Conservation Prioritization: Introduction to the Coastal Douglas-fir

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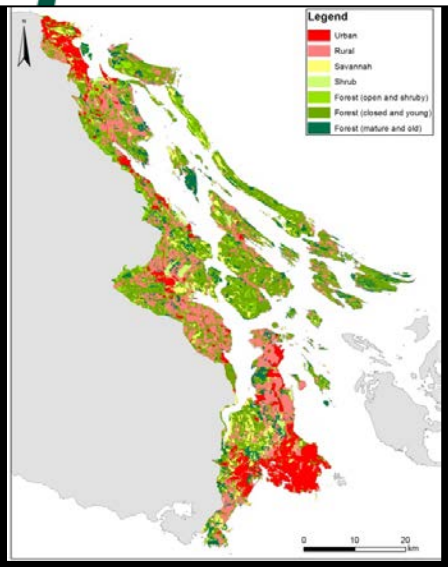
LIBER ERO FELLOWSHIP PROGRAM



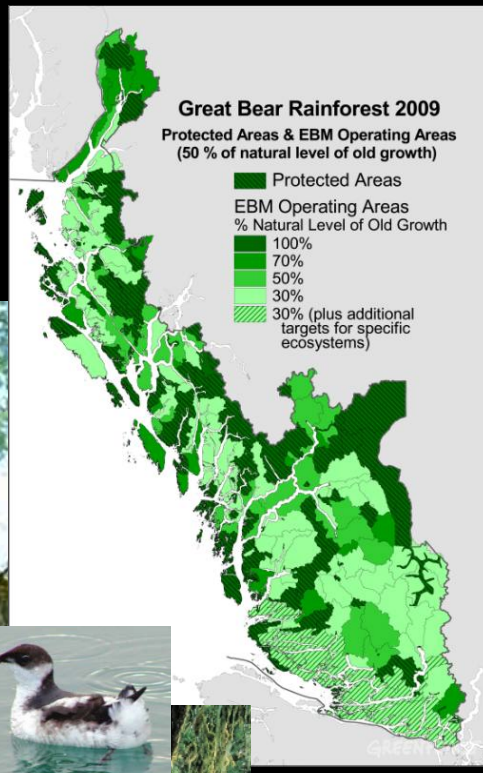
Traditional Goal of Conservation Area Design

Prioritize and Conserve ‘Intact’ or ‘Relic Ecosystems’

- Multiple criteria
- Decision support tools

Impractical in Human-dominated Landscapes

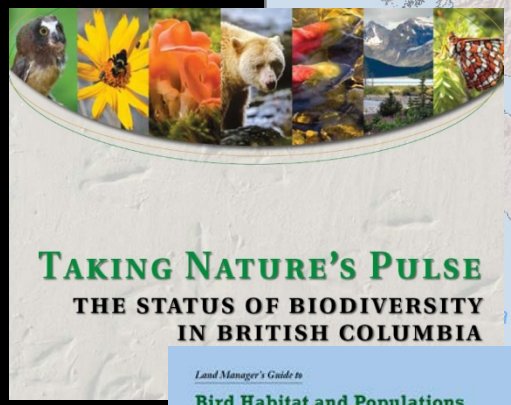
- No Benchmark Ecosystems
- Biological Survey Data Often Biased
- Many Threats Hard to Map

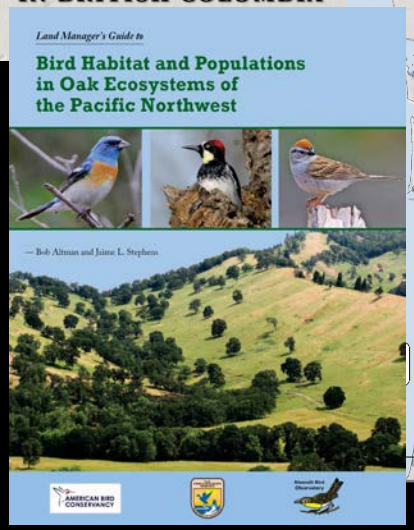


Dry Forest / Savanna Habitats of the Georgia Basin

- 49% Converted to Human Use
- < 3% Pre-settlement Forest Intact
- > 80% Privately-owned
- >153 Species At Risk
- Most Imperiled Ecosystem in BC

