Biodiversity Mapping in Southwest British Columbia: Solutions Workshop

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UBC Botanical Gardens, Vancouver, BC

CDFCP

UBC Botanical Garden

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https://www.cdfcp.ca/biodiversity-mapping-in-south-west-bc-solutions-workshop/

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Executive Summary

In October 2022 UBC Botanical Gardens and the Coastal Douglas-fir Conservation Partnership (CDFCP) held a Biodiversity Mapping in Southwest BC: Solutions Workshop. The aim of the workshop was to bring together mapping experts and users to share information relating to new approaches to mapping and to brainstorm collectively on how to identify a preferred set of layers for a Biodiversity Atlas. The purpose of the Atlas would be to provide spatial layers that support decision making by local government and First Nations in relation to climate change resilience and biodiversity.

The morning of the workshop was dedicated to sharing information and attendees heard presentations on the following subject areas;

- Setting the Context (Kelly Chapman, CDFCP)
- Mapping Land Cover and Vegetation Structure (Nicholas Coops, UBC)
- Climate and Ecological Mapping for Forest Adaptation to Climate Change (Tongli Wang, UBC)
- Provincial Ecosystem Mapping Initiatives (Jackie Churchill, Ministry of Land Water and Resource Management)
- Predicting the Distribution and Abundance of Culturally Important Plants (Sari Sunders, Ministry of Forests)
- Climate-Adaptive Planning (CAP-BC) (Peter Arcese, UBC)

Break out discussion groups in the afternoon looked at three subject areas;

- Ecosystem and land cover mapping.
- Ecosystem connectivity.
- Species and ecosystems at risk and culturally significant ecosystem mapping.

Key points raised by these discussions are presented below;

Topic Area	Key Discussion Points
Ecosystem and Land Cover Mapping	- Undertake a review of existing land cover and ecosystem layers used by local governments and First Nations. - Standardise the approach to land cover and ecosystem mapping used by local governments and First Nations. - Local governments and First Nations should collaboratively collect aerial, satellite and LiDAR imagery to obtain cost efficiencies. - Develop mapping in partnership with First Nations to ensure it reflects their values. - Focus on layers that are at a scale useful to local governments and First Nations and present the pros and cons of each layer. - Reflect on cost efficient methods that could update existing layers e.g. losses to Sensitive Ecosystems. - The resolution of mapping is likely to be different for a district, territory or municipality. - Need to produce a high-quality baseline image from which layers can be generated. - Need to be able to demonstrate how ecosystems have changed with time to assess future performance. - Need to identify how ecosystem information collected during the planning process can feed into decision making (e.g. make digital).

Topic Area	Key Discussion Points
	- Prioritisation models can illustrate areas of low ecological value enable decision makers to think backwards. - Provincial government needs to engage with local governments and other partners to identify how to extend TEM to areas not covered.
Ecological Connectivity	- Undertake a review of habitat connectivity mapping undertaken locally and internationally. - Consider how connectivity mapping is affected by the species of interest, audience, values and climate change. - Develop best practice guidance for connectivity mapping.
Species and ecosystems at risk and culturally significant ecosystem mapping	- There needs to be better awareness of existing species and ecosystems at risk datasets. - The datasets contain gaps and bias, therefore, methods of predicting locations of species and ecosystems at risk from environmental factors was discussed. - Values and role can influence the presentation of species and ecosystems at risk data. - Mapping should take into consideration cultural values from the start. - Objectives and targets help define success and enable tracking of performance. - A key gap is the absence of species at risk legislation.

Following the breakout discussions all attendees were brought back together for a group discussion to identifying key recommendations from the group;

- Undertake a pilot within the study area at a district level that enables the mapping methodologies discussed (e.g. Metro Vancouver, CWS) for land cover and SEI change mapping, above ground carbon stores and ecosystem connectivity to be trialed.
- Review whether existing standards support the layers developed in the trial or whether additional standards would need to be developed in partnership with government / First Nations.
- Review how species and ecosystems at risk datasets can be increased by incorporating data collected by non-governmental scientists e.g. consultants and the public, while not compromising the quality of the dataset.
- Future collaboration with local governments and First Nations is essential to ensure that the Atlas is a tool that would be of use to their decision makers and builds on the existing tools that they use.

1 Introduction to Biodiversity Mapping in Southwest BC

1.1 Problem Statement

Southwest BC's Georgia Basin lowlands host over 75% of BC's population and includes the Coastal Douglas-fir moist maritime subzone (CDFmm), home to the largest number of species and ecosystems at risk in the province. Per hectare, forests in the Basin have among the highest carbon storage capacity of any forest in BC, with those in old growth being some the highest carbon storing ecosystems in the world[1]. Georgia Basin ecosystems also provide critical ecosystem services, such as supplying water, controlling floods, improving air quality, providing salmon habitat, recreation and climate refuge. As the traditional territory of the Coast Salish and other First Nations, these ecosystems are also important to indigenous food security, and support a multitude of culturally important plants and animals.

BC's Georgia Basin ecosystems and the important services they provide, however, are under mounting pressure from development, timber harvesting, and climate change. Only a small percentage of lowland forests remain in old-growth, and almost half the area has been permanently converted by human activities. These pressures are compounding as climate change increases the intensity and frequency of heat, droughts, flooding, and wildfires, threatening the well being of BC's south coast communities, and their capacity and long-range options for adapting to climate change.

Healthy functioning ecosystems are our front-line defence against climate change. Nature-based climate solutions (NBS) are policies and actions that conserve and restore natural areas to reduce carbon emissions (climate change mitigation) and buffer climate change impacts (climate change adaptation). About 80% of lowland areas of BC's Georgia Basin are privately owned, and upland areas of Vancouver Island are mostly private managed forest land. As a result, the region is governed by a complex suite of federal, provincial and local government policies, bylaws, and regulations. This creates the risk of fragmented, competing or incompatible policies, and the potential emergence of perverse outcomes (whereby trying to solve one kind of environmental problem makes another worse).

