forests. The range of ecosystem components studied includes trees, plant community, soil physical, chemical and biological properties, arthropods, and microbes. Overall, it is relatively simple to determine statistical differences in ecosystem characteristics among reclamation treatments or between reclaimed and natural sites but it is far more challenging to quantify the ecological significance of these differences. For example, the use of upland-based cover soils results in plant communities more similar to natural forests but it is not known if the lack of certain species in early reclamation sites will be a long-term detriment to the ecosystem. The challenge now is to identify meaningful deviations from the desired ecosystem development trajectory and develop operational reclamation practices to help achieve the desired ecosystem outcomes.

# PLENARY SESSIONS

### Restoring Traditional Ecological Knowledge And Cultural Resilience: Practicing Tmixwcentrism

Jeannette Armstrong

To the Syilx Okanagan, restoring TEK is vital as the foundational relationship to the environment. Cultural resilience is a concept central to the Syilx practice of enowkinwixw, a traditional ecological knowledge decision-making process placing outcomes in the context of a healthy and productive land. I use the term tmixwcentrism to discuss this imperative that remains fierce into the contemporary as evident by a strong intervention role in the assertion and exercise of caretaking of our territory. The Syilx Okanagan work of ecological restoration is an aspect of on-going Syilx cultural resilience through the practice and implementation of enowkinwixw. The undertaking of the Syilx Okanagan to return salmon to the Okanagan River examples the enowkinwixw process in revitalizing TEK as the framework by which the Syilx Okanagan engage in reclaiming culture through ecological restitution. Tmixwcentrism is about rebuilding the knowledge relationship to our traditional territories and has led to a reinstitution of practice based in sound ecological values in the modern Syilx lifeway as cultural resilience. The work to revitalize Syilx harvesting practice examples a method of ecological restoration and entails reintroducing Syilx food cultural protocols and ceremonies toward a conscious rekindling of Syilx harvest restoration as a daily norm. Corntassel (2012: 89) reminds us, "These daily acts of renewal, whether through prayer, speaking your language, honoring your ancestors, etc., are the foundations of resurgence. It is through this renewal process that commitments are made to reclaim and restore cultural practices that have been neglected and/or disrupted."

### Wisdom and Knowledge Transfer

Michael Cody

Transfer of knowledge was essential for the rapid human development that occurred in the last century. Although transfer of wisdom and knowledge are in many ways instinctive among people, it also must not be taken for granted. With global complexity and increasing economic and environmental challenges, professionals are pressured to be responsive and continually improve outcomes. Key requirements for meeting this challenge include individual behaviours in the realm of curiosity, communication and passion for balanced, sustainable change. On a collective basis, we can develop communities of practice where learnings (from both research and applied practice) are shared and where mentorship, change management and knowledge transfer are core themes. Examples for discussion include learnings from agricultural extension in the developing world as well as industrial activity in the boreal. The Cenovus initiative in restoration of caribou habitat and specifically the LiDea project are profiled as an example for knowledge transfer with direct relevance to the global movement in ecological restoration.

### Bringing Back Bison to Banff National Park

Karsten Heuer

In February 2017, Parks Canada began a 5-year pilot project to reintroduce North America's largest land mammal (bison) to Canada's first national park (Banff). Join us for some behind-the-scenes stories of the politics, biology, logistics and philosophy of trying to restore a large and sometimes threatening animal to a place where it's been missing for 140+ years.

# CONCURRENT SESSIONS

## WEDNESDAY, FEBRUARY 14

## A - Burning Issues in Fire Restoration

### Did enhanced afforestation cause high severity peat burn in the Fort McMurray Horse River Wildfire?

Sophie Wilkinson

We found that post-drainage black spruce annual ring width increased non-linearly with drainage. Average basal diameter (BD) was 2.6 ± 1.2, 3.2 ± 2.0 and 7.9 ± 4.7 cm in undrained (UD), moderately drained (MD) and heavily drained (HD) treatments, respectively, and BD and depth of burn have a strong linear correlation. Depth of burn was significantly different between treatments ($p<0.001$) and averaged 2.5 ± 3.5, 6.4 ± 5.0 and 36.9± 29.6 cm for the UD, MD and HD treatments, respectively.

### Unique spatio-temporal insights in mixed-severity fire regime forests using paired dendroecological and photogrammetric data

Cameron Naficy

Mixed-severity fire regime (MSFR) forests exhibit complex fire-driven dynamics that vary over both space and time. Dendroecological methods have revealed much about the temporal dynamics of fire frequency, and in some cases fire severity, in MSFRs. However, much less is known about the spatial ecology of MSFRs for many regions and, in some cases, widely varying interpretations of the spatial dynamics of historical fire regimes have caused significant uncertainty. A principal barrier to reconstructing spatial pattern from dendroecological point data is the strong tradeoff between the spatial extent (necessary to capture variations in the fire regime) and grain (level of spatial detail) that can be achieved using geostatistical methods.

To address this problem we present an integrated data approach that pairs dendroecological data on the frequency and severity of wildfires with the spatial patterns of vegetation derived from high-resolution historical aerial imagery. We detail traditional photogrammetric and new digital stereophotogrammetric point cloud methods for feature extraction from historical imagery. The incorporation of the resulting vegetation patch boundaries and structural attributes improve dendroecological sample design, permit the scaling of point dendroecological data to spatially explicit patch boundaries, and modeling of fire regime parameters over large areas. This paired data approach provides robust spatio-temporal inferences about historical dynamics in MSFRs and permits analysis of fire regime dynamics at multiple scales (i.e. plots, patches, watersheds and regions). We demonstrate unique spatio-temporal insights achieved using this approach in MSFRs of the U.S. and Canadian Rockies.

### Garry Oak Ecosystem Stand History in Southwest British Columbia: Implications for Restoration, Management and Population Recovery

Celeste Barlow

Garry oak (*Quercus garryana)* ecosystems are one of the most endangered ecosystems in Canada. Fire Suppression often leads to conifer encroachment, hence prescribed fire is often proposed as a restoration tool. We used dendroecological methods to examine establishment patterns at three structurally different Garry oak stands in southwestern British Columbia and assessed the applicability of fire as a restoration tool. We found that 1) Garry oak and Douglas-fir recruitment corresponds with the end of the Little Ice Age Period (LIA) after the collapse of Indigenous populations but in some cases prior to European settlement. This expansion of trees after the LIA is consistent with the general collapse of Indigenous populations in the Americas. 2) A clear relation among Indigenous occupation, subsequent European settlement and development of oak woodland occurs at the Somenos Marsh site. 3) Regional climate, edaphic conditions, and periodic fire likely drives the characteristics of dry, shallow soil Garry oak woodlands. Prescribed burning by Indigenous peoples was not likely an important contributing factor. These sites require a more cautious approach to prescribed fire. 4) Garry oak can establish and grow quickly when conditions are favorable, as observed at the Tumbo Marsh site after conditions changed from a saltwater tidal flat into a freshwater marsh environment. The combination and comparison of site level historical records, site characteristics, and dendrochronological data provides a greater understanding the local and regional factors that shape the structure of these ecosystems and can guide restoration and fire management strategies.

# CONCURRENT SESSIONS

## WEDNESDAY, FEBRUARY 14

## A - Burning Issues in Fire Restoration (Continued)

### Resource patterns and fire disturbance in a dry Douglas-fir forest; Implications for restoration and management

Nicholas Hamilton

Pattern and process have long been considered important in maintaining and regenerating plant communities. Recognizing the interactions between ecosystem patterns, climate, and processes is an important step in formulating management objectives and treatments. In the dry Interior Douglas-fir forests ecosystem, long persistent forests and grasslands occupy sites that are similar in terms of climate and edaphic position. In this study, spatial-temporal soil moisture patterns at a forest-grassland ecotone are measured within and adjacent to grassland restoration (slash and burning) treatments. The measurements are compared to plant community composition and structure. After initial measurements were taken, a wildfire burned the study area, permitting before and after disturbance comparison of soil moisture patterns in grassland and forest plots. Based on preliminary data, it is hypothesized that interactions between ecosystem composition and disturbance regime promote vegetation type persistence in the long term. Results indicate that structurally complex forests create cascading layers of heterogeneity in soil moisture, fine fuel productivity, and disturbance patterns. Alternatively, homogeneity of grassland soil moisture resources result in continuous productivity and fire disturbance patterns, thereby preventing establishment of forests. Grassland restoration treatments have resulted in the partial re-establishment of grassland plant communities after several decades. However young forests have not attained the native plant community or heterogeneity of old forests, and did not retain a native grassland plant community. Therefore, re-establishment of old Douglas-fir forest attributes could prove exceedingly difficult.

### Altered mixed-severity fire regime has homogenised montane forests of Jasper National Park, Alberta

Raphael Chavardes

In Jasper National Park, Alberta, changes in 20th century land use altered the fire regime and reduced the diversity of montane forest structure and composition. We identified strong evidence of a historical mixed-severity fire regime using cross-dated, annually-resolved fire-scar records and stand age structures for a network of 29 sites. Following a succession of 13 fires recorded between 1646 and 1905, we found an absence of fires over the 20th century that coincided with fire exclusion and suppression. The change in the fire regime resulted in forests maturing simultaneously into closed canopies with persistent subcanopies that form ladder fuels and increase fire hazard. Although montane forests were historically resilient towards fires burning with a mix of severities, current forest structures are more conducive towards predominantly high-severity fires. Our findings provide support for ongoing proactive fire management actions such as allowing managed wildfires and the use of forest thinning and prescribed burning to mitigate fuel hazards, diversify forest structures and reduce the chance of a high-severity fire spreading across the landscape. These actions help restore fire as an ecological process and promote forest resilience mitigating the effects of a century of fire exclusion and suppression.

# CONCURRENT SESSIONS

## WEDNESDAY, FEBRUARY 14

## A - Burning Issues in Fire Restoration (Continued)

### The effect of time-since-burning on the abundance and growth of *Linaria dalmatica* and *Centaurea stoebe*

Gabrielle Hindley

Historically, wildfire functioned as an important disturbance in many ecosystems that resulted in heterogenous plant communities at the landscape scale. Fire suppression has been the dominant land management strategy, but has created more homogenous plant communities. Many agencies have implemented prescribed burns to restore plant communities and reduce fuel loads. However, the current plant communities do not resemble historic plant communities due to the predominance of a few native plants and exotic plants that have been spread from human vectors. I am interested in how the return of fire effects the abundance and growth of invasive plants, particularly *Linaria dalmatica* (Dalmatian toadflax) and *Centaurea stoebe* (spotted knapweed). The objective was to determine whether fire alone can help reduce the abundance and spread of these invasive plants or whether management should consider other control methods in combination with prescribed burns.

I conducted my study in Kenna Cartwright Park in Kamloops, B.C. I conducted vegetation monitoring in permanent sampling plots and collected data on the number of stems and the height of each stem of both Dalmatian toadflax and spotted knapweed. I had three treatments: prescribed burn, hand-pulling, and control. The prescribed burn treatments were implemented in March 2015 and March 2016. The results suggest that both abundance and growth of Dalmatian toadflax is enhanced through burning. However, I lack pre-burn data for the site. I have established a before-after-control-intervention design to distinguish whether the differences are due to treatment or initial conditions on the sites.

### Bringing back fire to Garry Oak ecosystems in the Gulf Islands National Park Reserve: An ecocultural restoration project

Marlow Pellatt

Fire suppression, aboriginal land-use, climate change, and post-colonial development have lead to drastic changes in the structure and number of Garry oak ecosystems in North America. Many of these ecosystems have been impacted by a lack of disturbance leading to the succession many sites into Douglas-fir dominated systems. The use of fire by indigenous people likely played an important role in maintaining Garry oak ecosystems, albeit for agriculture/harvest (i.e., Camas and other plants), open areas for settlement and defence, and for hunting purposes. My colleagues and I have document change in Garry oak and temperate rain forest species in south west BC using paleoecological methods (pollen, charcoal, phytolyths), tree rings, and historical information. This body of research shows that these ecosystems are dynamic often responding to site specific drivers of change and establishment. They also show the importance of people, fire and disturbance, and climate in the presence of these systems. Building on retrospective studies we have designed an eco-cultural restoration study on Tumbo Island in the Gulf Islands National Park Reserve. We have spent several years monitoring plant communities, edaphic characteristics, dendroecology, impacts of deer browse, and as of September 30, 2016 prescribed fire. In this talk we will discuss the journey from research to restoration, highlighting the largest prescribed burn of Garry oak ecosystems to take place in British Columbia. We will also discuss the logistical challenges and successes associated with the application of science and the need of a strong team to accomplish this Ecocultural restoration project.