  And Throughout the Pacific Northwest





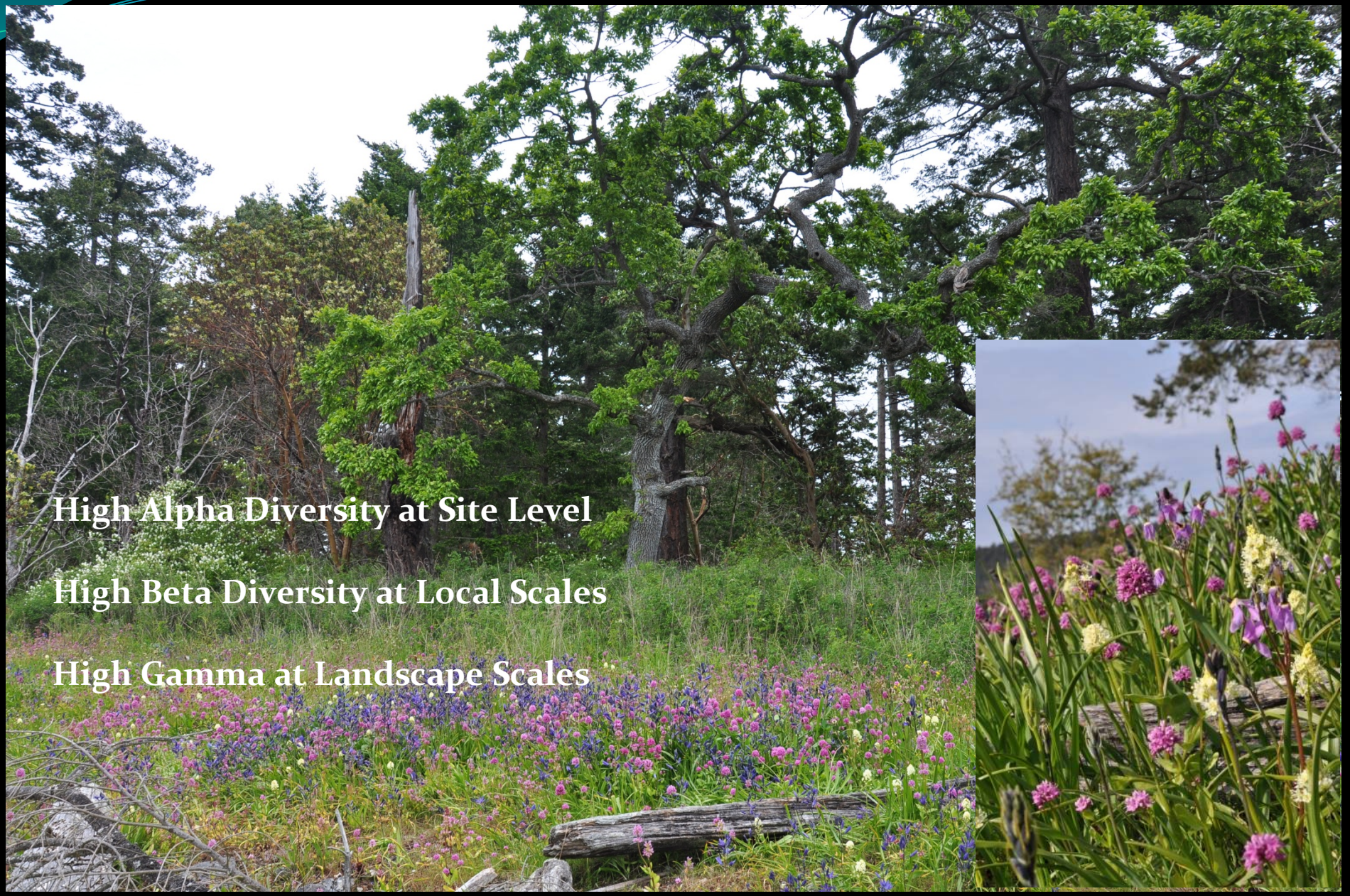
Forested Deep Soil Sites








Shallow-soil `Garry Oak` Meadow and Woodland



A Human Dominated Landscape

Lewis's woodpecker

Golden Paintbrush

Oak meadow

Western bluebird

Key Concerns

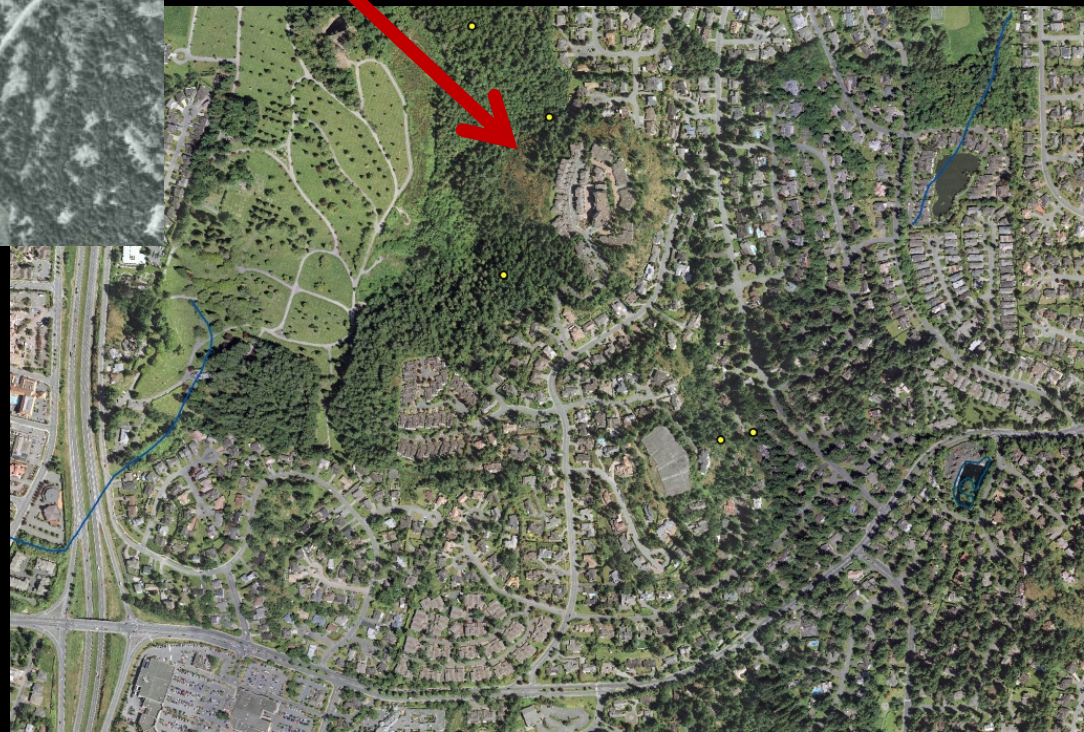
- Habitat loss/Fragmentation
- Viability of Small Populations
- Exotic Competitors/Predators
- Over-abundant Species

Habitat Loss and Fragmentation

Royal Oaks
Victoria, BC

1964 vs 2005

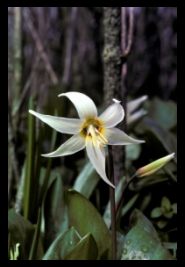
High Urgency, High Threat

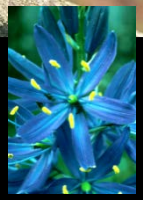


Viability?

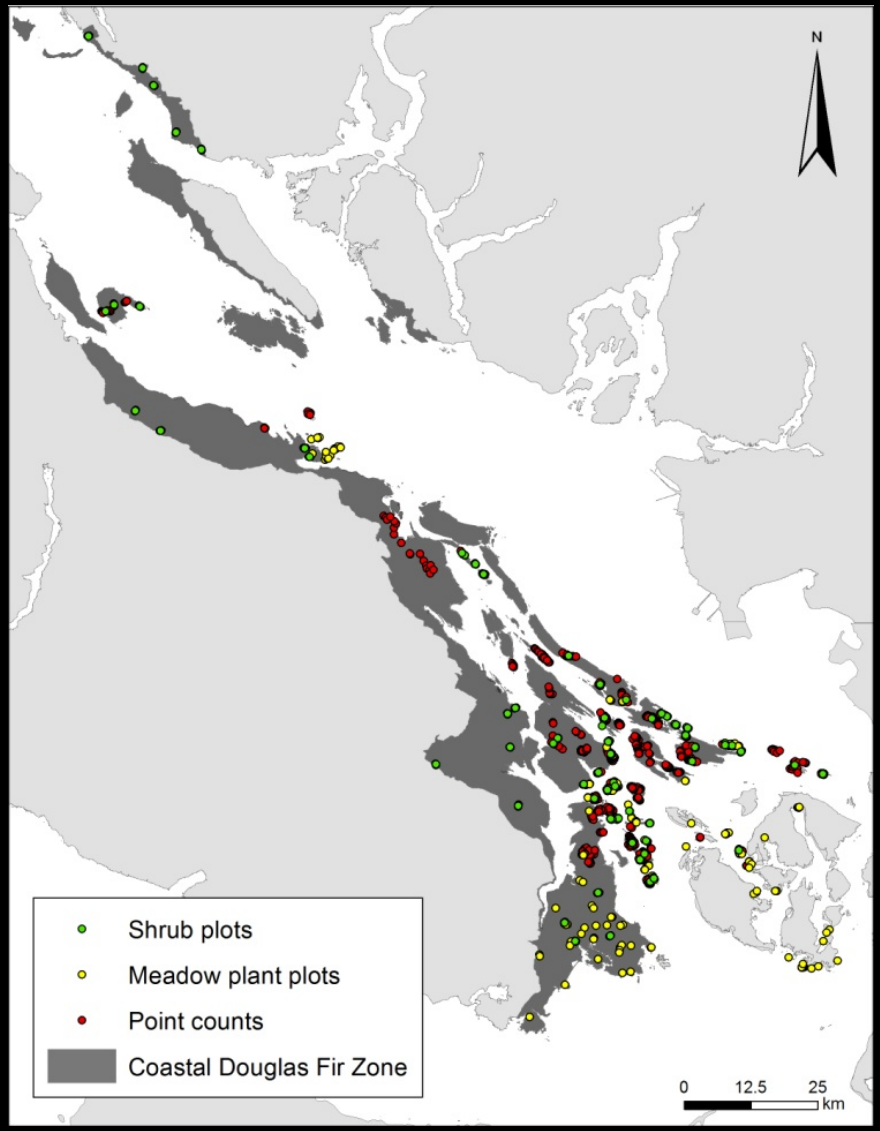
Indirect effects of humans: Deer in the CDFCP

- Historic Deer Densities Were Low due to Predation and Hunting





- Deer Often Exceed 1/ha where Predators and Hunting are Absent

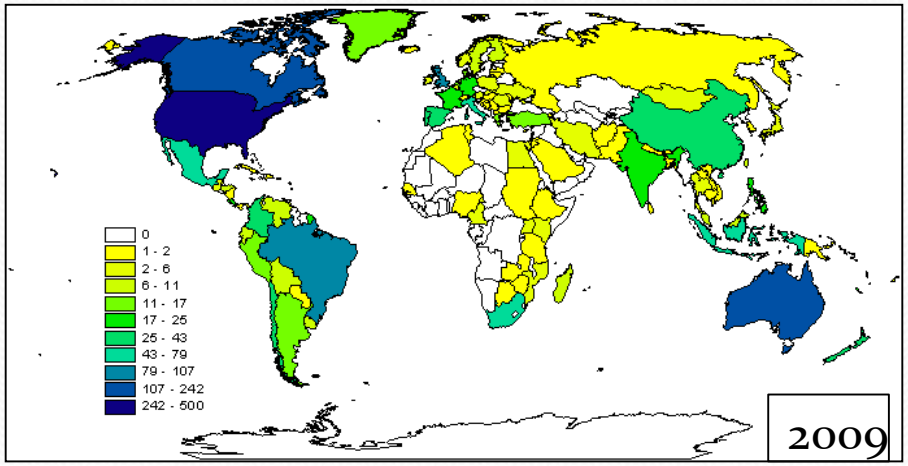


Conservation prioritization in the CDFCP area

- Decision support tools: **Marxan**
  - **Planning units** (e.g. properties, watersheds, hexagons, …)
  - **Species or Feature targets** (e.g. protect 20% old forest, …)
  - Create **compact reserve systems** to reduce e.g. edge effects

Why Marxan?

