

A Review of Decision Support Tools that Protect Naturebased Solutions



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## **Executive Summary**

The Action for Adaptation Project is being delivered by UBC Botanical Garden, the Coastal Douglas-fir Conservation Partnership (CDFCP) and UBC Okanagan. The project is focused on supporting local governments and First Nations in south-west British Columbia (BC) that are looking to accelerate how they mitigate and adapt to the effects of climate change through direct land protection, restoration of degraded habitats, and development of new or enhanced nature-based solutions.

The purpose of this report is to present the results of conversations and a review of 11 existing decision support tools. The review had the following objectives;

- 1. To identify through conversations what improved user experience.
- 2. To identify mapping platforms that are actively used in decision making and have features that enhance the user experience.
- 3. To identify tools that have led to a change in behaviour and management of the natural environment.

The conversations with local government and First Nations representaives identified the following gaps and opportunities:

- Local governments and First Nations will use all available data when planning and making decisions. If they are aware of its existence, it is not too dated and is from a verified source.
- Mapping tools need to be regularly updated as technologies advance and new information becomes available.
- The large number of maps and decision support tools that are available can mean that data is difficult for local government and First Nations to locate to guide decisions.
- Current, up to date, and readily accessible data is an important factor for decision support tool use and outcomes out of date information reduces the effectiveness of the tools.
- First Nations are looking to the Province or other organizations to help provide wall-to-wall mapping resources, as they often lack capacity and resources for in-house mapping services
- Some First Nations have identified the spatial mapping gaps that they would like to see filled, and are working to fill them internally if resources are available.
- The scale, resolution, accuracy, and precision of the data is important. Users often identify that data at national and international scales is not suitable at a regional or local level as it doesn't provide the level of detail required by users.
- Users prefer readily accessible, easy to use mapping platforms that allow data and maps to be downloaded online.
- Mapping information provided by consultants should be captured in a GIS database and made publicly available.
- Training on how to use new mapping tools would be required.

#### User Experience Feedback

The review of existing decision support tools identified the following features which improved user experience.

**Group Topic Areas and Multiple Layers Overlaid** – Mapping layers should be grouped into easily identifiable topic areas (e.g. carbon, drought) to enable the user to easily access the different mapping

products available from the homepage. However, layers need to be arranged so that layers from different topic areas can be viewed at the same time, with the ability to toggle layers on and off.

**Interpretive Information** – Mapping layers should be presented with a storyboard explaining the mapping information and its potential uses. This will increase the potential for its incorporation into planning documents, and outcomes generated by end users.

**Data Information** – Each mapping layer needs to have a short description (with a maximum of two paragraphs) of how the layer has been generated, its resolution, and a link to any associated scientific papers, where relevant.

**Downloadable Data** – Downloading of mapping layers needs to be simple and clearly indicated on the homepage of the platform.

**Importing Shapefiles** – This is a functionality end users indicated they needed in order to work with additional datasets of interest to the end users.

**Resolution** – Enable mapping to be viewed at multiple resolutions and a built-in automation that will grey out text in legend when the resolution is incorrect or incompatible at certain scales, preventing the mapping from being viewed.

Search Tool – Include a search tool for mapping layers built around key words.

User Guide – Include a user's guide on the homepage and audio or video tutorials where practical.

**Age of Data and Update Frequency** – Indicate the age of data and frequency of any updates or version number.

**Dashboard** – A summary dashboard improves user understanding of all the information held in the decision support platform.

**Prioritisation** – This should be an add on to allow users to prioritize based on the information provided by the platform rather than within the platform itself. Existing external prioritisation tools should be promoted rather than developing a new tool.

There are several decision support tools currently available in southwest BC, including:

- Existing local/regional governments/First Nations mapping tools;
- The Rush Initiative;
- Community Mapping Network;
- TerrAdapt; and
- Marine Data BC Portal

The Action for Adaptation Project should aim to share layers with the existing portals listed above that have sustained funding while also developing an open access Biodiversity Atlas portal.

Users indicated that it is often difficult to find up to date information due to the sheer number of decision support and data repository sites available. Therefore, the ability to place mapping layers in existing tools means that users will be able to find the layers they need in places they are used to

visiting. In addition, the project will need to provide training to local government and First Nations on the Biodiversity Atlas in order to increase overall usage of the layers shared.

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## 1 Introduction

## 1.1 Background

The Action for Adaptation Project is being delivered by UBC Botanical Garden, the Coastal Douglas-fir Conservation Partnership (CDFCP) and UBC Okanagan. The project is focused on supporting local governments and First Nations in south-west British Columbia (BC) that are looking to accelerate how they mitigate and adapt to the effects of climate change through direct land protection, restoration of degraded habitats, and development of new or enhanced nature-based solutions.

In 2022 and 2023, conversations were undertaken with representatives from federal, provincial and local governments, First Nations, non-profit conservation organisations, consultants and ecosystem services finance companies. The purpose of the conversations was to identify gaps and opportunities relating to policy, decision making tools and incentives.

These discussions highlighted the need for specific mapping layers and guidance on the integration of nature-based solutions into local and regional government and First Nations plans and strategies. To meet the needs of the targeted end users Action for Adaptation is working on the production of a Biodiversity Atlas and a Regional Climate Adaptation Plan.

## 1.2 Study Area

The study area for the Action for Adaptation project is indicated in **Figure 1** by the blue line boundary. The decision support tools reviewed in this report are not limited to the study area.