Governments, First Nations, industry and ENGOS need improved coordination and science-based decision and policy support to: incentivize nature-based solutions, support payments for ecosystem services, and overcome the barriers to conserving biodiversity and natural assets presented by escalating land and timber prices, amidst a complex land ownership and management landscape.

1.2 South Coast Nature-Based Solutions and Biodiversity Atlas Projects

In June 2022, the CDFCP and UBC Botanical Garden entered a partnership (**Appendix A**), with the aim of producing a digital Biodiversity Atlas for the Georgia Basin lowlands (and adjoining upland watersheds; see study area in **Figure 1**) that would provide First Nations, local governments and land managers with the tools they need to make informed decisions in relation to biodiversity conservation and climate change mitigation and adaptation.

[1] Smithwick, E., et al. (2002). Potential upper bounds of carbon stores in forests of the Pacific Northwest. Ecological Applications, 12(5), 1303-1317.

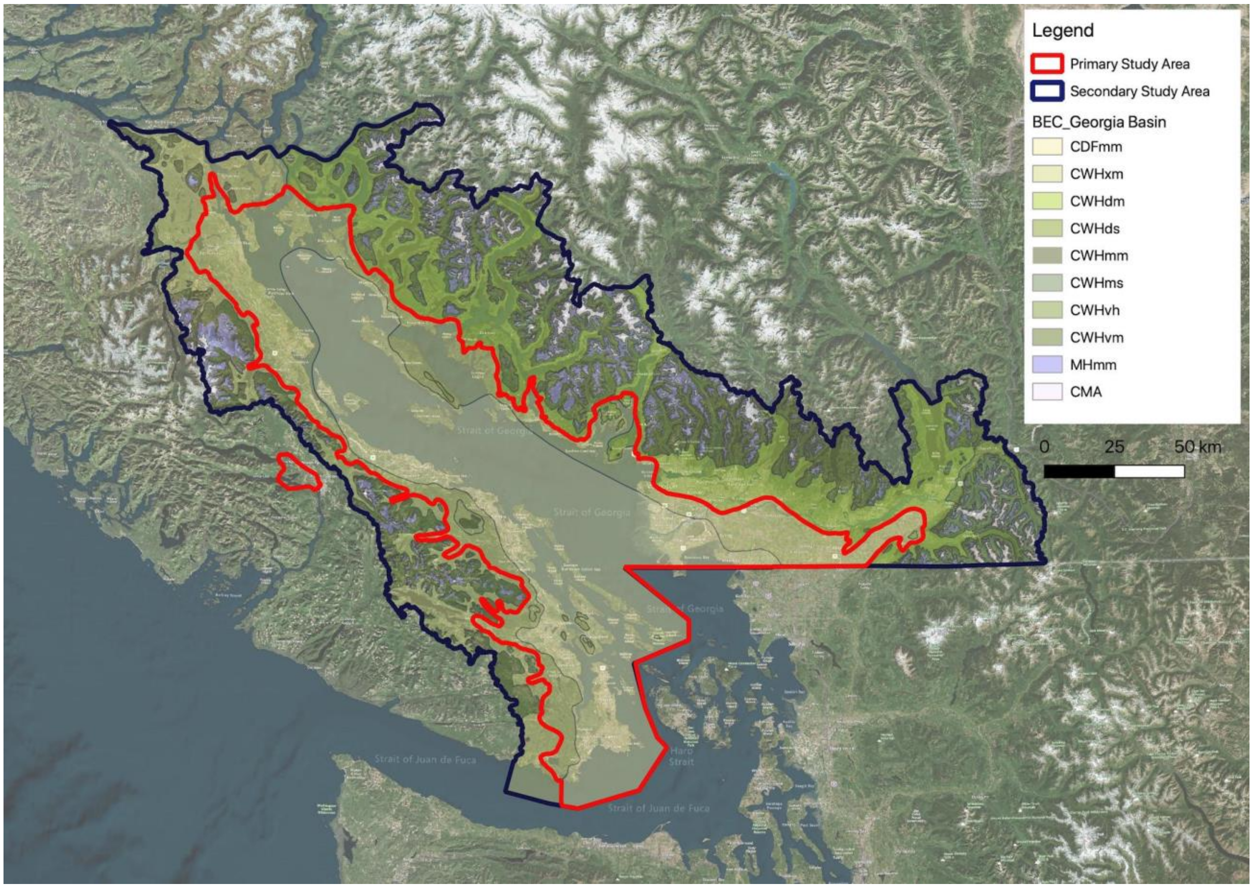


Figure 1. Primary study area outlined in red (Georgia Basin's dry lowlands – CDF and associated ecosystems), and secondary study area outlined in blue (lowlands and adjacent uplands combined).

The objective of this joint project is to **align efforts** of various groups and agencies working in the Georgia Basin area in:

1. Identifying a preferred set of spatial layers for planning (with a focus on local government and First Nation's needs).
2. Pooling resources and efforts to improve, expand, update and/or amalgamate *existing* spatial. layers for the above themes, where suitable and as needed.
3. Where needed, developing *new* region-wide spatial layers to address gaps in existing spatial data.
4. Identifying best practices for mapping standards and application.
5. Assembling and developing supporting policy and guidance.
6. Assembling into a *user friendly* interface: i.e. Biodiversity Atlas (which will include guidance on how to use the data to guide policy development).

Engaging and collaborating with First Nations and local governments is a priority, as is building on existing spatial and policy tools where possible. To date, the project team has held over 30 in-depth interviews with key informants, to better understand the needs and priorities of spatial data users, identify gaps and deficiencies, and identify potential collaborations and opportunities for filling them.

1.3 Biodiversity Mapping in Southwest BC: Solutions Workshop

On October 24, 2022, the CDFCP and the UBC Botanical Gardens co-hosted a Biodiversity Mapping in Southwest BC: Solutions Workshop to discuss gaps and opportunities highlighted through interviews relating to mapping of biodiversity and land cover. Layers addressing other themes, such as carbon storage and watershed resilience, will be similarly developed through a process of engagement and workshops with key informants and project partners.

