

# Plant Hardiness Zones, GIS, and choosing better plants for your Garden

R. Yaku Princess

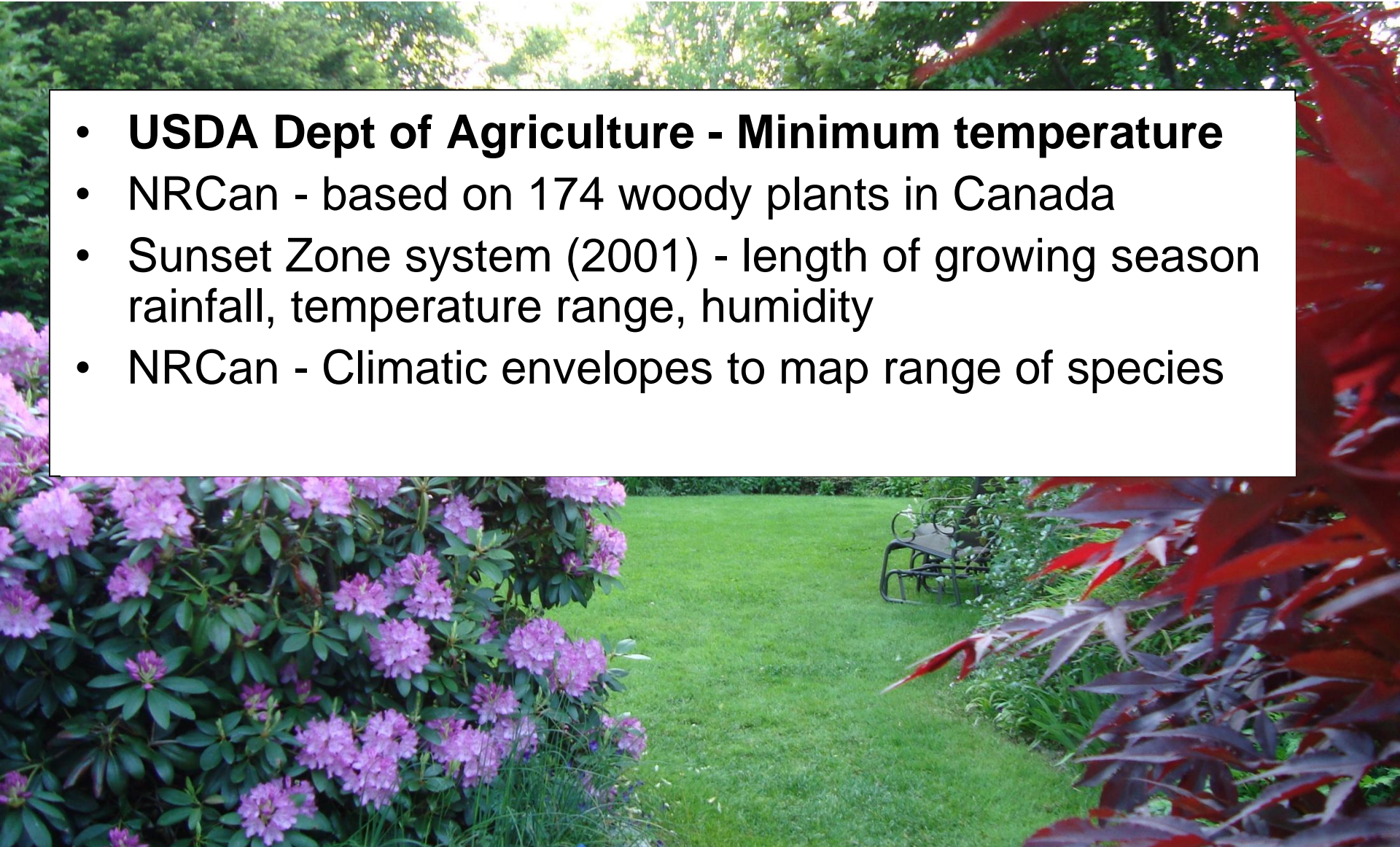


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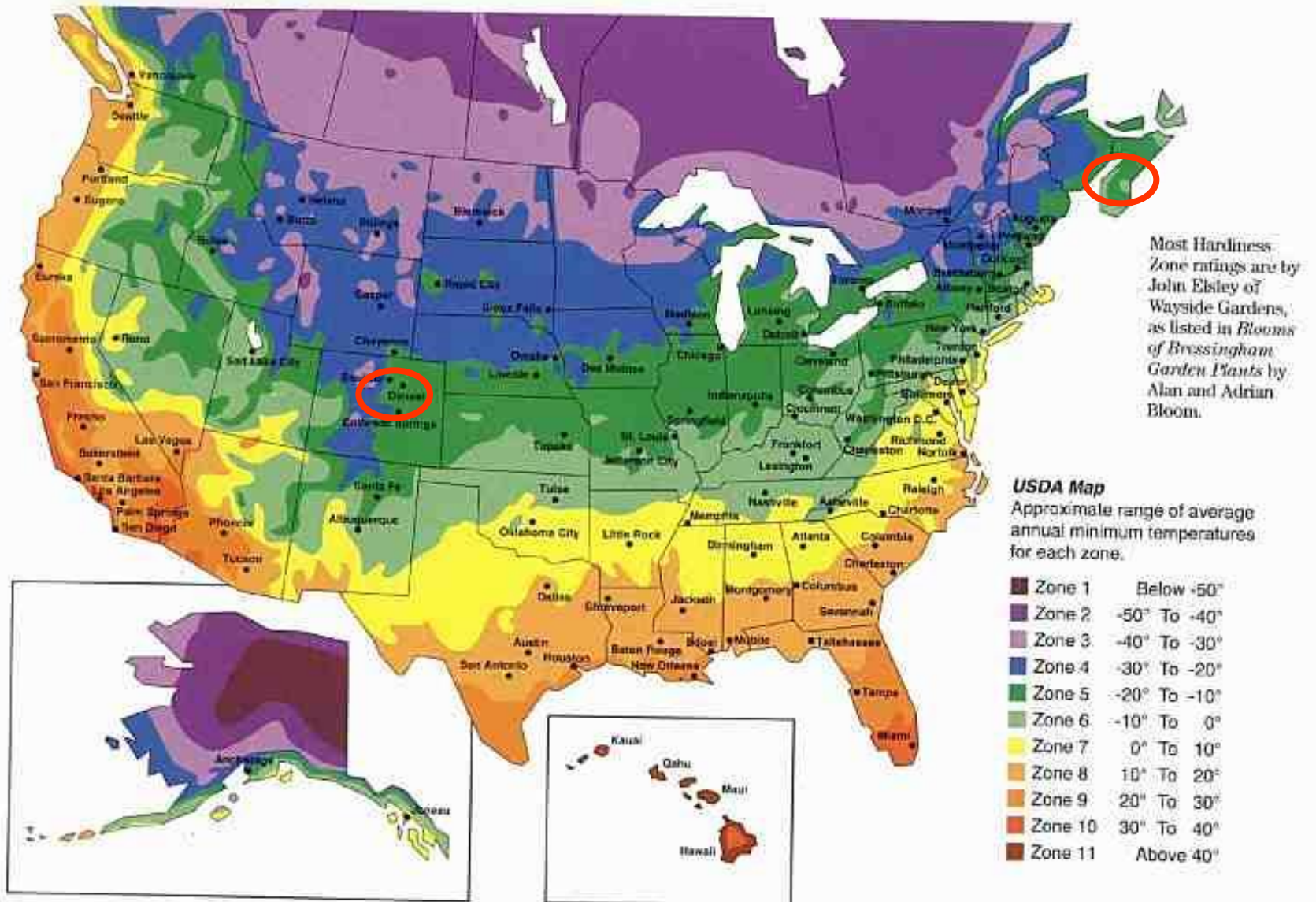


# How Plant Hardiness Zones are mapped in North America

- **USDA Dept of Agriculture - Minimum temperature**
- NRCan - based on 174 woody plants in Canada
- Sunset Zone system (2001) - length of growing season  
rainfall, temperature range, humidity
- NRCan - Climatic envelopes to map range of species