**Figure 1**. The red line boundary represents the CDFCP area of interest which incudes the CDFmm and CWHxm1. The blue line boundary represents the Action for Adaptation boundary which includes the catchments that feed the ecosystems in the CDFmm and CWHxm1.

## 1.3 Purpose of this Report

The purpose of this report is to present the results of conversations and a review of 11 existing decision support tools. The review had the following objectives;

- To identify through conversations what could improve user experience.
- To identify existing mapping platforms that are already actively used in decision making and have features that enhance the overall user experience.
- To identify current tools being used by local governments and First Nations that have led to a change in behaviour and management of the natural environment.

This report should be read in conjunction with the following reports:

- A Review of Mapping Support Tools Landcover.
- A Review of Mapping Support Tools Ecosystem Connectivity.
- A Review of Mapping Support Tools Carbon.

These reports looks at the mapping layers presented in the decision support tools in greater detail in relation to their value to local governments and First Nations for their decision making.

## 2 Decision Support Tools

## 2.1 Introduction

A key challenge for local governments and First Nations is to be able to view and consider large amounts of information when making decisions (e.g. cultural, economic, social, environmental). Several tools have been developed to aid planners and decision makers and these can be divided into two types:

- Multi-layer decision support tools this allows the user to view multiple layers, depending on their area of interest, and to make a land management decision based on this information and their values.
- Prioritisation tool this allows the viewer to draw on multiple mapping layers to answer specific questions or view outcomes in relation to land management (e.g. which parcels of land should we protect if we want to retain 30% of Canada's carbon stocks).

## 2.2 Summary of Conversation Responses

Conversations in 2022 and 2023 with planners and decision makers identified the following opinions in relation to the presentation of mapping layers:

- Local governments and First Nations will use all available data, the more detail the better.
- Mapping tools need to make sense to the end user.
- Mapping tools need to be regularly updated.
- Online mapping tools make data accessible for local governments. However, the number of tools currently available can mean that data is difficult to locate.
- First Nations are looking to the Province to provide wall-to-wall mapping resources.
- First Nations have identified the spatial mapping gaps that they would like to see filled and some of the barriers to collecting and presenting that data.
- National and international mapping is not suitable at a regional or local level as it doesn't provide the level of detail required by users.

- If a First Nation has capacity, they will access provincial and federal government datasets during referrals and decision making. However, First Nations often lack the capacity and mapping resources needed for land stewardship decision support.
- First Nations would like mapping platforms that allow data and maps to be downloaded and brought into their own mapping platforms to overlay with their cultural value layers, which are not publicly accessible.
- Mapping information provided by consultant reports should be captured in a GIS database and shared publicly.
- Some barriers to using mapping include: lack of internet access; lack of funds and capacity; and cultural sensitivity of data.
- Training on how to use new mapping tools would be required to support local government and First Nations.
- During referrals developers provide a kml file to use in Google Earth to locate a site. This is a useful feature to end users.

## 2.3 Multi-layer Decision Support Tools

The following review looks at currently available multi-layer decision support tools and prioritisation tools and presents their benefits and recommends areas that could be further developed to improve overall user experience.

## 2.3.1 UN Biodiversity Lab

<u>UN Biodiversity Lab</u> is a tool that provides spatial data developed to support parties to the UN Convention on Biological Diversity (CBD) in reporting their achievements and to inform conservation decision making (**Figure 2**). The tool includes approximately 200 layers including:

- Aboveground biomass carbon density for the year 2010 at a 300 m resolution.
- Below ground biomass carbon density for the year 2010 at a 300 m resolution.
- Areas of global significance for restoration developed from distribution maps for more than 180000 terrestrial vertebrates at a 1 km resolution.
- Bioclimatic Ecosystem Resilience Index (BERI) measures the capacity of natural ecosystems to retain species diversity in the face of climate change, as a function of ecosystem area, connectivity and integrity.
- European Space Agency (ESA) CCI Landcover (1992-2022) at 300 m and 1 km using the United Nations Food and Agriculture Organisations classification system.
- ESA World cover 2021 at 10 m.

## Benefits:

- The tool is simple to use as all mapping layers are presented in a single list on the homepage.
- There is a search tool for the mapping layers.
- Multiple layers can be overlaid.
- When a layer is active the legend provides an option to gain information on the layer including a simple description, a link to the connected scientific paper or source website and access to the data.
- The layers are worldwide and therefore highlight the importance of the natural environment in southwest BC from a global perspective.

#### Areas that could be enhanced:

- There are 200 layers in the tool covering a broad range of subjects in a single list. It is unlikely that many users would get to the bottom of the list of layers.
- The layers provide data for the world therefore the resolution is typically around 300 m. The resolution does not provide the level of detail needed (finer resolution is needed) for local government and First Nations to understand the impact of their decisions.



**Figure 2** UN Biodiversity Lab decision support tool – above ground biomass carbon density 2010, 300 m resolution.

## 2.3.2 The Rush Initiative

<u>The Rush Initiative</u> is a decision support tool that has been developed by community members to provide information to the community about the natural environment and to also stimulate conversation with local government and First Nations planners around climate adaptation (**Figure 3**). The layers have been grouped into topic area and present issues and potential solutions. Topic areas include:

- <u>Wood wide web</u> the mapping layers shared include a carbon sequestration layer that has been developed from landcover mapping and IPCC landcover class sequestration values.
- <u>Light footprint</u> illustrates where greenhouse gas (GHG) emissions from transportation have increased or decreased in 2020 in comparison with 2007. This is paired with information on public transport.
- <u>Neighbourhood to Naturehood</u> presents sensitive ecosystems and tree coverage.

