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Where Are They Now?

Nancy Bigelow has maintained strong ties to the Center for Global Change

Nancy Bigelow, Director of the Alaska Quaternary Center at UAF, has been an active member of the Center for Global Change's Science Steering Committee since Fall 2005. However, her involvement with CGC goes back much further than that. It began in 1993 when Nancy successfully submitted a proposal to the very first Global Change Student Research Grant Competition for a project entitled "Late-Glacial and Postglacial Climate of the Northern Alaska Range." Since then she has reviewed many proposals for the competition and serves frequently on the review panel that makes the final funding recommendations.

Originally from eastern Massachusetts, Nancy has lived in Fairbanks since 1985. She earned a B.A. in History from the University of Vermont and an M.A. in Anthropology

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Nancy Bigelow (far left) and colleagues Andrea Krumhardt, Mark Shapley and Amanda Booth on a coring trip at Eightmile Lake near Healy, Alaska, November 2006 (photo by Herbjørn Heggen). Inset: Nancy in 1994 (archives of the Center for Global Change).

Student Awardee's Research Gains International Attention

Katey Walter, a 2001 student grant recipient, is lead author on a paper published recently in *Nature* that was based in part on her project funded by CGC. "Methane Bubbling from Siberian Thaw Lakes as a Positive Feedback to Climate Warming" garnered international attention when it appeared in the September 7, 2006 issue of the journal.

Along with her colleagues Sergey Zimov, Jeff Chanton, Dave Verbyla and Terry Chapin, Katey reported on an important source of atmospheric methane that until recently has been underestimated but may in fact contribute significantly to a positive feedback mechanism for climate warming. They developed a new method to capture and study the methane bubbling up from the bottom of Siberian thaw lakes—lakes that are expanding into thawing permafrost—and found that this type of emission may increase the overall estimate of methane emissions from northern areas by up to 63% from previous numbers. This additional methane could be expected to contribute to further warming of the atmosphere, which would in turn cause more permafrost to thaw, creating a positive feedback cycle.

In November 2006, Katey reported to the Royal Society in London as part of a Trace Gas Biogeochemistry and Global Change meeting, presenting this work together with a first-order estimate of pan-arctic lake CH_4 emissions for publication in the upcoming volume of Philosophical Transactions of the Royal Society A. Together with co-authors, Katey plans to submit another chapter of her dissertation for publi-

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(archaeology) from UAF. It was while working on her Ph.D. in Anthropology at UAF (awarded in 1997) that Nancy received her CGC award. She says she found the competition to be a valuable learning experience and that writing a "concise and cogent" proposal was probably the most beneficial aspect for her.

As her academic degrees suggest, Nancy has always been excited to learn about what things were like in the past. She says that the student competition reminded her that while she finds paleo research interesting in and of itself, she also needed to look at the much larger picture and to tie her results in with what is known about global change. This perspective is evident in her current research.

As a researcher, Nancy's work focuses on the terrestrial paleoecology of the Quaternary era (the past 2 million or so years of Earth's history), mainly in Alaska. She uses either geologic sections or lake cores to analyze different proxies such as pollen and plant macrofossils (for vegetation), charcoal (forest fire history), and sediment stratigraphy (environment in which the sediment was deposited). In one recent project, Nancy found that a vegetation reconstruction from a lake core in southwest Alaska suggests that alder expanded after the massive Novarupta eruption in 1912. She notes that "to what extent the eruption and resulting volcanic ash promoted alder growth is still being discussed. This is important because alder expansion has become a hallmark of global change." Her results indicate either that global change affected the vegetation earlier than was previously thought, or that in this region, the ash itself promoted alder growth, or, more likely, that some combination of both factors was at work.

Nancy's continuing commitment to student research is demonstrated by the time and effort she willingly puts into writing reviews and serving on the review panel. As she reads each proposal, she keeps several criteria in mind: Is the research related to global change? Is the research feasible, with explicit goals? How well is the proposal written and/or presented? Nancy says that the best proposals do well in all three of these categories. She believes that the benefit for the student proposer lies primarily in the quality of each reviewer's comments. "I try to be positive, fair and detailed." Nancy also notes that "it happens on occasion that students are not given an award on the first attempt, but are encouraged to resubmit. If they address the reviewers' concerns when they resubmit the following year, the proposals are often exceptionally good and frequently rank near the top of the list."