# USDA hardiness Zones



-10 degrees Fahrenheit = -23.3 degrees Celsius

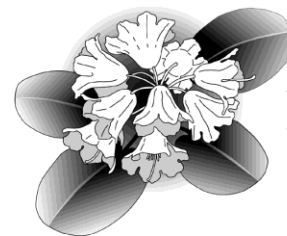


# How Plant Hardiness Zones are mapped in North America

- US Dept of Agriculture-minimum temperature
- **NRCan analysis of 174 woody plants in Canada (1967, 2000) from 108 stations perform included 7 climate variables**
- Sunset Zone system (2001) - length of growing season rainfall, temperature range, humidity
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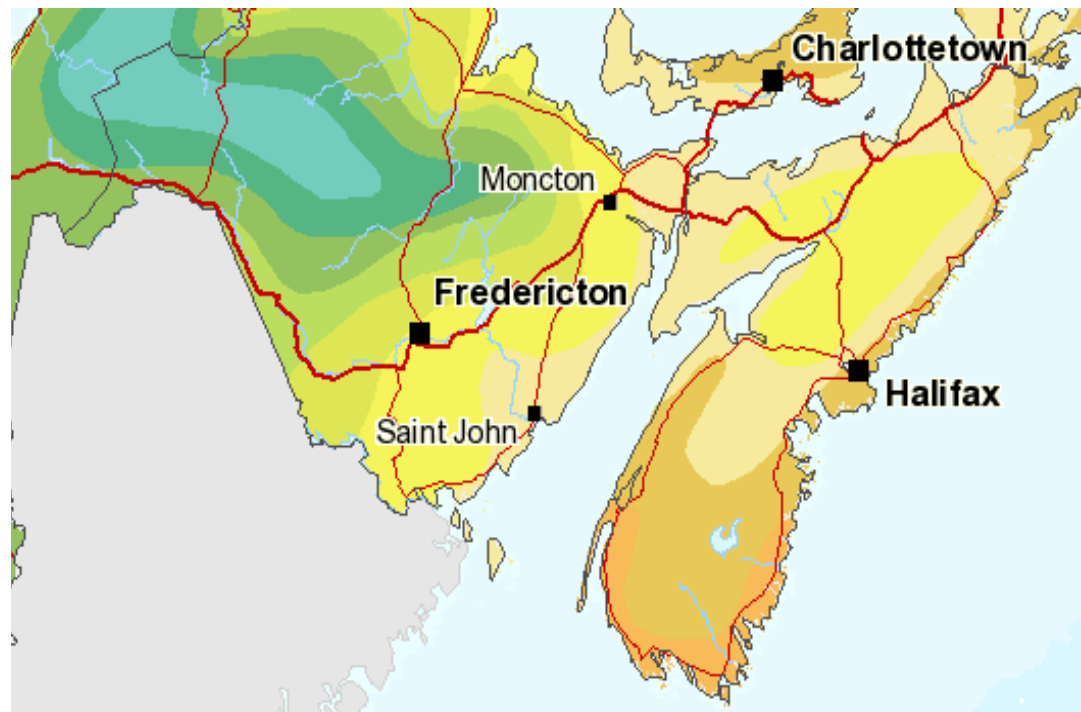
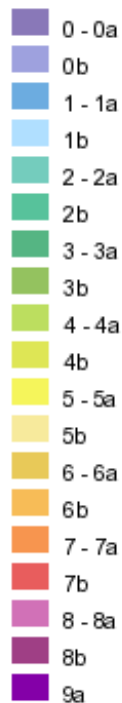
R. Minas Grand Pre



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In 1967, **Agriculture Canada** scientists created a plant hardiness map using Canadian plant survival data and a wider range of climatic variables, including minimum winter temperatures, length of the frost-free period, summer rainfall, maximum temperatures, snow cover, January rainfall and maximum wind speed.

