

**TITLE: Yellow-Cedar Decline: Evaluating Key Landscape Features of a Climate-Induced Forest Decline**

**LOCATION:** Tongass National Forest, Southeast Alaska, Region 10

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

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**COOPERATORS:**     Dave D'Amore, research soil scientist, PNW, Juneau, AK  
                              Greg Walker, Poker Flats Research Range manager, University of Alaska, Fairbanks, AK (use of drone)  
                              Dave Albert, Nature Conservancy, Juneau, AK (snow map)

**PROJECT OBJECTIVES:** The overarching goals of the yellow-cedar decline program are to better understand the cause of the decline problem and to use this knowledge and related information to develop a conservation strategy for this valuable species. The specific goals of this proposed project are to 1) produce a more resolute distribution map of yellow-cedar decline at the mid-spatial scale than is possible with the annual aerial detection survey; 2) use this map to test observations on terrain controls on the distribution of yellow-cedar decline, especially elevation and aspect; 3) develop new methods to detect and verify mapping of both healthy and declining yellow-cedar, contrasting two aerial platforms, helicopter and a remote control “drone”, unmanned aircraft imaging system; and 4) to revise the yellow-cedar decline risk map.

**JUSTIFICATION:** Yellow-cedar decline is the most wide-spread, long-term, and economically and ecologically important forest health issue in southeast Alaska. New information indicates that the problem is related to climate change resulting in early tree dehardening from warmer spring days, followed by freezing injury due to a reduced protective snow pack. We are evaluating yellow-cedar cedar decline at different spatial scales including broad (the entire panhandle of Alaska by aerial survey) and fine spatial scale (two watersheds by ground plots and remote sensing such as LiDAR). An intermediate spatial scale approach is needed because neither the broad nor the fine spatial scales are appropriate for FS ranger district project plans, nor for evaluating landscape features (especially elevation and aspect) associated with declining forests. We need to understand how elevation and aspect are related to yellow-cedar decline in order to model portions of the landscape of southeast Alaska that are suitable for yellow-cedar regeneration and management under different future climate scenarios. This information will also be incorporated into new next phase of risk map modeling.

**DESCRIPTION:**

**a. Background:** Yellow-cedar decline affects the most valuable tree species in the state and covers more than ½ million acres. The problem is likely related to a warming climate and reduced snowpack (see above). The distribution of this forest problem has

been thoroughly mapped during the annual aerial survey and is available to managers in GIS format. The resolution of the map is not adequate for either project level planning by resource specialists, nor for use in evaluating landscape features related to yellow-cedar decline. Although dead yellow-cedar can be mapped by air and detected on remotely sensed images, the presence and abundance of yellow-cedar in healthy forests is not easily distinguishable from other species and not currently quantified or mapped on a broad scale.

**b. Methods:**

We selected Mount Edgecumbe, an inactive volcano near Sitka, AK, as the best landscape for this mid spatial-scale project. It is unique in having radial symmetry and a fairly even slope gradient that apparently supports yellow-cedar forests from sea level to near timberline. These features are ideal for evaluating patterns of cedar distribution and health over combinations of elevation and aspect.

This project takes a tiered spatial scale approach to map yellow-cedar decline and surrounding healthy forests. The highly resolute Color Infrared (CIR) derived map can be used to check the accuracy of our typical and existing aerial survey map of the area. Observation by helicopter provides a closer examination of the CIR-mapped forest. Ground plots give a check for the helicopter observations. And, finally, an unmanned drone will be used to collect remotely sensed data in precisely the same locations to contrast with these more traditional forms of survey.

**c. Products:**

1. We have produced a poster and intend to published a paper on this mid-scale analysis of yellow-cedar. The poster will be displayed at the next Evaluation and Monitoring meeting.
2. Results from this project were folded into a developing management strategy for yellow-cedar under climate change. These were communicated by presentation and written publication.