In addition to the satisfaction of helping students, Nancy points out there are other benefits to participating in the review process: "quite often you come across really good proposals and creative projects. In addition, reading the proposals introduces me to topics and ideas that I may not have come across during my normal research activities." ❖

This is the second installment of a series featuring past student award recipients.

Katey Walter: Continued from p. 1

cation in *Science* on the role of thaw lakes as an atmospheric methane source during Holocene deglaciation.

This spring Katey will travel with the British Broadcasting Corporation to Cherskii, Siberia, to make a documentary film on permafrost thaw and lake methane dynamics as part of the BBC's brand new series on our planet, which will present a biography of Earth, looking at its past, present and future. Each episode (five in total) will focus on one of Earth's most powerful forces—in this particular case, the atmosphere.

Katey received her Ph.D. in Biology in May 2006. In December 2006 the Council of Graduate Schools presented her with the nation's most prestigious honor for doctoral dissertations, one of two awards given annually that recognize recent doctoral recipients who have already made significant contributions to their field. Katey will continue with her work on methane emissions from arctic lakes as an IPY (International Polar Year) postdoctoral fellow at UAF's Institute of Arctic Biology.

We congratulate Katey on her many successes and are pleased that we were able to contribute to her graduate education at UAF! ❖

Walter, K.M., S.A. Zimov, J.P. Chanton, D. Verbyla and F.S. Chapin III. 2006. Methane bubbling from Siberian thaw lakes as a positive feedback to global warming. Nature 443:71–75.

2007 Global Change Student Research Grant Competition

Application materials are now available for the 2007 student competition. A few highlights from the guidelines are outlined below. Be sure to carefully review the complete guidelines before applying. They are available for download at http://www.cgc.uaf.edu or in hard copy from the Center for Global Change in 306 IARC or from the Graduate School office in 202 Eielson.

Submission Deadline: Proposals are due at the Center for Global Change by 5 p.m. on Friday, February 23, 2007.

Eligibility: Students must have graduate or undergraduate status in a degree-granting program at UAF at the time the work will be conducted.

Research Areas: Social sciences, physical sciences, biological sciences, engineering

Award Duration and Amount: One or two years, up to $5,000 for each year. Awards will be announced in early May 2007.

Proposal Content and Page Length: Proposals should contain an abstract, justification and need (including relevance to global change or its effect upon arctic or subarctic processes, ecosystems, and/or societies), objectives and

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2006 Student Research Grant Recipients

The Center for Global Change and Arctic System Research, along with its funding partners, the Cooperative Institute for Arctic Research and the International Arctic Research Center, funded the following student projects through the 2006 Global Change Student Research Grant Competition. These 12 awards were selected from a total of 34 submitted:

Jason Addison, Department of Geology & Geophysics
Late Quaternary environmental change in the Gulf of Alaska

Michael Anderson, Department of Biology & Wildlife
Assessing the role of host selection by Alnus incana of specific Frankia strains in an overall nutrient acquisition strategy: implications for regional N inputs and global climate change

Travis Booms, Department of Biology & Wildlife
Gyrfalcon international nest inventory (GINI): a concurrent circumpolar nest survey and GIS model of unprecedented scale

Nathan Coutsoubos, Department of Biology & Wildlife/RAP
Tundra-nesting shorebirds in relation to landscape transformation and climate change

Ian Herriott, Department of Biology & Wildlife
Alive and active: microbial community dynamics in seasonally frozen boreal forest soils

Dawn Magness, Department of Biology & Wildlife/RAP
A survey of management strategies linking global change to decision-making in the National Wildlife Refuge System

Shannon McNeeley, Department of Anthropology/RAP
Climate change and variability in interior Alaska: an interdisciplinary approach to data integration and synthesis for establishing regional patterns relevant to stakeholders

Dmitry Nicolsky, Geophysical Institute
Investigating application of a GCM to simulations of long-term permafrost evolution

Sarah Runck, Department of Forest Sciences
Sensitivity of soil organic carbon to long-term throughfall exclusion in interior Alaska

Blaine Spellman, Department of Forest Sciences
White sweetclover in Alaska: can this invasive affect the floodplain vegetative community?

