Predicting the Distribution and Abundance of Culturally Important Plants

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Predicting the Distribution of Culturally Important Plants – Background and Rationale

- Need for data, tools, and mapping to support strategic decisions
  - Land Use Planning initiatives
  - Stewardship initiatives

- Interest in development of best management practices for meeting legislative requirements
  - Implementation of Great Bear LUO objectives
  - Support for shíshálh-B.C. Foundation Agreement

- Desire for community involvement in stewardship at a local scale
  - Identification of species and plant community
  - Cultural use


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Predicting the Distribution of Culturally Important Plants - Objectives

- Develop methods for prediction and mapping of culturally important plants

- Examine utility of emerging analytical methods and data technologies
  - Random forests and other machine learning modelling
  - Tools for spatializing polygon maps (DSMART)
  - LiDAR

- Assess importance of scale

- Enhance the utility of BEC and TEM for resource management

- Promote collaboration and reconciliation through co-development of knowledge and integration of cultural knowledge in management tools and decision-making processes


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Focal Species – Comparing outcomes for Species with Different Ecological Characteristics

Species A

- More of a “site specialist” associated with
  - Finer scales of information
  - Wetter, richer sites
  - Canopy openings, disturbed areas
- We expected the following types of variables to be important:
  - Site series
  - Topographic position
  - Canopy structure (old forest)

Species B

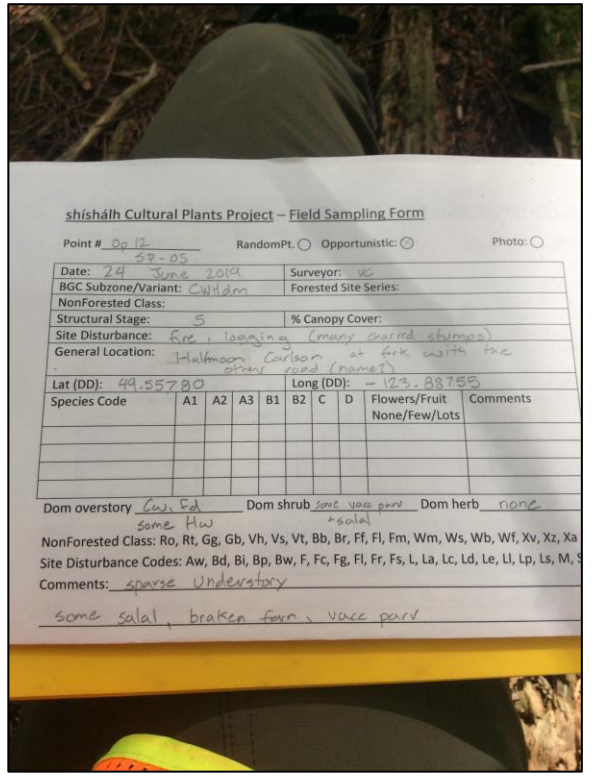
- More of a “site generalist” associated with
  - Coarser scales of information
  - BEC variants, broad site types
  - Late successional forest
- We expected the following types of variables to be important:
  - Climate (BEC variant indicators)
  - Structural stage/successional status

Predicting Distribution of Culturally Important Plants – Field Data Collection

2019
- In collaboration with Scott Hawker, Ecora
- Developed sampling scheme and data sheets
- 77 plots with Species 1 or 2 samples across 3 BEC variants

2020
- Collaborated with staff from the shíshálh Nation and Sunshine Coast NR District
- Upgraded to digital data entry (IPads)
- 84 plots sampled across 3 variants

- Scott Hawker (Ecora) undertook independent data entry associated with validation of Strategic NR predictive maps
  - These data could enhance FLNRORD modelling



shíshálh Cultural Plants Project – Field Sampling Form

Point # Op 12 58-05 RandomPt. ○ Opportunistic: ○ Photo: ○

Date: 24 June 2019 Surveyor: VC

BGC Subzone/Variant: CWHdm Forested Site Series:

NonForested Class:

Structural Stage: 5 % Canopy Cover:

Site Disturbance: fire, logging (many charred stumps)

General Location: Halfmoon Carlson at fork with the other road (name?)