Plant Hardiness Zones 1967

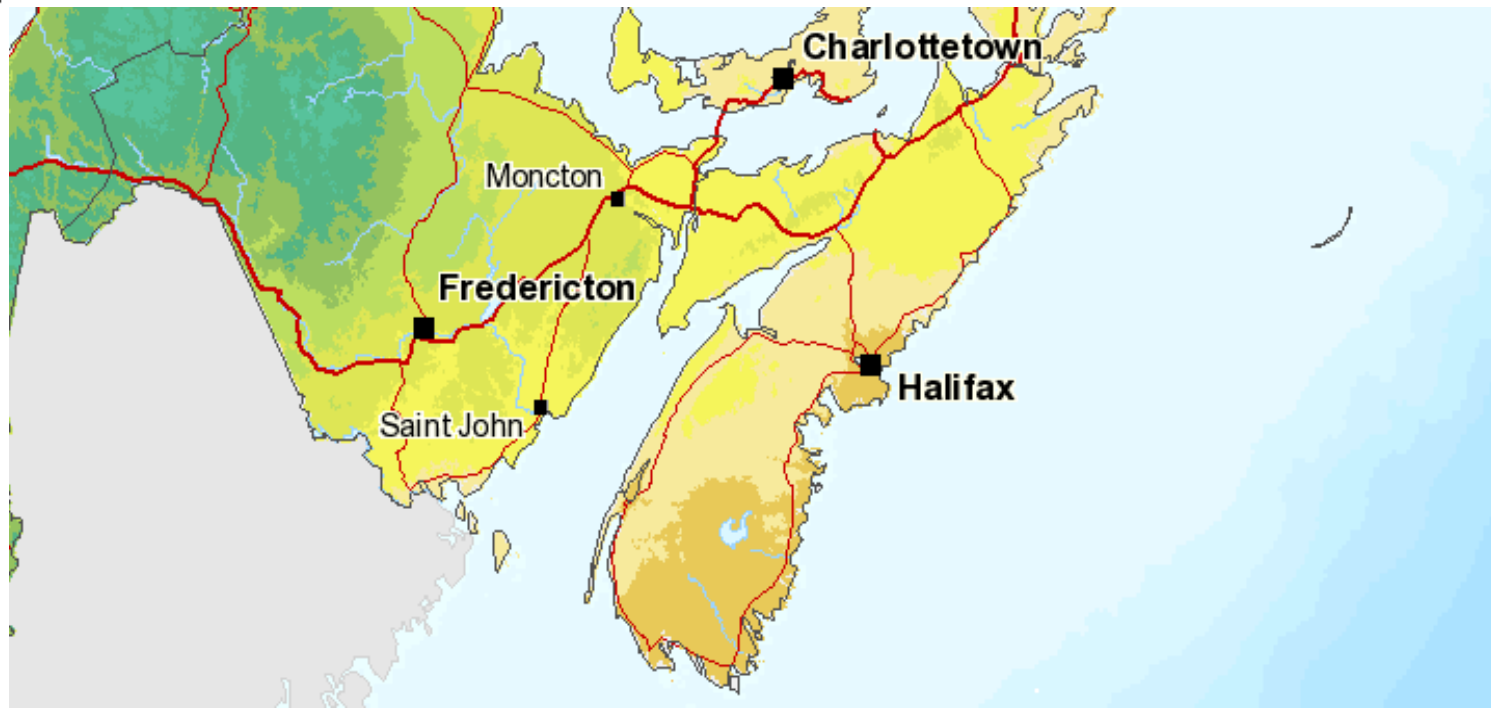


# Natural Resources Canada's Canadian Forest Service

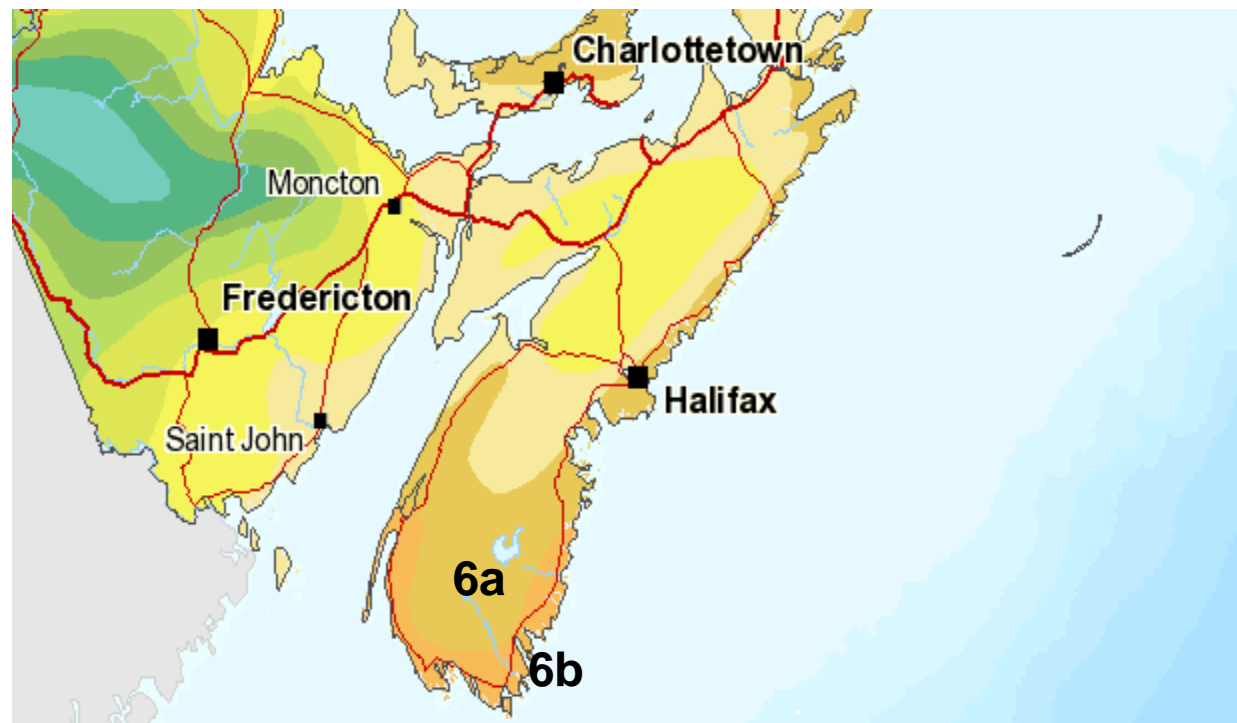
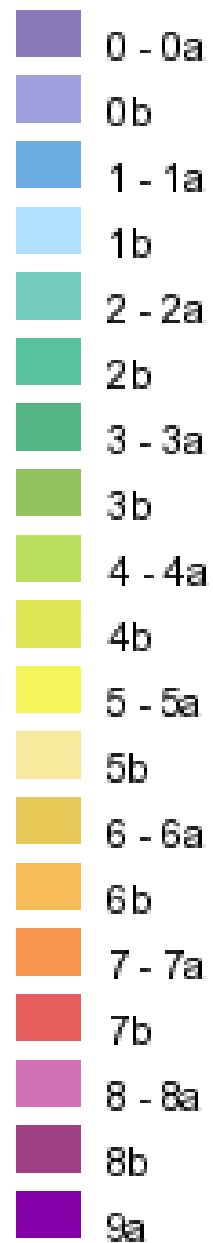
scientists have now updated the plant hardiness zones using the same variables and more recent climate data (1961-90). They have used modern climate mapping techniques and incorporated the effect of elevation. The new map indicates that there have been changes in the hardiness zones that are generally consistent with what is known about climate change..

Plant Hardiness Zones 2000

- 0a
- 0b
- 1a
- 1b
- 2a
- 2b
- 3a
- 3b
- 4a
- 4b
- 5a
- 5b
- 6a
- 6b
- 7a
- 7b
- 8a



# Plant Hardiness Zones 1967



2000



Zone 6a diminished

Zone 6b eliminated



NRCan Forest Service is now **"Going Beyond the Zones"** and developing potential range maps for **individual species** by collecting **species specific** information.



*R. catawbiense*



# **Going Beyond the Zones: using climate envelopes to map plant range limits**

- **Accurate location data for the plant of interest- 30-50 well distributed observations**
- **Generate a bioclimatic model using high resolution climate data**
- **<http://sis.agr.gc.ca/cansis/nsdb/climate/hardiness/intro.html>**



**R. maximum**

# Climate Variables

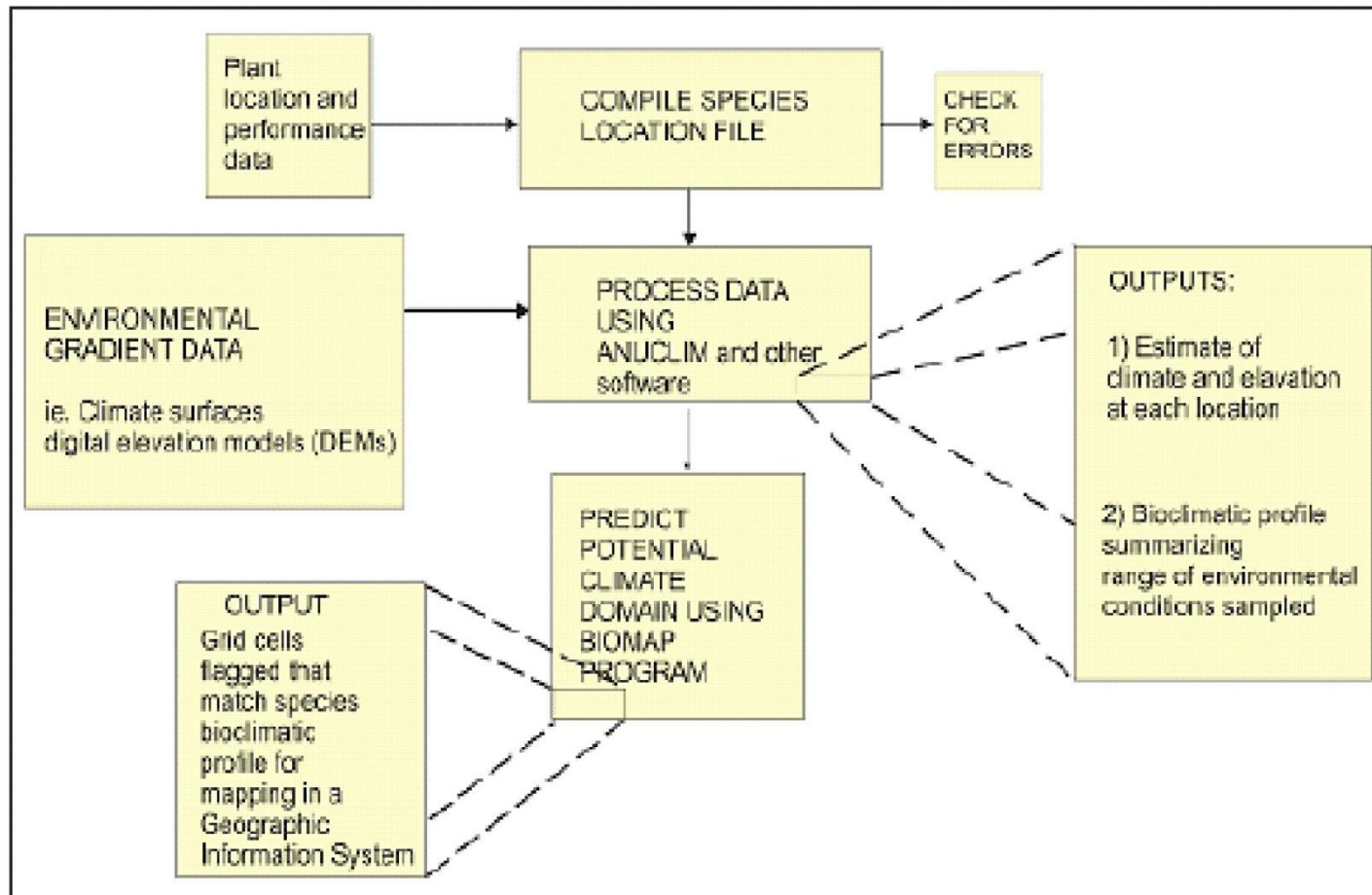
**Table 1.** Climate variables that may be used in the bioclimate range mapping. Some experimentation will occur to determine the best combination.

Temperature	Precipitation
Annual mean temperature	Annual precipitation
Annual mean maximum temp	Seasonality (coefficient of variance)
Annual mean minimum temp.	Precipitation of the wettest month
Maximum diurnal range	Precipitation of the driest month
Mean temp. of hottest month	Precipitation of the wettest quarter
Mean temp. of coldest month	Precipitation of the driest quarter
Seasonal temperature range	Precipitation of the hottest quarter
Maximum temp. of hottest month	Precipitation of the coldest quarter
Minimum temp. of coldest month	
Annual range	