Ina Timling, Department of Biology & Wildlife
Fungal response to manipulated snow depth in moist acidic tundra

Katie Villano, Department of Biology & Wildlife
Assessing wildfire burn susceptibility to invasive plant colonization in black spruce forests of interior Alaska

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2007 competition: Continued from p. 2

approach. Maximum page length is 5 single-spaced pages in no smaller than 11 point font.

Evaluation Criteria: Proposals are judged according to the following criteria with approximate weighing factors:

1. Scientific and technical merit of the proposed research. (30%)
2. Relevance to global change or its effect upon arctic or subarctic processes, ecosystems, and/or societies. (30%)
3. Feasibility of the proposed research as written. (30%)
4. Presentation of proposed research in an interdisciplinary context or demonstration of relevance beyond a single discipline. (10%)

Review Process: All proposals will be prescreened by a subset of the Center for Global Change scientific steering committee for compliance with guidelines, relevance to the competition, and overall presentation (coherence, correct English usage, absence of typographical and citation errors). Proposals remaining after this screening will be sent out for review by UAF faculty and other professionals. Following this, a review panel of UAF faculty meets to discuss the proposals and mail reviews and make funding recommendations. ❖

Student Research Grant Reports—Past Recipients

Implications of Observed Climate Change for Reindeer Herding on the Seward Peninsula, Alaska

*by **Kumi Rattenbury**, RAP/Department of Biology and Wildlife, UAF*

Introduction

Central to the climate change discussion is the impact of weather and other environmental conditions on land and natural resource–based livelihoods. Reindeer herding on the Seward Peninsula, Alaska is no less affected by weather, ice or snow cover today than when reindeer were introduced to the region in 1891. However, favorable conditions may be more critical today because of the threat of loss to the Western Arctic Caribou Herd that has wintered in the region since the late 1980s (Schneider et al., 2005). Herders state that delayed onset of winter conditions has become the norm in recent years and this may preclude the ability to move reindeer from the path of migrating caribou in early winter. Moreover, changes to expected storm frequency and snowfall and earlier break-up in recent years have negatively affected the ability to access, slaughter, corral, and protect the herd from predators. Because the majority of herding occurs in the winter due to the ease of access by snowmachine, climate change resulting in shorter and warmer winters is anticipated to further hinder this key industry on the Seward Peninsula.

The adaptability of herding to changing conditions is locally specific and dependent on the linkages and processes within the social–ecological systems (SES) that comprise each herder's situation. An SES is the relationship of people with their environment (Robards and Alessa, 2004). There is significant variation between individual herders on the Seward Peninsula for residence, range location and terrain, amount of loss to caribou, management style, family and economic situation—in essence large variation between individual SESs. Because of these differences, an interdisciplinary case study with one herder was conducted to address the following objectives:

1) Describe winter herding practices and the conditions that influence herd management;
2) Document and illustrate changes to those conditions;
3) Examine how weather station data may or may not contribute to the understanding of "herdable" weather conditions in the region; and
4) Relate herding adaptations to caribou and climate change with the entire herding SES.

Methods

This study focused on the past and current herding practices and weather observations of a reindeer herder from Teller, Alaska. He has lost 90% of his herd to caribou, but continues to manage the remaining reindeer despite the possibility of caribou migrating onto or near his range each winter. Research was initiated in the winter of 2003–2004, and included field interviews, where the landscape, microclimate variation, and specific herding practices were discussed; mapping interviews, during which past and current range use, caribou movement, and areas of environmental concern were marked on topographic maps; weekly phone conversations, when we matched herding activities with concurrent weather station data; and additional discussions about weather requirements for various herding activities. There were also significant opportunities for participant observation during scheduled herding activities such as moving and corralling the herd and slaughter.