This report documents the outcomes of the workshop and presents the results of a pre-workshop questionnaire issued to participants in **Appendix B**. It also provides recommendations and options for moving forward with developing, augmenting and/or updating preferred biodiversity and land cover spatial layers for the proposed south coast Biodiversity Atlas.

1.3.1 Workshop Objectives

The objectives of the workshop were to:

- Present a summary of data gap analysis results to date.
- Share and learn about other relevant mapping projects.
- Brainstorm collectively on ideas for developing a preferred set of layers for a Biodiversity Atlas, in terms of future direction, shared and individual action.
- Build relationships and meet other people who are doing similar work.
- Identify experts to work together on resolving the gaps or problems.
- Define tangible next steps towards building a biodiversity atlas for the study area.

1.3.2 Workshop Structure and Participants

To help structure the workshop, a pre-workshop questionnaire was sent to participants to garner feedback on mapping related recommendations proposed by informants during the in-depth interviews (e.g. areas of agreement and disagreement). These results are presented in **Appendix B.** Prior to the workshop participants were also asked to recommend and share information about useful spatial layers relevant to the south coast region. These are presented in **Appendix C.**

The workshop agenda and list of participants are in **Appendix D**. An overview of the workshop structure is described below:

Morning

- Welcome and Introductions (Tara Moreau and Dionne Bunsha, UBC Botanical Gardens)
- Setting the Context (Kelly Chapman, CDFCP)
- Invited presentations
    - Mapping Land Cover and Vegetation Structure (Nicholas Coops, UBC)
    - Climate and Ecological Mapping for Forest Adaptation to Climate Change (Tongli Wang, UBC)
    - Provincial Ecosystem Mapping Initiatives (Jackie Churchill, Ministry of Land Water and Resource Management)
    - Predicting the Distribution and Abundance of Culturally Important Plants (Sari Sunders, Ministry of Forests)
    - Climate-Adaptive Planning (CAP-BC) (Peter Arcese, UBC)

Afternoon

- Break out sessions, addressing challenges related to land cover change and ecosystem mapping, species and ecosystems at risk mapping and regional connectivity.
- Whole group discussion.
- Closing (Tara Moreau).

Section 2 of this report contains an overview of the morning's presentations (see **Appendix E** for the actual presentation slides). **Section 3** contains the key points raised during the afternoon breakout sessions, and the comments raised during the final whole group discussion.

2 Overview of Presentations

2.1 Introduction

An objective of the workshop was to share information about existing and new mapping projects, which is why the first part of the day was set aside for presentations. The topic areas for the presentations were selected from the in-depth interviews, which identified new approaches / technologies that could change our approach to mapping.

As indicated in **Section 1.3.2** six presentations were delivered; titled;

- Setting the Context (Kelly Chapman, CDFCP)
- Mapping Land Cover and Vegetation Structure (Nicholas Coops, UBC)
- Climate and Ecological Mapping for Forest Adaptation to Climate Change (Tongli Wang, UBC)
- Provincial Ecosystem Mapping Initiatives (Jackie Churchill, Ministry of Land Water and Resource Management)
- Predicting the Distribution and Abundance of Culturally Important Plants (Sari Sunders, Ministry of Forests)
- Climate-Adaptive Planning (CAP-BC) (Peter Arcese, UBC)

The slide show and recordings for each presentation can be accessed through the CDFCP website[2], in **Appendix E**.

[2] https://www.cdfcp.ca/biodiversity-mapping-in-south-west-bc-solutions-workshop/

2.2 Setting the Context

Presented by Kelly Chapman*, Coastal Douglas-fir Conservation Partnership*

The ecosystems in BC's Georgia basin are under pressure from development, timber harvesting and climate change. Our ability to protect these ecosystems can be inhibited by the complexity of land ownership (predominantly private land), the complex regulatory system in place and a lack of information in a format that decision makers can use.

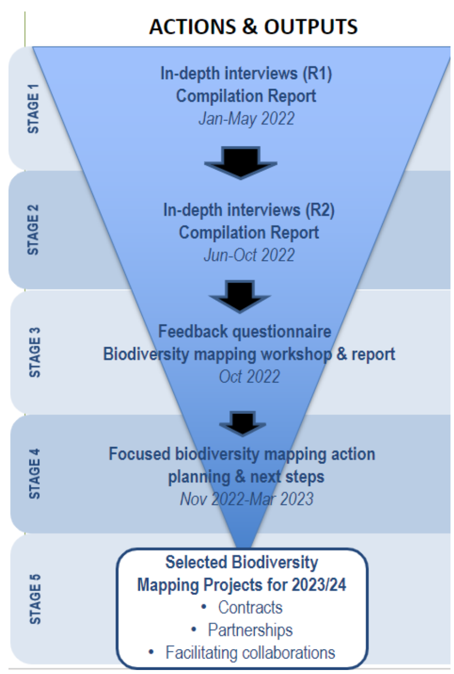
The project has selected two study areas. The Coastal Douglas-fir Conservation Partnership (CDFCP) boundary (red line **Figure 1**) and a secondary study area boundary which incorporates the third order watersheds that feed into the coastal communities. Our focus is on supporting local government and First Nations in their decision making.

The UBC Botanical Gardens and Coastal Douglas-fir Conservation Partnership (CDFCP) have partnered for this biodiversity mapping project, and it is reliant on the contribution made by mapping experts and users.

The objective of this project is to align and collaborate with groups and agencies working in the Georgia Basin to create a mapping tool to support local governments and First Nations in their decision making. We know there is a massive amount of spatial data available, but users are struggling to navigate this data and identify what is important. The project is looking to improve existing resources, if needed, and fill gaps. A key part of the project will be the provision of guidance documentation for end users, such as standards and policy. The aspiration is to present this information on a user-friendly interface, Biodiversity Atlas.