Hennon, P.E. 2007. The vital role of snow in protecting yellow-cedar from an extensive forest decline in Alaska. In: McGurk, B., ed.. Proceedings of the 75th Western Snow Conference. San Francisco, CA.: San Francisco Public Utilities Commission. In press.

Hennon, P.E.; D'Amore, D.; Wittwer, D.; Caouette, J. 2007. Yellow-cedar decline: conserving a climate-sensitive tree species as Alaska warms. In: Deal, R., ed. Proceedings of National Silviculture Workshop. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. In press.

3. Results of the Mt. Edgecumbe project were presented with personnel from the Tongass National Forest and the Alaskan public. In FY07, this information was presented at five presentations in Sitka, Ketchikan (2), Wrangell, and Juneau.

4. Use new knowledge on role of elevation and aspect to refine the next generation of risk map for yellow-cedar decline that incorporates altered late winter/early spring snow patterns by in a warming climate (future).

**d. Schedule of Activities:**

First year (FY07):

Acquire CIR photography, produce yellow-cedar decline map, check the map with over flight, conduct helicopter and ground observations of healthy forests. Produce preliminary maps.

Second year (FY08): Produce final maps, perform analyses on mapped data, conduct drone flights, contrast drone flight data with previous techniques, revise poster and produce manuscript.

**e. Progress/Accomplishments:**

**Progress in FY07:**

1) We developed a high resolution distribution map of dead yellow-cedar stands for on Mt. Edgecumbe using color infrared photography at a scale of 1:60,000. The map was then assessed for accuracy and revised based on an observation flight in a small aircraft. This map derived from aerial photography interpretation was then contrasted to the coarser map of decline from the typical aerial survey. Contrasts were made in terms of total acres and number of polygons mapped to evaluate coarseness between these two approaches.

2) We used the final CIR-derived map to evaluate the influence of elevation and aspect on the distribution of yellow-cedar decline. Results indicate an elevational limit to yellow-cedar decline, and this limit is dependent on aspect (i.e., decline occurs at higher elevation on the warmer S and SW aspects).

3) We designed and executed a helicopter survey to map the composition of the forest in the upper elevation apparently healthy forests. This required a new approach because differentiating yellow-cedar and other tree species is difficult from aerial photographs or observation from airplanes. A total of 86 sample points were assessed via helicopter observations at predetermined locations designed as a radial systematic grid. The percentage of the stand that was live and dead was assessed, as was the species composition of the live trees. We then constructed a Kriged interpolated map depicting the relative abundance of yellow-cedar in these higher elevation healthy forests.

4) We assessed the accuracy of the helicopter observations on species composition in the live forest (see 3 above) by measuring trees on 53 ground plots in these forests.

**Expectations in FY08:**

We intend to evaluate the use of a “drone”, unmanned aircraft system, with onboard infrared imaging systems to accomplish steps 1 and 3 above. Mapping results from the

“drone” will be contrasted with analysis of CIR-photography of the dead forests and helicopter observations of live forests.

**COSTS:**

	<b>Item</b>	<b>Requested FHM EM Funding</b>	<b>Other-Source Funding</b>	<b>Source</b>
<b>YEAR ONE</b>				
<b>Administration</b>	Salary		9,000	FHP,PNW
	Overhead		2,000	FHP,PNW
	Travel	4,000		
<b>Procurements</b>	Contracting	4,000		
	Equipment	1,500	6,000	FHP
	Supplies	500		
	<b>Total</b>	<b>\$9,000</b>	<b>\$17,000</b>	

	<b>Item</b>	<b>Requested FHM EM Funding</b>	<b>Other-Source Funding</b>	<b>Source</b>
<b>YEAR TWO</b>				
<b>Administration</b>	Salary		9,000	UAF, FHP, PNW
	Overhead		2000	FHP,PNW
	Travel	4,000		
<b>Procurements</b>	Contracting	4,000		
	Equipment	500	70,000 drone	UAF
	Supplies	1500		
	<b>Total</b>	<b>\$9,000</b>	<b>\$81,000</b>	