- Aids systematic conservation planning
- Near optimal spatial reserve systems
- Most widely used worldwide
- Transparent, inclusive and defensible decision making process



What can Marxan do?

- Identify areas that meet targets for a range of input features for minimal cost
- Uses concept of complementarity
  (Select new conservation areas so that each one complements the others in the biodiversity features they contain)
- Can maximise compactness
- Can include data on ecological processes, threats, and condition

Decision-support, not a decision-maker

What problem does Marxan solve?

Score of the configuration being tested =

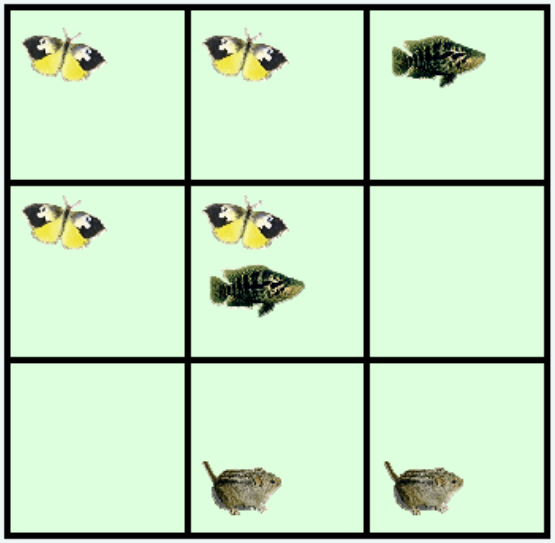
$$Cost$$

$$+$$

$$Boundary\ Length\ Modifier \times Boundary\ Cost\ of\ the\ reserve\ system$$

$$+$$

$$Species\ Penalty\ Factor \times Penalty\ incurred\ for\ unmet\ targets$$

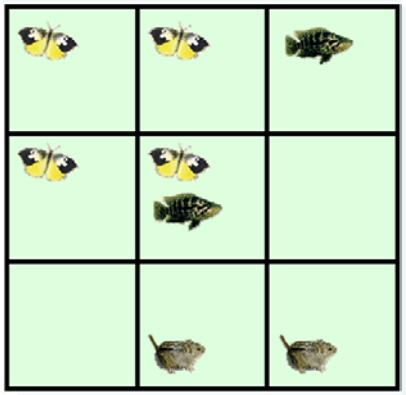


Each planning unit costs 1

Boundary length modifier value = 1.5.

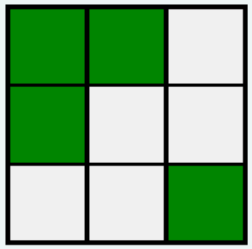
The species penalty factor for all three species is 10.

Illustrations by Bob Smith (DICE)

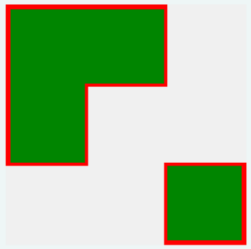


Measuring overall score

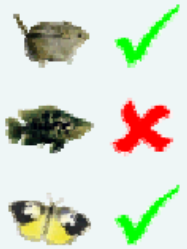
Total score



Total PU cost = 4

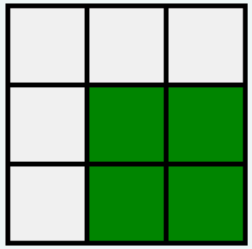


Boundary = 12 * 1.5

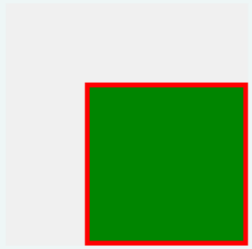


SPF = 10

32



Total PU cost = 4



Boundary = 8 * 1.5

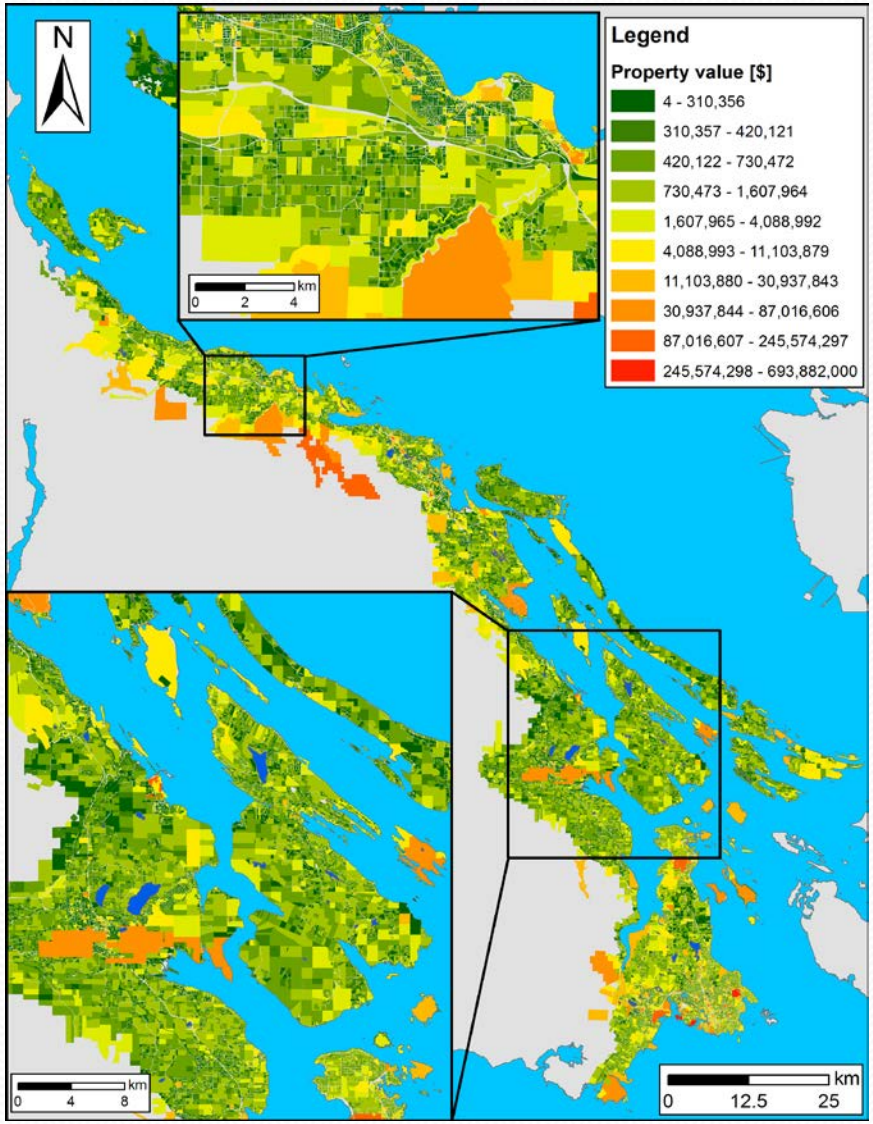
SPF = 0

16

Illustrations by Bob Smith (DICE)

Planning units

- Land base of the CDFCP: ~198,000 properties
- Possible solutions for a reserve system: 2^198,000 > atoms in the Universe
- How to optimize prioritization? Simulated Annealing