The themes for the spatial layers we are looking to develop include land cover and change, biodiversity, carbon storage, watershed resilience and wildfire resilience. At the workshop, we focused on land cover and change and biodiversity mapping, including; ecosystem mapping, ecological connectivity and climate shifts and species and ecological communities at risk.

The approach to the project is a collaborative learning and action research approach (qualitative research approach) for tackling complex problems. You start by consulting widely and then converge on a solution. The process began in January 2022 with interviews which led to the understanding of the problems and then the potential solutions. This workshop is part way through the process of working through the problem and is important for the establishment of relationships and to develop a shared understanding.



Land cover and biodiversity are two themes that we are investigating but we will also be looking to undertake further First Nations engagement, carbon workshop and sensitive watershed features mapping workshop.

A review of the project's current understanding of mapping challenges obtained from interviews was provided e.g. out of date, inconsistent resolution etc. (**Appendix B**).

2.3 Mapping Land Cover and Vegetation Structure

Presented by Nicholas Coops, Canada Research Chair in Remote Sensing Forest Sciences Centre, University of British Columbia.

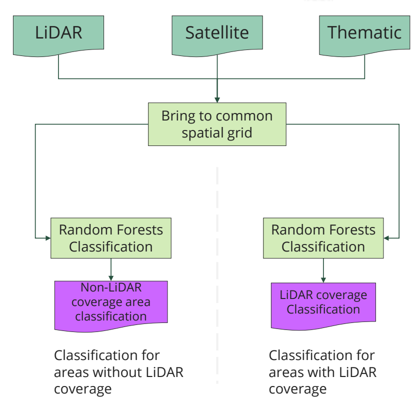
People ask can remote sensing provide a single comprehensive dataset? The answer is, there is no complete dataset. There is a need to understand the strengths and weaknesses of various data types and consider how we can use them to answer the questions we want to analyze.

We know that we need detailed land cover and vegetation structure information for a wide variety of applications, but there is no standard Canadian classification system with agreed classes and definitions. Therefore, it comes down to the user to determine what those classifications will be and how much they are able to spend producing the mapping and then updating it.

We understand the limitations relating to the classic approach to collecting aerial imagery; expensive, lack of trained staff, not compatible with GIS etc. We understand that moving towards using satellite data and LiDAR could fill some gaps in knowledge. Free daily satellite imagery is not providing us with the data for the analyses we want to do (250 m pixel). Even Landsat at 30 m would not provide us the detail needed for local level planning. Sentinel is better as it provides a 10 m pixel, but you still might struggle to undertake vegetation classification on a local level. However, below 10 m (3m) you must pay (Rapideye – Metro Vancouver, Planet, Spot 6). A critical step is to obtain a good comprehensive spatial layer (baseline) that you can then map over. However, these are 2D images - you need aerial LiDAR to obtain 3D imagery. Space borne LiDAR doesn't give us a map, it provides points. The problem with aerial LiDAR is there will be gaps as it is only flown in patches, and it will have been flown in different years.

In an urban area LiDAR can be used to map every tree (Metro Vancouver). This is difficult to do in a forest but why would you want to? In relation to biomass and carbon you might think about individual trees in the peri urban environment but take a forestry-based approach (20x20m grid) for stands of trees. LiDAR will provide good estimates of above ground biomass and subsequently carbon.

Metro Vancouver realized that they didn't have LiDAR everywhere so they would need to use multiple products; 5 m land cover map of Metro Vancouver using satellite data (Rapideye) and a 3 m layer where they had LiDAR. This produces two maps, and you then need to consider how the layers will be used for decision making. You need to also remember that you will need ground data to make the classifications accurate.



In relation to change in land cover you need to invest in a high quality 2022 map and then update it. Don't use remote sensing to remap the classes each year, instead use it to map change.

Key Messages:
- Need a high-quality base image.
- Augment with aerial LiDAR where available.
- Need agreement on the desired classes / hierarchy.
- Track land cover change using remote sensing imagery to identify change.

2.4 Climate and Ecological Mapping for Forest Adaptation to Climate Change

Presented by Tongli Wang, Associate Professor, Department of Forest and Conservation Sciences, University of British Columbia

Our work is focused on climate, ecosystems and species mapping. Trees are important to us as they absorb and store carbon, but to do this they need to be healthy. Unhealthy trees can become a source of CO_2. Individual trees species are adapted to a specified range of climatic conditions (climatic niche), but climate change is causing a mismatch between the current location of trees and the climatic conditions they are experiencing. When trees end up outside of their climate niche they are maladapted and vulnerable to insects, diseases and other hazards (fire). At the same time, it takes species a long time to migrate to areas where climate conditions are more suitable.

The climate niche distribution model enables us to understand where conditions could be suitable for a species / ecosystem in the future. The understanding of where species / ecosystems will die out (extirpation), adapt and migrate enables us to tailor our management and conservation strategies e.g. introduce new species, in situ conservation or assisted migration.

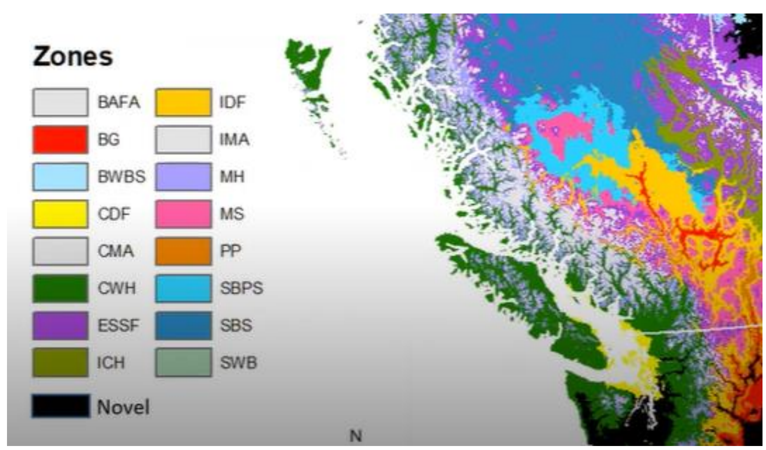
Projections of the BEC zones for future climates are called “Flying BEC” zones. As the climate models (Flying BEC 1.0, 2.0, 3.0) evolve so will the accuracy of the predictions in relation to the potential location of Biogeoclimatic (BEC) zones in the future. The present model (Flying BEC 2.0) is not able to predict the type of ecosystems present in areas where climate reflects current conditions in the US consequently the model shows these areas in Canada as a novel (unknown) ecosystem. Flying BEC 3.0 work is being undertaken to address this.