Lat (DD): 49.55780 Long (DD): −123.88755

Species Code	A1	A2	A3	B1	B2	C	D	Flowers/Fruit None/Few/Lots	Comments

Dom overstory Cw, Fd some Hw Dom shrub some vacc parv +salal Dom herb none

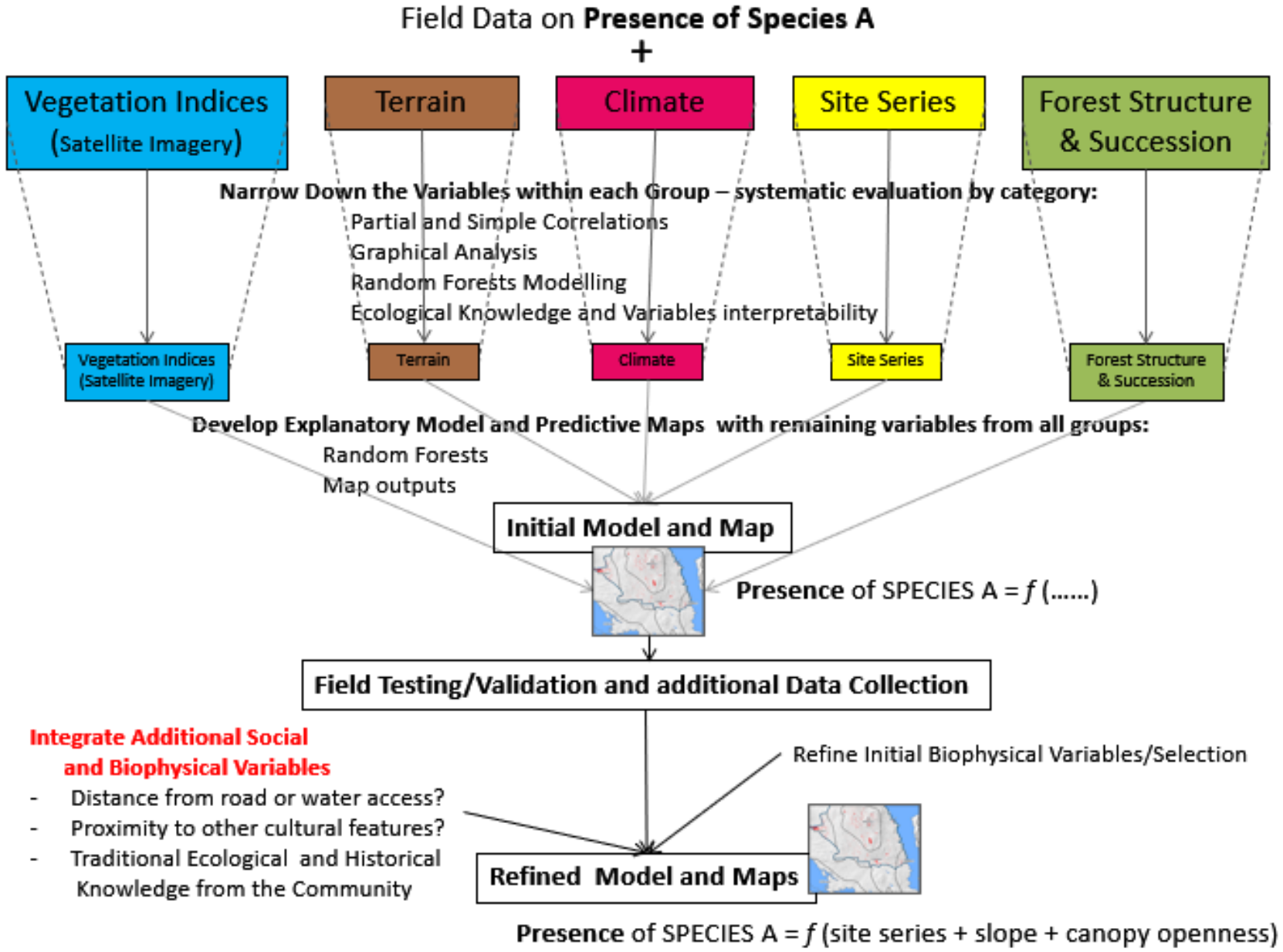
NonForested Class: Ro, Rt, Gg, Gb, Vh, Vs, Vt, Bb, Br, Ff, Fl, Fm, Wm, Ws, Wb, Wf, Xv, Xz, Xa