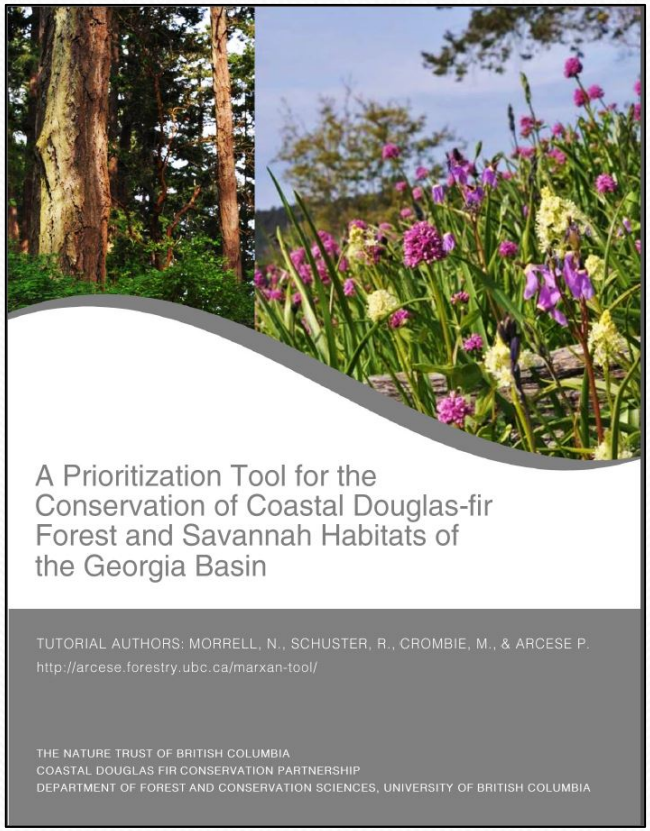
Coastal Douglas Fir Conservation Partnership:

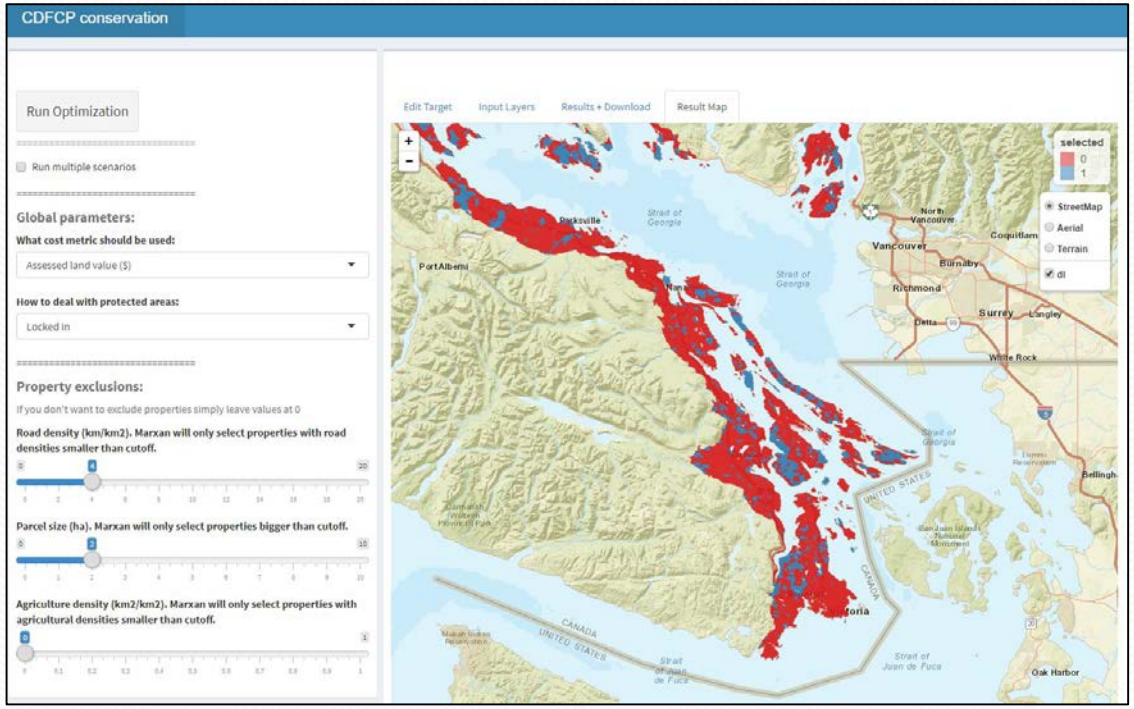
Facilitate Consensus Decisions on Protection

Shiny
by RStudio
A web application framework for R

Current tool version

http://forbasin.forestry.ubc.ca/CDFCP_prioritization/





Old Forest Birds
Savannah Birds
Beta Diversity
Wetland Birds
Shrub Birds
Human Commensal Birds
Inverse of Hum Com Birds
Standing Carbon
Carbon Sequestration Potential
TEM Element Occurrence
SEI Coastal Bluff
SEI Herbaceous
SEI Older Forest
SEI Riparian
SEI Second Growth Forest
SEI Sparsely Vegetated
SEI Woodland
SEI Wetland

Native Plant Species Richness
Fish
Herptiles
California Buttercup
Contorted-pod Evening Primrose
Dense Flowered Lupine
Dense Spike-primrose
Foothill Sedge
Oregan Forestsnail
Maoun's Meadowfoam'
While Meconella
Coast Microseris
Marbeld Murrulet
Fragrant Popcorn
Sand-verbena Moth
Area

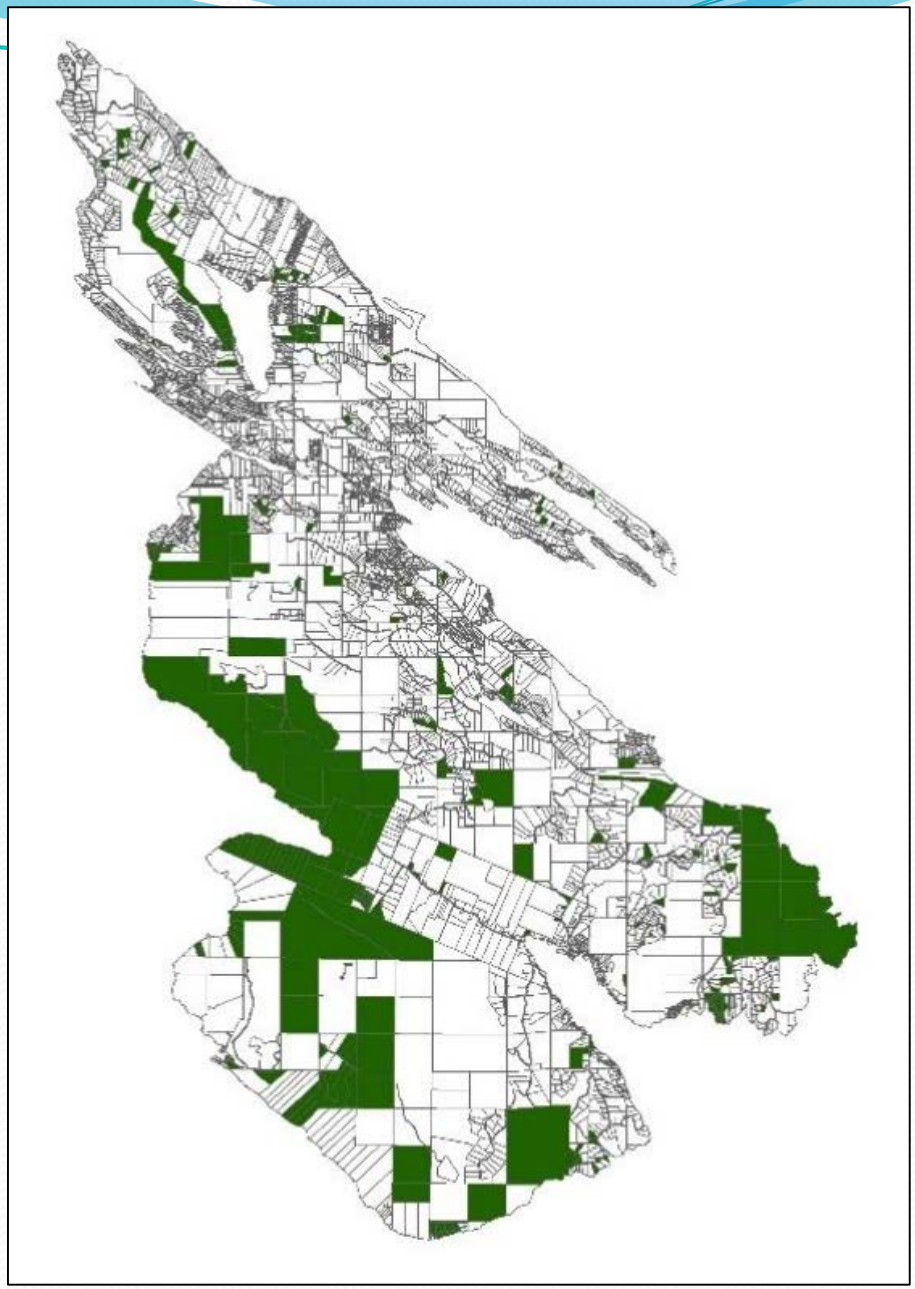
Applications?