The model indicates that the Coastal Douglas-fir moist maritime (CDFmm) subzone as currently described by the BEC classification system may not persist in its current form by 2080, but it is important to note that the component species of the sub zone may be present. For example the current predictions suggest that the climatic range of Garry oak will expand further north in BC. A concerning result of the models is the suggestion that native species richness along the south-west coast of BC will decline by 2080.

It should be noted that the resolution of the mapping is at 1 km. To understand how the CDFmm responds to climate change, modelling could be undertaken at a finer resolution (250 m) to highlight pockets where this BEC subzone may persist in its current form.

Potential planning applications:

- Ecological connectivity/corridor analysis - whether a corridor will likely be there in future.
- Identifying potential climate refugia (e.g. wetter, cooler areas where ecological communities are more likely to persist)
- Conservation planning– climate niche profiles can provide information about where a species will be suitable/unsuitable.



Current range of BEC Zones

2.5 Ecosystem Mapping in BC

Presented by Jackie Churchill, Ecosystem Mapping Ecologist, Ministry of Land, Water and Resource Stewardship (LWRS), Government of British Columbia

Ecosystem mapping is a landscape stratified into map units (polygons) based on ecological criteria; climate, physiography / topography, surficial material, soil, vegetation. There are provincially standardized systems in place based on Biogeoclimatic Ecosystem Classification (BEC) and Ecosystem Mapping Standards (RISC) to ensure that classification is consistent across regions and disciplines. Ecosystem mapping provides a baseline for planning and management. It helps us understand trends and future conditions (e.g. effects of climate change). However, these maps contain a lot of information in their metadata, and they need to be fully understood to be used effectively.

There are numerous approaches to ecosystem mapping. The approach you take will be influenced by cost, scale and the confidence you need in the end product. Mapping can be expert-driven image-based vector mapping (i.e. Terrestrial Ecosystem Mapping (TEM)), or data-driven modeled raster predictions (i.e. Predictive Ecosystem Mapping (PEM)).

Mapping products available in the CDFCP study area include:
Terrestrial Ecosystem Mapping (TEM) - in areas where this mapping has been completed it provides a seamless mapping layer. It captures a broad range of attributes which means that by mining into the metadata you can theme maps in many ways e.g. sensitive ecosystems, wildlife habitat etc. However, it uses complex coding which means it can exclude many potential users. This is an expensive approach to mapping.

Sensitive Ecosystem Inventory (SEI) – this is feature-based mapping where you delineate specific pre-determined features (e.g. mature forest, grassland) producing multiple disjointed polygons. This approach is often preferred by users as it has simple coding and is therefore easily understood.

Provincial mapping can be accessed in several different ways; TEI website, BC Data Catalogue, iMapBC, HabitatWizard or by emailing TEI_Mail@gov.bc.ca.

The Terrestrial Ecosystem Information (TEI) team are aiming to;

- Increase consistency in ecosystem mapping across BC.
- Improve utility for land management and ecosystem-based decision making.
- Increase ease of analysis for all users.
- Increase collaboration with subject matter experts and end users.

The province has recently undertaken a project to map Garry oak and its associated ecosystems. This process reviewed existing mapping, involved a review of aerial imagery plus field verification. The project visited 133 potential Garry oak sites of which only 16 were classified as this ecosystem post visit, highlighting the need for field verification of small ecosystems. Due to the scale of these ecosystems, they were mapped as a point feature rather than a polygon on the TEM.

Final remark:

- The aim is to provide consistent, user-friendly ecosystem mapping that supports decision-making.

2.6 Predicting the Distribution and Abundance of Culturally Important Plants

Presented by Sari Saunders, Research Section Head (Research Ecology), Ministry of Forests, Government of British Columbia

The project is looking at whether we can predict the distribution and abundance of culturally important plants within the context of ecosystem mapping. This work was delivered as a collaboration, with the intention of supporting strategic land use planning, stewardship initiatives, guiding management practices and to engage with local First Nation communities.

There are existing mapping tools such as Terrestrial Ecosystem Mapping (TEM) but often in one polygon you will have up to three ecosystems. So how do you determine the precise location of the ecosystems within the polygon and subsequently determine the potential for an individual species to be present. We focused on tools such as DSMART which is able to break apart polygons and considered how LiDAR could be used.

The project focused on two plant species that were identified to be culturally important to the shíshálh First Nation. Species A was a 'Site Specialist', Species B was a 'Site Generalist'. The project wanted to understand whether the ability to predict the location of a generalist species would be more difficult than a specialist species or whether the approach just needs to be undertaken at a courser scale e.g. BEC zone versus a wet site beneath open canopy.

Five categories of data were used in the model; vegetation (satellite imagery), terrain, climate, site series and forest structure / succession. These layers were used to predict the potential location of a species. Field validation was undertaken, and additional social and biophysical attributes were fed into the model such as the importance of plant abundance and fruiting to the shíshálh First Nation.