# CONCURRENT SESSIONS

## WEDNESDAY, FEBRUARY 14

## B - Butterflies to Bison in Restoration

### Diversity by Design - a multi-species approach to mitigation and ecosystem restoration

Pamela Zevit

It is increasingly recognized that habitat mitigation and restoration projects cannot just be about protecting a single species but need to employ a "multi-species approach" to maximize conservation impact. Conflicts can arise between actions which are aimed at recovering one species but which may adversely impact another species. With the increased stressors on species and habitats, broadening the potential benefits of mitigation banking and restoration efforts to include aspects such as endangered species and biodiversity targets, while working to avoid unintentional conflicts and risks to non-target species is needed. In southwest British Columbia, the South Coast Conservation Program has sought to address this through a "Diversity by Design" approach, to fulfill an identified need for science-based guidance for stewards, land managers, and practitioners involved in species at risk habitat protection, restoration, mitigation and ecosystem management.

### Using adaptive management to reduce uncertainty and respond to changing management needs in ecological restoration

Carol Murray

Adaptive management can be an effective way to systematically address uncertainty in ecological restoration programs, allowing managers to focus effort on the actions most likely to achieve the intended objectives. It also provides a structured mechanism for science-based modifications to ecological management actions in response to climate change and other anthropogenic pressures that challenge managers to meet multiple and often competing objectives. This presentation shares how adaptive management is being designed for restoration of habitat for recovery of the endangered the pallid sturgeon (*Scaphirhynchus albus*), interior least tern (*Sternula antillarum athalassos*), and piping plover (*Charadrius melodus*) in the Missouri River. This program has addressed a wide range of science, stakeholder, regulatory and governance challenges, and provides a rich example of structured, rigorous adaptive management and how it can improve management and social resilience in a rapidly changing world. The presentation will also provide general AM principles and practices which can be applied in smaller scale restoration programs.

### Putting collaborative caribou habitat restoration into practice at the landscape scale

Paula Bentham

The British Columbia Oil and Gas Research and Innovation Society's Parker Caribou Range Restoration Program Plan is the first plan to propose application of habitat restoration techniques over an entire boreal caribou range in Canada. Oil and gas and forestry activities within the Parker Range are expected to be low over the coming decade, providing the opportunity to apply and monitor, with minimal expectation of human disturbance, the effectiveness of habitat restoration over a landscape caribou range scale. The overall objective is to transition low quality boreal caribou habitat into higher quality habitat by reducing the benefits predators and their primary prey gain through linear corridor use, and establish a vegetation trajectory on these corridors that will in the long term increase habitat intactness. The plan has been designed to be implemented over a multi-year period, completing desktop disturbance mapping and implementation planning (2015-2016), implementing restoration treatments through tactical implementation design (2017-2021), and conducting both pre and post-treatment monitoring. This project is building connections between stakeholder and local Indigenous communities, informing restoration and mitigation policies in British Columbia and ensuring consistent practices are being applied to maximize restoration effectiveness benefits for caribou.

# CONCURRENT SESSIONS

## WEDNESDAY, FEBRUARY 14

### B - Butterflies to Bison in Restoration (Continued)

#### Restoring endangered western painted turtle populations throughout the South Coast region of British Columbia

Deanna MacTavish

The Western Painted Turtle (*Chrysemys picta bellii*) is the only remaining native freshwater turtle in British Columbia, Canada. Coastal populations are federally endangered and many historically occupied sites no longer support viable populations due to several factors including habitat loss, road mortality, pollution and poaching. To mitigate these issues and increase populations of Western Painted Turtles, the Coastal Painted Turtle Project has successfully carried out numerous activities since 2009. These activities include the creation of nesting beaches and basking habitat areas, removal of introduced species, development of a population enhancement strategy, and partnership with numerous government, naturalist and First Nations groups. Though creation of nesting beaches and basking habitat as well as removal of invasive species has improved the status of populations, many sites could not be restored through habitat enhancement alone. As the majority of occupied sites had very few turtles and low reproduction and recruitment rates, it was determined these populations would need to be augmented in order to recover. In partnership with Wildlife Preservation Canada and the province of British Columbia, a population enhancement strategy involving headstarted turtles was proposed in 2013. The headstarting program, which involves rearing young from salvaged eggs or wild-hatched young over their first year and releasing them into historically occupied or assessed suitable habitat, has greatly increased turtle hatchling survival. Through the development and implementation of these activities, populations of Western Painted Turtles have increased and the range of this species has expanded throughout the South Coast region.

#### Road salt effects on an urban salmon stream

Alan James

Stoney Creek begins on the Simon Fraser University campus on Burnaby Mountain in northeast Burnaby, B.C., and it empties into the Brunette River near the east end of Burnaby Lake. It is home to 5 species of salmon (Chum, Coho, Pink, Chinook, Steelhead), Cutthroat trout, and the tiny, endangered Nooksack Dace that lives in the lower reach of Stoney Creek and in the Brunette River. Volunteers with The Stoney Creek Environment Committee spent several years monitoring the water quality in Stoney Creek and traced high levels of chloride contamination to a 30-year-old open road-salt storage facility on the SFU campus. A bio-assay of Chum salmon eggs in the winter of 2008-2009 showed that the hatch percentage in the creek was similar to that of hatchery raised eggs. However, the alevins and fry in the contaminated tributary had more than twice the mortalities and deformities than those in the control location. Other studies have shown that Coho salmon are more susceptible to road runoff than Chum. Datalogger monitoring of the conductivity showed that during winter snowfalls, when salt was spread on the roadways, the pulses were on the order of 3 hours. In the summer, groundwater supplies the salt to the creek. Most studies of toxicity use the standard method of gradually raising the contaminant until 50% of the organisms die. The unique nature of the salt contamination in Stoney Creek requires a different approach. Lessons we learn in Stoney Creek can be applied across Canada.

# CONCURRENT SESSIONS

## WEDNESDAY, FEBRUARY 14

## B - Butterflies to Bison in Restoration (Continued)

### Mine reclamation planning in high elevation caribou range advancing habitat restoration research through an academic partnership with the mining industry, First Nations, and scientists

Joanna Preston

Quintette is a steelmaking coal property, which operated for nearly 18 years until a portion of it (Quintette Legacy) permanently ceased operations in August 2000. The remainder of the property has been under care and maintenance status through 2017. It is located approximately 20 km south of Tumbler Ridge, British Columbia, within the Quintette caribou herd range. This herd is part of the central mountain population of woodland caribou (*Rangifer tarandus*), which is a federal species at risk. A portion of Quintette Legacy occurs within high elevation winter and summer range, which once comprised an alpine ecosystem that supported caribou. Teck Resources Limited (Teck) is working with Stantec Consulting to develop an updated closure and reclamation plan for Quintette Legacy. Restoration of an alpine ecosystem as functional caribou habitat presents many challenges, and methods remain largely untested. To meet this challenge, Teck is in the process of forming a partnership with Stantec Consulting, First Nations, and British Columbia Institute of Technology/Simon Fraser University's joint Masters Program in Ecological Restoration to help establish a reclamation research program, with one of the objectives being to improve the Quintette Legacy area for caribou. The reclamation research program will focus on identifying priorities, developing tools and experimental trials to understand the feasibility of caribou habitat restoration in an alpine ecosystem, and identifying potential restoration techniques. The closure and reclamation plan will be reviewed and adapted as results from the reclamation research program become available.

## C - Tailings to Tamaracks in Mine Reclamation

### Effects of cover soil stockpile on plant community development in reclaimed boreal forest

Amalesh Dhar

Stockpiling of topsoil can influence vegetation development following reclamation. Topsoil is commonly salvaged prior to mining and used directly or stockpiled for various lengths of time until it is needed. During stockpiling topsoil has a tendency of change chemically, biologically and physically. Stockpiling influence the availability and vigour of vegetative propagules and seed, and can lead to increases in the abundance of some weedy species. This study uses data from monitoring plots to assess how stockpiling of topsoil impacts plant community development on reclaimed oil sands mine sites in northern Alberta. Development of plant communities differed distinctly between the directly placed and stockpiled topsoil treatments even 18 years after reclamation. Direct placement of topsoil resulted in higher percent cover, species richness and diversity. The NMDS (non-metric multidimensional scaling) and MRPP (multi-response permutation procedure) also revealed compositional differentiation between the treatments. Moreover, indicator species analysis showed direct placement treatment dominated by the perennial community while grasses and annual forb species dominated the stockpile treatment. In addition, analysis of species co-occurrence suggested that only 1.4% of the potential pairwise associations were significant where the number of positive associations was greater than the negative associations (10 positive and 6 negative). Overall, results indicate that stockpiling leads to slower the ecosystem recovery. Direct placement of topsoil appears to follow the typical early successional progress of boreal forests (from a ruderal and annual community to perennial community), thus ecosystem recovery would be much faster and may reduce reclamation management costs due to the reduced soil handling.

# CONCURRENT SESSIONS

## WEDNESDAY, FEBRUARY 14

## C - Tailings to Tamaracks in Mine Reclamation (Continued)

### Rehabilitation of aquatic and terrestrial ecosystems following the Mount Polley Mine tailings dam embankment breach

Katie McMahen

On August 4, 2014, a foundation failure occurred at the Mount Polley Mine Tailings Storage Facility disturbing downstream aquatic and terrestrial ecosystems through erosion and tailings deposition. Mount Polley Mining Corporation's immediate response to the TSF embankment breach prioritized assessing and managing human health and safety risks; initiating a comprehensive environmental monitoring program; and implementing sediment and erosion control measures in the Hazeltine Creek corridor. This presentation provides an overview of the reclamation measures conducted over the past 3.5 years, which have been guided by results of ongoing environmental monitoring and the human health and ecological impact assessments in an adaptive management process. In the aquatic environments, this includes reconstruction of the Hazeltine Creek and lower Edney Creek channels and installation of fish habitat features. In terrestrial environments, this includes tailings management, re-contouring, creation of forest ecosystem microsites and habitats, and re-vegetation. Selection and prioritization of reclamation methods will be discussed, along with successes including return of fish to Edney Creek.

### Evaluating the effectiveness of soil amendments in restoring boreal plant communities in a post gold mine environment

Sean Rapai

Our research team is currently evaluating practical methods for restoring native plant communities on the Detour Lake mine property in northeastern Ontario. A field trial was established on the mine property in 2015 to evaluate and demonstrate the effectiveness of varying soil amendment techniques on soil chemistry parameters, the establishment and growth of vascular plants, and soil health. Mine overburden from the Detour Gold mine has been amended with soil amendments that include NPK (Nitrogen, Phosphorus, Potassium) fertilizer, peat, treated biosolids, and a winter-kill cover crop of oats, along with native seed and seedlings. The study uses ocular estimates of plant cover, soil chemistry and 16s metabarcoding techniques to measure the effectiveness of these treatments. This presentation provides the early results of this large scale field trial, and how soil amendments influence plant growth and establishment, soil fertility and soil health in a post mine environment.

### Surface soil handling and stockpile impacts on plant propagules and establishment of native plant communities

Dean MacKenzie

Conservation of forest surface soil is critical for development of self-sustaining forest ecosystems on post-mined land. Salvaging the surface soil from upland boreal forests received little attention in the past and was often not required. Research has shown forest surface soil provides an economical, diverse and abundant source of native propagules and an important source of nutrients and soil fauna. Salvage depth affects soil quality and potential for in situ propagules to emerge. Salvaging too deep will dilute the propagule and organic matter content of the forest floor with underlying mineral soil; however, salvaging too shallow may not provide sufficient root to soil contact for successful emergence of vegetative propagules. Optimal salvage depth is impacted by various factors such as soil texture, donor source location and reclamation objectives. Salvaged surface soil should be directly placed if native vegetation establishment is desired, as stockpiling surface soil for even short periods of time reduces viability of most boreal plant species and causes substantial changes to soil chemical properties. Viability of seeds within stockpiles can be managed in the short term by altering stockpile size and timing of construction. Optimal placement depth and distribution of surface soil is also dependent on many factors including salvage depth, substrate quality and reclamation objectives. Data from field research at operational and plot scales are presented to support best practices. Various adaptive management practices developed from theory, research and operations to help reduce negative impacts on soil quality and viability of native propagules are discussed.