• <u>Beat the heat</u> – presents tree coverage and mapping of areas that experienced extreme temperatures during the heat domes.

#### Benefits:

- This tool is easy to use, maps are simple and clear, and the information has been grouped into topic areas to simplify the user experience.
- The tool includes links to where information has been obtained.
- It provides a storyboard of information on positive steps a community member could take.

#### Areas that could be enhanced:

- The approach to presenting carbon sequestration on the landscape could be developed further, but it does start to illustrate the value of ecosystems for carbon storage.
- The topic areas have headings that are not always easy to understand e.g. wood-wide web.
- The clustering of layers beneath heading tabs means that layers in multiple topic areas can not be viewed at one time e.g. mapping under beat the heat can't be viewed with mapping layers under wood wide web.



Figure 3 The Rush Initiative decision support tool – Carbon sequestration, using IPCC values.

## 2.3.3 Greenprint

The Maryland Department of Natural Resources has developed a decision support tool called <u>Greenprint</u> (**Figure 4**). This provides multiple mapping layers in one location with the view of supporting decisions in relation to the selection of land for protection and development by state employees. The tool also includes a parcel evaluation tool which can provide a summary of information held within layers per parcel. Mapping layers include:

- Ecosystem services includes 20+ layers generated from a project title <u>Accounting for</u> <u>Maryland's Ecosystem Services</u>, including a Net Carbon Sequestration layer (10 m resolution).
- Protected lands.

- Coastal resilience assessment / sea level vulnerability.
- Biodiversity Conservation Network.
- Green Infrastructure / canopy cover.

### Benefits:

- The scale of the mapping would be useful at a municipal and regional district level in Canada due to the 10 m resolution and the ability to obtain information on a parcel-by-parcel basis.
- The grouping of layers helps the user as you have a clear understanding of all the layers available from the homepage of the mapping viewer, but layers under any topic can be viewed at one time.
- All mapping layers come with a clear description of the information presented and how to find further information.
- The user can upload a georeferenced shape file to locate an area of interest. This was a functionality that First Nations indicated they use a lot when trying to identify a development area sent to them through the referrals process.

### Areas that could be enhanced:

- There is the potential that municipal governments would seek to tailor layers such as green infrastructure (ecological connectivity), as this tool is focused at a state (regional) level and often municipal governments will value areas that at a regional level are considered to be of lower value.
- The descriptions indicate where information is drawn from, but links are not provided. However, links are easily broken and need a lot of maintenance.



Figure 4 Greenprint decision support tool - Net Carbon Sequestration layer.

## 2.3.4 iMap and Habitat Wizard

iMap and Habitat Wizard are two tools that have been developed by the province of BC to share mapping layers that they have produced. Habitat Wizard is a focused subset of the data held within iMap that provides access to fish, wildlife and ecosystem information. In iMap the user needs to navigate to a tab that enables the import of provincial data layers. Layers are then grouped in relation to subject area e.g. agriculture; air and climate; fish wildlife and plant species. Habitat Wizard is easier to use as it presents information from one of these topic areas and the layers are already loaded. The remainder of the functionality is the similar between the two decision support tools. Both tools allow mapping to be exported as jpg, pdf, tiff, geotiff etc, but iMap has the additional functionality to download the original dataset.

### **Benefits:**

- A broad spectrum of provincial data can be viewed.
- Shapefiles can be imported to crop data to an area of interest.
- Data can be downloaded.
- Mapping / data has undergone rigorous review and verification.
- Multiple layers can be overlaid.

### Areas that could be enhanced:

- Large exports of data can overwhelm iMap leading to failure to download.
- The large quantity of data and functionality can be intimidating to people not used to using mapping platforms.
- It takes along time for new mapping to be uploaded by the province due to the rigorous review process information undergoes e.g. years.
- Not all provincial data is uploaded.
- Limited GHG emissions data is shared through iMap and what is shared is out of date e.g. Community Energy and Emissions Inventory 2007 only, not including deforestation numbers.
- Large datasets make the platform slow to upload information/mapping layers.
- Mapping layers are at different scales which means information may not be presented if the viewer is at the wrong resolution, and it is not always obvious that this is the problem.