HOBO® weather stations that recorded temperature, wind speed, and wind direction were deployed in the late winter and spring of 2004 and again in 2005 at critical herding sites on the herder's range. Weather station data were also analyzed from permanent stations in the region including those run by UAF's Water and Environmental Research Center at Kougarok and the Teller airport, and the National Weather Service station in Nome. Snow depth and snow hardness were recorded via transects at the HOBO® stations.

The herder was asked to rate the weather and trail conditions on days that he traveled to and worked with his herd ("minimal" or "good" in terms of herd accessibility and travel speed) as well as to indicate days when conditions were too "poor" for travel. Weather station data, snow data, and the herder's observations of the weather were compared with these ratings. GIS maps were made to illustrate the spatial relationships between reindeer distribution, herd management activities, and caribou distribution for the winters of 2003–2004 and 2004–2005. The relationship between station data, the herder's observations and his ratings, and the GIS data were then tied into a discussion of his herding SES with implications for past, current, and future challenges and opportunities.

Research Findings and Conclusions

Weather station data, including calculated windchill, did not correlate with the herder's ratings of daily weather conditions. Instead reduced visibility due to falling or blowing snow, flat light, and/or fog were implicated for most "poor" rated days in both winters. Moreover, "poor" trail conditions likewise prevented travel in particular due to inadequately frozen waterways and occasionally due to significantly low, significantly deep, or melting snow cover. However, certain situations trumped poor weather or trails (excluding the freeze-up of waterways). The herder traveled under poor conditions when the herd was in immediate danger of predators or of mixing with caribou, or when he was traveling to flatter, more familiar territory on his range. On the other hand, extremely inclement weather and other environmental conditions occasionally combined to inhibit herding at critical times. In November and December of 2004, a late freeze-up and frequently stormy and foggy weather prevented the herder from regrouping and moving his herd to a caribou-safe area. In fact, the low visibility increased the "skittishness" of the reindeer when he attempted to move them. In December, a valuable group of steers wandered off range presumably in the company of caribou that had been observed in the vicinity. These steers were never recovered.

The role of weather, and ultimately climatic expectations, fits within a decision tree that is constantly changing as factors change within the entire SES. In the past the herder would travel on very low or no snow cover when he could afford an additional, expendable snowmachine. This is not the case today as the small herd and depressed antler prices have significantly reduced the profitability of the herd. Inclement weather limits herd access and can seriously disrupt the balancing act between increasing herd monitoring under caribou presence and finding the economic means to do so. The costs of continuing to herd are no longer offset by antler and meat sales, but are now met by employment in non-herding jobs and increased personal time on the range.

Delayed freeze-up (as in 1996, 2002, and 2004), frequent storms (as in fall 2004) and early break-up (as in April 2004) decrease herder mobility and have been implicated in instances of herd loss to caribou or predators. If such events occur more frequently, as is expected by numerous local knowledge holders and climate change models, herders will have to expand their caribou mitigation strategies to include adaptations for shorter and warmer winters.

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Assessing the Feasibility of Conversion from Fossil Fuel to Wood Energy for Power Generation in Rural Alaska

*by **Nancy Fresco**, RAP/Department of Biology and Wildlife, UAF*

Introduction

In rural Alaskan communities, the use of fossil fuel for power generation is associated with high economic, social, and ecological costs. Local concerns regarding fuel prices, environmental contamination, and the effects of global climate change have resulted in increased interest in renewable energy sources.

In this study I assessed the feasibility of switching from fossil fuels to biomass systems using wood energy in rural Alaskan villages in forested regions of Interior Alaska. My results indicated that the installation costs of biomass systems would be recouped within ten years for at least 21 communities in the region. All but the largest remote communities in the Interior could meet all their electrical demand and some heating needs with a sustainable harvest of forest biomass within a radius of 10 km of the village. Marketable carbon credits may add an additional incentive for fuel conversion, particularly if U.S. prices eventually rise to match European levels. Biomass conversion also offers potential social benefits of providing local employment, retaining money locally, and reducing the risk of catastrophic wildfire near human habitation.