# CONCURRENT SESSIONS

## WEDNESDAY, FEBRUARY 14

### C - Tailings to Tamaracks in Mine Reclamation (Continued)

#### Phytoremediation in a tailing of a Chilean Copper mine

Estefania Milla-Moreno

Mining is by far the most productive business in Chile. Nowadays Chile has about 603 mining tails and holds the biggest deposit of toxic waste in Latin America. Whenever a tailing pond wall collapses the heavy metals and chemical materials captive in them are rapidly released contaminating rivers and creeks in the surrounding region. For this reason it is mandatory to develop research that incorporates sustainable solutions for mining closures, ensuring safety for local communities and ecosystems. The proposed research can help develop soil and water recovery strategies for sites next to mining tails through 'Phytoremediation'. This biotechnology uses plants and their associated microbes to remove pollutants promoting environmental clean up for in situ soil remediation. There is evidence that 420 species, 28% of the native regional flora of the Coquimbo Region of Chile has potential for mine stabilization. A polyculture of native local species that spontaneously colonize tailings on the area is chosen to investigate the tolerance limits of these species in a fieldwork experiment under heavy metal contaminated substrates. Species with superior performance will be analyzed for photosynthesis, stomatal behavior, WUE and elemental composition, along with anatomical traits and copper localization within leaf, stem and root tissues. These plants will have something in common in terms of microanatomy that will allow them to overcome the various stresses in situ: pH, Cu levels, organic mater content thought to be the most important ones. This research aims to address if: Species that sequester the most metals in leaves have higher evapotranspiration rates relative to those that storage them in the roots, Plants will be sequestering metals at cell wall and vacuoles, and HM tolerance reflects species' ability to exclude or sequester metals at the whole plant or organ level.

#### Hitchhiker planting: an alternative deployment strategy for ensuring the establishment of desirable native herbaceous species on disturbed industrial sites

Amanda Schoonmaker

Native herbaceous plants such as fireweed, goldenrod and asters are important components when re-vegetating industrial sites and have potential utility in early reclamation. They may provide protection for shade-tolerant woody species and create desirable native vegetation cover, allowing for natural ingress of understory species that require protection. Native herbaceous plants may also provide a barrier to invasion of weedy species by occupying physical space (above and below-ground). However, consistently ensuring establishment of native herbaceous species on reclaimed industrial sites can be challenging as reliance on natural recovery is not consistent and intentional deployment is often limited by a lack of accessible seed and plant propagules. Incorporating or hitchhiking native forbs into the same nursery container as a shrub or tree is a potential means of efficiently establishing native forbs on a disturbed site. This presentation will overview the basic premises around hitchhiker planting, approaches and considerations when growing mixed-species container stock in a nursery as well as early findings from a range of ongoing field studies utilizing this approach. In general, we have observed that it is possible to grow multiple species in the same nursery container and also to have both species persist on reclaimed industrial sites. Mixtures that are generally favorable are those where a slow growing and fast-growing species are placed together (such as white spruce with fireweed). Mixtures where both are fast-growing (such as green alder with fireweed) are much more

# CONCURRENT SESSIONS

## WEDNESDAY, FEBRUARY 14

### C - Tailings to Tamaracks in Mine Reclamation (Continued)

difficult to produce in the nursery and obtain consistent persistence after planting.

**Effects of reclamation practices on plant community development after oil sands mining in boreal forest**
Amalesh Dhar

The ecosystem development process of oil sand reclamation sites in comparison with natural ecosystems can provide the basis for reclamation success. Thus, understanding the effects of reclamation treatments on plant community development is an important step in developing realistic indicators for reclamation of upland oil sands sites. The main objectives of this study is to examine the development trend of plant community on different reclamation cover soil types (i) clay over overburden (CO), (ii) clay over tailing sand (CT), (iii) peat mineral mix over overburden (PMMO) and (iv) peat mineral mix over tailing sand (PMMT) in comparison to natural forests in the light of species diversity, compositional changes and co-occurrence pattern. The results indicated that cover percent of plant community followed the general trend in ecosystem recovery process in all reclamation treatments compare to natural boreal forests of this region. Although species richness and diversity indices showed some level of variation among the treatments but their species composition were not significantly differed among the reclamation treatments. The NMDS (non-metric multidimensional scaling) also revealed a clear compositional differentiation in the reclamation treatments from the natural forest. The probabilistic model of species co-occurrence indicated that plant community assembly in oil sand reclamation sites is still in progress and represented 4.5 % in PMMT and 5.4% in PMMO significant pairwise species association compared to natural forest 24.9%. The outcomes of this study can enhance our understanding in developing a realistic prescription for oil sand reclamation in Alberta.

# CONCURRENT SESSIONS

## THURSDAY, FEBRUARY 15

## A - Rising Tides in Marine and Estuary Restoration

### Invertebrate, sediment, and blue carbon attributes within an estuarine ecosystem in relation to disturbance regime

Erin Roberts

Geochemical and biological attributes of three intertidal areas in the Squamish Estuary with different levels of disturbance (low, medium, and high) were assessed to determine short-term ecosystem responses to localized restoration. Sediment and macroinvertebrate variables were analyzed among sites to characterize the ecosystems response and provide insight on the nature and process of an assisted successional trajectory. We also determined the role of fine woody debris (FWD, 6 mm-256 mm) as a carbon sink (i.e. blue carbon) by calculating and comparing among the three disturbance regimes amounts of carbon captured by the FWD. Invertebrate composition and biomass were lowest on the site with the highest level of disturbance. The high disturbance site also contained the highest percentage of fine sand (0.0067 mm to 0.25 mm). The medium site contained more invertebrates than the low disturbance site indicating that something other than localized disturbance is affecting the invertebrate community on the low site. All sites exhibited a less-rich and less-diverse invertebrate community than that of historical records (circa. 1970-1980). The average carbon content in FWD for the three study sites ranged from 25.27 $g/m^2$ in the low site to 502.12 $g/m^2$ in the high site with total carbon pools of 1958.27 kg, 779.54 kg, and 88.45 kg for the high, medium and low sites respectively indicating that FWD is an important sink for carbon within disturbed environments. Restoration efforts indicate that some traits on the high site are similar to those on medium site (and to a lesser degree low site). Additional years of monitoring are needed to determine if there is a converging trend across ecosystem traits on study sites. However, if the objective is to restore the former log handling site and east delta to a free-flowing and sediment depositing environment, more representative of historical conditions, larger landscape level treatments will need to be considered.

### Blue carbon on the Pacific Coast of Canada: Measuring coastal carbon stocks in Pacific Rim National Park Reserve and the Clayoquot Biosphere Reserve

Marlow Pellatt

Climate change mitigation involves reductions in anthropogenic emissions of greenhouse gases. Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g., through reforestation, conservation and restoration. Blue carbon is a term that recognizes the role of coastal wetlands and seagrass systems in the global carbon cycle. Tidal marshes, tidal forested wetlands, and seagrasses sequester carbon dioxide from the atmosphere continuously, in some cases over thousands of years, building stocks of carbon in organic-rich soils. It has been estimated that blue carbon systems cover less than 2% of the area of the world's oceans but sequester at least 50% of the carbon stored in ocean sediments. In Canada, seagrass and saltmarsh ecosystems are well represented in Canada's coastal National Parks and National Marine Conservation Areas (NMCAs). These coastal ecosystems provide numerous ecosystem services in addition to blue carbon such as fish nursery habitats and erosion protection. Many of these systems are in need of protection and restoration, and will be impacted by rising sea levels, extreme weather events, and terrestrial activities such as erosion and pollution. In addition to important ecosystem services, the restoration of seagrass and saltmarsh communities is a cost-effective part of a broader climate change mitigation strategy. Parks Canada, the Commission for Environmental Cooperation, and Simon Fraser University are studying blue carbon (seagrass and saltmarsh) stocks in Canada including Pacific Rim National Park Reserve, the Clayoquot Sound Biosphere Reserve, and Boundary Bay. This presentation will discuss some preliminary results of this research and how it may serve as climate change co-benefit

# CONCURRENT SESSIONS

## THURSDAY, FEBRUARY 15

## A - Rising Tides in Marine and Estuary Restoration (Continued)

### Squamish Estuary Brownfield Restoration Project

Edith Tobe

In the 1950s a log sort was constructed in the Central Estuary basin in the Squamish Estuary. As a condition of the 1999 Squamish Estuary Management Plan the log sort was to be relocated by 2014. However, as there was no requirement for the site to be restored, the Squamish River Watershed Society, in late 2014 and early 2015, began securing funding, permits, and approvals to undertake a full restoration the 4.7 hectare site back into tidally influenced wetland salt marsh. Project partners included Squamish Nation, Fisheries and Oceans Canada, and Ministry of Forests, Lands, Natural Resource Operations, and District of Squamish. Some of the key objectives of this project included: creation of new tidal channels; planting native riparian vegetation; removal of fill, wood waste materials, and overburden and returning the site to historic grades to allow natural estuarine processes to resume; monitoring the site to gauge the carbon sequestering potential (through identifying soil composition, depth, woody debris, and plant matter); installation of educational interpretive signage; exploring eelgrass restoration in the sub-tidal shorelines; and establishing the site as a living classroom for university public school students. The project commenced in March 2015 and was completed by April 2017 and included the planting over 2,000 native trees, shrubs, and sedges, 500 eelgrass shoots, and 20 volunteer days with over 200 volunteers. As well, there are ongoing student research projects. Monitoring is ongoing and included a pre-construction survey, soil sampling, bathymetry, aerial surveys, carbon studies, fish presence and usage, and wildlife values.

### Research into the cause of brackish marsh recession in the Fraser River estuary

Eric Balke

At least 160 ha (30%) of the brackish marsh on Sturgeon Bank in the Fraser River estuary has disappeared since 1989. A collaborative effort between the provincial and federal governments and industry aims to determine the cause(s) of the recession to inform future restoration efforts. Three adjacent low-elevation brackish marshes along the delta front have also receded to varying degrees. River training structures and regular dredging of the Fraser River divert sediments and fresh water, and thus alter sediment and salinity patterns along the delta front. Lesser snow geese (*Anser c. caerulescens*) preferentially grub bulrush, and the Fraser-Skagit population has increased 2-3 fold over the last three decades. Investigation of the marsh recession to date includes (1) describing historical rates and patterns of recession, (2) assessing the present environment (e.g., sediment accretion rates and salinity regimes), and (3) conducting inferential experiments to identify factors that contribute to marsh loss and prevent recovery. No single recession hypothesis we tested singularly explains the recession. The anticipated effects of climate change, especially sea-level rise, pose additional threats to all tidal marshes in the Fraser River estuary.

### Deltaport causeway shoreline and intertidal saltmarsh rehabilitation project 2017

Scott Black

Tidal and sub-tidal ecosystems in the vicinity of Roberts Bank, BC provide numerous benefits to people and nature, including fisheries production, wildlife habitat, water quality improvement, and shoreline protection. Restoring and enhancing intertidal ecosystem functions is important in order to maintain these benefits. The re-engineering of the Deltaport-south causeway shoreline has reinstated tidal flows and created the morphology and physical conditions that emulate local salt marsh analogues. Re-establishing plant cover is essential for restoring ecosystem functions, but revegetation can be difficult in severe sites, such as salt marshes that experience hypersalinity and extreme wave action. The primary purposes of this intertidal project was to re-establish appropriate salt tolerant vegetation in the created habitat and to identify optimal techniques for salt marsh restoration in the area. Salt marsh revegetation focused on transplanting (planting plugs or propagules salvaged from adjacent areas) and has met with various degrees of success over the first season of growth.

# CONCURRENT SESSIONS

## THURSDAY, FEBRUARY 15

## A - Rising Tides in Marine and Estuary Restoration (Continued)

### Englishman River Estuary Restoration: A partnership approach to promoting climate change resiliency and restoring habitat through local knowledge and the development of hydrodynamic/wave models

Peter deKoning

Since the 1930s, the natural river and estuarine processes and associated riparian habitats in the Englishman River Estuary have been altered by human-made structures and activities including dikes, roads, residential development, industrial uses and ditching. Today portions of the Englishman Estuary are nearly completely cut off from tidal and riverine hydrology. These historic impacts and current challenges have deteriorated the habitat condition and accessibility to a myriad of fish and wildlife species for refuge, foraging and rearing. As part of a 5-year project to restore natural estuarine processes and promote climate change resilience, the West Coast Conservation Land Management Program identified the removal of a sea berm known to constrict tidal flows to the western portion of the estuary as a high priority project. Northwest Hydraulic Consultants developed a hydrodynamic model and wave model to determine the effects of removing the berm on tidal inundation, currents, and waves in the estuary, including the effect of future sea level rise due to climate change. Model simulations showed the berm removal would increase the frequency and duration of tidal inundation, and would promote sediment accretion in the estuary which is an important process for the tidal marsh to maintain its characteristics with rising sea levels. In August 2017, working with Fisheries and Oceans Canada (DFO), the sea berm was removed and efforts are underway to monitor the effectiveness of the restoration efforts.