Site Disturbance Codes: Aw, Bd, Bi, Bp, Bw, F, Fc, Fg, Fl, Fr, Fs, L, La, Lc, Ld, Le, Ll, Lp, Ls, M, S

Comments: sparse Understory

some salal, broken fern, vacc parv

Predicting Distribution of Culturally Important Plants - Approach



Explicitly data driven

versus

Expert driven analysis

Predicting Distribution of Culturally Important Plants – Input variables

Vegetation Indices (Satellite Imagery)

145 maps (variables)

Terrain

18 maps (variables)

Climate

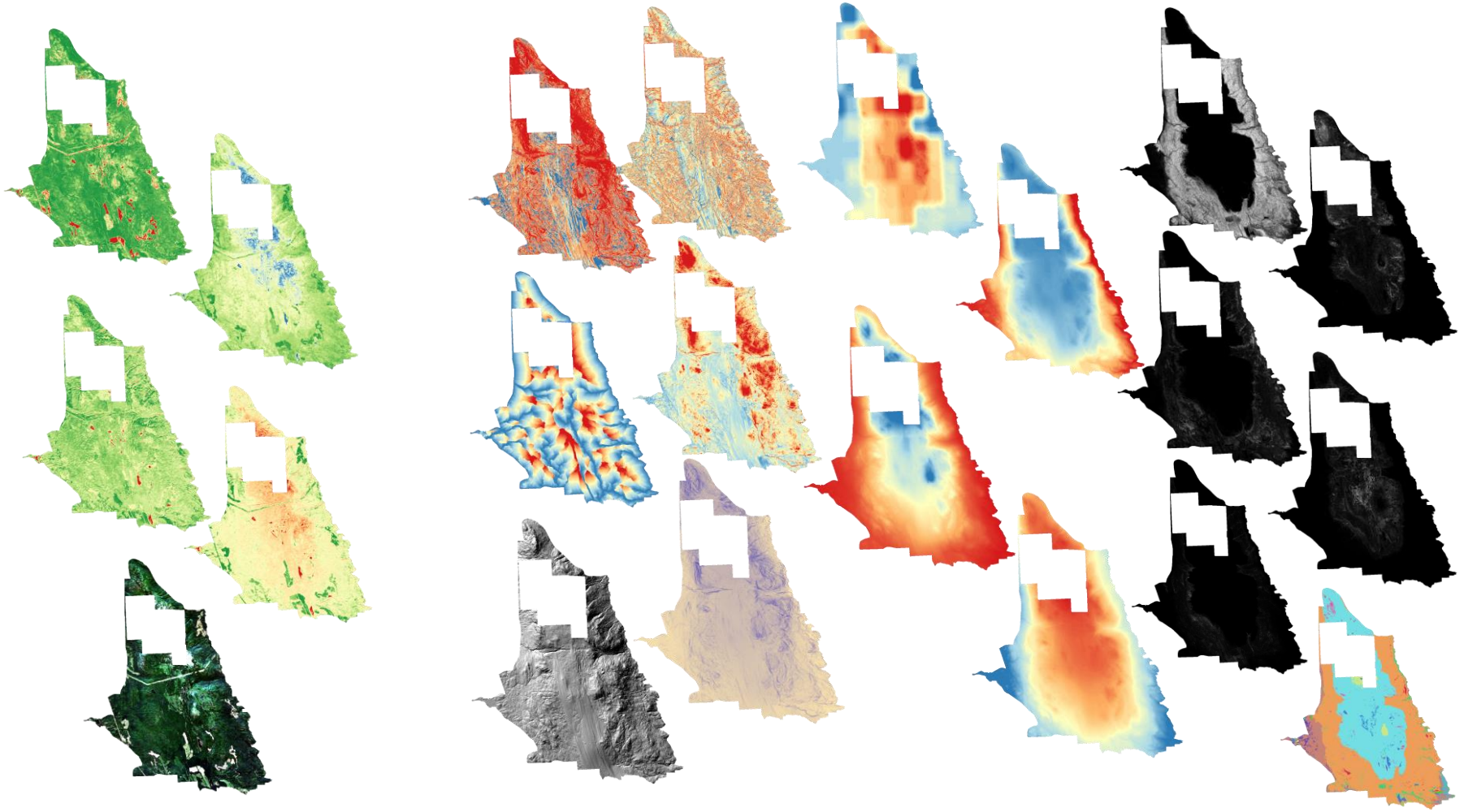
150 maps (variables)