| BRITISH<br>COLUMBIA Habitat                           | Wizard                      |   |  |   |   | Search                              |
|---|-----------------------------|---|--|---|---|-------------------------------------|
| Navigation Maps & Data Sources Report                 | s and Printing Markup       | Analysis                                      |  |   |   |                                     |
| DISCLAIMER Full Extent Zoom In Zoom Out Pan           | Previous Extent Next Extent | Initial View                                  | Bookmarks Coordinates                      | Albers Lat / Long UTM                       | Watershed<br>Search   |                                     |
| Layers 🚍 🛪  | < I want to                 | 1836  | 10917 00784 4284                           | 692089058 585491228                         |   |                                     |
| + 🛛 Base Map  | +                           | 55724   | 55714 55774                                | 55779 3577940501<br>557791582               |   |                                     |
| + 🗆 EcoCat  | -                           | 35774   | 55774                                      | 1538 3842                                   | 1590  |                                     |
| +  Stream Crossing (PSCIS)                            | 9902                        | e 134   | 854138192 44849 5577                       | Brde. 6766 138183                           | 602857624544 7214524270<br>159015841544                                   |                                     |
| + 🗆 Invasive Species                                  | 56741                       | 16548482                                      | 38192138192 16680 1349<br>55980 7110727813 | 4923 134922 12074 134926774                 | 4078  |                                     |
| + Z Fisheries   | 600                         | 9 134937Hightands                             | 193 109 171 104923                         | 4923 134924 184927 102                      | 10446   |                                     |
| + 🗌 Wildlife  | 103388                      | 1027 102                                      | 9468 <sup>9468</sup> 134923                | 134923<br>91125 134927 134927 134927 134928 | 103463  | 3                                   |
| + 🗌 Wildlife Habitat Features                         | 165416680                   | 1150016121612 13                              | 493850773                                  | 134941 41853 1020 97<br>101937 1499 134930  | 493237660 140505 37078<br>4241853 161622835 7964<br>134933 161622835 7964 | 7964                                |
| <ul> <li>Endangered Species and Ecosystems</li> </ul> | 4806 BUAADO                 | 41842 55880 Langford                          | 55773 134939<br>La 134938 6858 1098310     | 6880  | 37860   | 6918                                |
| Species and Ecosystems at Ri                          | 134362 134362 36205         | 29268   | 126513 109168                              | 134943 37138                                | 1510 37644 9234<br>134846 193669266                                       | 6                                   |
| Species and Ecosystems at Ris >                       | 9904 134362 165             | 34940 41842                                   | 9056 7100 7124 13<br>9196 7100 7032        | 34944034945 3707                            | 7337073 37046   | 8152 80198664                       |
| Species and Ecosystems at Ris >                       | 134362                      | 68605   | 134948                                     | 4170 Victor                                 | 114 37073 37046 21977<br>8 37073 135651                                   | 7810                                |
| Critical Habitat for Federally                        | 125762567                   | 75  |  | 10687014673                                 | 91891 3794637046  | 71070                               |
| Critical Habitat for Federally-L >                    | 1638 U38169 E 18557         | 764L 555276 C N                               | D  | 9806 442                                    | 6 37973 1430804468<br>4444 9638   |                                     |
| + 🗌 Wildlife Management Units                         | 91869 10452 410             | 72 557.63                                     | 1079                                       |   | 30360<br>8644<br>8662   |                                     |
| 🎢 Home 📚 Layers                                       | Basemaps WKID: 4324         | Lat: 48.5091<br>Lat: 48.5091<br>Lon: 123.2606 | 954<br>5° N ∯ ISB®] Scale 1: 144.448       | ♥ Go 0 1.5                                  | 3km ritish Columbia, Dat  | aBC, GeoBC   GeoBC, DataBC, TomTom, |

Figure 5 Habitat Wizard decision support tool – species and ecosystems at risk.

**Note:** The following local governments use licensed Geocortex Essentials technology for the Esri ArcGIS platform, which is the same or similar user interface used by iMap and Habitat Wizard. Consequently, they have similar benefits and areas of potential improvement, therefore, these decision support tools have not been reviewed separately in this report.

- Capital Regional District Regional Map
- Islands Trust MapIT
- West Vancouver
- Sunshine Coast Regional District

## Areas that could be enhanced:

• An additional limitation of the local government map viewers is that there is typically no capability to download maps and data.

## 2.3.5 TerrAdapt

TerrAdapt is a conservation tool based on remote sensing and conservation data that is updated annually for the Cascadia region in Washington and British Columbia (**Figure 6**). The tool includes annual mapping layers for species and ecosystems from 1984 to present. The tool also aims to take into consideration changing climate and its effect on the range of species and ecosystems. The tool has three categories of information / analysis:

- **Monitor** annual collection of information for species, ecosystems and environmental conditions.
- **Project** future risks of climate change to species and ecosystems range presented for each decade from present to 2100 (small number of species).

• **Prioritise** – critical areas for the implementation of conservation actions to increase resilience to emerging threats (not functioning at the time of review).

The maps are linked to a dashboard that allows the user to generate focused reports to observe trends (e.g. changing range of grizzly bear habitat within the shíshálh Nation swiya boundary from 1984-2021).

This tool has the potential to extend into both categories of decision support tool reviewed in this report (multi-layer and prioritisation). However, the prioritisation function of this web tool was not available at the time of this report as the site is underdevelopment.

### Benefits:

- Updated annually from remote sensing data.
- Mapping extends from 1984-present.
- Easy to navigate through the layers and they are quick to upload.
- Resolution of mapping is 30 m which is at a scale that could be used at a territorial or regional scale, unlikely to be useful at a municipal level.
- Has the potential to include mapping to present the current situation, consider changes due to climate change and then prioritise what ecosystems should be protected, but full functionality is not available.

### Areas that could be enhanced:

- Site is still underdevelopment, and potentially considered a prototype so it does not have full functionality.
- Species included in the mapping are limited, therefore, full understanding of topic areas such as connectivity is not provided.



Figure 6 TerrAdapt projection for temperate forest connectivity in 2100.

## 2.3.6 Strait of Georgia Data Centre / Marine Reference Guide

The <u>Strait of Georgia Data Centre</u> is a data archive for marine ecosystem information. The information held in the data centre is from academic and community science and indigenous knowledge holders and comes in the form of static maps, animations and story maps. The <u>Strait of Georgia Marine Reference</u> <u>Guide</u> is a mapping viewer that enables the user to look at multiple layers without downloading data, which can be done through the <u>Marine Data BC Portal</u>.