### Cold water upwelling in coastal embayments of Lake Ontario: Implications for restoration

Nicole Sulewski

Coastal wetlands are an important ecosystem in the Great Lakes basin, providing spawning area and warm water refuge for numerous fish species during cold water upwelling events. Urbanization along the northwestern shore of Lake Ontario has led to a depletion of coastal wetlands, replacing them with artificial embayments. Five artificial embayments and one coastal marsh in Mississauga, ON were studied to determine if the artificial embayments function as warm water refuge during upwelling events. Temperature loggers were placed in each study site, and temperature was recorded every 15 minutes from July to October 2017. Upwelling events were isolated from the data, and frequency and extent of upwelling was determined. The results will inform the creation of future embayments, restoration of existing embayments, and conservation of Great Lakes coastal wetlands to create resilient ecosystems.

## B - Innovative Standards, Metrics and Approaches

### Utilizing SER's International Standards to improve restoration outcomes

Bethanie Walder

Ecological restoration is increasingly promoted and funded as an important solution for environmental degradation and climate change throughout the world. However, international agreement on what constitutes restoration does not exist, nor does systematic oversight of restoration projects. When sole ecosystem services (e.g. carbon sequestration, flood control, wood products), drive the "restoration" agenda, the results may not be as ecologically restorative as intended. SER's International Standards for the Practice of Ecological Restoration provide a framework for: assessing and promoting ecologically- and socially-sound restoration that achieves multiple benefits including improving the biodiversity outcomes of climate and reforestation initiatives. This presentation will introduce SER's International Standards while also discussing how they can be incorporated into ongoing restoration programs at the planning, implementation, and monitoring phases. Integrating SER's scientifically- and socially-sound standards into private, state and federal restoration projects can help ensure these activities achieve desired ecological and social goals.

# CONCURRENT SESSIONS

## THURSDAY, FEBRUARY 15

## B - Innovative Standards, Metrics and Approaches (Continued)

### Forest landscape restoration in Canada. Opportunities and challenges in the international context

Renee Lapointe

Global Forest Landscape Restoration (GFLR) offers an unprecedented opportunity to restore degraded lands into functional and working landscapes that deliver co-benefits to multiple stakeholders . Recent efforts by non-governmental organizations have been launched with the goal of achieving large-scale restoration targets. Over 20 countries and regional initiatives have already committed to restore close to 150 million hectares of degraded land and are seeking ways to integrate restoration strategies into a sustainable forest management and conservation agenda. However, the path towards achieving these goals is unmapped due to the challenges of navigating poorly understood ecological, socio-economic and governance impediments and the complexity of integrating multiple benefits and stakeholders. We put in perspective the opportunities and challenges for Canada to be an active player in respect to these international initiatives by addressing multidisciplinary knowledge gaps and issues: What are the international organizations and landscape-scale restoration programs; what are the principles of a GFLR approach; Are they relevant for the Canadian context; What are the tools and strategies available to move from target to implementation, and what key policies are needed to facilitate restoration at large scale. Sustainable forest management practices in Canada could be valued to support international commitments. However, recurrent large-scale anthropogenic disturbances combined with natural disturbances may challenge effective restoration in Canada. Policy that is driven by multi-stakeholder decision-making may also be needed to move toward a national framework supported by a multidisciplinary research agenda.

### Priority ranking project: an exercise in invasive plant treatment planning using land-based social values as a driver

Lisa Scott

Effective and efficient prioritization of invasive plant treatments is an important aspect of land management and ecological restoration. In light of an increasing number of invasive plant species and limited funds for treatment, it's important to find a way to prioritize potential treatment sites and maximize treatment value. In the Okanagan-Similkameen region of BC, we have identified several social factors and used these to drive treatment planning. Spatial data layers with quantifiable social values were identified including spring range for livestock, ungulate winter range, conservation lands, recreation reserves, community watersheds and biodiversity strategy conservation ranking. An MS Access based geographic calculator was used to create a priority rank by querying each resultant polygon for the presence of each social factor. Following this, invasive plants were also ranked and analyzed against the land-based tool to develop a matrix for planning treatments. We have determined that this adaptive management tool allows land managers to understand and justify decisions and allocation of resources. It provides an effective means of accomplishing restoration and maintenance goals, and assisting in maximizing treatment impact under budget constraints.

### A qualitative assessment of urban ecosystem resilience using a habitat quality index

Valentin Schaefer

The quality of urban habitats is complicated to assess quantitatively because of the combination of natural and anthropogenic influences and the synergisms between them. A Habitat Quality Index offers a tool for establishing baselines and measuring progress in urban restoration. Twelve characteristics important in determining habitat quality in urban areas such as patch size, buffers, biodiversity and age, were each assigned ratings on a qualitative Likert scale and assessed for sites in Oxford, England. The characteristics were applied to a spectrum of five habitats ranging from highly disturbed to a mature functional natural ecosystem. The two smallest, youngest, most disturbed areas, Astona's Eyot and Burgess Park, used to both be landfills have been partially restored and were expected to have the least resilience. Both of these areas had the lowest scores for the Habitat Quality Index of 37% and 34% of maximum. The largest and oldest area, Wytham Woods, was expected to be the most resilient. It had a score of 86% of maximum. The two sites which were considered to be transitional in becoming resilient, Port Meadow and Magdalen College, had scores of 60% and 69% of maximum respectively. In developing resilience, disturbed urban areas pass a threshold, progressing from being ornamental landscapes that lack resilience to more mature functional landscapes with the greater diversity and more complex symbiotic relationships that make them resilient. The Habitat Quality Index successfully described this trend.

# CONCURRENT SESSIONS

## THURSDAY, FEBRUARY 15

## B - Innovative Standards, Metrics and Approaches (Continued)

### Minimal disturbance pipeline construction and habitat restoration practices in forested uplands and lowlands

Jennifer Barker

Minimal surface disturbance (MSD) construction techniques are an integral practice in restoring habitat in the shortest possible duration. By leaving organic soils, root layers, and seed source undisturbed, these techniques help to maintain the building blocks necessary for the rapid recovery of natural systems. Combining MSD with innovative solutions for access management along rights-of-way and incorporating post-construction monitoring activities leads to rapid revegetation and successful habitat restoration over time. This is especially important for the restoration of peatlands and habitat for Species at Risk, such as the woodland caribou.

### Natural processes for the restoration of drastically disturbed sites

David Polster

Natural processes have been "restoring" natural disturbances since the advent of terrestrial vegetation on earth over 400 million years ago. By understanding how these processes operate to treat naturally disturbed sites, these same processes can be applied to sites humans disturb. Landslides, shoreline erosion, volcanic eruptions and other natural disturbances recover over time. Key elements in this recovery are the pioneering species that are involved. In many cases, these species are adapted to tolerate the low nutrient content of disturbed sites by fixing nitrogen. Similarly, some pioneering species produced abundant organic matter and therefore build rich soils on the disturbance. In addition to the species, the physical conditions such as steep slopes or coarse textured substrates are ameliorated by natural processes. Similar constraints that occur at human caused disturbances can be solved in similar manners. This paper presents the details of how natural recovery processes can be applied to human disturbances. By using natural processes for the restoration of significant disturbances the effort and therefore the cost of the restoration work is reduced from traditional restoration treatments.

### Applications of adaptable and quantitative soil quality assessment framework in land reclamation

Abimbola Ojekanmi

The need for an adaptable soil quality assessment (SQA) framework in land reclamation is related to diversities of objectives, land use, site-specific challenges, remediation options, geological, soil and hydrological dynamics, climate, vegetation and differences in intensity of anthropogenic impacts on natural systems. Therefore, there is the need for a consistent and quantitative SQA framework to demonstrate the restoration of soil and related ecosystem functions. We proposed a four-step iterative framework with an emphasis on application of soil quality functions (SQF), that calibrate soil quality indicators with an objective measure of performance. Designed SQF are validated for site-specific use based on ability to repeat known treatment effects on soil functions of interest and further applied in rating the quality of reclamation covers. Applications includes SQA in design of peat-mineral mix covers, identifying critical thresholds to guide soil conservation and reconstruction operations, assessing vegetation growth in reclaimed sites, performance of remediation technologies, among others.

# CONCURRENT SESSIONS

## THURSDAY, FEBRUARY 15

## C - Culturing Ecosystems and a Culture of Restoration

### The Taku River Tlingit First Nation Otter Creek Wetland Development Project

Michael Keefer

The Taku River Tlingit First Nation (TRTFN) has partnered with a consultant team that includes Keefer Ecological Services, Lotic Environmental and Dobson Engineering to design a wetland for the restoration of a historic mining area that has not been restored. The site for this wetland can be characterised as an area in ecological recovery that most closely resembles a gravel pit with a sediment choked stream, Otter Creek, that is flowing through the site. With the goal of enhancing biodiversity, reducing sediment loads flowing into nearby Surprise Lake and enhancing connectivity, it was determined that a constructed wetland would meet many of these objectives. Funding was successfully received from the National Wetland Conservation Fund to the Taku River Tlingit First Nation's lands department. This project has just completed a first season that has resulted in a preliminary wetland design, training of TRTFN Land Guardians, as well as a native plant seed collection. This presentation will convey the overall hyrological and ecological picture of the greater Otter Creek watershed Wetland as well as the methods and preliminary design for the wetland construction.

### The Context of the Taku River Tlingit First Nation Wetland Development Project

Trevor Williams

The Taku River Tlingit First Nation (TRTFN) has a large traditional territory located in the extreme northwestern corner of BC that borders both Alaska and Yukon Territory. Most community members live around Atlin, the area's only town that was founded largely due to the placer mining industry that was one of the early gold rushes that began in 1890s. The placer industry has had substantial long-term effects on the region's aquatic and terrestrial ecology. Industrial activity tends to fluctuate widely due to gold prices. Unlike for BC's major mines, this industry has been largely unregulated and continues to have drastic effects on fish and wildlife habitat. The Taku River Tlingit have been engaged for over two decades in trying to protect their territory from the effects of these mines, including through the Atlin Taku Land Use Plan. However, they have had disappointingly few wins at improving practices due to a lack of buy-in from the proponents and the slow pace of change in the improvement of mining regulations from the provincial government. As a means of effecting change, the community has initiated training, experimental native plant seedings, lichen transplanting, outreach with the placer industry proponents and engagement through the government to government Shared Decision-Making Agreement, and got funding to create Wetland Restoration Project. Integral to all of these initiatives is the TRTFN Land Guardians program. This presentation will outline the activities being undertaken by TRTFN to minimize negative impacts from the placer sector and to restore abandoned mine sites.

### It's a dirty job but someone has to do it: an environmental contractor's perspective on restoring wetlands on an old golf course on Salt Spring Island

Christopher Drake

In 2013 the Salt Spring Island Conservancy acquired Blackburn Lake Nature Reserve, an old organic golf course that had previously been an important wetland. Over the years, an ambitious project has been undertaken to restore several hectares, combining the skills and energies of biologists, NGO's workers, volunteers, and contractors. And while the planning and coordinating is carried out by the primary biologists, much of the hard work and ongoing maintenance is contracted out to self-employed environmental professionals. Using the wetland restoration at Blackburn Lake as an example, I will explore what it means to make a living as an restoration contractor. Not only is the work sometimes dirty and slimy, and often boring and repetitive, there are also many aspects of contracting that you don't learn when you study science. Finding contracts, writing quotes and invoices, bookkeeping, advertising, customer relations - as a self-employed environmental restoration professional these are all concepts that are learned on the fly (and don't necessarily come naturally to biologist types). Should we consider ecological restoration as a trade as much as a science? To stay self-employed in this field certainly takes a reasonable amount of creativity. However the benefits are many, not the least being the chance to be involved in important and fascinating projects such as the wetland restoration around beautiful Blackburn Lake.

# CONCURRENT SESSIONS

## THURSDAY, FEBRUARY 15

## C - Culturing Ecosystems and a Culture of Restoration (Continued)

### Restoration of a process: Fire in the Monarch Butterfly Biosphere Reserve

Diego R Pérez-Salicrup

One of the first steps in restoration efforts should be to identify the sources of disturbance, and evaluate whether it is possible to stop them or at least reduce their impact. Then, realistic restoration goals should be defined, considering the disturbance regime in the area of interest, aiming for ecosystem integrity, social welfare, and eventual resilience to disturbances. In this manuscript we evaluate the current modifications to the fire regime in Coniferous Forests in the Monarch Butterfly Biosphere Reserve, in Central Mexico, and then present the current conditions and potential scenarios to restore it, considering the integrity and resilience of the socio-ecosystem. We found that both historic and current human activity in the Biosphere Reserve have modified the fire regime in Abies religiosa forests stands, but not in *Pinus pseudostrobus* stands. Human activity can not be eliminated from the Biosphere Reserve, although some activities could be modified to reduce their impact on fire regimes. Other activities may actually help the ecosystem avoid catastrophic fires. The synergies between different disturbances might increase the risk of going beyond a threshold were forests might regenerate. Hence, resilience in this socio-ecosystem can only be achieved by working closely with inhabitants in the Reserve and its zone of influence, so their fire management decisions follow natural regimes as closely as possible, but considering their uses of forests.