Site Series

39 maps (variables)

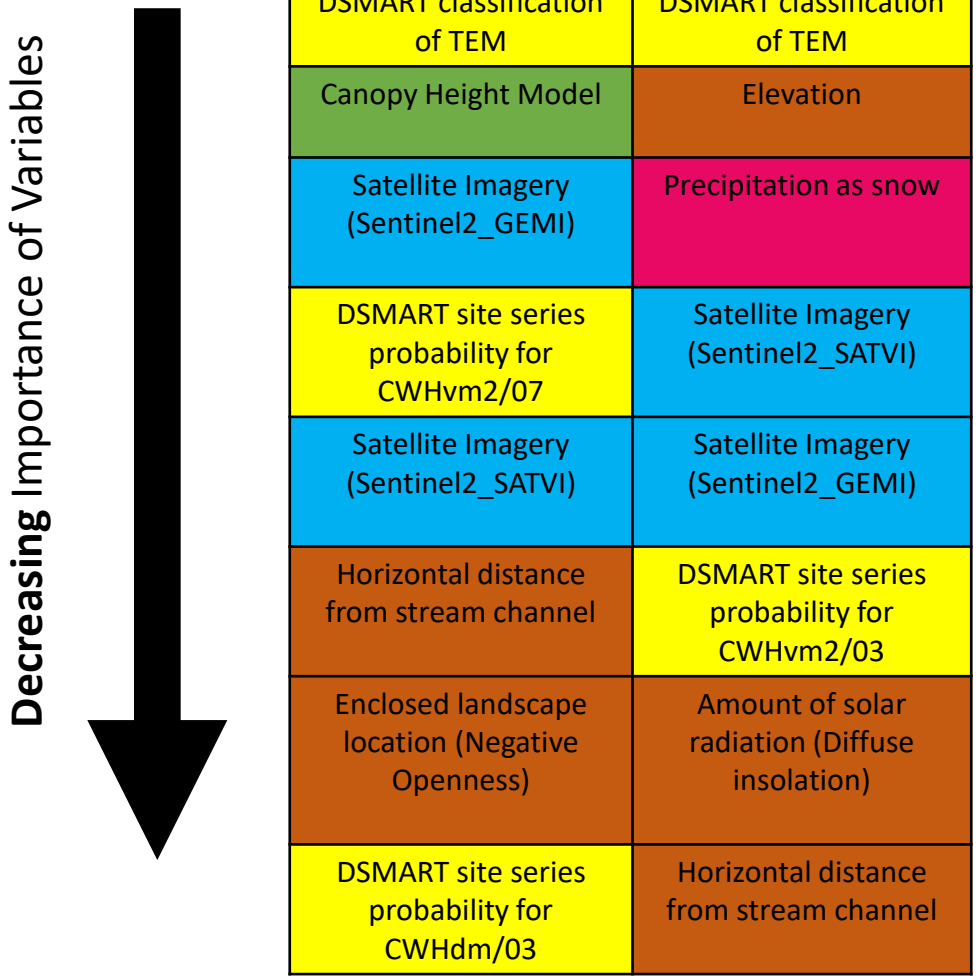
Forest Structure & Succession

VRI and LiDAR derived



Terrain variables which include elevation, slope, aspect and many others were derived separately from TRIM and LiDAR