The Nature Trust of British Columbia

Acquire Biodiverse Parcels

Minimize Management Costs, Maximize Return on Conservation Investments

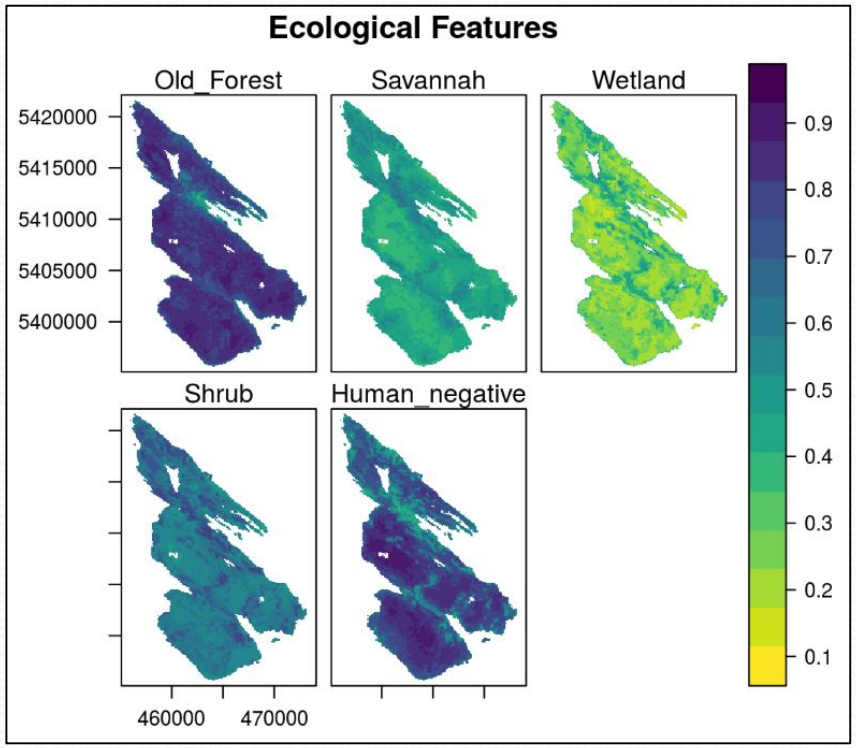
Develop Contact Lists to Engage Private Landowners in Conservation at Landscape Scales



prioritizr

Systematic conservation prioritization in R

Prioritizr is an *R* package for solving systematic conservation prioritization problems using integer linear programming (ILP) techniques. The package

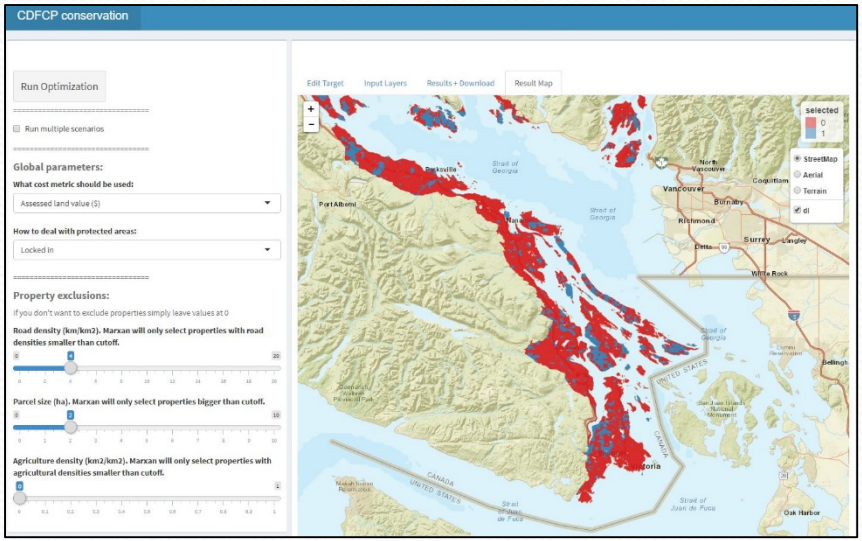


Hanson JO, Schuster R, Morrell N, Strimas-Mackey M, Watts ME, Arcese P, Bennett J, Possingham HP (2017). prioritizr: Systematic Conservation Prioritization in R. R package version 3.0.3.

https://github.com/prioritizr/prioritizr

Under development

Combine CDFCP tool with prioritizr to allow users to interactively build and customize conservation planning problems.



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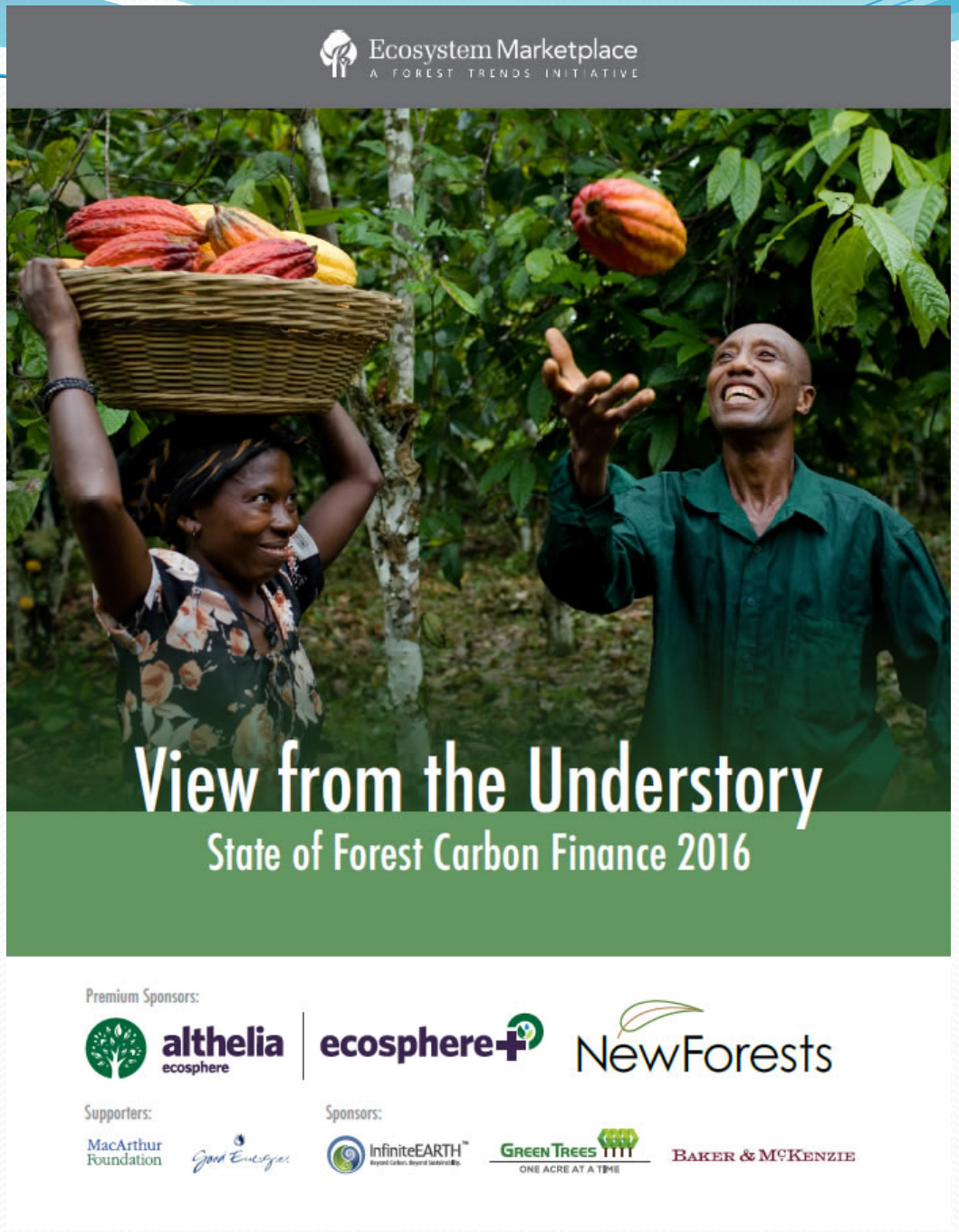
Payments for Ecosystem Services