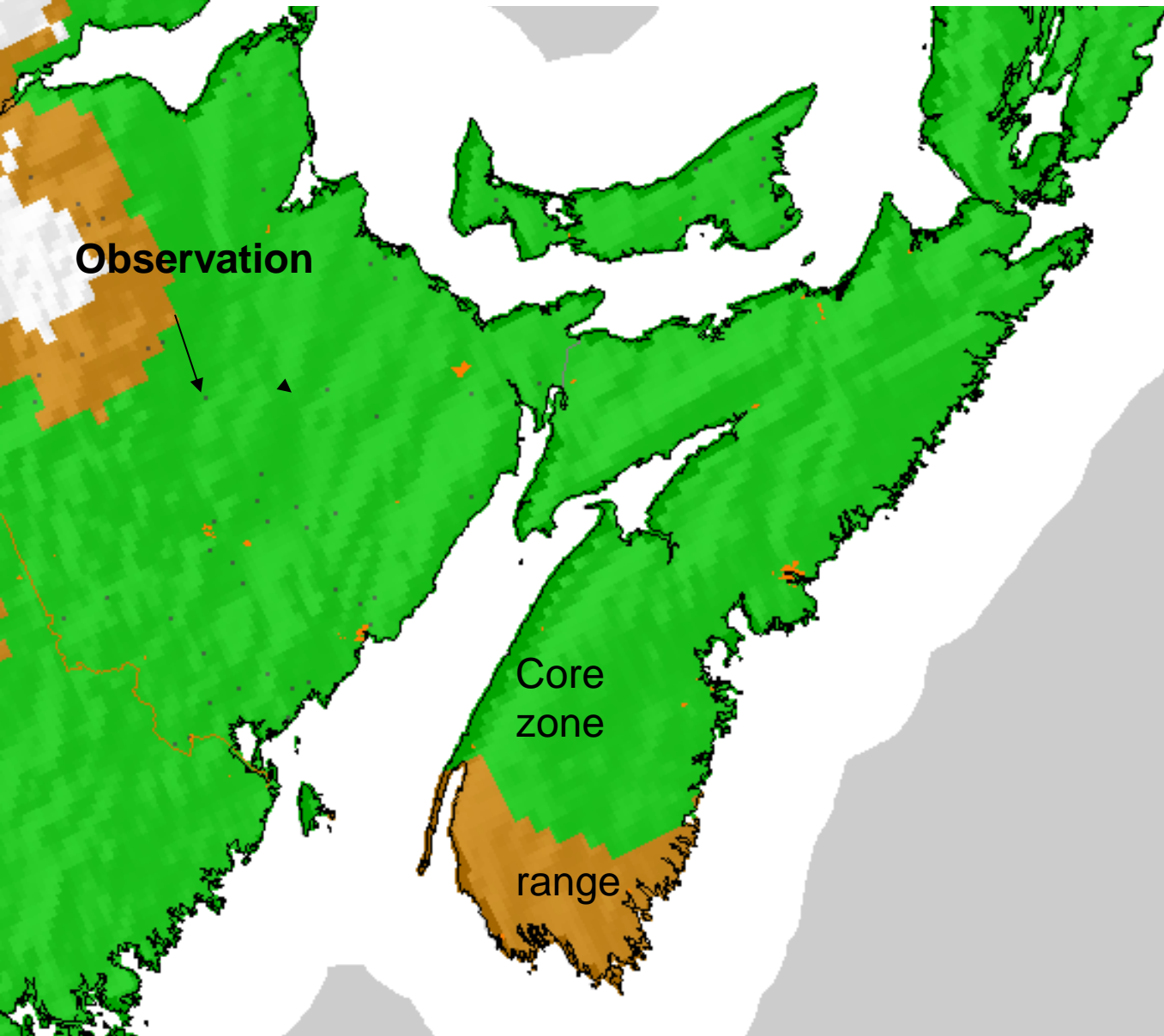


# Steps to create zone map for a plant

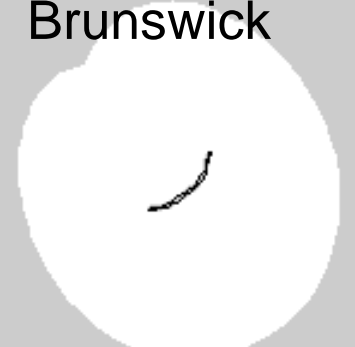
**Figure 1.** Steps involved in making plant specific climatic range maps.



# Range of *R. canadense* from NRCan site



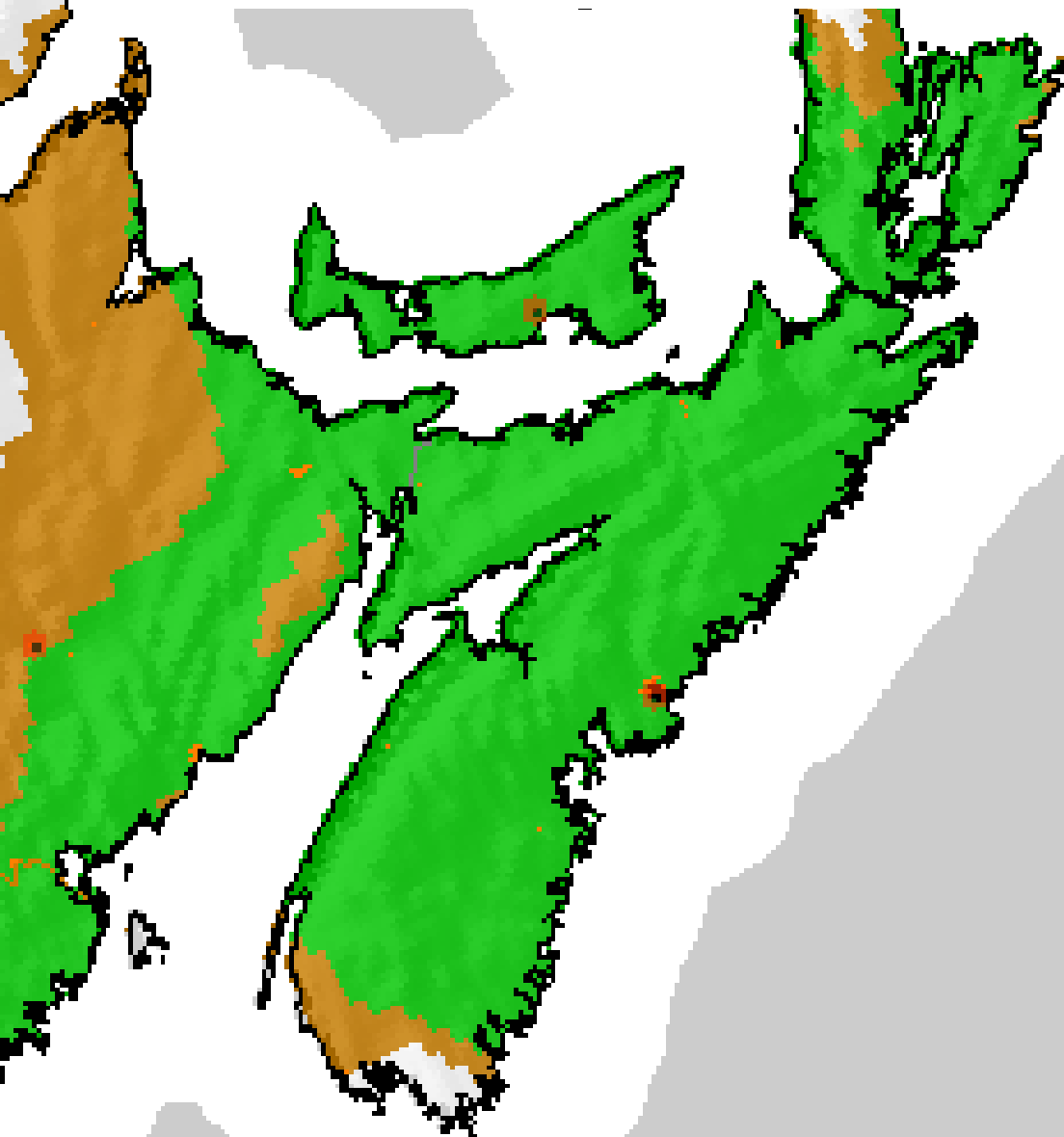
144 observations  
many in New  
Brunswick



