

TITLE: How Climate Shapes Yellow-cedar in Alaska: Use of Inventory Plots to Evaluate Broad-Scale Occurrence, Cedar Decline, and Migration

LOCATION: Southeast Alaska, primarily Tongass National Forest

DATE: 2010

DURATION: Year 2 of 2-year project **FUNDING SOURCE:** Base

PROJECT LEADER: Paul Hennon, Pathologist, phennon@fs.fed.us, 907-586-8769

COOPERATORS: John Caouette, Statistician, The Nature Conservancy, Juneau, AK; Dustin Wittwer, GIS and aerial survey specialist, FHP, Juneau, AK

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PROJECT OBJECTIVES:

1. Develop a new host distribution map and GIS layer for yellow-cedar and an associated model with independent variables related to climate (latitude, elevation, soil drainage, and projected snow accumulation) and dependent variables that reflect tree response (trees/ac, QMD, basal area/ac). This modeling effort will benefit the next national risk map effort.
2. Explore and graphically display how climate factors latitude, elevation, soil drainage, and snow have influenced:
 - General occurrence (species distribution)
 - Mortality (the decline problem)
 - Regeneration (migration)
3. Using PRISM output, construct a new high resolution snow model. Evaluate the leading method to characterize soil drainage (e.g., perhaps remotely sensed canopy openness) and produce a new high resolution GIS layer with 2 or 3 drainage classes.

JUSTIFICATION:

- a. **Linkage** This project has origins in the annual aerial detection survey where cedar decline is mapped each year. FIA and other ground-based inventory information will be used to verify trends identified in the aerial survey on how landscape patterns, especially the interaction of latitude and elevation, are associated with the occurrence of yellow-cedar decline. These inventories go a step further, however, because they will yield information on healthy (green) cedar forests which are not detectable by aerial survey or remote sensing.
- b. **Significance** Yellow-cedar is invaluable commercially and culturally (to Native people).
- c. **Biological impact** Species diversity is threatened because high latitude forests contain so few tree species.
- d. **Scientific Basis/Feasibility** Our team has built a strong case in the scientific literature for the role of climate change in the cause of yellow-cedar decline.
- e. **Priority Issues** addressed from Request for Proposals. Climate change.

DESCRIPTION:

a. Background: Yellow-cedar is of great value commercially, ecologically, and culturally in southeast AK. FHP aerial detection surveys reveal that a forest decline affects the species on over 500,000 ac. Survey results indicate that the distribution of mortality has been influenced by climate factors, essentially limiting tree death by latitude and elevation. Our recently published research on yellow-cedar decline implicates a climate-induced seasonal freezing injury to tree roots, and shows how snow protects cedars from this injury. The lack of information on the occurrence and distribution of healthy (green) cedar forests (not detectable from aerial surveys) has repeatedly hampered our ability to estimate the proportion of the cedar resource affected by this decline, and to provide advice about where cedar conservation and management efforts should be directed.

b. Methods: Our proposed approach moves beyond aerial detection survey and remote sensing to use ground-based inventory plot information. We have been amassing vegetation inventory plot information for the last few years to remedy this problem, creating one of the richest sets of

vegetation plot data available anywhere. Some plot inventories are now available for use; we are still working with partners to recover the oldest inventories. For FIA plots, we are working with FIA Anchorage on this project.

Plot inventories available now:

1990s FIA GRID inventory [done]	~4,000 plots
1980s North Tongass (Chatham) inventory [done]	~2,000 plots
1980s South Tongass (Stikine, Ketchikan) inventory [done]	~2,000 plots
Tongass Stand Exam plots [done in some key areas]	~30,000 plots
Size-density model [done]	~2,000 plots

Inventory plot data to become available in 2009:

Composite 1950-1970s inventory [ongoing]	~4,000 plots
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We are analyzing plots to establish both maps and GIS layers for yellow-cedar occurrence. Analysis is successfully demonstrating the strong influence of elevation in segregating the occurrence of tree species. Adding mortality and regeneration to analyses is providing a sense of “climate stability index” by elevation for each species.

We have used PRISM and an elevational adjustment (Wang UBC) to develop a snow model for the landscape around Mount Edgecumbe to contrast with the occurrence of remotely-sensed cedar decline. This year we will expand the model for broad-scale use in southeast Alaska using the conservative B2 of the HADCM2 global circulation model to project future snow zones ahead nearly 100 years.

Our team: Caouette is a statistician, a SAS expert, and is familiar with each of these inventories; Wittwer is an exceptional expert with GIS analysis and with PRISM models, and Hennon is a leading authority on the ecology of yellow-cedar and its decline. We work closely with FIA frequently seek expert advice on PRISM and global circulation models.

c. Products: A new distribution (host) model and GIS layer will be produced for yellow-cedar. We will also produce separate and combined maps for the two major risk factors for cedar decline: snow accumulation and soil drainage. These GIS layers on host type and risk factors will be the basis for the next risk map analysis for cedar decline.

Beyond maps, this project will clarify how climate variables have shaped and continue to shape yellow-cedar with a focus on 1) the distribution of the tree, 2) distribution of the decline problem, and 3) areas where yellow-cedar is actively regenerating (and potentially migrating).

d. Schedule of Activities:

Year 1:

- Use existing inventory data (see above) to produce yellow-cedar maps and GIS layers for general occurrence, mortality, and regeneration [coarse GIS layer is done, high resolution map will be produced in 2010].
- Establish relationships of occurrence, mortality, and regeneration with latitude, elevation, and secondary components such as soil drainage [done, with soil drainage factor to be added in 2010].
- Construct a snow model for all of southeast Alaska using new PRISM tool and HADCM3 general circulation models based on the preliminary Mt Edgecumbe snow model [nearly complete, will be finished by fall 2009].
- Present findings at international symposium on redcedar and yellow-cedar [this meeting was delayed until May 2010 where findings will be presented]
- Recover and prepare data from older inventories (1950s -1970s) for use in year 2 [progress is still underway on these older inventories].

Year 2:

- Revise maps and GIS layers, from year 1 using complete compliment of inventories.
- Integrate GIS layers, including the 100-year snow model projection and soil drainage classes to produce a final map and GIS layer that identifies areas of southeast Alaska that are suitable and unsuitable for yellow-cedar conservation and active management into the future.
- Synthesize all findings into a publication, promote to forest managers and policy makers, present at the 2010 International Cedar Symposium.

e. Progress/Accomplishments:

Progress during 2009 for each part of the project is stated above in (d).

COSTS:

	Item	Requested FHM EM Funding	Other-Source Funding	Source
YEAR 1				TongNF/TNC
Administration	Salary			“
	Overhead	2,000	3,000	“
	Travel	2,000	3,000	“
Procurements	Contracting	10,000	15,000	“
	Equipment		1,000	“
	Supplies	1,000	2,000	“
Total		\$15,000	\$24,000	“

	Item	Requested FHM EM Funding	Other-Source Funding	Source
YEAR 2				RO, IM
Administration	Salary			“
	Overhead	2,000	3,000	“
	Travel	2,000	3,000	“
Procurements	Contracting	10,000	15,000	“
	Equipment		1,000	“
	Supplies	1,000	2,000	“
Total		\$15,000	\$24,000	“

We have been promoting this project to the Regional Office of the Alaska Region and have secured inventory and monitoring funds that will begin in FY2010 to help accelerate this project. Contracted amount is primarily to support John Caouette, statistician, The Nature Conservancy (TNC). The mix of funds from these two outside sources is expected to be 70:30, respectively.