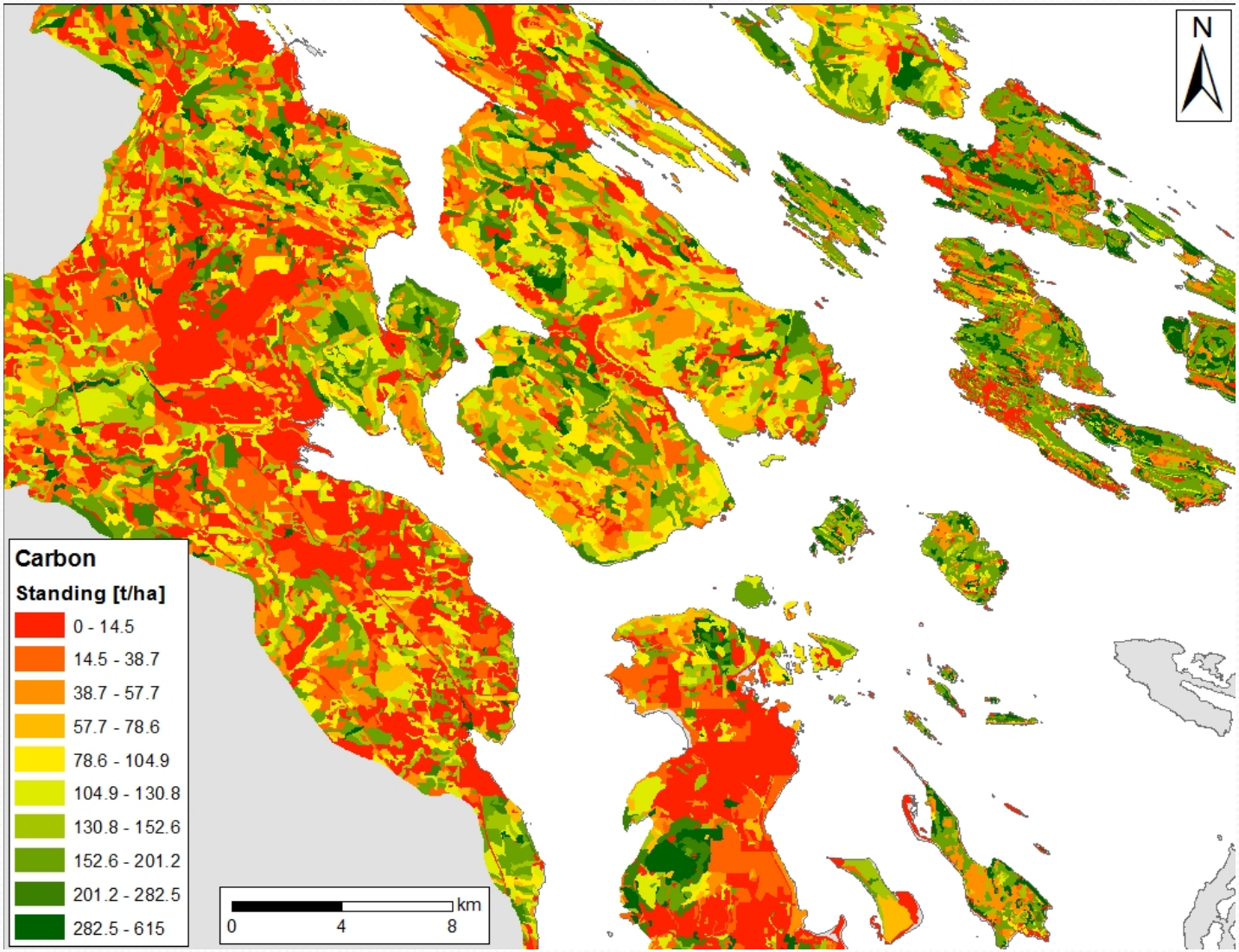
$6 Billion Invested to 2016 in Carbon



Synergies: High Value Forests Have Standing Carbon In Excess of 200 t/ha

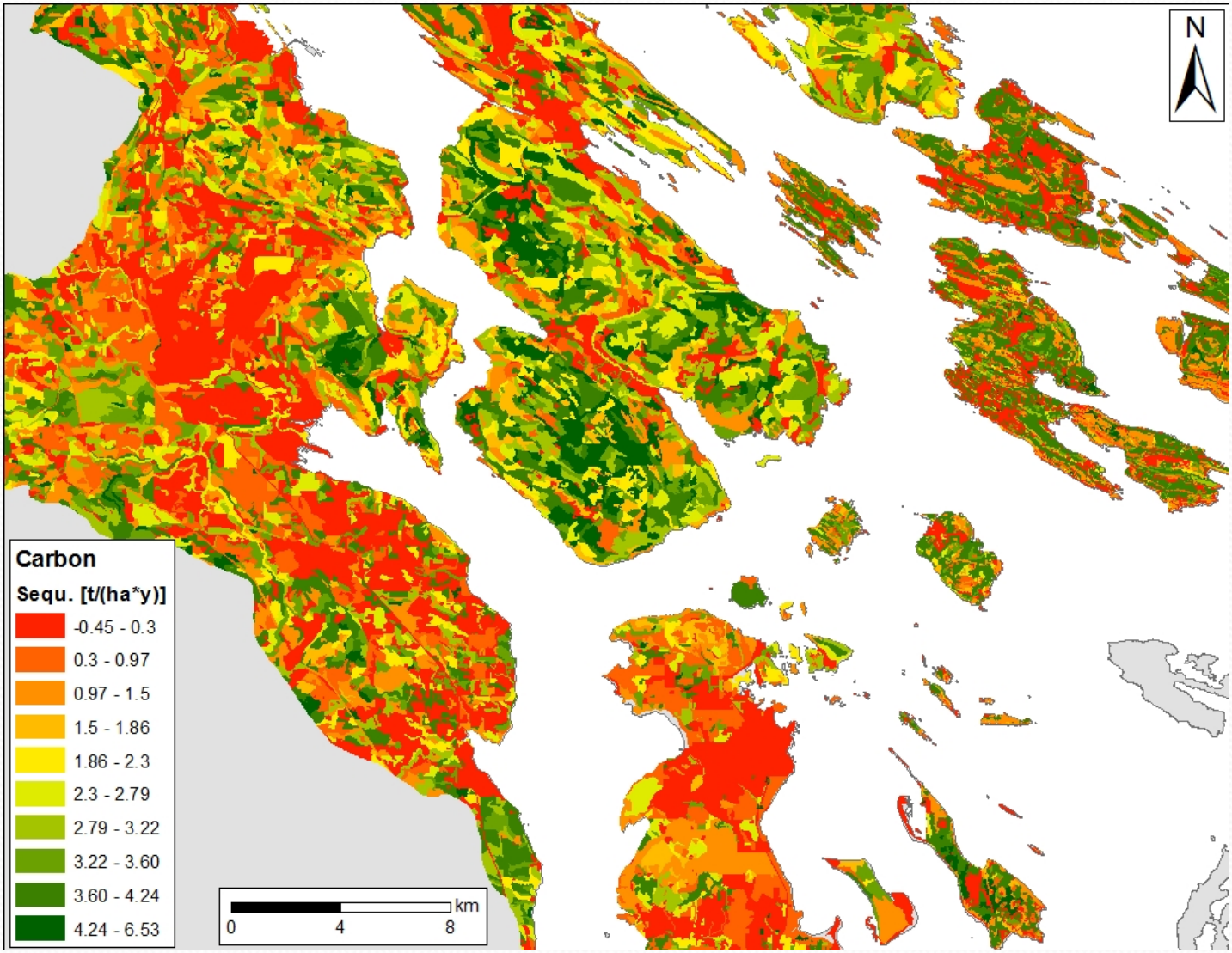
Standing Carbon in High Value Forests in the Georgia Basin is Currently Worth $4-10K/ha