*R. canadense*



# Range of *R. maximum* from NRCan site



119  
observations  
few from Nova  
Scotia

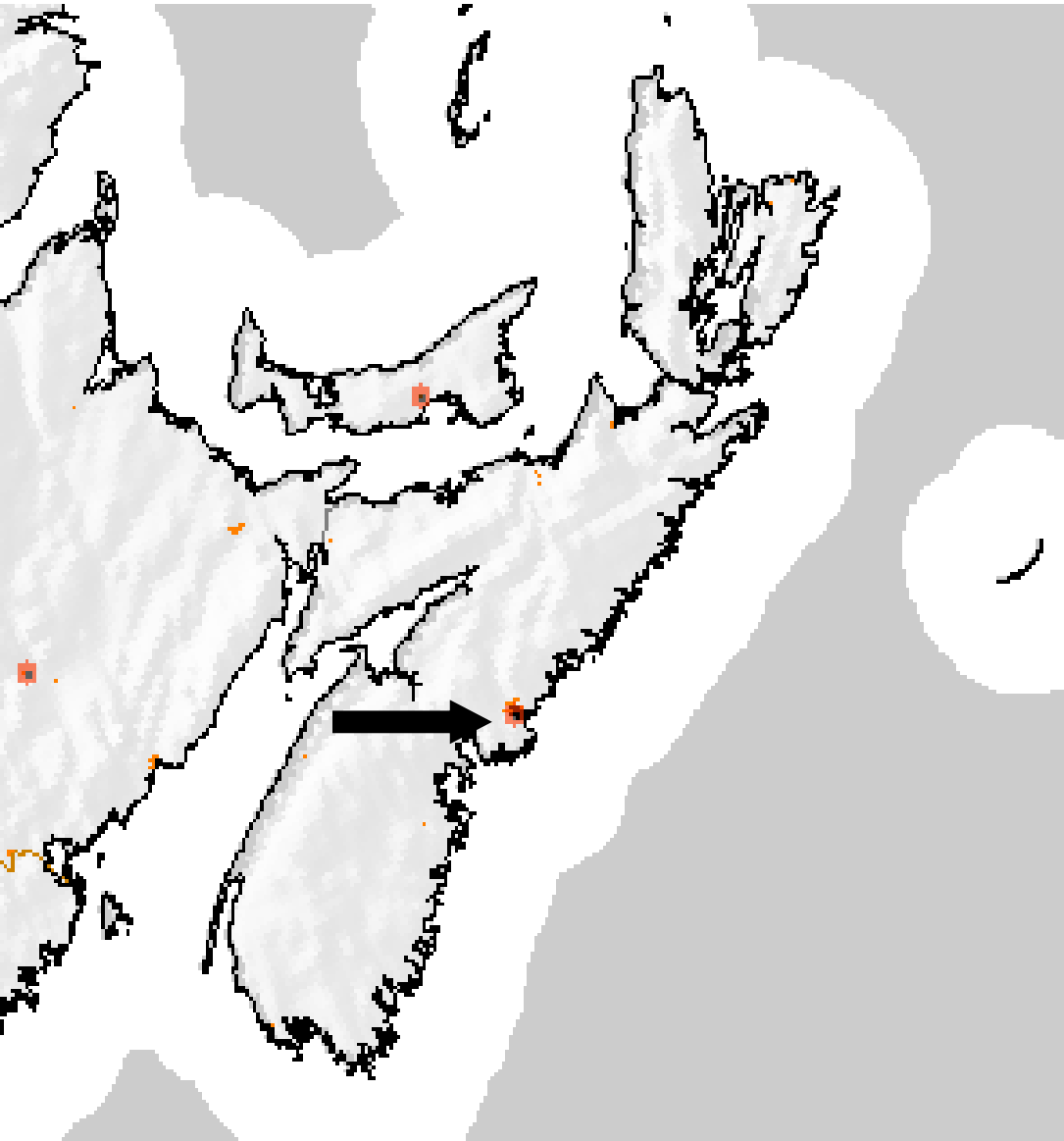


*R. maximum*

# Rhododendron yakushimanum hybrids

More data needed

Only 5 observations



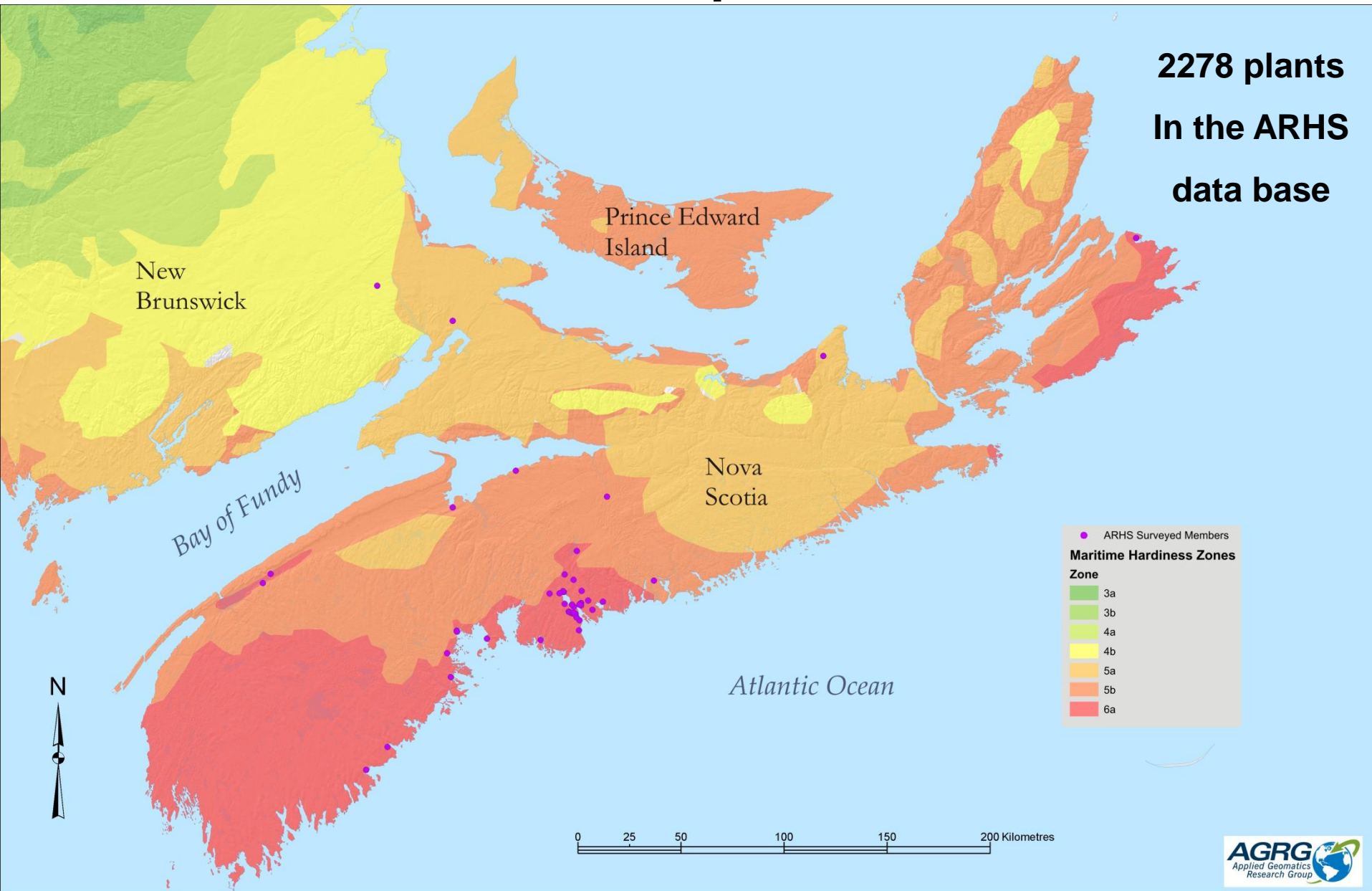
*R. yakushimanum* varieties



*R. yakushimanum* hybrid



# ARHS gardens overlaid on Hardiness Zone Map





# Zone sensitive Plants



*Ilex glabra* (inkberry)