### Community to Community: Growing Stronger Together Black Cottonwood Restoration Project

Kasey Moran

Foundation tree species, like black cottonwood (*Populus trichocarpa*), have a disproportionate influence on the ecosystems that they are a part of. In BC, black cottonwood supports a number of Red Listed plant communities and wildlife species on land and in the water by providing nesting habitat, erosion control, leaf litter, shade, and many other benefits. In traditional Syilx territory (the Okanagan-Similkameen region), black cottonwood / mulx is considered vital to the health of the land and people. However, since European colonization, anthropogenic factors have led to a 63% reduction in the cover of black cottonwood - red osier dogwood ecosystems. Active restoration may be necessary to allow for their persistence and recovery, since many of these pressures, like river diking, are ongoing and directly prevent re-establishment. This Canada 150-funded project has contributed to an improved ecological and social landscape by turning black cottonwood/mulx restoration into an act of truth and reconciliation as trees are planted and traditional ecological- and western scientific knowledge is shared within the community. Three-years of monitoring and measurement of physical habitat characteristics will add value to the project by allowing us to ask questions about optimal planting conditions and restoration techniques for this important species.

# CONCURRENT SESSIONS

## FRIDAY, FEBRUARY 16

## A - The Hype About Hyper-Abundant Herbivores

### Futility of the hunt: how effective are deer culls and passive management for restoring the forests of Haida Gwaii?

Dylan Mendenhall

Non-native Sitka black-tailed deer have invaded nearly every island in the archipelago of Haida Gwaii. In the absence of natural predators, intensive deer browsing has shifted successional trajectories, reduced understory plant abundance and altered the species composition of these temperate rainforests. Deer culls have been used for restoring some of the islands of Haida Gwaii, yet little is known about the capacity of these invaded ecosystems for autogenic repair. To evaluate passive management as a strategy for restoring native plant communities, we first compared the vegetation of islands invaded by Sitka black-tailed deer with islands naturally absent of deer. In a separate experiment, we surveyed the vegetation of an invaded island using paired plots inside and outside of 20-year-old herbivore exclosures. There were significant differences in the diversity and composition of the understory plant community on invaded islands compared with reference islands absent of deer. Although herbivore exclosures significantly increased overall plant abundance, they did not affect species richness, species evenness or community composition. Our research suggests that invaded forests have a limited capacity for autogenic repair. While some plant species are able to persist under extreme deer browsing, other native species may require reintroduction. We conclude that passive management is an ineffective strategy for ecological restoration following a deer cull.

### Ten years of hyperabundant wildlife management Parks Canada: policy, implementation, and outcomes

Emily Gonzales

Hyperabundant wildlife degrade ecosystems by damaging vegetation that is habitat for other species. The Canadian National Parks Act (2000) requires the maintenance of ecological integrity and protection of species at risk. Parks Canada needed a mechanism to restore ecosystems damaged by hyperabundant wildlife. Since 2007, the Hyperabundant Wildlife Population Management Directive has provided a consistent, evidence-based approach that prioritizes partnerships with Indigenous peoples. This Directive indicates the circumstances in which hyperabundant wildlife will be managed in Parks Canada, the general principles that will be respected, the processes and procedures that must be followed, and the associated responsibilities and accountabilities. The Directive requires parks to develop a Management Plan that demonstrates the damage to ecological integrity. It must contain an options analysis, monitoring plan, consultation plan, and a communications strategy. More than 40 operations have taken place in five national parks and one national historic site since 2007. This session provides an overview of those operations, the consultations and public and stakeholder responses, the ecological and social outcomes of hyperabundant management in national parks, and lessons learned. A key lesson learned is that the objective of hyperabundant wildlife management is not wildlife management. Media messages and monitoring need to stay focused on the real objective, which is ecological restoration.

### Deer drive community and evolutionary changes in the threatened Garry oak ecosystem

Cora Skaien

Ungulate browsing can drastically alter species abundance or performance, or cause evolutionary change in species' traits related to fitness and survival. In the Southern Gulf Islands, British Columbia, the threatened and heavily invaded Garry oak and maritime meadow ecosystems experience deer densities as high as 100 deer/km$^2$. To experimentally assess the impact of deer herbivory, we erected two exclosures on Sidney Island in April, 2012 and assessed native species performance in 2014 and 2016. In August, 2013, 4800 *Plectritis congesta* seeds, which originated from islands with histories of high or low deer densities, were systematically planted in and outside exclosures. In May 2014, native species cover was 2-fold greater inside exclosures than outside. Iconic *Brodiaea* species particularly benefited from deer exclusion, with 3.7 times more cover, 2.3 times higher corm abundance and 3.4 times more volume per corm inside exclosures than outside. *Brodiaea* species corm abundance and overall biomass was even higher in 2016. The survival of *P. congesta* plants was severely reduced outside exclosures regardless of browsing history, but plants originating from islands with deer had 3-fold higher survival than plants from islands without deer. Plants that originated from islands with deer grew low to the ground until mid-spring to avoid herbivory, whereas plants from islands without deer bolted several months earlier making them more susceptible to herbivory. These results suggest that removal of deer is sufficient to instigate restoration of these degraded ecosystems, and that *P. congesta* populations are locally adapted to resist herbivory on islands with deer.

# CONCURRENT SESSIONS

## FRIDAY, FEBRUARY 16

## A - The Hype About Hyper-Abundant Herbivores (Continued)

### A multitude of herbivores determine restoration strategies

Luise Hermanutz

Non-native herbivores, including hyperabundant ungulates, have modified forested ecosystems globally causing forests to regenerate to alternate stable states after disturbance. Land managers are interested in developing best practices to restore degraded forests. Cumulative impacts of non-native species have resulted in a lack of regeneration in balsam fir-dominated coastal forests in Newfoundland following natural canopy disturbance by insects. Recruitment of an understory fir layer is compromised by heavy predation on cones/seeds by non-native red squirrels and birds, and post-dispersal seed and seedling predation by non-native rodents and slugs. Seedlings that do survive and grow to the sapling stage are heavily browsing by non-native moose, so that recruitment to reproductive-aged trees is compromised, further limiting cone production. Based on the levels of post-dispersal predation, seedlings were chosen rather than seed to restore the foundation species. Balsam fir seedlings were planted along a gradient of disturbance from closed canopy forest to large insect-disturbed gaps under various ground preparation treatments (field planting, aboveground suppression, and scarification) in Terra Nova National Park. Seedling performance (survival, growth, and browsing occurrence) was monitored over 2 years. Better growth, lower survival, and higher browsing intensity were observed with increasing forest disturbance, with taller seedlings performing the best. There were no substantial biological benefits among ground treatments, which are costly and time-consuming to implement; therefore active restoration in boreal forests can be implemented using standard forestry planting protocols, independently of the forest degradation.

### Deer Oh Deer: Investigating the cascading ecological effects of non-indigenous ungulates on Haida Gwaii

Sue Grayston

In the 19th century Sitka black-tailed deer were introduced to Haida Gwaii, an archipelago of over 150 islands off the north-west coast of British Columbia. In the absence of predators, the deer population has grown exponentially to the current estimate of 13-30 deer Km-2 and has had major impacts on the plant and songbird communities of these islands. The deer have altered the structure of forest vegetation through preferential browsing of more palatable species; western redcedar, in particular, has been virtually eliminated from many islands and many of the understory ericaceous shrubs, herbs and ferns have also been dramatically reduced. Reduction in plant species abundance and diversity has cascading ecological effects on ground-nesting songbird populations, through habitat loss and reduced invertebrate food sources. Whilst the impacts of deer on aboveground vegetation is fairly well established, in comparison there is a paucity of knowledge on the effects of deer on soils and belowground organisms and processes. The vital role that soil organisms play in soil carbon storage and nutrient cycling processes and consequent known feedbacks to plant nutrition and growth means such investigations are critical. Deer effects on soil can be direct through trampling and deposition of waste products, or indirect through effects on vegetation composition. In this presentation I will discuss new research being conducted in Haida Gwaii to address these knowledge gaps.

### Gained in translation: Distilling international expertise into local knowledge and support for the Llgaay gwii sdiihlda - Restoring balance, Haida Gwaii Deer Eradication

Robyn Irvine

The first large scale, multi-island deer eradication in Canada occurred on Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve, and Haida Heritage Site (Gwaii Haanas) in summer of 2017. The Restoring Balance (Llgaay gwii sdiihlda) project worked to remove all deer and confirm the absence of the invasive species using internationally tested techniques in a phased approach. Deemed necessary by the Archipelag Management Board in order to address the heavy overbrowsing impacts of the invasive Sitka Black-tailed Deer on the coastal forests with Gwaii Haanas, the operational plan was developed by international eradication experts and was based on techniques show to be effective in other parts of the world. The ideas, methods and skills of an international group were gleaned to help leapfrog Canada forward on the eradication learning curve. How this approach worked or did not function will be discussed. For the project to even begin, acceptance and understanding of the local community was requisite and the communication approach used to raise awareness of invasive species management will be discussed.

# CONCURRENT SESSIONS

## FRIDAY, FEBRUARY 16

## B - Rooting Around Plant and Soil Restoration

### Restoration of soil organic matter on degraded sites: important and surprising findings from recent research

Cindy Prescott

Fundamental to the success of large-scale reclamation is development of a functioning soil, including the amount, properties and rates of accumulation of soil organic matter (SOM). Restoration practices can benefit from the considerable scientific effort in recent years to better understand the processes through which SOM is formed and stabilized. Surprisingly, there is growing evidence that the most stable SOM is produced from labile (not recalcitrant) organic matter, as it is the processing of organic materials through the soil microbial community that causes it to be transformed into stable microbial residues. Roots, particularly fine roots, and rhizodeposits are now thought to be an important source of SOM. Soil fauna and nitrogen additions, rather than hastening decomposition, may transform organic matter into more recalcitrant and stable forms. These findings have profound implications for the selection of restoration actions that can best hasten soil development and improve soil fertility on degraded sites.

### Rebuilding urban ecosystems to maximize stored carbon and water filtration

Michael Rawson Clark and Alison Wilson

Urbanization is a world-wide phenomenon, resulting in the loss of natural ecosystems and reduced ecological functions and processes of developed areas. One factor that is missing from restored ecosystems is charcoal levels. In Edmonton, Alberta, collaboration between a developer, MLC Group, the University of Alberta, and native ecosystem rebuilder Clark Ecoscience and Sustainability are assessing the wetland and upland soil carbon application impacts on water filtration. This was done in a storm water management facility (SWMF). Soil charcoal through the pyrolysis of pine killed by Dendroctonus ponderosae was applied at four levels across four blocks: 0, 2 and 6 (natural levels of boreal forest), and 18 tons C ha-1. Rebuilding was done in 2015. In 2016 soils were analyzed for charcoal persistence and nitrogen retention. Total soil carbon increased linearly with application across the amendment scale, from 77 to 79 to 82 and to 86 Mg C ha-1. However, this was found to occur in only the uplands, not the wetlands. Nitrogen did not differ between charcoal treatments. There was also a strong correlation between total soil carbon and nitrogen in all of the treatments, suggesting that at the early stage total soil carbon and nitrogen are greatly affected by the early-rebuilding effects. Given that charcoal amendments have effects over decades, this first year result is positive, as it demonstrates applied charcoal stability.

### Soil nematodes as bioindicators of restoration success in a northern fescue prairie

Victory Coffey

Forest encroachment resulting from fire suppression, modified grazing, and climate change poses a threat to northern prairie ecosystems. Encroaching trees alter the composition and function of plant and soil communities and can compromise the restoration of affected prairies. Our objective was to determine whether legacies of forest encroachment persist in restored prairie communities and whether soilborne nematodes can be used as bioindicators of the soil food web during restoration. To accomplish this, we compared the structure, diversity, and function of soil nematode communities along a chronosequence of prairie restoration following tree removal. Study sites were located within two historic white spruce (*Picea glauca*) plantations established between 1930 and 1940 on rough fescue prairies in Riding Mountain National Park, MB. Within each site, we compared plant and soil nematode communities between areas of native prairie, remaining plantation stands, and three tree removal treatments. Our observations indicate that shifts in plant community structure following tree removal were accompanied by shifts in nematode feeding groups, with fungal and bacterial feeding nematodes decreasing over time and plant parasitic nematodes increasing to levels similar to those observed in native prairie. However, unlike the native prairie, the overall diversity of both the plant and nematode community declined with time and was lowest in the oldest restored treatment. Our results indicate that soil nematodes are sensitive to changes in the plant community following the removal of trees and can be effective indicators of changes in soil food web structure following the restoration of northern fescue prairies.