The Strait of Georgia Marine Reference Guide uses an ESRI online mapping interface. The mapping layers are presented by topic areas which means they can be viewed on one page. Individual maps can then be accessed through dropdowns.

The advantage of the Data Centre is that the mapping is presented with other supporting information with the intent of aiding the user to understand and interpret the information shared by site.

### Benefits:

- Simple presentation of layers grouped into topic areas. Grouped in a way that enables layers from any grouping to be viewed at one time.
- Mapping layers and shapefiles can be uploaded and overlaid in this tool.
- The mapping interface (Esri) is similar or the same as that used by local governments so many users will be comfortable interacting with this type of tool.
- Includes a user guide in the mapper (written document).
- The attribute table of the dataset can be viewed, which is a feature not seen in any other mapping platform.
- The source of data is clearly indicated.
- The legend indicates if the viewing map is currently at the wrong resolution to view data by greying out text.

## Areas that could be enhanced:

- Mapping layers can not be downloaded directly from the Guide, but layers can be accessed through Marine Data BC Portal.
- Source of data is indicated but there is no summary information linked to the layer to allow the user to quickly understand the data.



Figure 7 Strait of Georgia Marine Reference Guide – Predicted sensitivity to sea level rise 2100.

**Note:** The following local governments use an Esri ArcGIS platform, which is the same or a similar user interface used by the Strait of Georgia Marine Reference Guide. Consequently, they have similar benefits and areas of potential improvement, therefore, these decision support tools have not been reviewed separately in this report.

- City of Vancouver VanMap Viewer
- District of Sechelt <u>Sechelt Explorer</u>

## 2.3.7 Forest Inventory and Analysis Land Resources Explorer

The <u>Forest Inventory and Analysis Land Resources Explorer</u> decision support tool has been developed to aid the US Forestry Service with land management decisions as directed by the Farm Bill. The site is maintained through Google Earth Engine. The data held is focused on forest cover and change, including wildfire. The resolution of the mapping is at 30 m, and land cover mapping has been produced annually from 1985 – 2022.

A key feature of this webtool, not seen in others that have been reviewed, is the Land Resources Dashboard. This provides a summary of landcover within each of the counties and states.

## **Benefits:**

- Simple to use with a small selection of layers that span a large time frame.
- Good resolution for local government and First Nations planning.
- All data can be downloaded.
- Has a timelapse tool.
- Has a dashboard.
- Maintenance is a legal requirement under the Farm Bill.

### Areas that could be enhanced

• The information presented is focused on land use change and the impact of wildfire, it doesn't include additional layers that would benefit decision makers e.g. biodiversity.



Figure 8 US Forestry Service Land Resources Dashboard.

## 2.3.8 Urban Adaptation Map Viewer – European Environment Agency

<u>Urban Adaptation Map Viewer</u> is a decision support tool developed by the European Environment Agency to provide an overview of the current and future climate hazards facing European cites, their vulnerabilities and their ability to adapt (**Figure 9**). The information is presented under topic headings; heat; flooding (river, coastal, pluvial); water scarcity; wildfires; vector-borne diseases and social vulnerability. The user can also look at additional mapping layers linked to these topic areas.

Each of the layers is presented with information about the hazard, how cites can adapt and additional resources. This enables the user of the map viewer to interpret the information presented immediately. The layout of the websites suggests it is an Esri platform albeit different to those described above.

## **Benefits:**

- Mapping is grouped into topic areas focused on the hazards of climate change, which potentially is how local governments and First Nations might be looking for information to feed into their planning documents.
- Supporting information is provided to help the user understand the information they are presented and detailing how they could respond to it.
- Tabs running along the top of the page with topic areas are easy to understand and use, but it means that mapping layers within each of the topic area can not be opened at the same time.

• When a topic area e.g. heat is selected the key mapping information is presented, but the user is provided with additional associated layers they may want to access.

#### Areas that could be enhanced

• The data has two resolutions; city or European. This could impact on the value of this dataset for other decision making e.g. local and regional.



Figure 9 European Environment Agency Urban Adaptation Map Viewer – heat.

## 2.3.9 NASA - Worldview

The imagery generated by NASA's constellation of satellites has been used to generate several mapping products which can be accessed through NASA's Worldview tool (**Figure 10**). The mapping layers cover events such as the identification of wildfires and hurricanes. It also includes layers focused on land cover such as the vegetation index NDVI<sup>1</sup>, tree canopy models, land cover type and above ground biomass.

#### **Benefits:**

- A good illustration of the diversity of ways that satellite data is being used.
- Provides potentially new approaches to identifying and responding to emergencies such as wildfire in remote locations.
- Provides a sliding scale at the base of the page to move through time.
- Information tabs connected to each layer provide sufficient information to understand what the layer is showing and links to the associated research papers.

#### Areas that could be enhanced

• Imagery can only be viewed at a set resolution, and it is not that easy to figure out what that is. Each layer has a different viewing resolution.

<sup>&</sup>lt;sup>1</sup> Normalized difference vegetation index (NDVI) is a simple graphical indicator that is often used to analyze RS measurements and assess whether the target being observed contains green health vegetation or not.

- The time period covered by each product is not continuous e.g. landcover 2019-2021.
- Resolution is too low for local government and First Nations planning.
- Imagery / maps are not available for download, but snapshots can be taken or shared by link.



Figure 10 NASA Worldview – Aboveground biomass.