UGA112

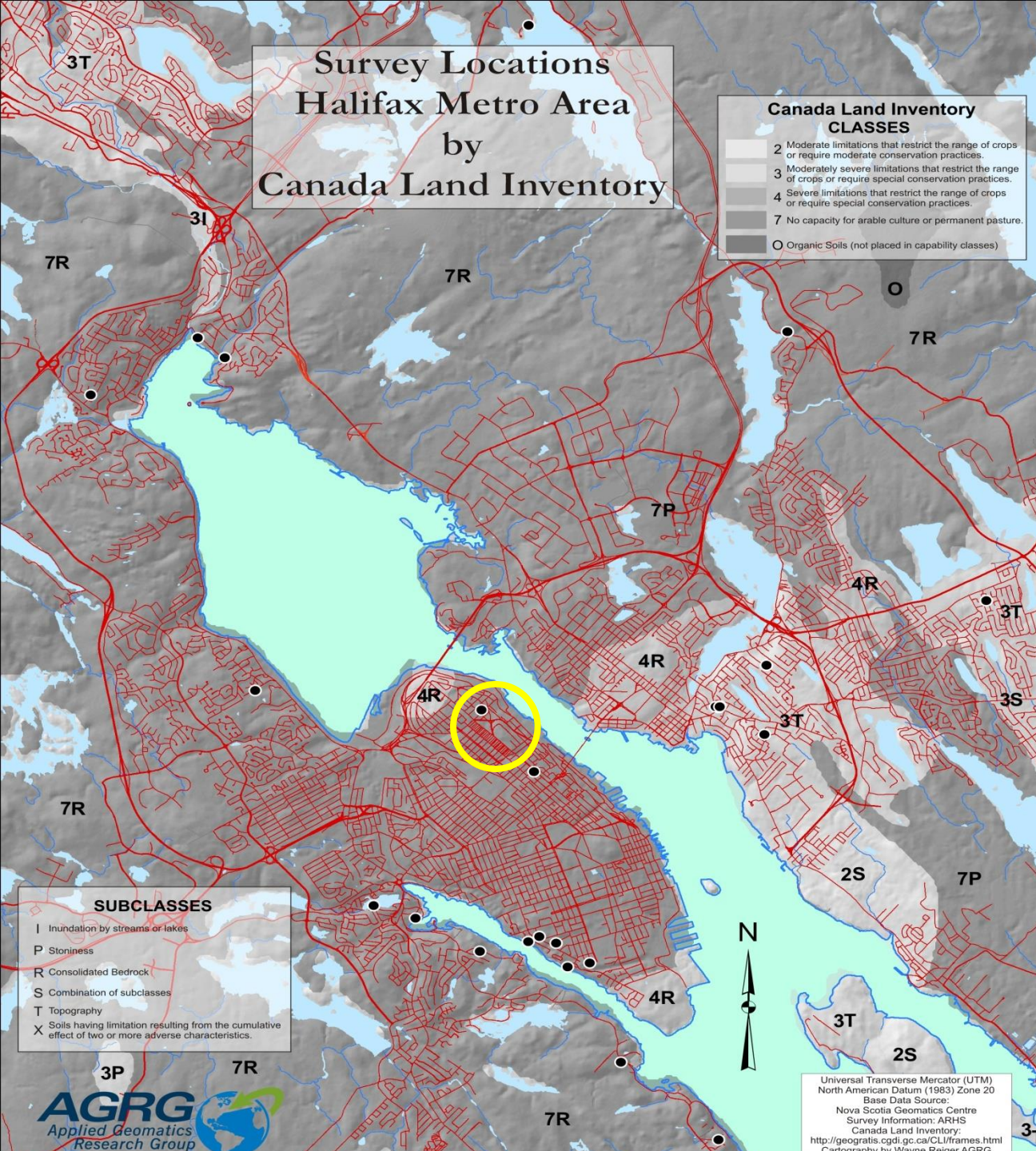


UGA1362007



UGA1362003

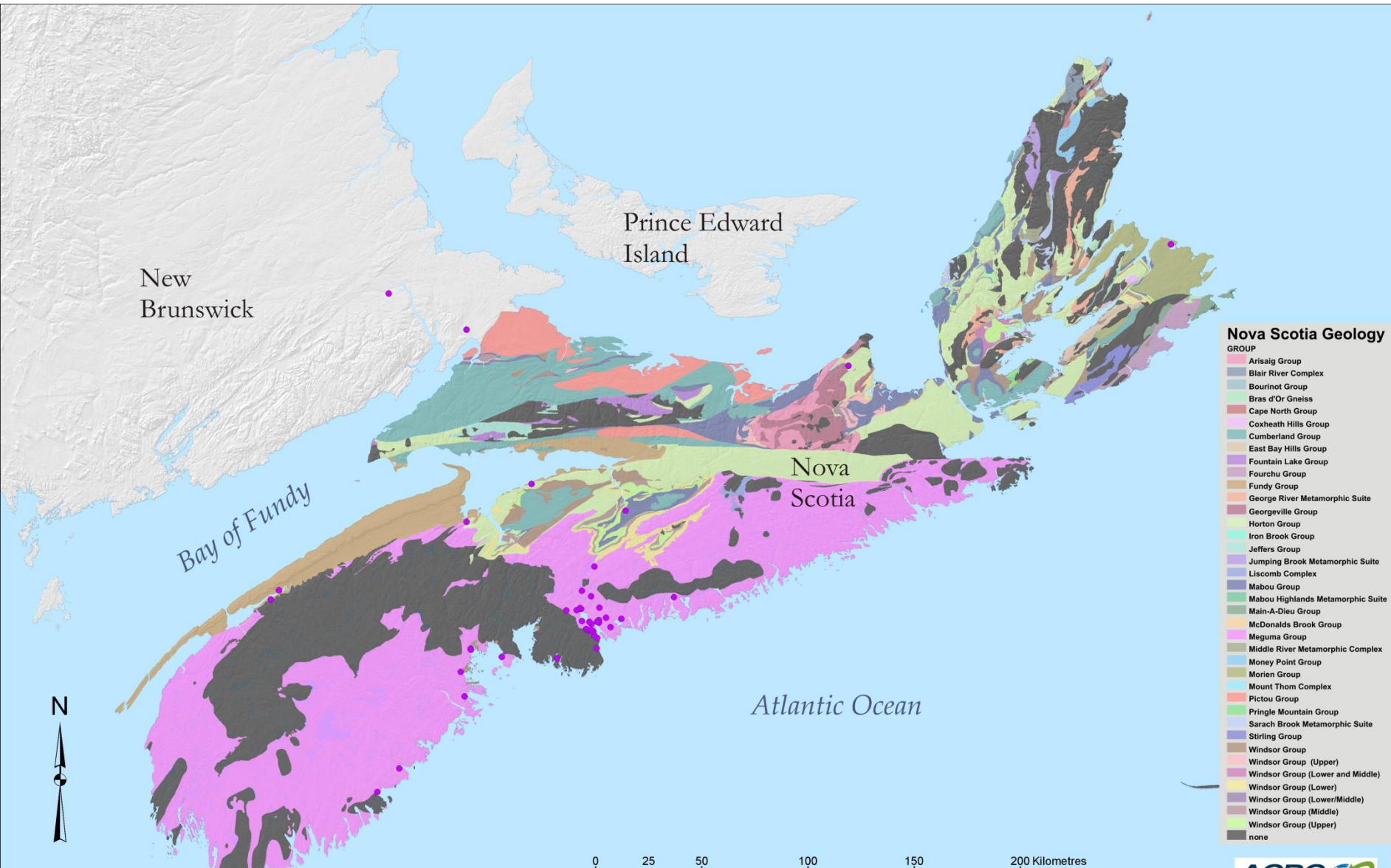




**Soils  
mapping  
too general  
to be  
useful**



# ARHS gardens overlaid on Geology Map





This **solar resource map for the Province of Nova Scotia**, Canada shows average solar energy incident on a horizontal surface (KWh/m<sup>2</sup>) per day for the month of July for the 2007, 2008, 2009 and 2010 calendar years. The solar resource was calculated based on NASA's Geostationary Operational Environmental Satellite (GOES) images that record cloud cover over a portion of the Earth's surface every half hour at a spatial resolution of one square kilometre. This map is a result of processing over 8800 GOES images for the month of July. The solar resource is overlaid transparently on a shaded relief of the Province of Nova Scotia.

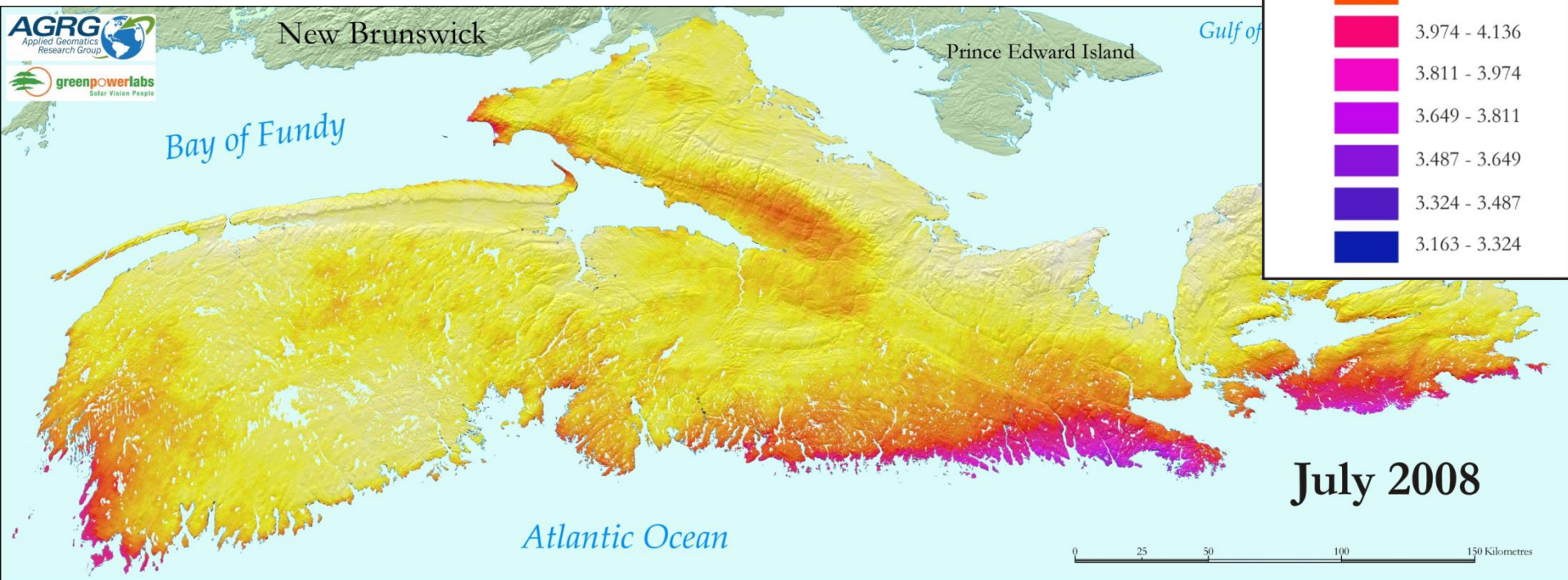
David Colville, Wayne Reiger and Steven Bird  
Applied Geomatics Research Group