# CONCURRENT SESSIONS

## FRIDAY, FEBRUARY 16

### B - Rooting Around Plant and Soil Restoration (Continued)

#### Opportunities and challenges for restoring northern ecosystems with locally sourced biological soil crust

Katherine Stewart

Increasing disturbance of soils is resulting in a greater number of early successional habitats globally. Creating both a need and opportunity to examine the fundamental role of biogeochemical interfaces in ecosystem development. Due to their ubiquitous distribution and unique physiology, establishment of biological soil crust (BSC) communities and corresponding initiation of key ecosystem functions is a common early successional process. BSCs are soil surface communities composed of lichens, mosses, liverworts, cyanobacteria, fungi, bacteria and archaea. Active restoration of disturbed soils with local BSCs may increase surface stability, promote nutrient cycling and provide well-adapted early successional communities. In a series of northern arctic and alpine trials, BSC inoculation has resulted in relatively rapid establishment and recovery of nitrogen and carbon fixation on disturbed substrates. However, there are several challenges associated with active restoration of these communities, including sufficient on-site resources, alterations in BSC community composition, and lags in the recovery of ecosystem functions. Substrate-based growing systems may provide a means of increasing BSC resources for larger-scale restoration efforts. Examining the development and function of BSC assemblages in relation to soil physical, chemical and microbial properties is required for accurately predicting restored BSC community assembly, as well as, optimization of materials for site-specific requirements. By determining how BSC communities develop and in turn modify the soil environment we can increase our understanding of early successional processes and ability to restore pathways that promote long-term ecosystem health.

#### Importance of species diversity in the revegetation of Alberta's northern fescue prairies

Rafael Otfinowski

Restoration of grassland ecosystems is critical to the provision of ecosystem services, however, legacies of historic disturbances pose a challenge to grassland restoration. In the northern Great Plains of North America, continued fragmentation and disturbance of northern fescue prairies has prompted more stringent criteria to regulate the revegetation of native prairies disturbed by industrial activities. Here, we evaluate methods of revegetating northern fescue prairies, disturbed by energy development, and test the hypothesis that higher richness of species seeded within disturbed areas improves the structure, diversity, and composition of revegetated communities. Our results demonstrate that disturbed northern fescue prairies are able to recover their structural elements, including vegetative and ground cover and plant litter, irrespective of the number of species in the seed mixes. Despite this, revegetated areas remained more weedy compared to adjacent native prairies, seven years following seeding treatments, and lagged in the establishment of plains rough fescue. Based on our observations, persistent differences in the species composition of disturbed and undisturbed prairies highlight that all efforts should be practiced to minimize the scale of disturbance of northern fescue prairies through energy development.

# CONCURRENT SESSIONS

## FRIDAY, FEBRUARY 16

## B - Rooting Around Plant and Soil Restoration (Continued)

### Aspen parkland restoration in urban Alberta: Integrating native wetland, prairie, and forest ecotones to maximise ecosystem functions and services

Sascha Bachmann

Edmonton's first rebuilt native ecosystem within a storm water management facility (SWMF) mimics local table-lands with natural soil profiles to maximize ecosystem function and services. Wetland, Rough-Fescue Prairie and Aspen mixedwood forest aspects were emulated based on reference studies and pre-disturbance soil assessments. Over 77 graminoid, forb, shrub and tree species were incorporated into plant community development to create a self-sustaining system. Since its establishment in 2010, CES is monitoring how plant reproductive strategies, plant diversity, productivity (above and belowground competition) can influence the rebuilding success. Our research focusses on the resilience of rhizomatous (R) vs. non-rhizomatous (NR) plant communities to alien species invasion. We hypothesized that soil chemistry under rhizomatous plants will become more similar to native ecosystems than areas with plants that reproduce with flowers alone. Our findings are based on five years of investigating a novel urban ecosystem. Soil nitrogen started 16 times higher than at natural grasslands, but is decreasing quickly so that soil nutrients are approaching reference site levels after only 3 year. After establishment, rhizomatous species produced 30% more belowground biomass than species in the NR treatments. Among native species, forb biomass nearly doubled from 2011 to 2012, but graminoid biomass declined, especially so in the R treatments. Alien invasive species biomass was initially three times higher in the R treatments than in the NR, but drastic increases of invasive nitrogen fixers in both treatments (mainly *V. cracca*) tipped the mass balance to NR treatment.

## C - Saturate Your Thirst for Wetlands and Peatlands

### Flooding, Drought and Wetlands: How wetland restoration and long-term watershed planning can increase ecosystem resilience

Carrie Nadeau

Wetlands are natural buffers and can function as part of a drought mitigation or flood control system, especially when planning for the effects of climate change. In the Okanagan, climate change is expected to bring more powerful storms, longer drought cycles, greater evaporation, and longer, hotter growing seasons as we have experienced in recent years. In 2015, the Okanagan had a mild winter with little snow, early peak inflows, and warm temperatures leading to extreme drought conditions for the summer. In 2017, a warm winter, above-average precipitation, and rain on snow events led to flooding, causing wide-spread impacts to Okanagan communities and ecosystems. Wetlands absorb, store and slowly release water, reducing the effects of flooding and mitigating impacts from drought. However, over 84% of low elevation wetlands within the Okanagan and Similkameen Valleys have been lost to development. Recent case studies from the Central and Okanagan-Similkameen provide examples of wetland restoration and conservation, and how communities are planning to increase resiliency in response to climate change.

### Considering the effects of hydrology treatments on peatland soil respiration

Katrina Napora

Peatlands are characterized by a deep accumulation of plant matter, which forms as a result of anoxia caused by soil saturation. The VA Department of Game and Inland Fisheries is raising water levels in the Cavalier Wildlife Management Area (CWMA) in southeastern Virginia in order to rehabilitate peatland functions. The purpose of this research was to determine the effect of water levels on soil carbon emissions as a guide for hydrologic management. We obtained 48 soil cores from 4 sites, 12 cores per site, and maintained 4 conditions ranging from drained to saturated, with three replicates from each site in each treatment. CO2 emission rates of the soil cores were measured twice a week for a month with a LiCOR 6400 instrument. Drier treatments exhibited higher carbon emissions than the saturated treatment, which suggests that if fully restored hydrology is not practical, partially restored hydrology at CWMA is preferred over no hydrologic restoration.

# CONCURRENT SESSIONS

## FRIDAY, FEBRUARY 16

### C - Saturate Your Thirst for Wetlands and Peatlands (Continued)

#### Ecological Restoration within the lower Pitt River, British Columbia, Canada

Mark Adams

The impetus for ecological restoration within the lower Pitt River of British Columbia was the regulatory requirement to create fish habitat to offset the loss of drainage ditches associated with urban development. Rather than create fragments of fish habitat within an otherwise developed landscape, the project design pursues the restoration of ecosystem functions by linking created features with existing natural features of the lower Pitt River ecosystem. Fish habitat is created as a result of the larger effort to restore ecosystem functions. The design location for ecological restoration was behind a dyke; original soils and topography had been retained. A contemporary site outside of the dyke, within natural floodplain influenced by both tidal and fluvial processes, with similar soils and topography, was utilized as the model for design. Based on this model, the dyke was relocated inland. Morphological features characteristic of the habitat model were constructed. Assemblages of plant species representative of assemblages that occur at the contemporary site were planted. The product is a 6.5 hectare floodplain complex representative of floodplain features once associated with the project location. This ecosystem-approach to ecological restoration challenges the mainstream approach to restoration, whereby fragmented landscape features are created to address very specific impacts attributable to isolated development activities. It serves not only to meet antiquated habitat compensation objectives, but also to restore larger ecosystem functions through integration of natural function and connectivity of habitats.

#### Pave paradise and put up a borrow pit: A case study on monitoring constructed wetlands

Tara Bodeux

Borrow pit excavation is a common practice for base material sourcing as part of highway construction. Alberta Transportation (AT) developed a plan to modify borrow pits into constructed wetlands to compensate for natural wetland loss. Through lessons learned during construction and monitoring, constructed wetlands are now excavated with design criteria that maximize the potential for constructed wetlands to function as resilient wetlands. Tetra Tech Canada has been monitoring constructed wetlands as part of the AT Highway 63 twinning project (Atmore to Fort McMurray, Alberta) for the past six years. At the completion of monitoring, all constructed wetlands in the monitoring program are evaluated to determine whether progression towards naturalization is occurring. This case study will present observations and trends concerning the naturalization of constructed wetlands along Highway 63. Tetra Tech Canada monitored several parameters biannually for five years; six measurements of these parameters were found to be useful naturalization indicators: water quality, the floristic quality index, vegetation species richness, presence of obligate wetland wildlife species, aquatic invertebrate species richness, and the aquatic invertebrate ETSD index. Constructed wetland monitoring results are compared to reference wetland results and given score for each parameter. The parameter scores are totaled to give a naturalization progress rank to each constructed wetland (i.e., Needs Improvement, Low, Medium, High).

#### Zero to fen in the oil sands: Peat application and water sedge establishment in a constructed peatland

Mallory Hazell

Peatland reclamation on a former oil sands surface mines is becoming increasingly important as many peatlands are disturbed, or removed entirely, during mine operations in northern Alberta. To create sustainable peatlands in a constructed setting, suitable hydrology, water and soil chemistry, vegetation, and substrate must exist; I examine the use, amount, and fate of reclamation peat, and the establishment of water sedge (*Carex aquatilis*), under a number of semi-controlled environmental conditions on a former oil sands surface mine. I report the fate of reclamation peat, and the establishment of water sedge at three initial peat thicknesses (0, 5, and 30 cm), and three positions relative to the water table (High, Intermediate, and Low). Because fens have fluctuating water tables, the positions represent a range of realistic moisture conditions, with the low positioned plots initially established under water. To improve peat prescriptions for reclamation, initial peat thickness may need to be overestimated, as peat placed for reclamation subsided and compressed markedly. Peat subsidence can be minimized, and water sedge establishment improved, under intermediate moisture levels; more specifically, when the water table elevation is near the surface. This research address important knowledge gaps and informs best management practices for peatland reclamation on former oil sands surface mines.

# CONCURRENT SESSIONS

## FRIDAY, FEBRUARY 16

### C - Saturate Your Thirst for Wetlands and Peatlands (Continued)

#### Mitigating wildfire carbon loss in managed northern peatlands through restoration

James Michael Waddington

Wildfire frequency and severity are expected to increase in forested temperate and boreal ecosystems. Recent research indicates that northern peatlands are no exceptions to these risks and may be particularly vulnerable. These ecosystems represent a major component of the global carbon cycle and serve as contemporary and long-term net carbon sink. However, severe, deep burning, fires on these organic soils may not only compromise long-term carbon storage by releasing large amounts of carbon but also impose a real threat to human health and economies through smoke pollution and large costs in fire suppression, respectively. As research in tropical peatlands has revealed, these risks are likely enhanced when northern peatlands are drained and/or mined. Here we examine whether peatland restoration (re-wetting) practices can mitigate the risk of deep burns (>20 cm) and provide management recommendations. We synthesize the effects of drainage on peat moisture content and show how drainage and mining can weaken ecohydrological feedbacks in peatlands, making drained peatlands vulnerable to deep burns and carbon loss. We use bulk density and moisture data from burned, unburned and restored peatlands to evaluate the risk of deep burns under various conditions (differences in peat properties, extent of water table drop) using a new peat smouldering model. Climate change scenarios are shown to explore future risks of deep peat burning in extensively drained areas such as northern Europe. Combining modeling and experimental data we conclude that restoration can successfully lower the risk of deep burns if, for example, a new peat moss layer is established which will ensure a higher moisture content.

#### Soil seed bank and above-ground vegetation composition on the Elwha River followind dam removal

Cody Thomas

By altering flood, hydrochory, and sediment regimes, large dams have been shown to reduce downstream plant diversity and increase the number of nonnative species present. Dam removal could potentially reverse these effects, but there have been few studies documenting changes to plant communities and diversity following large dam removal. The Elwha River in Washington State, the site of the largest dam removals to date, provides a unique opportunity to observe the effect of dams and removal on riparian vegetation and the soil seed bank. The objectives of our research were to determine 1) whether dam removal restores downstream diversity and composition, and 2) how the soil seed bank differs between riparian landforms following dam removal. To address these questions, we surveyed vascular plant species composition and cover at ~75 100 m2 plots located above, below, and between the two dams. Plots were randomly stratified across riparian landforms, and sampled twice before (2005 and 2010), and four times after (2013, 2014, 2016, 2017) dam removal. Soil was collected from each plot during the summer of 2017, before being grown out in a greenhouse. In 2016 we found a slight, non-significant increase in native species richness below the dams ($p = 0.08$), continuing an upward trend from previous years. Analysis of data collected in 2017 is ongoing. The large influx of sediment into the system following dam removal may be affecting natural recovery of native species, and we predict that with more time, species richness will increase to reference levels.