Predicting the Distribution of Culturally Important Plants – Working Models



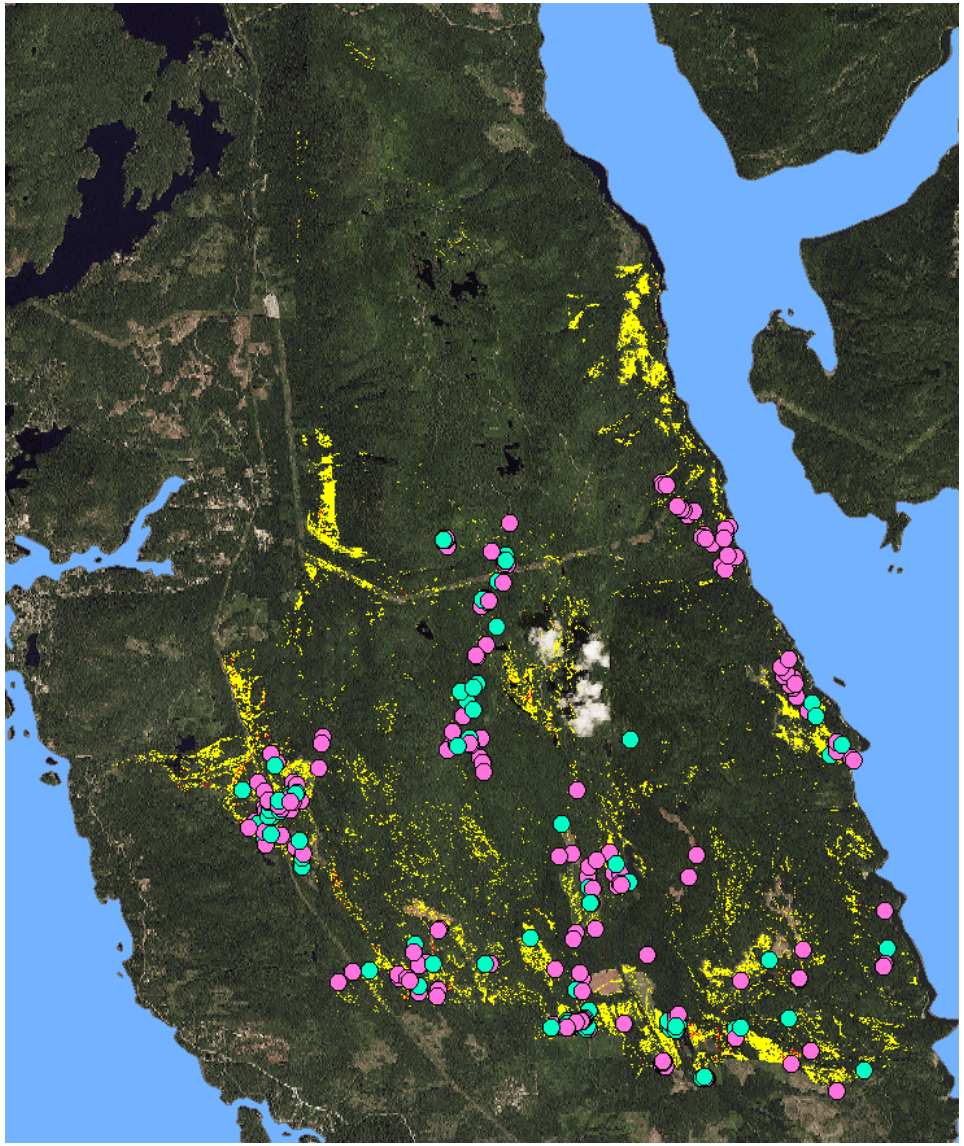
Sensitivity – the ability to correctly predict the presence of a target species
Specificity – the ability to correctly predict the absence of a target species
Accuracy – the ability to correctly predict presence and absence