Alexandre Pavlovski and  
Vladimir Kostylev  
Green Power Labs Inc

### Average Insolation

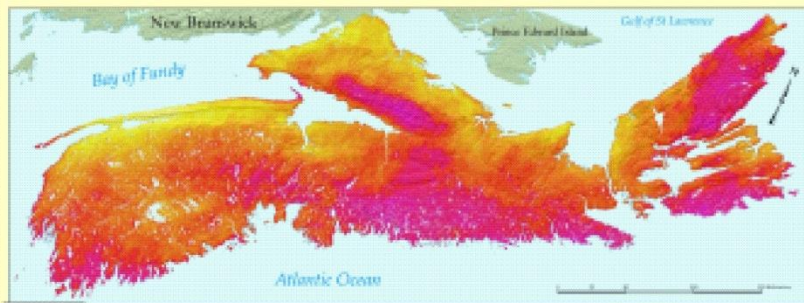
KWh/m<sup>2</sup>/day

	4.958 - 5.110
	4.785 - 4.958
	4.623 - 4.785
	4.461 - 4.623
	4.298 - 4.461
	4.136 - 4.298
	3.974 - 4.136
	3.811 - 3.974
	3.649 - 3.811
	3.487 - 3.649
	3.324 - 3.487
	3.163 - 3.324