# POSTER SESSION

## THURSDAY, FEBRUARY 15

### Organic matter accumulation in reclaimed soils beneath different vegetation types in the Athabasca oil sands

Jeff Anderson

Developing a functioning soil is the foundation of successful large-scale reclamation. Along with other qualities, this includes the amounts, properties and rates of accumulation of soil organic matter (SOM). Unfortunately, focus on soil development often ends at material placement, and ignores the in situ development which occurs to these materials through weathering and biological activities. Our research has looked at whether initially similar soils will look different based on the kind of vegetation which has been established on them. Knowing the effect of vegetation treatment on soil development is integral to understanding the successional dynamics of a reclaimed system.

Our study focused on how SOM accumulation on similarly constructed reclaimed mineral soils was affected by three vegetation treatments; Deciduous (*Populus tremuloides Mitchx./balsamifera L.*), Spruce (*Picea glauca* (Moench) Voss.) and non-forested grassland. The operational soil treatments did not differ between three vegetation treatments. Seventeen sites were studied: 4 reclaimed deciduous, 5 reclaimed spruce, 4 reclaimed grass, and 4 natural forest.

The findings show that SOM concentrations increased beneath the deciduous and grassland, but not the spruce treatments. Indications suggest that the primary modes of SOM deposition are from macrofaunal bioturbation, as well as root litter in grasslands, and dissolved organic matter from the forest floor in deciduous forests.

### Water ways design inquiry - Engaging in ecological restoration through creative collaboration

Jeannette Angel

The Water Ways project involves community-based design research for an interactive media exhibition that investigates the nature of human-water relationships in the Okanagan Valley. The selected focus of this presentation addresses human-water relationships through an exploration of cottonwood restoration in riparian areas. The research process employs the innovative use of interactive and situated audio and visual media to create engaging experiences. This will be a creative platform for dialogue across diverse community-based, poetic, traditional and scientific water knowledges of the past and present to envision sustainable water futures. Design inquiry, as a methodology, uses media art to represent and connect multiple perspectives embedded in the land that are critical in communicating and building community resilience for social and ecological wellbeing. The processes and goals of inquiry evolve through iterative cycles of gathering contextual knowledge within communities, including local wisdoms, stories and interviews collected as land-based media and soundscapes, as well as design prototyping, critical reflection and redesign. As such there is a framing and reframing of the problem setting, working towards the creation of a reflective space for place-based communal knowledge sharing. This project exemplifies a collaborative research process that engages communities in restoring people to the land and water through an immersive media art exhibition. The collaborators draw on their previous interdisciplinary research sharing creative design practices, Indigenous knowledges, environmental anthropology and scientific modelling.

### Restoring carbon sequestration processes in a degraded wet meadow

Lydia Baldwin

Wet meadows throughout the Sierra Nevada that were historically disturbed are currently losing both soil water holding capacity and the ability to store carbon. While these wetlands formerly functioned as sinks of carbon dioxide, they could now act as significant sources of $CO_2$ to the atmosphere. Given the imminent threat of climate change, it is vital to explore techniques to facilitate the potential recovery of a greenhouse gas sink. Furthermore, the maintenance and addition of carbon to soil can also enhance its water holding capacity. I am testing whether the reestablishment of a sedge dominated community at Tuolumne Meadows, a high elevation wet meadow in Yosemite National Park, will restore the meadow to a carbon accumulating ecosystem. In 2016, 20,000 *Carex scopulorum* (mountain sedge) were planted into the meadow and by the end of the summer of 2018, over 100,000 more will also be planted. Gross primary production and plant respiration are being monitored to create a model of growing season carbon dynamics to determine if these treatments increase the meadow's carbon storage. The outcome of this restoration project will inform land managers facing similar issues of drying meadows with potentially large losses of $CO_2$.

# POSTER SESSION

## THURSDAY, FEBRUARY 15

### The structural development of soil microbial communities in reclaimed sites of a metal mine; implications to restoration of anthropogenic disturbances

Landon Benson

Anthropogenic activities (e.g., surface mining) affect the structure of terrestrial systems, leading to diminished ecosystem functions (e.g., nutrient availability). With the cumulative area of disturbance caused by mining in British Columbia approximating 50,823 ha, it is necessary to ensure that the regulatory requirements and project objectives for the reclamation and restoration of mined lands are directed by biologically relevant metrics-of-success. The recovery of soil microbial community structure and function following reclamation of mined lands in British Columbia is not well understood. In this study, phospholipid fatty acid analysis (PLFA) was used to compare the biomass of soil microbial communities in undisturbed reference sites and reclaimed sites. Using a one-way ANOVA and Tukey's HSD test, it was observed that total microbial biomass within reclaimed sites was significantly lower than undisturbed forests until 30 years post reclamation. Canonical correspondence analysis (CCA) indicated that the observed differences in microbial community biomass between reclaimed sites was affected by changes in soil pH and the concentration of soil copper through time. Further analysis revealed that the presence of native vegetation species within reclaimed sites was highly correlated to increases in microbial community biomass. Due to the long-term requirements of physical, chemical, and biological soil development, the assessment of mine reclamation projects should exceed at least 30 years post completion to properly evaluate the recovery of ecosystem structure and function. To successfully expedite the development soil microbial communities within disturbed sites, a minimum of four reclamation techniques should be completed, including the improvement site connectivity, alteration of soil micronutrients, modification of soil pH, and inoculation of soil with native microbial communities adapted to local conditions.

### Mixed-severity fire history in a dry mixed-conifer forest reveals a drastically altered fire regime and supports the need for proactive management to reduce the potential of high severity fire

Wesley Brookes

Within dry mixed-conifer forests, an absence of fire has lead to dense, homogenized stands, and increased fuel loads. These factors have increased the potential for high-severity fires and puts communities living in and around these forests at risk. Using tree-rings and fire scars to reconstruct the fire history near Williams Lake, B.C., I found evidence of a mixed-severity fire regime as well as substantial internal heterogeneity in intensity with which individual fires burned. The fire record included 22 fires between 1619 and 2015 with a mean interval of 15 years. Two of the most severe and widespread fires burned in 1840 and 1863 and resulted in cohorts at 71% of plots that persist today. Thus, the forest we see today is a legacy from a fire that burned 155 years ago. The absence of fire since 1863 is likely a consequence of a cessation of First Nations burning, cattle grazing, and mineral exploration in the 1860s in combination with fire suppression beginning in the 1900s. My results provide support for proactive management that aims to restore the historic diversity of forest structures across the landscape and increase stand-level heterogeneity. Treatments should promote successional diversity by mimicking historical frequent low-severity surface fires as well as patches created by moderate- and high-severity fire. The re-introduction fire to the landscape via managed wildfire, prescribed fire, and/or other forms of fuel mitigation can be effective components of restoration while reducing chances of widespread high-severity fire.

# POSTER SESSION

## THURSDAY, FEBRUARY 15

### Invasive deer alter soil microbial community structure and biomass in old growth forests

Catriona Catomeris

Human-mediated changes to herbivorous mammal populations have made wildlife management a common conservation concern. Despite the importance of soil microbes for nutrient cycling in forest ecosystems, we have a poor understanding of how aboveground herbivores affect belowground communities. Sitka black-tailed deer (*Odocoileus hemionus sitchensis*) were introduced to Haida Gwaii, BC in the late 1800s and they have since invaded most of the islands in the archipelago. In this natural experiment, soil microbial communities were compared between 1) deer-inhabited islands and, 2) deer-free islands. Soil microbial functional diversity and biomass were assessed using phospholipid fatty acids. Available soil nutrients were measured using Plant Root Simulatorâ„¢ probes. Multivariate analyses of PLFA profiles revealed differences in microbial community structure due to deer presence as well as an island effect. Signature fatty acids indicated fungal biomass was higher on deer-free than deer-inhabited islands, although the difference was only marginally significant. Bacterial biomass, especially that of gram positive bacteria, was also greater on deer-free islands than on deer-inhabited islands. These findings suggest that deer directly or indirectly alter soil microbial communities, particularly bacteria, in forest ecosystems.

### Is climate change driving yellow-cedar decline on Haida Gwaii?

Vanessa Comeau

Forest die-back driven by climate change is of great concern around the globe. In the Pacific Northwest, yellow-cedar (*Xanthocyparis nootkatensis*) decline has captured the attention of forest practitioners because it is ecologically important, culturally significant and economically valuable. The driving factor of regional decline is thought to be climatic warming, which has led to reduced snowpack and exposed fine roots to freezing damage. Decline is most prevalent along the coast of southern Alaska and British Columbia. In recent years, yellow-cedar decline has been observed on the islands of Haida Gwaii, where it was previously absent. The proposed mechanisms may not adequately explain the decline on Haida Gwaii due to the temperate climate and the ephemeral snow pack. To further investigate the mechanism for decline, my research used dendrochronology to quantify climate-growth relationships and reconstructed stand dynamics of the declining stands to test the hypothesis that climate is driving yellow-cedar decline on Haida Gwaii. The yellow-cedar stands sampled are experiencing elevated levels of death and decline, the pattern of which is not consistent with self-thinning or competition. Additionally, healthy yellow-cedar trees demonstrated different growth patterns than those that are declining or have died. Warm temperatures facilitated increasing growth in the 20th century, with the greatest increase seen in healthy live trees. Increased growth was also associated with abundant winter precipitation, which is consistent with the proposed mechanism. Uncovering the drivers of decline in yellow-cedar on Haida Gwaii is essential for the management and conservation of the species.

### Wildfire: Building social-ecological resilience at the Williams Lake Community Forest, BC

Kelsey Copes-Gerbitz

The threat of catastrophic wildfire is increasingly becoming a reality, with devastating consequences for human and ecological communities worldwide. The 2017 wildfire season is the worst in British Columbia's (BC) recorded history, with over 1.2 million hectares (ha) burned and over 46,000 people evacuated. Despite efforts since 2003 to initiate community engagement and hazardous fuels treatments, most BC communities are still vulnerable to catastrophic wildfire because of a myopic view of the historic role of fire in both an ecological and cultural context. Utilizing an interdisciplinary, mixed-methods approach, this research aims to (1) understand the historic ecological elements of the fire regime (such as fire frequency and severity), (2) explore the indigenous paradigm regarding wildfire, and (3) develop community-driven strategies to enhance community resilience to wildfire. The research area is the 6000ha Ne Sextsine block of the Williams Lake Community Forest (WLCF), situated in the fire-prone Douglas-fir forest and located in the wildland-urban interface of Williams Lake. As a partnership between the Williams Lake Indian Band and City of Williams Lake, the WLCF is managed for a range of values and driven by a mandate to protect the WLCF from losses due to wildfire. In collaboration with the Williams Lake Indian Band, this research combines traditional ecological knowledge and dendrochronology to develop a comprehensive understanding of the historic role of fire in the WLCF. This understanding is necessary for enabling community resilience to catastrophic wildfire through pro-active management strategies that respect both the cultural and ecological history of the region.

# POSTER SESSION

## THURSDAY, FEBRUARY 15

### Chiixuu tll iinasdll: Restoring balance in the sea with kelp forest restoration in Gwaii Haanas

Lynn Lee

For nearly 200 years the ocean ecosystems of Gwaii Haanas have been out of balance due to the extirpation of sea otters by the maritime fur trade. Sea otters are voracious eaters of shellfish like sea urchins, crabs, clams and abalone. Without sea otter predation, these shellfish became very abundant. Today, kelp forests are greatly diminished from their former abundance and limited in depth and areal extent due to voracious grazing by hyperabundant sea urchins. Degraded kelp forests negatively impact marine ecosystems and species at risk including endangered northern abalone and COSEWIC-listed rockfishes by reducing habitat that provides food and protective cover, reducing primary productivity in nearshore ecosystems, and decreasing protection from coastal erosion forces. In fall 2018, we will be significantly reducing urchin abundance at Gaysiigas Gwaay (Murchison Island) to restore kelp forests along approximately 3 km of shoreline. Gwaii Haanas' collaborative management partners – Parks Canada Agency, Council of the Haida Nation, and Fisheries and Oceans Canada – will be working with commercial sea urchin fishers and processors through the Pacific Urchin Harvesters Association, to mimic sea otter predation by removing more than 75% of the urchins. Urchins that are marketable will be fished for commercial processing and for provision of traditional foods, guuding.ngaay (red urchin roe) and styuu (green urchin roe), to the Haida communities.