~3-15% of Acquisition Cost



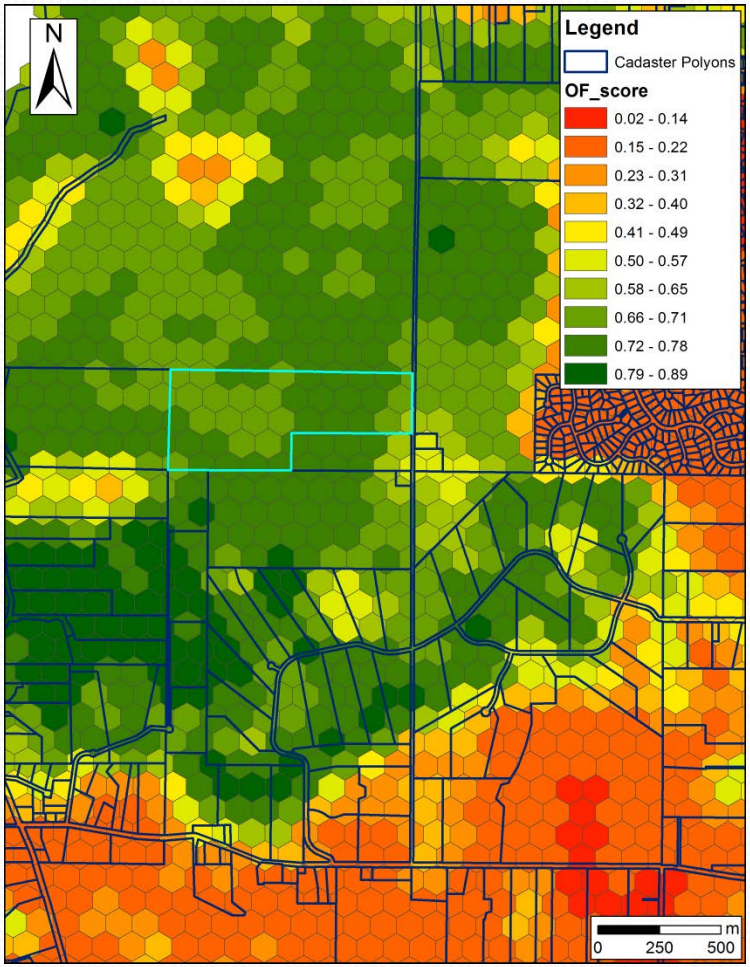
Synergies: High Value Forests Are Often Adjacent to Younger Forest With High Sequestration

High Sequestration Rates in Young Forest May Facilitate Landscape Level Planning



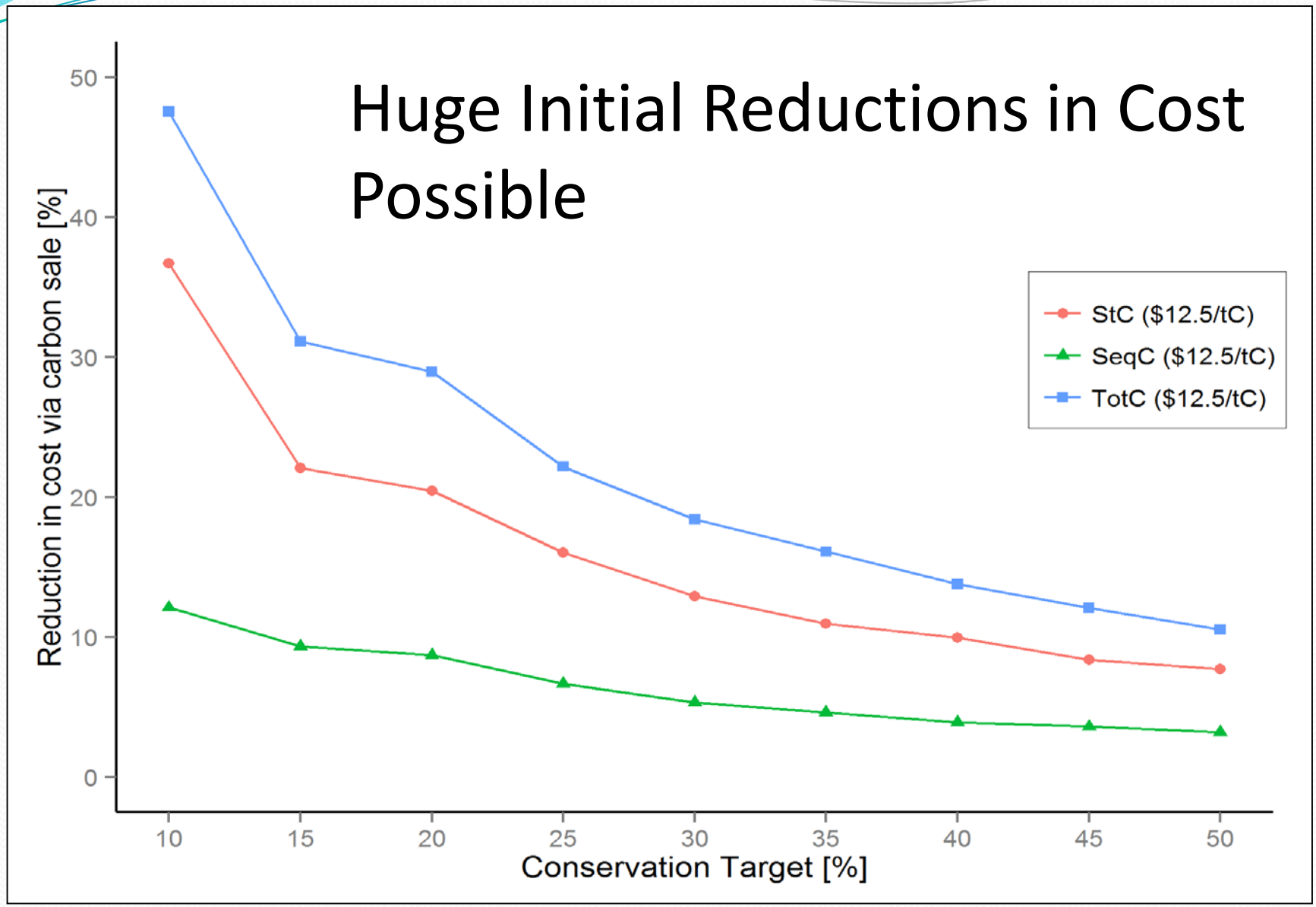
Biodiversity – Carbon Synergy in the Conservation of Forested Land

- Biodiversity features
  - β-diversity of Old Forest and Savanna Bird Communities
- Carbon budget model
  - Standing Carbon
  - Sequestration potential
- Cost metrics used:
  1. Total Land Value (TLV)
  2. TLV – Standing Carbon * $/t
  3. TLV – Sequestration Potential (20a) * $/t
  4. TVL – Stand. Carb *$/t – Sequ. Pot. * $/t



$/t presented: 12.5 (average cost payed by Pacific Carbon Trust)