Important Considerations in Energy Conversion in Rural Interior Alaska

Village fuel systems

Approximately 200 villages in Alaska are "off-grid" and are supplied with electricity by diesel generators. Due to the high costs of fuel transport and storage in rural Alaska, energy prices are extremely high. And while rising fuel prices are likely to be the single greatest driver for a change from diesel-only systems, such a change would have other benefits as well. Diesel power generation causes air pollution; problems with effective fuel storage can lead to soil and groundwater contamination from spills; spills during transport or transfer can result in larger-scale contamination and risks to humans and wildlife; the risk of non-delivery of fuel under adverse conditions can result in loss of power; and the high cost of diesel fosters a dependency on subsidies. By contrast, new biomass technologies, including relatively simple boiler systems fueled by wood products, allow for both more efficient energy conversion and greatly reduced emissions of particulates and carbon monoxide.

Role of fire and fire suppression in rural Interior Alaska

Historically, naturally occurring fires in Interior Alaska have created a variegated landscape with multiple age-classes of forest succession (Dyrness et al., 1986). However, fire suppression around inhabited areas tends to decrease average annual area burned (DeWilde and Chapin, in press), which over time will tend to increase average forest stand age and reduce this variability, while also increasing the risk of future fires. While harvest and fire create different disturbances in forested areas (Rees and Juday, 2002), selective harvest does offer a means of introducing age-class variability and can reduce fire risk around communities.

Carbon markets

Markets for carbon credits have already appeared, even in nations that are not signatories of the Kyoto Protocol. In the U.S., the Chicago Climate Exchange (CCX) is currently the most viable carbon credit market. Unlike credits based on converting open land to forest, reforestation, or increased forest stocking, fuel offset credits are not one-time credits; as more fossil fuel use is offset over time, more credits can be earned.

Methods

For selected Interior Alaskan villages I created a simple model to estimate the forested area required to supply aboveground tree biomass over a rotation length that would mimic natural fire cycles while reducing fire risk in communities, optimizing aesthetic and subsistence values, and protecting ecosystem integrity. To do this, I incorporated ecological, economic, and social factors into the model.

Ecological considerations

Values for the energy available from whole trees, the biomass of black spruce available, and the efficiency of energy production were all drawn from available literature. In general, I made conservative estimates to avoid overestimating the viability of fuel conversion. Model output was expressed as maximum travel distance to obtain wood fuel.

Economic considerations

For the economic analysis, I considered not only the costs and benefits of construction, operation, maintenance, fuels, employment and carbon sequestration credits for diesel versus biomass systems, but also circulation of cash income and non-cash commodities within communities, and the effects of subsidies.

I estimated the cost of fuel procurement based on actual costs of clearing and thinning projects in rural communities. I calculated the potential value of carbon sequestration credits using data on existing markets in the U.S. and in Europe.

Social considerations

Analysis of social feasibility was primarily qualitative rather than quantitative, and included assessment of:

1) Existing social infrastructure related to village electrical utility management and funding, fire prevention, and biomass harvest;
2) Threshold requirements (make-or-break factors needed within a particular community or at a broader scale);
3) Existing institutional barriers to change;
4) Potential positive social feedback;
5) Potential negative social feedback; and
6) Lessons learned from existing biomass projects in rural Alaska.

Results

Ecological feasibility

Using nominal parameter values and a forest rotation length of 110 years, the model calculation of the maximum travel distance required to collect enough mature black spruce to meet average electrical loads ranged from 1.1 km to 12.8 km.

With the exception of the two largest communities, the maximum travel distance was calculated to be 6.2 km or less, a distance easily reachable by snowmachine or four-wheeler, allowing for relatively low-tech harvest using chainsaws and a portable chipper.

Economic Feasibility

For many of the communities in this analysis, total annual operating costs for electrical generation would be lower if all or part of the village's diesel power were converted to a biomass-fueled system.

When the added benefit stream of potential carbon sequestration credits is added to the potential annual savings gained by biomass fuel conversion, wood-fired electrical generation becomes more favorable. If 2006 prices were used as a baseline, model runs would become consistently favorable in almost all communities.