### Impact of introduced deer on nitrogen cycling in Haida Gwaii forests

Morgane Maillard

Introduced non-native species are altering the ecology of natural communities at an unprecedented rate. On the Canadian archipelago of Haida Gwaii in 1878, non-indigenous Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) were introduced, and in the absence of predators, deer populations have rapidly increased, with detrimental effects on native aboveground plant and animal communities. Knowledge on how deer affect belowground organisms and processes is lacking and needed, given the vital role soil organisms play in nutrient cycling and the consequent feedbacks to plant nutrition and growth. Deer may accelerate nitrogen cycling through deposition of high quality litter and waste products. Conversely, their selective foraging increases the abundance of plants with lower quality litter, and this can slow down nitrogen cycling. To address these crucial questions we compared soil microbial communities and nitrogen cycling processes between islands with and without deer and inside and outside deer exclosures. This study aims to fill a gap in our knowledge about how browsing mammals affect belowground processes. By quantifying the impact of deer and damage reversibility, it also aims to give clues for land-management strategies.

### Spotted knapweed management: Restoring native host plants for the half-moon hairstreak (*Satyrium semiluna*)

Sonya Oetterich

Invasive species management is important to maintaining biodiversity; however, management practices may be counterproductive if they threaten the persistence of endangered species. Blakiston fan (Waterton Lakes National Park, AB), a 200 ha alluvial fan, is mapped as critical habitat for the endangered half-moon hairstreak (*Satyrium semiluna*) butterfly. This study will asses the alternative hypotheses of decline of the hairstreak, with the goal of developing a management strategy for spotted knapweed (*Centaurea stoebe*) that does not conflict with the protection of the butterfly under the Species at Risk Act. A knapweed control experiment is used to assess the effects of four treatments on the within-season changes in cover of knapweed and native host plants. A vegetation survey of Blakiston fan and hairstreak surveys is used to assess the changes in cover of knapweed and native host plants, and changes in distribution of the hairstreak since 2008. Resulting trends are used to inform the development of a restoration plan for the larval and nectar host plants of the endangered butterfly. This restoration plan will address the issue of food limitation, the most likely hypothesis of decline of the half-moon hairstreak.

# POSTER SESSION

## THURSDAY, FEBRUARY 15

### Effects of organic fertilizer (cow dung) amendment on phytoremediation of copper andiron-contaminated aquatic environment by water hyacinth (*Eichhornia crassipes* [Mart.] Solms)

Isreal Ugochukwu Oshiojum

This study was carried out to investigate the ability of water hyacinth (Eichhornia crassipes) to absorb and translocate Fe and Cu in the presence of cow dung as a biostimulant. The study was conducted with three concentrations of Fe and Cu; 10mg/L, 15mg/L, 20mg/L and control (0mg/L) and were separately amended at two concentrations (0.5mg/L and 1.0mg/L) of organic fertilizer (cow dung). Translocation Factors (TF) for Fe ranged between 0.49Â±0.57-0.68Â±0.27 in leaf, and 0.64Â±0.17-0.77Â±0.18 in the stem, while the TF for Cu ranged from 0.78Â±0.08-1.12Â±0.12 in leaf and 0.72Â±0.32-1.09Â±0.19 in the stem. The highest bioconcentration factor (BCF) for Fe and Cu were 2.32Â±0.65 at 20mg/L and 0.72Â±0.01 at 15mg/L obtained in the root and leaf respectively, indicating that the accumulation potential of Fe by water hyacinth is higher than Cu. The effects of biostimulation by organic fertilizer (Cow dung) on metal uptake showed that Fe and Cu were mostly absorbed in the root in the treatment amended at 1.0mg Cow dung/Litre of water and lowest in the control. Thus, nutrient amendment increased the uptake of Fe and Cu by water hyacinth. According to the accumulation capabilities of the investigated plant (*Eichhornia crassipes*), this study showed that the plant is a promising candidate for phytoremediation and bio-monitoring programmes for contaminated water especially those polluted with metals like Fe and Cu. Therefore, water hyacinth can be helpful in the restoration of metal-polluted aquatic ecosystems.

### Examining the role of terrestrial lichen transplants in restoring woodland caribou winter habitat: A case study

Sean Rapai

The development of habitat restoration techniques for restoring critical woodland caribou (*Rangifer tarandus caribou*) winter habitat will play an important role in meeting the management thresholds in woodland caribou recovery plans. The goal is to restore disturbed environments within critical winter habitat for the declining woodland caribou. Woodland caribou are diet specialists, utilizing lichen-rich habitat for forage during winter months. *Cladonia sub-genus Cladina* are the most frequently eaten species during this time. This poster presentation will provide: 1) A review of previously used methods for transplanting *Cladonia sub-genus Cladina* and their feasibility in restoring woodland caribou winter habitat, 2) A step-by-step protocol on how to carry out a terrestrial lichen transplant program (using *Cladonia sub-genus Cladina* and *C. uncialis*), and 3) An evaluation of our protocol through the establishment of a case study in northern British Columbia. Our results indicate that transplanting *C. sub-genus Cladina* fragments is the most efficient technique for transplanting terrestrial lichen communities, but transplanting lichen patches or mats may also be effective.

### Restoration potential of the Harrison Salmon Stronghold (Harrison River)

Tyne Roberts

The purpose of this project was to develop a comprehensive screening tool informed by ecological, economic and cultural filters, and to produce an interactive database identifying historic and potential salmon habitat restoration opportunities within the Harrison Salmon Stronghold (50 square kilometres centred around the Harrison River). The Project consisted of a two-phase approach: first, identification and mapping of potential restoration opportunities in the Lower Harrison Watershed; and second, ranking identified opportunities based ontheir potential value to society. The first phase was completed through literature review, field surveys, and the acquisition of orthoimagery and LiDAR, which was used to map existing and potential fish habitat; twenty potential restoration opportunities were subsequently proposed. The second phase was completed by using an ecological filter to estimate each proposed site's contribution to fish production and the ecological health of the watershed; an economic filter to estimate the comparable net present value of a site; and a social filter to estimate cultural importance and potential value to society. The identification ranking of the twenty potential restoration projects proposed in this study will assist resource managers and community members in identifying and prioritizing restoration opportunities within the Harrison Salmon Stronghold.

# POSTER SESSION

## THURSDAY, FEBRUARY 15

### Interim reforestation of soil stockpiles: using nature to more effectively achieve future land reclamation goals in a forested landscape

Amanda Schoonmaker

Industrial disturbances, whether in the mining or oil and gas sector, typically result in the clearing of forests and stockpiling of surface soils during the development and operational phases of industrial activity. In Alberta, operators are mandated to ensure stockpiles are stable and non-erosive, constructed in order to maximize soil surface area (shallower slopes being optimal) and that weeds or other invasive species are managed appropriately. Management of these stockpiles will be required until final reclamation activities when the facilities are removed, the site is re-contoured and stockpiled soils are spread. Historical (and present) practices include seeding with grasses and use of chemical herbicides to control establishment of noxious weeds. Temporary reforestation of soil stockpiles, is an alternative, though not widely utilized practice that may better fit the fundamental long-term final reclamation goals in forested settings (restoring a functional forest). Potential benefits of temporary reforestation of stockpiled soil include: long-term erosion control, reduced invasion of weedy vegetation through increased forest cover and shading and increased habitat availability for wildlife. In addition, temporary reforestation is also likely to enhance the root and seed propagule bank and provide coarse woody material final reclamation. This poster will present an alternative approach to conventional soil stockpile management, the interim (or temporary) reforestation of soil stockpiles. In 2015, a case study was initiated on 8 hectares of an in-situ facility soil stockpile. An overview of the operational activities and findings during the first two growing seasons will be presented.

### Validation of plant growth regulator products for the enhancement of germination, growth and development of native plants

Christina Small

Plant growth regulators (PGRs) are natural plant hormones that influence plant metabolism, growth, and development in response to its environment, by stimulating enzymes and/or enzyme systems. All plants naturally produce, contain and regulate PGRs, as they are involved in every aspect of plant growth and development; all which are essential for plant survival. In addition to their ability to mediate environmental stress, PGRs have the capacity to influence cell division, cell expansion, as well as cell structure and function. The overall goal of the study was to investigate the use of PGRs as innovative technologies to enhance the germination, growth and development of native grasses and forbs, by evaluating the applicability, feasibility, and transferability of currently available products used in agriculture, viticulture and horticulture. A germination trial was conducted on 8 native grasses and 2 forbs using 7 readily available products containing the following PGRs, including auxins, cytokinins, gibberellins, and brassinosteriods. Experimental results will be presented showcasing improvements in germination rate, shoot and root length, and vigor 14 days post-seeding; depending on the trialed species and treatment. The results suggest that there may be significant opportunities to use PGRs for seed development, plant propagation and bioengineering in both greenhouse-based and field-based revegetation and restoration applications. PGR use on native plants may improve the ecological recovery of disturbed lands by reducing the time frame for reclamation, aiding industry in achieving ecological restoration goals and objectives.

# POSTER SESSION

## THURSDAY, FEBRUARY 15

### Quantifying a novel method of grassland restoration using the Plug and Spread treatment in a shortgrass prairie system in Northern New Mexico

Heidi Strickfaden

Global grasslands have sustained extensive loss from anthropogenic land changes. Since European settlement, American shortgrass prairies have declined 20-85%, with the steepest declines in the Great Plains, where 99.9% of native prairies have been lost. In the southwest, climate change analysts predict extended drought, seasonally unpredictable monsoons, and intense brief storms. These climatic changes may exacerbate declines in New Mexico's fragile grasslands. The Plug and Spread treatment is a novel approach to restore degraded grasslands by increasing surface hydrologic connectivity. The technique is an adaptation from the Plug and Pond method, and utilizes seasonal runoff that have been drained away from grasslands by human activities. This study develops a framework for evaluating how this restoration method may be used to restore grasslands by quantifying vegetation response to increased hydrologic connectivity. Three earthen plugs will be built in two study sites and paired with a handful of grade control rock structures to reconnect formerly channelized gully runoff back to the grasslands. The plugs also stem grassland loss from erosion by diverting flows in gullies, ponding surface water, and redistributing sheet flows in controlled velocities. We use percent cover, biomass and species diversity to measure vegetative recovery, and quantify changes in hydrologic connectivity by measuring soil infiltration across our study sites. Pre- and post-treatment and seasonal changes with annual monsoon events will elucidate vegetation changes across various temporal scales. Increased hydrologic connectivity via the Plug and Spread treatment may increase grassland resilience in light of climate change challenges.

### Restoring coastal sand ecosystems in the Gulf Islands National Park Reserve: An opportunity for partnerships and collaboration

Rebecca Tranmer

The coastal sand ecosystem on Sidney Spit, Gulf Islands National Park Reserve, supports several plant and animal species at risk, including the Common Nighthawk (*Chordeiles minor*). The invasion of Scotch broom (*Cystisus scoparius*) and other non-native plant species into the naturally sparse vegetative community has degraded the ecosystem and resulted in poor ecological integrity. The Park has developed and initiated a restoration plan to restore a portion of the coastal sand ecosystem on Sidney Spit. The Park's restoration work provided an opportunity for a student from the Simon Fraser University/British Columbia Institute of Technology joint Masters Program in Ecological Restoration Program to investigate habitat use of Common Nighthawk and fill knowledge gaps relating to this species use of coastal sand ecosystems. The research project involved quantifying nest-site attributes, estimating nest success, and developing a logistic regression model to predict nest presence. By expanding the field of knowledge on focal species at risk, restoration projects can be tailored to include informed species-specific restoration goals and monitoring targets.

### Restoration of salmonid spawning habitat in the Upper Serpentine River

Brenley Yuan

Salmonids are iconic species in British Columbia and have substantial ecological, economic, social, recreational, and cultural value. However, urbanization and storm water management practices have altered the hydrology of many salmonid-bearing streams. Impervious surfaces, storm water integration into waterways, and channelization result in flashy streams that experience accelerated erosion of spawning gravel. Until storm water management infrastructure can be retrofitted, gravel addition can be implemented to mitigate the loss of spawning habitat. While gravel addition is well-documented in sediment-starved reaches downstream of dams, little information exists on the effectiveness of this method in urban streams. This project aims to create a restoration plan to increase suitable spawning habitat through gravel addition at seven sites in the Upper Serpentine River. Stream channel surveys and a tracer rock study will be conducted at each site to estimate bed shear stress during high flows. Calculations will be used to determine whether instream structures are required to reduce tractive forces below the critical shear stress at which placed gravels become unstable. A long-term monitoring plan will be created to evaluate whether restoration achieves species-specific spawning requirements. As precipitation is expected to increase in the Pacific Northwest, erosion will continue to be an issue in urban streams. Therefore, outcomes from this project can be used to inform future restoration efforts in the region and increase resilience of urban streams to climate change.


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