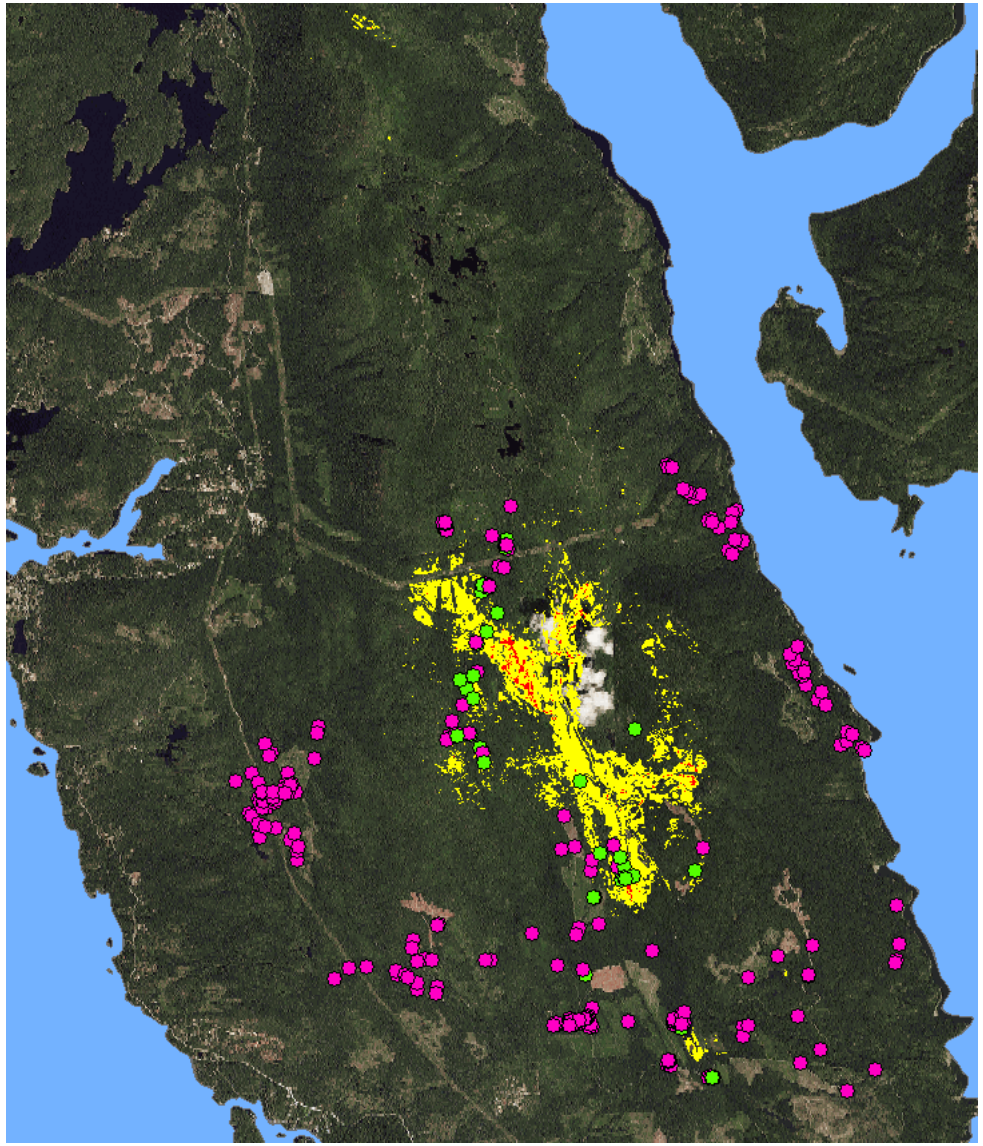
	Scale (m)	Accuracy	Sensitivity	Specificity
Species A	4m (DEM)	80% (79%)	**73% (68%)**	89% (87%)
Species B	25m (DEM)	91% (87%)	**41% (33%)**	97% (95%)

- Accuracy of the Species B map is higher *but*
- Ability to correctly predict the presence of Species B is much lower (poor sensitivity)
  - because of fewer sample points with Species A present
  - because it is more of a “generalist” species on the landscape