Social Feasibility

My qualitative social analysis yielded a conceptual map of where wood fuel might fit into village economies. Harvest of biomass fuels would provide local jobs, which in turn would bolster the local cash economy by recirculating money within each village. In contrast, payments for fossil fuels represent a monetary flow out of communities. Income from carbon credits would create a cash flow into the community from an outside source—something that is often in short supply in rural Alaska.

Potential barriers to change include inertia in available funding and subsidies, and low value of carbon credits. Threshold factors necessary for success include community involvement and skills as well as the formation of effective collaboration between funding sources, project managers, and local communities.

Conclusion

In rural Alaska villages, economic conditions make fossil fuel use unusually expensive, while social conditions favor autonomy and local employment. Ecological conditions are likely to allow for harvesting a sustainable fuel source in a manner that enhances rather than detracts from ecological resilience, due to the complex relationship between fire, forest succession, forest resources, fire suppression, and human settlements. Biomass fuels are likely to increase the long-term social and ecological resilience of village communities to externally driven changes, including fluctuations in fossil fuel prices due to state, national, or international policies; variability in Alaska's economic outlook, which might in turn impact subsidies; and changes in fire risk and fire management, driven by climate change and by state and federal fire budgets.

For all of these reasons, Interior Alaska village communities are in a position to be at the forefront in developing biomass fuels programs. Villages selected based on the combined social, ecological and social model outlined here would almost certainly reap benefits from the transition.

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Rees, D.C. and G. P. Juday. 2002. Plant species diversity on logged versus burned sites in central Alaska. *Forest Ecology and Management* 155(1–3):291–302. ❖

Widespread Decline of Yellow-cedar and Climatic Change in Southeastern Alaska

*by **Colin Beier**, RAP/Department of Biology & Wildlife*

Introduction

Yellow-cedar is the most valuable and long-lived tree in Alaska, yet the species is experiencing a dramatic decline across nearly 200,000 hectares of coastal temperate rainforest in southeastern Alaska. Twenty years of investigation have ruled out biotic causes (e.g., insects, fungi, pathogens) and have pointed towards a climatic explanation. Cedar dieback occurs almost exclusively in low-elevation populations established during the Little Ice Age, a period of cooling that ended regionally circa 1880. Based on prior research, we hypothesized that yellow-cedar decline has occurred in response to post–Little Ice Age warming via a mechanism involving thaw–freeze cycles in late winter. Thaws in late winter may trigger early, premature growth in yellow-cedar and reduce the snow cover that insulates soils from temperature extremes. Under these conditions, yellow-cedar may be more vulnerable to early-spring frosts that are common in southeastern Alaska. We studied this hypothesis at a landscape scale, using tree rings and weather records to describe changes in winter climate, the influence of climate on cedar growth, and the role of thaw–freeze events in cedar mortality during the 20th century.

The Cedar Decline Mystery

Yellow-cedar (*Chamaecyparis nootkatensis*), also known as Alaska cedar or yellow-cypress, is a long-lived, slow-growing tree species with an extensive natural range from northern California to Prince William Sound in southcentral Alaska. In Alaska, yellow-cedar can be found from near timberline to sea level, while populations south of Alaska generally are limited to high elevations (Harris, 1990). Decline of yellow-cedar has been observed on nearly 200,000 ha in southeast Alaska, and most recently in northern coastal British Columbia. Two decades of research on cedar decline has effectively ruled out biotic mechanisms (e.g., higher fungi, oomycetes, insects, nematodes, viruses and mycoplasmas, bears) and suggested an abiotic, climatic mechanism.

Most declining cedar stands are found in low elevation open-canopy forests on poorly drained soils, while cedar stands on similar sites at higher elevations remain healthy. Yellow-cedar is a precocious grower, able to rapidly initiate spring growth (dehardening) once temperatures warm sufficiently. The species may be more vulnerable to freezing injury because most trees have very shallow root systems in saturated soils (Hennon and Shaw, 1997). Spring freezing injury to conifers tends to be more severe on warm slopes or at low elevations (Havranek and Tranquillini, 1995); both factors are consistent with cedar decline, which is almost entirely found at low elevations, and more commonly on south- and southwest-facing slopes. Stand age studies suggest that the onset of decline occurred circa 1880, at the end of the Little Ice Age in southeast Alaska (Hennon et al., 1990). In sum, these observations have generated our hypothesis of cedar decline as a climate-driven phenomenon, resulting from an increased likelihood of thaw–freeze damage since the Little Ice Age.