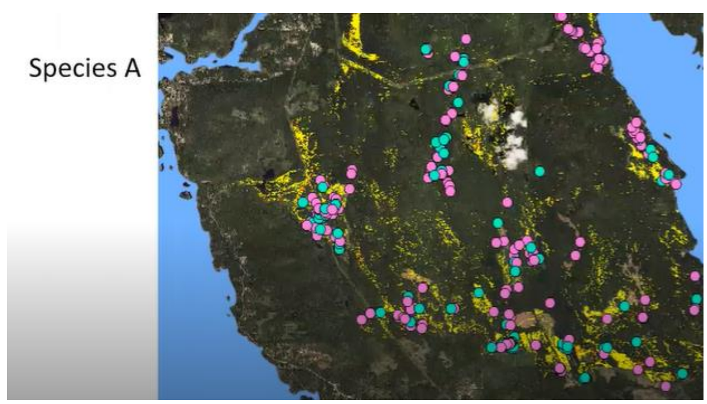
In the application of the model, we found that some of our predictions were true in relation to factors that influenced the location of species. For example, climatic variables (elevation, snow) were more important in predicting the location of the generalist species. For the 'specialist', it was landscape position, site series. The most important variable for both species was the DSMART classification of TEM.

It was concluded that the models could be useful in predicting the location of culturally valuable species. The predictors were found to differ between generalist and specialist species. The scale of each of the different data layers may vary and it was found that fine resolution (LiDAR) didn't necessarily lead to increased model accuracy. Limited species data is a limiting factor on the confidence of accuracy of the model and maps.

The project is on-going and is looking at alternative models and layers to improve accuracy.

Key Messages:

- Predictive modelling can be used to identify the location of culturally important plant species but the predictions are impacted by the limited information on the distribution of some species.

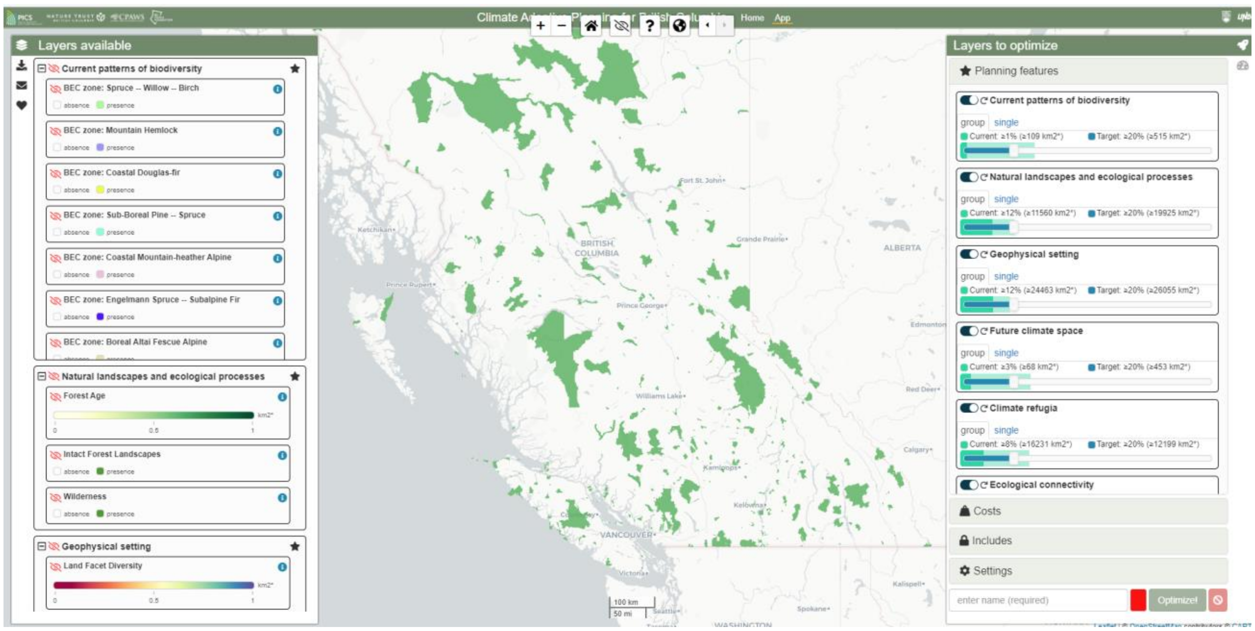


Map illustrating the predicted location of Species A

2.7 Climate-Adaptive Planning: CAP-BC

Presented by Peter Arcese, Forest Renewal BC Chair in Conservation Biology, University of British Columbia

As a decision maker you may have access to a number of different maps and then you are placed in a situation of having to balance a range of interests and values. UBC and UNBC have developed a tool that enables the user to define a broad range of different priorities based on their own data layers. A couple of examples were given to demonstrate how the tool could be used. The first scenario looked at identifying priority areas for biodiversity drawing on 40 layers of information. This output could potentially be used to identify land for purchase. The second scenario took a step further and asked for sites to be identified for purchase that would include 25% of BC's biodiversity, 50% of all the stored carbon in BC and 50% of mapped ecosystem services in BC. This identified a significant proportion of the province so you could set an additional control over the top e.g. we only want to look at 25% of the province. https://csl.gis.unbc.ca/CAP-BC/



Screenshot of the Climate Adaptive Planning Tool developed at UNBC and UBC

3 Break out Discussion

3.1 Introduction

In the afternoon session, five break out groups were formed to address data gaps in three topic area identified during interviews with planners, First Nations staff, consultants, scientists and mapping experts.

The three topic areas for the groups were:

1. Ecosystem and land cover mapping (3 groups)
2. Ecosystem connectivity (1 group)
3. Species and ecosystems at risk and culturally significant ecosystem mapping (1 group)

A handout was given to each group (see **Appendix F**), with instructions, prompts/questions related to the topic area, a summary of identified challenges and recommendations made during the in-depth interviews. The instructions to each breakout group were as follows:

- Briefly consider some or all of the prompts below (depending on group members' knowledge/ experience/ interest*).*
- For each, consider opportunities for collaborating and pooling resources between projects and organizations, and who could be involved (e.g. as part of a working group)?
- For consideration:
    - Challenges raised in interviews.
    - Recommendations & comments made in the pre-workshop questionnaire (see **Appendix B**)

Each group was also given a handout illustrating the differences between different types of mapping **(Appendix G).** The ecosystem connectivity group was also given a handout with an overview of different types of connectivity analyses that have been done in the province **(Appendix H).**

The following is a summary of the points raised by each group in their notes and while reporting back on their discussion.