Predicting the Distribution of Culturally Important Plants – Working Maps

Species A





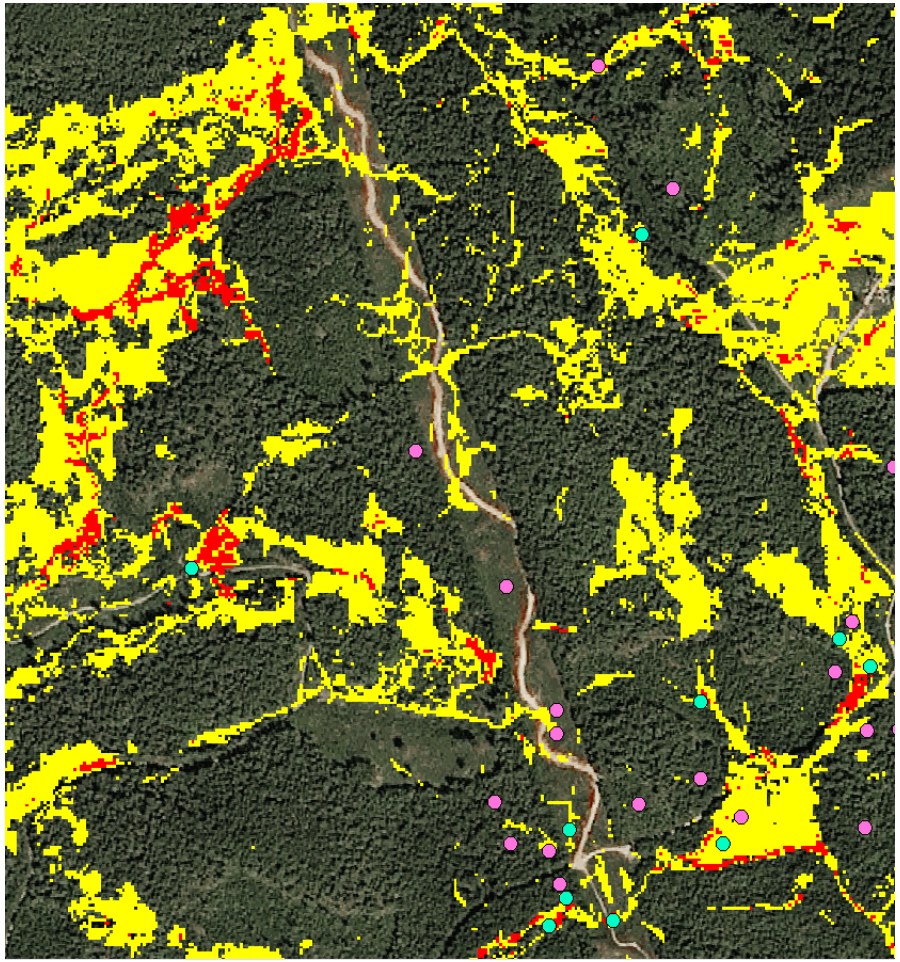
Species B

50-75% probability

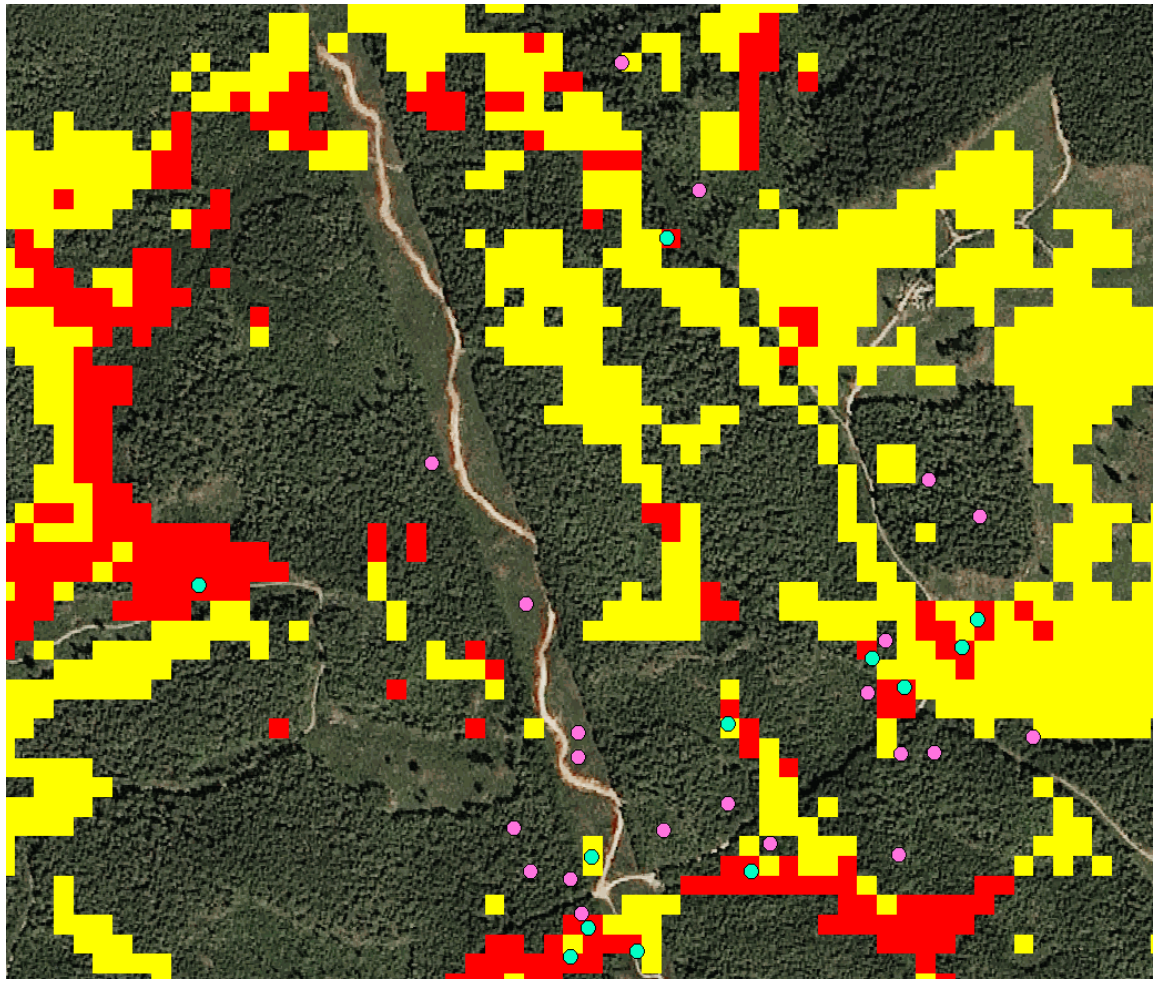
75-100% probability

Predicting the Distribution of Culturally Important Plants – Map Resolutions

Species A results - LiDAR 4m resolution



Species B results - LiDAR 25m resolution



50-75% probability

75-100% probability

Predicting the Distribution of Culturally Important Plants – take home messages (to this point)

- Data driven modelling approaches are informative
  - Can examine importance of multiple variables and categories of variables beyond initial hypotheses/expectations of experts
  - Allows exploration of relationships even with small datasets

- Different predictors are important for different species
  - Specialists vs. generalists
  - Important variables supported initial hypotheses

- Different variables are important at different scales of analysis and prediction
  - Fine(st) resolutions of data may not increase model accuracy
    - Utility of LiDAR?
    - Appropriate scales for use of some data, e.g., canopy height models?

- The “best” predictive map depends on the question and the trade-off of accuracy vs. efficiency
  - Strategic planning *versus*
  - Finding a specific species for a specific use

- Limited input data on species presence restricts confidence in models and maps

Predicting the Distribution of Culturally Important Plants – Current and Next Steps

- Expanding the study area – larger sample sizes and new (TEM, LiDAR) datasets available
- Assessing utility of other modelling approaches – MaxEnt