## 2.3.10 Half Earth Project Map

The Half Earth Project is promoting the idea of protecting half of the earth for nature. To aid this objective they developed a mapping tool which includes a presentation of areas in need of additional conservation effort (**Figure 11**). This includes the southern end of Vancouver Island. The tool is visually appealing and focused a small number of topic areas: biodiversity; protection; human pressures and carbon. The tool also includes an analysis function which provides a summary for your geographical area of interest in relation to:

- Number of terrestrial species including status and range information.
- Total protected area in relation to land mass.
- Species Protection Index how well each country is performing against species targets.
- How much humans have affected the area.

The tool includes a visual tutorial which helps the user understand how to use the tool.

#### **Benefits:**

- Visually attractive site with a small number of mapping layers grouped into topics, that allow mapping from multiple topics to be viewed at once.
- The in-built video tutorial provides a good overview of the tool.
- Layers have an information tab to indicate the source of data.
- The analysis tool to provide an overview of environmental performance of each country is simple but effective means of tracking progress. However, it is not clear if the layers will be updated.

### Areas that could be enhanced

- The resolution of the mapping is suited to national planning rather than local government and First Nations planning.
- Its not clear if this website will be maintained in the long term.



Figure 11 Half Earth Project Map – Irrecoverable land carbon<sup>2</sup>.

## 2.3.11 Biodiversity Atlas of British Columbia

Biodiversity BC formed in 2005 in response to an announcement in 2004 of a new partnership between government and non-government organisations called BC Trust for Public Lands. The objective of Biodiversity BC was to develop a provincial Biodiversity Strategy. In 2008, their mandate changed and they became a science foundation for environmental action and to increase public awareness about the importance of biodiversity in British Columbia. In 2009, Biodiversity BC went into hibernation as funding ended.

The work undertaken by Biodiversity BC led to the development of the Biodiversity Atlas of British Columbia and a state of the environment report titled 'Taking Nature's Pulse: The Status of Biodiversity in British Columbia (**Figure 12**).

The Atlas was a precursor to the online mapping platforms we have today. The mapping layers could be accessed by contacting Biodiversity BC or viewed through the Taking Nature's Pulse report. Mapping covered the following topic areas:

- Ecosystem, species and genetic diversity.
- Threats to biodiversity conversion, degradation, invasive species, disturbance, climate change.

<sup>&</sup>lt;sup>2</sup> Irrecoverable carbon refers to the vast natural stores of carbon that are vulnerable to release due to human activity and, if lost, could not be restored by 2050. This layer shows tons of irrecoverable carbon per hectare in both biomass and soils. Data are displayed at a 1 km resolution. Source: Noon et al., 2021.

The Atlas layers could hold important information for understanding changes in ecosystem and species health.

### Benefits:

- Atlas and Taking Nature's Pulse report provides important information to assess trends.
- Mapping was undertaken by NGOs and government and will have drawn on a broad range of information and been the subject of rigorous review.
- Maps and the information they contain will have been used to obtain additional funding and to justify the protection of land.

#### Areas that could be enhanced

- Maps need to be accessed in a GIS format to understand how they can be used in the future.
- Mapping was completed for all of BC, therefore it is not clear what is the resolution of information held within the Atlas.



Figure 12 Biodiversity Atlas of British Columbia – Species richness

## 2.4 Prioritisation Tools

## 2.4.1 Climate Adaptive Planning for BC (CAP-BC)

<u>CAP-BC</u> is an <u>online prioritisation tool</u> that has been designed to provide a set of outcomes to support decisions for adapting conservation planning. The web-tool is preloaded with data grouped into seven major conservation approaches (Planning Features):

- Current patterns of biodiversity.
- Natural landscapes and ecological processes.
- Geophysical setting.
- Future climate space.
- Climate refugia.
- Ecological connectivity.
- Ecological services.

Each of these conservation approaches draws on several mapping layers of information. The tool allows the user to determine how much of each of these features you want to maintain e.g. 30% of carbon stores in BC<sup>3</sup>. The user can also add additional parameters (Costs) e.g. distance from human footprint or stipulate that land should be in a protected area (Includes). **Figure 13 and 14** illustrate the difference in area selection when the user wants to protect 30% of carbon stores in BC but selects the additional parameter that these land parcels be in a protected area (**Figure 13**) or not (**Figure 14**).

The tool provides a summary of the analysis on screen, and a table of the analysis can also be downloaded. There isn't a function that would enable the map itself to be downloaded.

#### **Benefits:**

- Analyses multiple layers to present solutions to questions or management decisions.
- The tool can be run at a 1 km and 5 km scale, however this is still probably too low a resolution for local governments and First Nations who are working at a 5 30 m resolution.
- The tool clearly indicates where information has been obtained.

## Areas that could be enhanced:

- The tool is assessing the best location for protection of the natural environment at a BC scale. Site selection would be different at a municipality or a regional district scale e.g. 30% protection of carbon storage in the Sunshine Coast Regional District vs BC.
- The tool would benefit from an in-software guide on how to use the tool, as you need to follow several steps to complete the analysis.
- The user would need to have targets in relation to protection of the natural environment and its ecosystem services to use the tool e.g. protect 30% of biodiversity rich land; protect 30% of connectivity etc.
- Mapping can not be downloaded, only an excel summary of the analysis.