3.2 Ecosystem and Land Cover Mapping

The summary presented below provides an overview of the discussion undertaken by three groups. A detailed list of the points made in these discussions are presented in **Appendix K.**

Collaboration & Sharing

The groups highlighted that for local governments to achieve the best outcome they need to reflect on the mapping work that has been undertaken (e.g. Metro Vancouver – SEI and Land cover) and then standardize the approach to ecosystem and land cover mapping in the region. Potentially the standards may include decision trees as it is unlikely that a single map will addresses all the needs of decision makers. To make the mapping process cost-efficient, local governments should coordinate on the collection of aerial, satellite and LiDAR imagery and also on how to use new products as they become available.

The mapping work being undertaken by local governments needs to be in partnership with First Nations to ensure that products reflect their values and meet their needs. Potentially mapping could present landscape areas of value to First Nations where further consultation is needed, avoiding the need to share culturally sensitive information e.g. sanctuary zones.

Data

The discussion highlighted that we have high quality mapping layers such as the Terrestrial Ecosystem Mapping (TEM) and the Canadian Wetland Inventory (in development), but end users are often;

- unaware of these tools as there are so many of them,
- unaware of the information held in each individual tool because they capture many attributes,
- they may not be at a resolution that is useful for local governments / First Nations; and
- they can be hard to interpret, e.g. they use codes.

Therefore, there is a need to focus in on the layers that are at a scale that is useful for local governments and First Nations and present the pros and cons to those layers.

There can also be limitations with products such as TEM and the Sensitive Ecosystem Inventory (SEI);

- they don't cover the whole province;
- they can be expensive to produce; and
- can become out of date.

However recent projects, such as the Canadian Wildlife Service (CWS) SEI on Vancouver Island Change Project, have illustrated that in some cases mapping products can be updated efficiently and cheaply (18 hours of student time[3]). It was highlighted that if mapping products are of value to multiple levels of government e.g. SEI and TEM, they should pool resources to improve coverage and update these mapping tools. Layers should also be pre-themed e.g. SEI or wildlife habitat, to enable ease of down load and use by local governments and First Nations.

It is understood that often a mapping product developed by the federal or provincial government is not at a resolution that is useful to a local government / First Nation (e.g. > 1 km pixels). It is also important to remember at a local government level that the resolution of a mapping product may vary between a regional district / First Nation territory and a municipality (e.g. land cover classifications).

The importance of accurate baseline mapping was highlighted – high quality, high resolution potentially using LiDAR, albeit that it was also indicated that LiDAR is not seamless for the region and there may be issues with resolution e.g. 2016 dataset. It was also stressed that it's not just about establishing a baseline now, we need to know the extent of ecosystems historically to determine our performance.

It was highlighted that local governments are receiving data through the development permit process, but this information is not used / shared for political reasons and also because the data would need to be mined and uploaded on to the governments system. The mining for information could be undertaken by an intern, but further work would be needed to incorporate this information into the decision-making process.

Prioritization models have been run over the study area. These usually indicate that 25% of the landscape is of low ecological value. Consequently, the prioritization tool could enable local governments and First Nations to think backwards in relation to planning e.g. focus development in the 25% of the landscape which is of low ecological value.

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[3] Only change to existing SEI polygons was tracked; now-mature forest that was not included in the original SEI mapping (because it was too young) was not included in the update.

3.3 Ecological Connectivity

The summary presented below provides an overview of the discussion undertaken by one group at the workshop. A detailed list of the points made in these discussions are presented in **Appendix K**.

The discussion highlighted several approaches to mapping ecological connectivity (structural vs functional, circuit theory etc.) and that local governments, First Nations and academic institutions (UBC) in the study area have been undertaking ecological connectivity mapping. Therefore, it was recommended that the first step should be to review the mapping that has been undertaken locally and internationally (Transboundary working group for Cascadia).

It was discussed that connectivity mapping can be affected by:

- the species of interest e.g. large carnivores need different ecological connectivity to amphibians;
- the audience e.g. regional/territorial scale versus municipal;
- values e.g. colonial perspective of what is of value; and
- should take into consideration climate change predictions.

The contributors concluded that it was important that connectivity mapping looked beyond political boundaries and suggested that one of the next steps could be to combine data sets and work with local governments and First Nations to develop best practice guidance (e.g. Develop with Care) for connectivity mapping.

3.4 Species and ecosystems at risk and culturally significant ecosystem mapping

The summary presented below provides an overview of the discussion undertaken by one group. A detailed list of the points made in these discussions are presented in **Appendix K**.

Mapping

The discussion highlighted that there are several datasets that present information on the location of species and ecosystems at risk but there needs to be better awareness of available datasets, particularly as they are renewed. However, this information still contains gaps and bias. The scale and remote nature of the landscape in BC means that records are incomplete and focused in areas that people can get to readily. Therefore, methods of predicting the location of species and ecosystems at risk from environmental factors were discussed.

The group discussed boundaries suggesting that the blue boundary proposed for the CDFCP/UBC project (**Figure 1**) would be preferable over the red line boundary in relation to mapping species and ecosystems at risk. The group also discussed how values and roles can impact on species and ecosystem mapping, in that a provincial worker may focus only on provincial species and this could affect the mapping products they produce. They may not take into consideration federally listed species or species of cultural value. This could subsequently effect decision making by local governments who depend on provincial resources.