- Integrating additional variables
  - **Structural and successional information from plot data** – Coordinating with other projects housed within MoF/LWRS/MoE and with academic collaborators
  - Other factors of import to the Nations for management and stewardship of species
- Acquiring additional data for validation and model refinement
  - **BEC data from other parts of the same variants**
  - New plots associated with TEM in the broader study area
  - Collaborations with the Nations in both subproject areas
- Writing up technical report and ms based on shÍshálh subproject
- Supporting integration of Strategic NR and MoF approaches within resource planning initiatives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Predicting the Distribution of Culturally Important Plants – Current and Next Steps

- Expanding the study extent – overlap of new TEM and new LiDAR for Sechelt area

- Integrating additional variables
    - Tristan working with the LiDAR and spectral imagery – more options as have raw data
    - Rasterization of VRI-derived metrics (e.g., QMD, crown closure, height difference between R1 and L1, foliage biomass)
    - More careful assessment and "tidying" of the TEM input data

- Assessing utility of other modelling approaches – MaxEnt for modeling species distributions
    - Robust results with small sample sizes
    - Presence only method
    - Often outperforms other approaches (predictive accuracy)

- Workshop with shíshálh staff and elders to integrate
    - Logistics
    - Important features beyond presence
    - Other sources of presence data (historical ecological knowledge?)