<sup>&</sup>lt;sup>3</sup> Sothe, Camile; Gonsamo, Alemu; Snider, James; Arabian, Joyce; Kurz, Werner A.; Finkelstein, Sarah (2021): Carbon storage and distribution in terrestrial ecosystems of Canada. 4TU.ResearchData. Collection. https://doi.org/10.4121/c.5421810.v3



Figure 13 CAP-BC – 30% of BC's carbon stores located in protected areas in BC, no other parameters.





## 2.5 Recommendations for Decision Support Tools

The purpose of this review was to identify features within each of the decision support tools that improved user experience and increased their understanding of the information shared, and this information is provided below.

It should be noted that most of the tools reviewed used an ESRI (commercial) platform.

**Group Topic Areas and Multiple Layers Overlaid** – The decision support tools used several approaches to presenting layers, including:

- a full list of all layers on the homepage e.g. UN Biodiversity Lab;
- layers grouped into topics linked to tabs at the top of the page e.g. Urban Adaptation Planner;
- layers grouped into topic within list e.g. Greenprint; or
- layers grouped in a tool that the user has to find and open e.g. iMap.

The easiest interface identified is where the topic groups are viewed on the first page as tabs such as Urban Adaptation Map Viewer, but this prevents mapping layers under different topic headings being opened together. Therefore, the approach presented by Greenprint or the Strait of Georgia Marine Reference Guide where the layers are grouped into topic within a list is the recommended approach.

**Interpretive Information** – Mapping layers providing a short summary of what the layer is showing and why it is relevant to the user with additional links was considered to improve user experience. Good examples included the Urban Adaptation Map Viewer and The Rush Initiative. The information displayed needs to be succinct and focused.

**Data Information** – Each mapping layer needs to have a short description (with a maximum of two paragraphs) of how the layer has been generated, its resolution and a link to associated scientific papers, where relevant. A good example of how this information can be presented is in the UN Biodiversity Lab information tabs.

**Downloadable Data** – The download of mapping layers needs to be simple. A good example viewed was in the Forestry Inventory and Analysis Land Resources Explorer, where the download tab is located below the layers and visible immediately when the mapping platform is opened.

**Importing Shapefiles** – This was identified as a key need for users during conversations. This capability was offered within the Strait of Georgia Marine Reference Guide and iMap.

**Resolution** – Not all mapping could be viewed at multiple resolutions and it was not always obvious that this was the problem when a map was not visible, or what the correct resolution was e.g. iMap and Worldview. It is preferable if a map can be viewed at multiple resolutions or the legend should clearly show this is the problem e.g. grey out text.

**Search Tool** – A search tool that seeks key words is advantageous when a mapping viewer includes a lot of layers e.g. UN Biodiversity Lab, iMap and Worldview.

**User Guide** – A user should be directed to a written and audio/video guide on entering the online viewer and be provided as a tab in the page e.g. Half Earth Project or Strait of Georgia Marine Reference Guide.

**Age of Data and Update Frequency** – The UN Biodiversity Lab clearly indicates on each of the mapping layers the period the mapping covers. TerrAdapt was the only website which indicated the intended period for updating mapping layers -annually. A key limitation of iMap is that the user is not aware if the information they are viewing is the latest version.

**Dashboard** – The Forestry Inventory and Analysis Land Resources Explorer, Urban Adaptation Map Viewer and TerrAdapt websites include tools that provide a summary of data per area. This is considered a key feature for improving user experience. Ideally the tool should be able to present the current situation for each municipality, regional district or First Nation territory and where relevant present trends in change e.g. TerrAdapt. This will allow local governments and First Nations to understand the effect of their decision making.

**Prioritisation** – This should be an add on rather than be located within the existing platform itself. Existing prioritisation tools should be promoted rather than developing a new tool. Prioritisation tools that enable users to upload their own layers are likely to be of greatest value to local governments and First Nations as decisions will then be at a relevant scale for their decision making (e.g. Marxan / prioritizr R)

Sharing layers - There are several decision support tools currently available in southwest BC.

- Existing local/regional governments/First Nations mapping tools;
- The Rush Initiative;
- Community Mapping Network;
- TerrAdapt; and
- Marine Data BC Portal

The Action for Adaptation Project should aim to share layers with existing portals that have sustained funding while also developing the Biodiversity Atlas:

Users indicated that it is often difficult to find up to date information due to the number of sites available. Therefore, placing the mapping layers in existing tools means that users will be able to find the layers in places they are used to visiting. In addition, the Action of Adaptation project will need to provide training to local government and First Nations on the tool to increase usage and uptake.

Appendix A – Overview Table

## A1- Overview of Decision Support Tools

 Table A1 Review of decision support tools that enable multiple layers to be viewed.