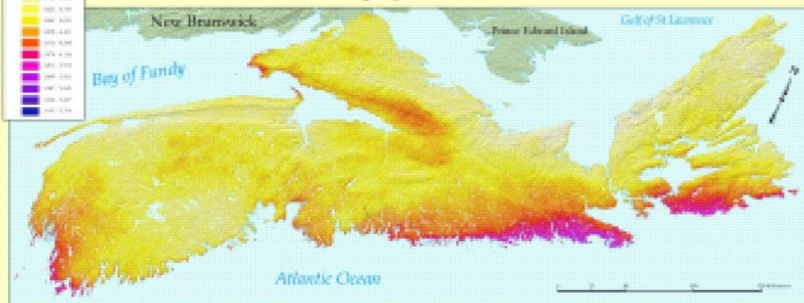


# July Solar Comparison

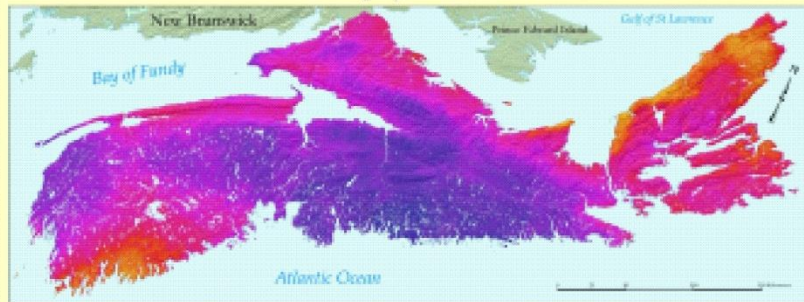
July 2007



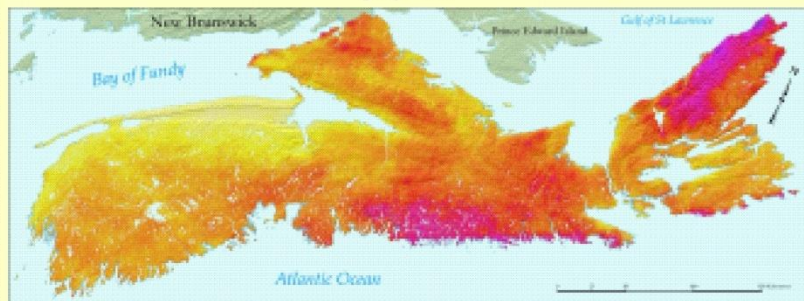
July 2008



July 2009



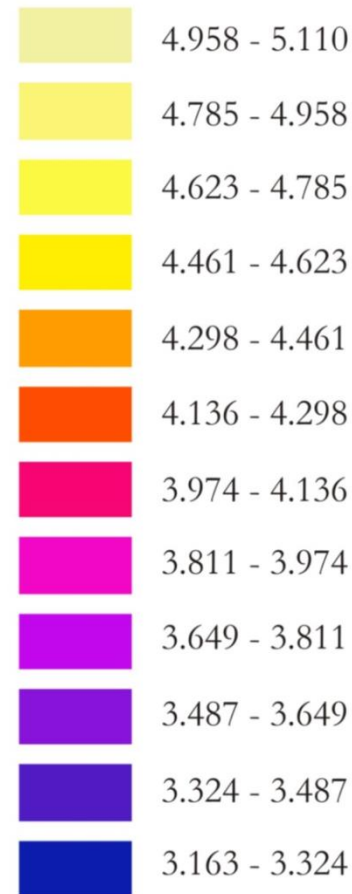
July 2010



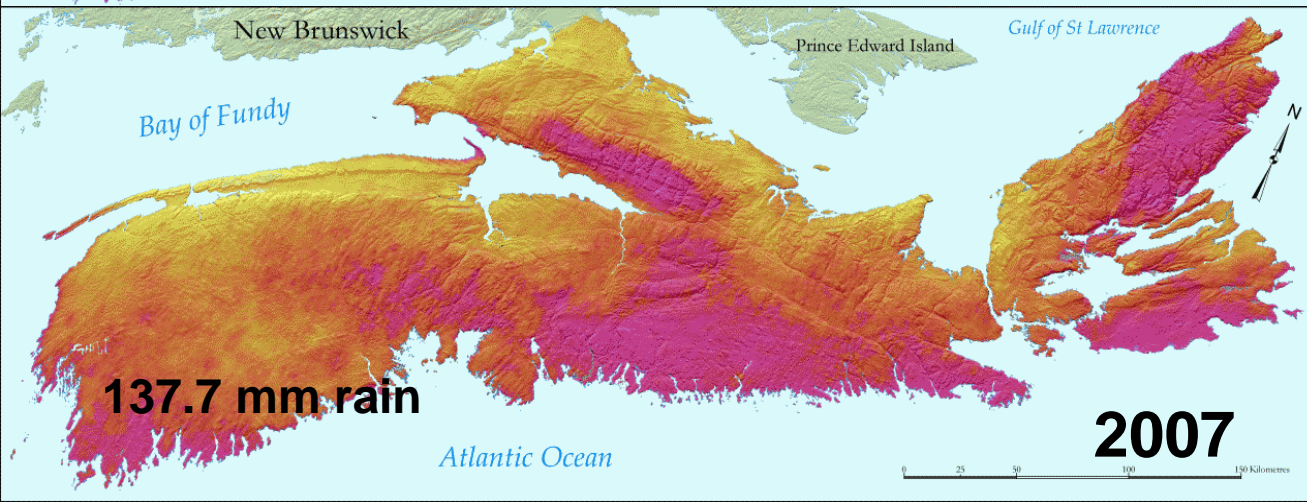
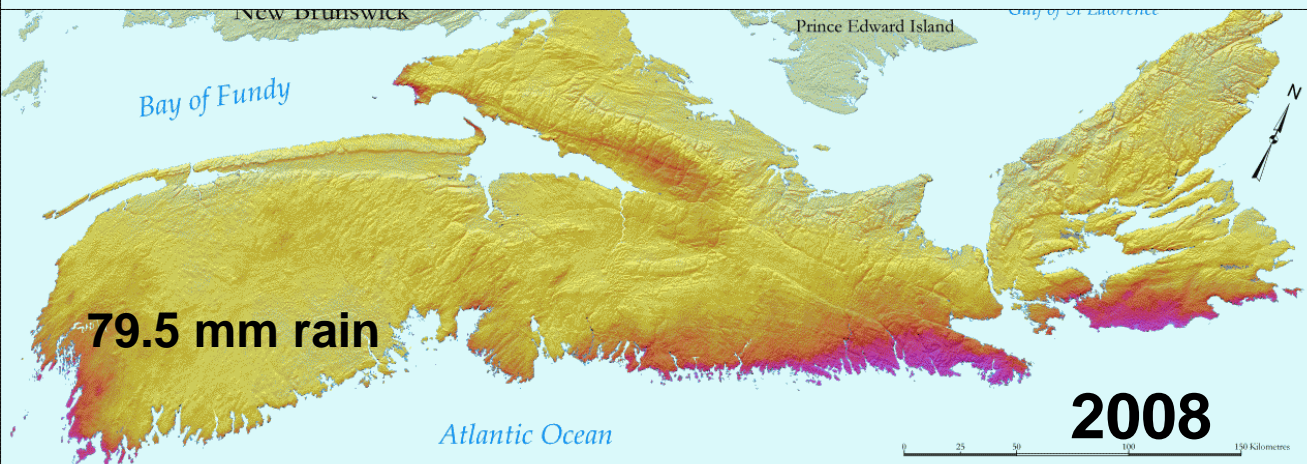
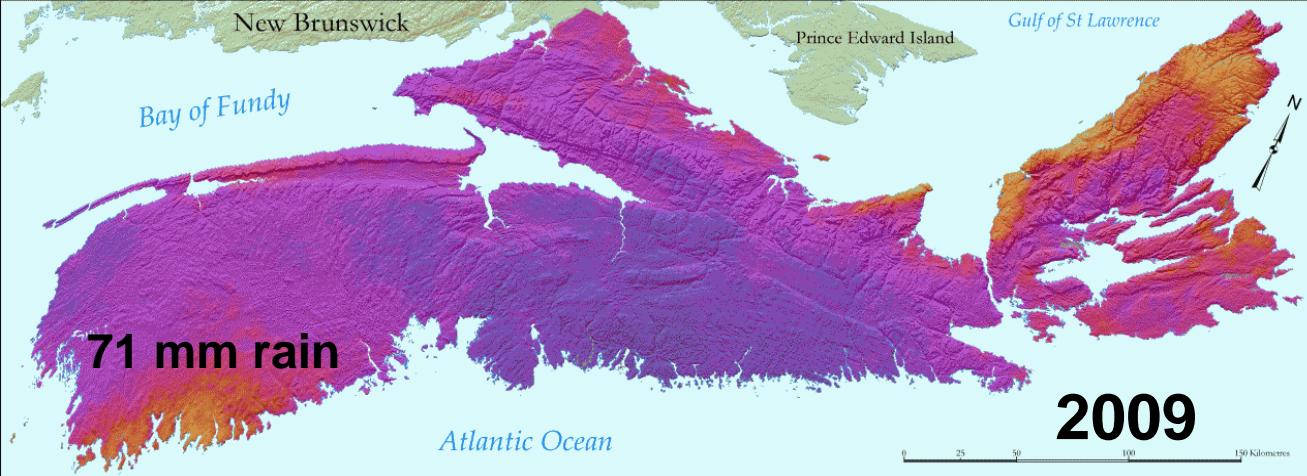
Heavy bud set occurred in the three years with greatest sun  
Poor bud set in the dark July of 2009

## Average Insolation

KWh/m<sup>2</sup>/day







Rain amounts  
(Halifax)  
compared to  
Solar  
Radiation in  
July



# Commonly Grown Rhododendrons by ARHS

## 2000-2007-2002

- April Mist 26 grower
- Minas Grand Pre 24
- Ginny Gee 22
- Wren 22
- Bluenose 21
- Capistrano 21
- Manitau 21
- Isola Bella 20
- Millenium 19
- *Schillendbachii* 19
- Stewartsonia 19
- Henry's Red 18
- April Rose 17
- Calsap 17
- Fantastica 17
- Golfer 17
- *Mist Maiden* 17
- *Dora amateis* 16
- *Franceca* 16
- *Vincrest* 16
- *Helsinki* 15
- *Steele's Late and Lovely*
- *Weston's Aglo* 12





# Poor Doers from ARHS survey

- Bluenose 8
- Minas Grand Pre 5
- Capistrano 4
- Henry's Red 4
- Calsap 4



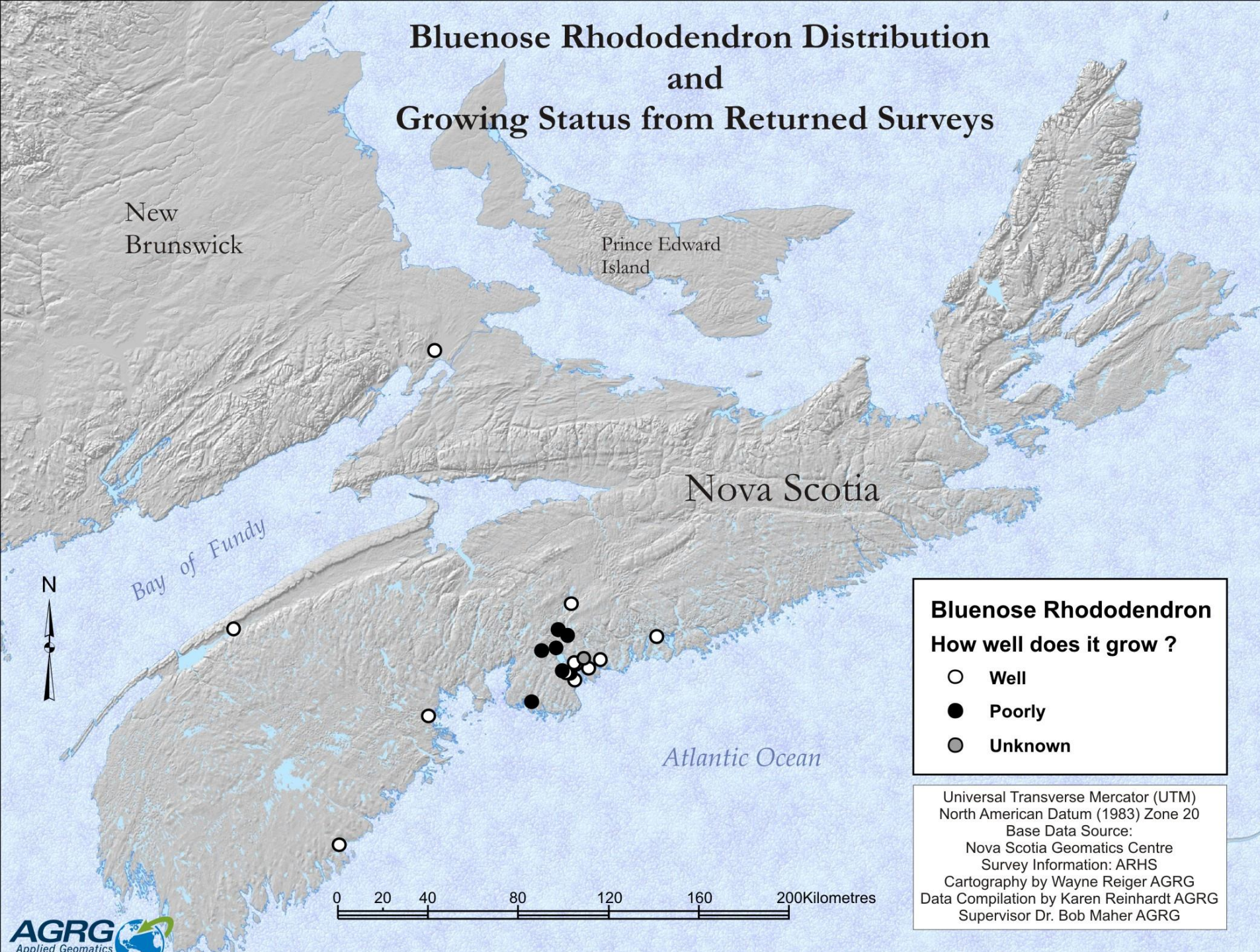
Minas Grand Pre



Capistrano



# Bluenose Rhododendron Distribution and Growing Status from Returned Surveys





# Next steps

- Web Portal
- **Simple** additional surveys to augment critical data sets
- Do we wish to take part in surveys that support NRCan initiatives



*R. mucronulatum* 'Cornell Pink'



# Acknowledgements

- **Dr. Bob Maher COGS**
- **Karen Rheinhardt**
- **Wayne Reigner**
- **Dr. Dan Mckenny NRCan**
- **James Bruce NS Natural Resources**

R. hybrid Nancy Steele

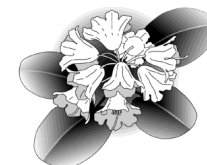


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