Biodiversity - Carbon



Schuster, Martin & Arcese 2014 PLoS One

Exercise I: Carbon offsets

http://www.richard-schuster.com/ILP/

OPEN ACCESS Freely available online

PLOS ONE

Bird Community Conservation and Carbon Offsets in Western North America

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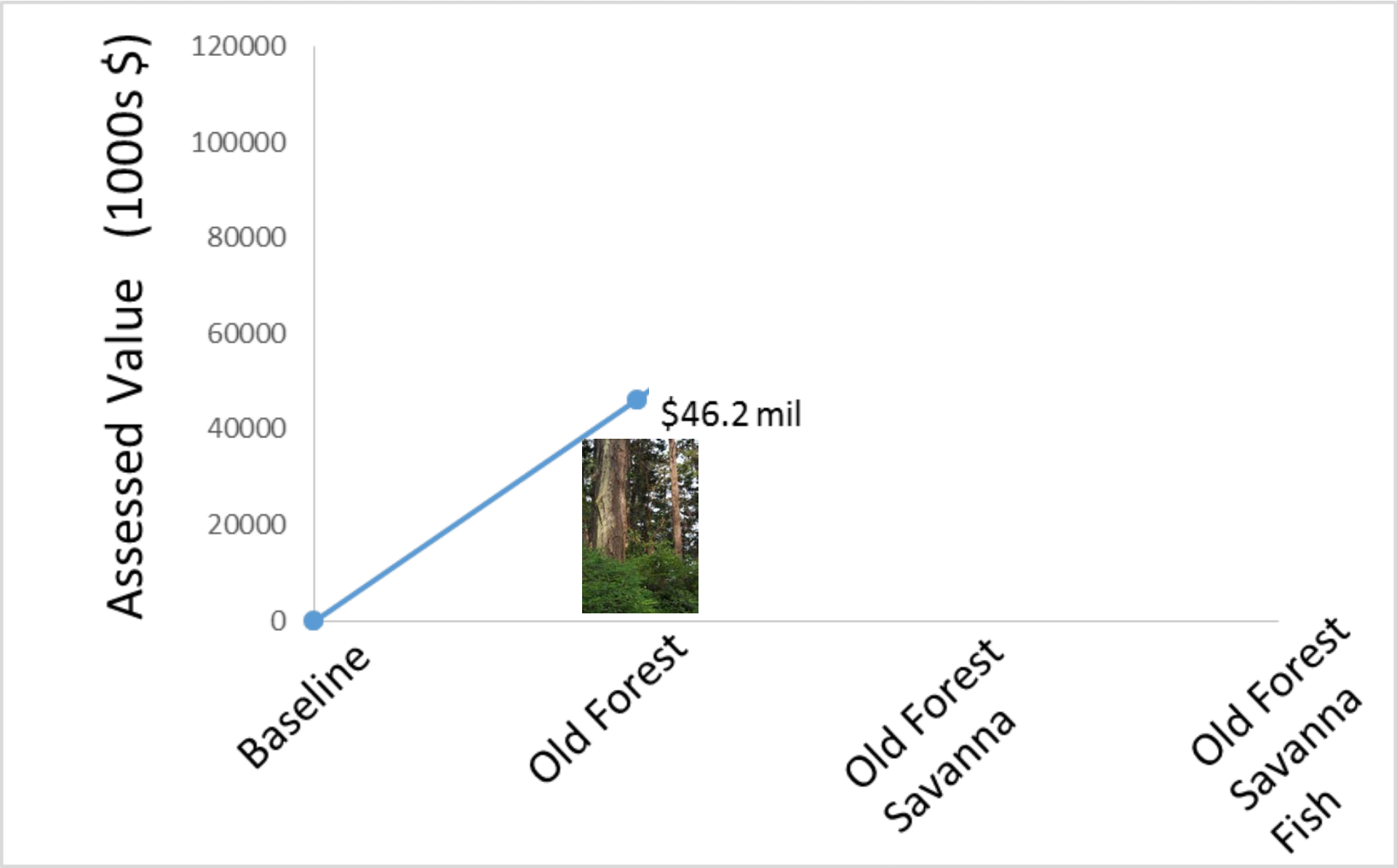
Strategic Investment for ‘Co-benefits’

Standing / Sequestered Carbon

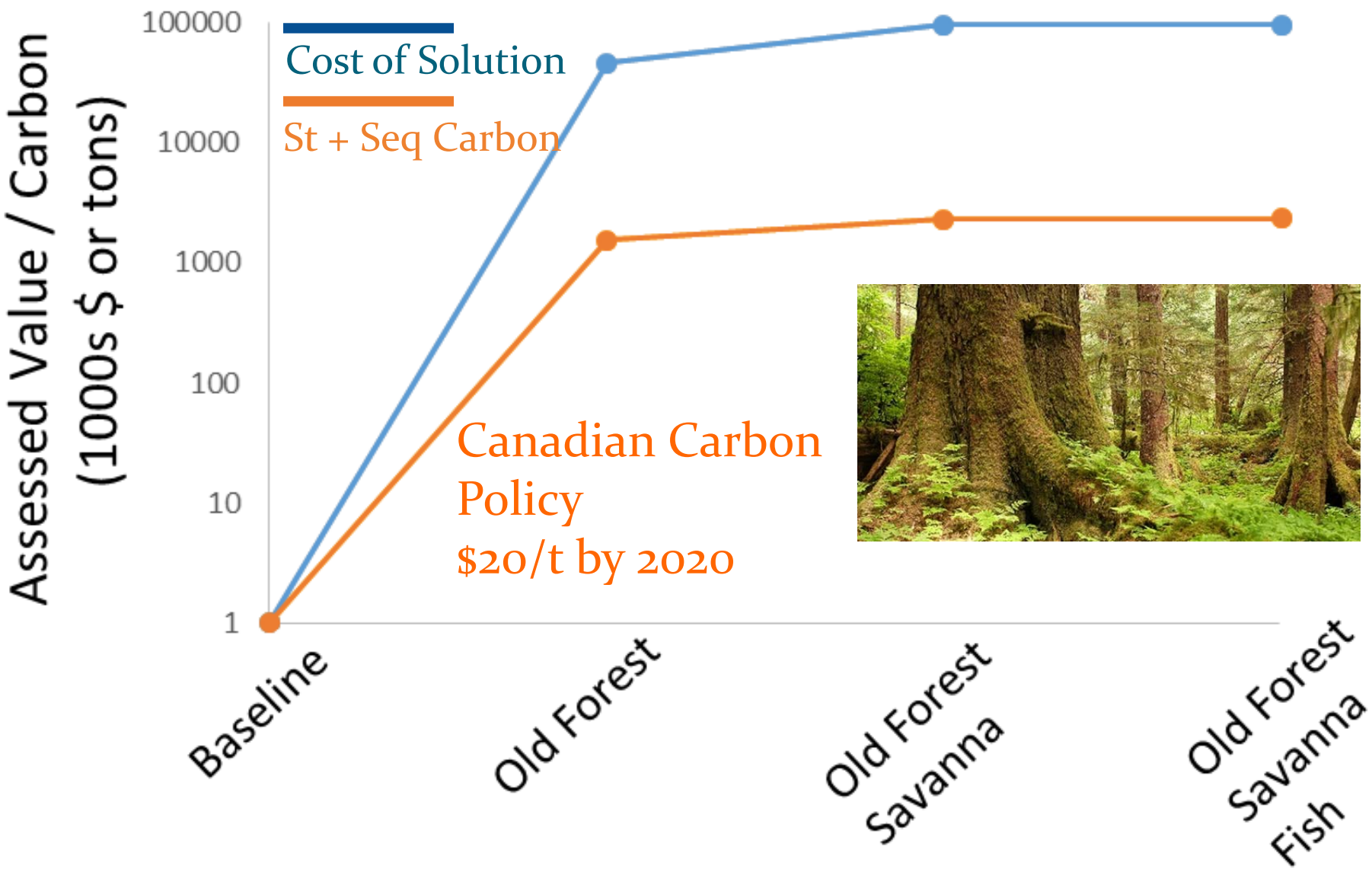
Water Quality / Supply

Beneficial Farm Practices

Coastal Douglas-fir Carbon Co-Benefit



Coastal Douglas-fir Carbon Co-Benefit



Coastal Douglas-fir Carbon Co-Benefit

Strategic Investment for ‘Co-benefits’

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Exercise II: Complementarity

http://www.richard-schuster.com/ILP/