The mapping should take into consideration cultural values from the start, using models such as CoVIS (Learning Through Collaborative Visualization). It was highlighted that culturally important plants often align with provincial / federally listed species at risk, however, there are other sensitive cultural features that do not align with western science mapping. First Nations bring a more wholistic view to the project.

Tracking progress

The group spent some time talking about the need for objectives and targets relating to land protection and subsequently preventing the continual loss of species and ecosystems at risk. It was felt that clear objectives and targets were needed if a defensible argument against certain developments were to be made. The discussion identified that there was a need to take into consideration that the ecosystems along the south-west coast of BC have been modified and that this should be reflected in objectives and target setting (e.g. current situation should not be consider the baseline scenario). The group discussed whether targets needed to be numerical, and opinions were expressed for and against this approach. It was felt that once there were clear objectives and targets you can then monitor progress. The group discussed tools that are currently available for demonstrating progress e.g. SPOT – provincial tool.

It was identified that a key gap is the absence of provincial legislation that proactively encourages local governments to protect species and ecosystems at risk. At present elected officials in local government can choose to ignore protected species information in a planning application as there is currently no legal protection.

4 Group Discussion

4.1 Introductions

The breakout session presentations were followed by a group discussion. The purpose of the discussion was to identify key recommendations and areas where attendees may be able to support the project going forward. **Appendix K** presents detailed information of the discussion, which covered a broad range of topics. The summary below is focused on those topic areas directly related to the next steps of the project.

4.2 Piloting Spatial Layers

The intent of the CDFCP / UBC Botanical Gardens Atlas is to pull together key existing environmental layers (land cover change, ecosystem connectivity, carbon, hydrologically sensitive ecosystems etc.) that local governments and First Nations can use to make decisions that will lead to climate change resilience and prevent the loss of biodiversity. If gaps in information exist, then the project will explore how these gaps can be filled in partnership with other organizations.

It was suggested that the first step should be to identify what layers have been produced by the local governments, First Nations, academics and ENGOs. Identify similarities in approach and differences. Then undertake a pilot within the study area (blue boundary, **Figure 1**). Apply the different methodologies at a district level to see where the differences lie and whether they are significant. For example, if you took a structural approach rather than a functional approach to ecosystem connectivity mapping would the corridors and hubs differ significantly. It was noted that Metro Vancouver and UBC have been working on new approaches to tracking land use change and the application of these new approaches should form part of the pilot, to see if the approach would be applicable in areas with different datasets e.g. less aerial LiDAR.

It was highlighted that during the in-depth interviews undertaken by the CDFCP in 2022 that a list of the environmental layers, mentioned by interviewees, were compiled into a document that attendees could view and add to. This information is presented in **Appendix I**. However, it was noted that this information does not go down to the detail of what layer each individual local government or First Nation in the study area is using in relation to land cover, connectivity etc., this information would need to be collected prior to the pilot.

It was highlighted that the user interface with the Atlas will be a key consideration (high quality visitor experience) and it was recommended that the project team should reflect on existing websites such as the Biodiversity Atlas of British Columbia[4].

The Atlas being developed by the CDFCP / UBC Botanical Gardens aims to be a decision support tool for local governments and First Nations. However, it was highlighted that data sharing will be problematic for First Nations because the information is confidential.

4.3 Mapping Standards and Guidelines

It was identified that standards exist for undertaking specific mapping activities. e.g. SEI or TEM mapping. As mapping layers are developed for the Atlas, the project team will need to consider whether the existing standards provide the information that local governments and First Nations need or whether they need to be simplified or presented differently to enable all parties to understand how this information can be

[4] http://www.biodiversitybc.org/assets/Default/BBC_Biodiversity_Atlas.pdf

used for their decision making. If the approach to mapping is new, e.g. UBC land cover change approach, then standards may need to be produced and support sought from the province, local governments and First Nations. If new standards are required, then advice should be gained from organizations that have experience on how to do this, such as the province and the Municipal Natural Assets Institute (MNAI).

It was highlighted that environmental development permit areas (EDPAs) are an effective tool for managing the effects of development. It was suggested that through this project, existing policy tools should be highlighted (e.g. reference the Green Bylaws Toolkit) and promote the use of check lists during planning (e.g. Develop with Care).

4.4 Data Handling

The breakout discussions highlighted that the collection of data on species and ecosystems at risk is difficult and often biased due to the scale of the landscape within BC and human accessibility. In addition, data collected by consultants appointed by developers and through citizen science is not always in a format that can be readily accessed or is not supported / endorsed by governmental organizations e.g. CDC and local governments. This means that information that could improve our decision-making is dismissed. Further consideration is needed as to how this information could be handled better, for example, establish guidelines on how species and ecosystem data is to be submitted to local governments by developers so that it is received in a GIS format that is compatible with the local government internal mapping system.

4.5 Future Collaboration

Attendees indicated that they would like to remain informed of progress as the layers for the Atlas develop. The level of each members involvement will depend on the layer currently being developed, their experience / knowledge and the value of the layer to the attendee. It was suggested that it would be beneficial to host a second workshop that brings together local government, First Nation and province to talk about emerging mapping tools.

It was indicated by attendees that the workshop had been useful to understand how much information is available.

Appendices

Appendices can be accessed by visiting the CDFCP website
https://www.cdfcp.ca/biodiversity-mapping-in-south-west-bc-solutions-workshop/

APPENDIX A: Biodiversity Atlas project description, CDFCP Nature Smart Project and UBC Botanical Gardens Climate Adaptation Project

APPENDIX B: Pre-workshop questionnaire results

APPENDIX C: Mapping tools recommended by workshop participants

APPENDIX D: Workshop Agenda & Participants

APPENDIX E: Presentation slides

APPENDIX F: Break out group instructions and prompts

APPENDIX G: Illustrations of different types of mapping

APPENDIX H: Examples of connectivity analyses in BC

APPENDIX I: Inventory of spatial layers identified during in-depth interviews

APPENDIX J: Glossary of terms

APPENDIX K Breakout and Group Discussion