| Name of<br>Product   | Single<br>(S) or<br>multiple<br>(M)<br>layers | Biodiversity | Carbon /<br>GHG<br>Emissions | Landcover<br>/ Land-<br>use | Coastal | Flooding | Heat /<br>Wildfire | Forest /<br>Tree<br>Cover | Description   |  |  |
|--|---|--------------|------------------------------|-----------------------------|---------|----------|--------------------|---------------------------|---|--|--|
| Multi-layer Decision Support Tools   |   |              |                              |                             |         |          |                    |                           |   |  |  |
| <u>UN</u><br><u>Biodiversity</u><br><u>Lab</u>                                   | Μ   | Yes          | Yes                          | Yes                         | Yes     | Yes      | Yes                | Yes                       | A decision support tool with<br>high quality mapping at a level<br>of detail that would be useful<br>for national and potentially<br>provincial planning and<br>decision making. There are<br>also a few layers that could be<br>used by local government and<br>First Nations e.g. landcover at<br>10 m and areas of global<br>significance for restoration. |  |  |
| <u>The Rush</u><br>Initiative  | Μ   | Yes          | Yes                          | No                          | Yes     | Yes      | Yes                | Yes                       | Community tool that shares a<br>lot of useful environmental<br>information in an easy-to-use<br>format. The detail of the<br>mapping could be enhanced,<br>but that can occur over time.  |  |  |
| <u>Maryland</u><br><u>Greenprint–</u><br><u>Parcel</u><br><u>Evaluation Tool</u> | Μ   | Y            | Y                            | Y                           | Y       | Y        | No                 | Yes                       | Multi-layer decision support<br>tool that includes biological<br>and climate layers. GreenPrint<br>includes a Parcel Evaluation<br>Tool which presents a<br>Conservation Benefits and<br>Ecosystem Service Assessment   |  |  |

| Name of<br>Product   | Single<br>(S) or<br>multiple<br>(M)<br>layers | Biodiversity | Carbon /<br>GHG<br>Emissions | Landcover<br>/ Land-<br>use | Coastal | Flooding | Heat /<br>Wildfire | Forest /<br>Tree<br>Cover | Description  |
|--|---|--------------|------------------------------|-----------------------------|---------|----------|--------------------|---------------------------|--|
|  |   |              |                              |                             |         |          |                    |                           | Report Card for each land parcel. Its easy to navigate.  |
| <u>iMap</u> and<br><u>Habitat Wizard</u>                               | Μ   | Yes          | Limited /<br>Outdated        | No                          | No      | Yes      | Wildfire           | No                        | These tools contain a lot of<br>provincial information, but it<br>only shows some of the data<br>held by the province. It is also<br>often outdated and the tool<br>itself can be difficult to use due<br>to its complexity or size of<br>mapping files. Limited<br>information relating to carbon<br>storage, sequestration and<br>emissions. |
| <u>TerrAdapt</u>   | Μ   | Yes          | No                           | Yes                         | No      | No       | No                 | Yes                       | TerrAdapt provides annual<br>species, ecosystem and<br>environmental mapping from<br>1984-present. The tool is<br>developing to include climate<br>projections for species and<br>ecosystems and how to<br>priortise for the protection of<br>land in a changing climate.  |
| Straits of<br>Georgia Data<br>Centre /<br>Marine<br>Reference<br>Guide | Μ   | Yes          | Yes                          | No                          | Yes     | Yes      | No                 | No                        | The guide and portal have<br>been designed to be used<br>together. The guide allows<br>layers to be viewed which can<br>then be downloaded from the<br>portal.   |

| Name of<br>Product   | Single<br>(S) or<br>multiple<br>(M)<br>layers | Biodiversity | Carbon /<br>GHG<br>Emissions | Landcover<br>/ Land-<br>use | Coastal          | Flooding | Heat /<br>Wildfire | Forest /<br>Tree<br>Cover | Description  |
|--|---|--------------|------------------------------|-----------------------------|------------------|----------|--------------------|---------------------------|--|
| Forest<br>Inventory and<br>Analysis Land<br>Resources<br>Explorer        | Μ   | No           | No                           | Yes                         | No               | No       | Yes                | Yes                       | Decision tool developed to<br>support land management<br>decisions as directed by the<br>Farm Bill. The focus is on<br>change to forest landcover<br>through human disturbance<br>and wildfire.  |
| Urban<br>Adaptation<br>Map Viewer –<br>European<br>Environment<br>Agency | Μ   | No           | No                           | No                          | Yes              | Yes      | Yes                | No                        | The focus of the presentation<br>is on areas of climate<br>adaptation – heat, flooding,<br>water scarcity, wildfire etc. and<br>how these changes impact on<br>urban centres.  |
| <u>NASA Earth</u><br><u>Data – World</u><br><u>View</u>                  | Μ   | No           | Yes                          | Yes - NDVI                  | Yes –<br>sea ice | No       | Yes                | NDVI                      | Worldview allows users to<br>access products produced from<br>NASA's constellation of<br>satellites. The resolution of the<br>imagery is not suitable for local<br>government and First Nations<br>planning but provides<br>interesting layers relating to<br>carbon and wildfire. |
| Half Earth<br>Project Map  | Μ   | Yes          | Yes                          | Yes                         | Yes              | No       | No                 | No                        | Very visually attractive<br>mapping site with a small<br>number of topics and layers.<br>Includes good training models.<br>Resolution is low as it is a<br>world mapping tool.   |

| Name of<br>Product                                 | Single<br>(S) or<br>multiple<br>(M)<br>layers | Biodiversity | Carbon /<br>GHG<br>Emissions | Landcover<br>/ Land-<br>use | Coastal | Flooding | Heat /<br>Wildfire | Forest /<br>Tree<br>Cover | Description  |
|--|---|--------------|------------------------------|-----------------------------|---------|----------|--------------------|---------------------------|--|
| <b>Prioritisation To</b>                           | ols   |              |                              |                             |         |          |                    |                           |  |
| Climate<br>Adaptive<br>Planning for<br>BC (CAP-BC) | Μ   | Yes          | Yes                          | Yes                         | No      | No       | No                 | Yes                       | Prioritization tool for BC which<br>has uploaded datasets that can<br>be used to build an analysis<br>depending on an organisations<br>desired outcomes from land<br>management. |