Tree Rings and Weather Stations

We constructed an extensive tree ring record and regional climate history to evaluate our hypothesis at large spatial and temporal scales. Our landscape-scale approach was coupled with microclimatic observations at paired sites in an intensively studied watershed. Our analysis of tree rings and weather records had several objectives:

1) Understand the impacts of climate change on winter conditions in southeast Alaska;
2) Verify that declining populations were established during the Little Ice Age;
3) Compare yellow-cedar growth chronologies among declining and healthy stands;
4) Generate climatic predictors of cedar growth;
5) Describe the influence of late winter weather on cedar growth and decline; and
6) Identify freezing events that may have triggered cedar dieback.

The weather record was based on eight primary stations located near sea level, and required a significant amount of gap-filling and interpolation prior to analysis. Tree cores were collected from living trees at twenty sites across the region; eighteen of these stands were affected by cedar decline, while two were healthy. Our final sample consisted of 254 trees (from a total of 312 sampled) and represented the broad geographical extent of the decline phenomenon. Our regional climate history and dendrochronology (tree ring record) were the first created for the entire region of southeast Alaska.

What is Killing the Trees?

We found several lines of evidence to support the hypothesis that yellow-cedar decline has been driven by climatic changes since the Little Ice Age. Winter weather in southeast Alaska has become warmer and wetter during the 20th century. This shift has created potentially deleterious conditions for low-elevation yellow-cedar populations, associated with decreasing snowfall and an increasing frequency of thaw–freeze events. These trends suggest a significant distinction between contemporary and Little Ice Age winter conditions, especially at elevations near sea level where thawing temperatures are occurring earlier in the winter. Yellow-cedar's precocious growth behavior may have provided a competitive advantage during the Little Ice Age, but it appears this adaptation is poorly suited to modern climate.

Nearly all yellow-cedar trees in the sample populations were established during the Little Ice Age, with a majority dating back at least to the 1700s. Declining cedar populations shared a common growth pattern at a landscape scale that was characterized by common stress periods and about twice the interannual variation since the onset of decline (1910–present) compared to the variability pre-decline (1800–1909). This pattern, or climatic signal, was largely driven by variation in late-winter weather. The common stress periods (circa 1936, 1958 and 1987) appear to be partially related to early thaws and the subsequent hard freezes that are common in southeast Alaska during the early spring. A severe regional thaw–freeze event and below-average snowfall in 1987 resulted in an extremely low growth year for declining cedar throughout the region, and a pulse of mortality (based on snag ages) followed by a rapid growth response consistent with competitive release. Comparison of 1987 growth rings in healthy and declining sites within the same watershed suggested that thaw–freeze events may only be deleterious in the absence of insulating snow cover. High elevation cedar forest responded negatively to the 1987 thaw–freeze, but these forests remain unaffected by decline. This difference is probably due to snow cover, which is deeper and more persistent at high elevations, and buffers against soil freezing in these open-canopy stands (D'Amore and Hennon, 2006). In fact, the landscape pattern of cedar decline correlates spatially with low snowfall areas (based on a snowfall model for southeast Alaska). If warming and declining snowfall trends continue, cedar decline may expand from low elevation sites to currently healthy upland forests. This type of expansion has already been observed at a few decline sites in southeast Alaska, raising alarm for scientists and managers concerned with maintaining this long-lived, valuable species in the temperate rainforests of southeast Alaska.

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ACCAP Alaska Center for Climate Assessment & Policy

Announcing the Alaska Center for Climate Assessment and Policy

http://www.uaf.edu/accap/

With funding from the National Oceanic and Atmospheric Administration (NOAA), the Alaska Center for Climate Assessment and Policy (ACCAP) was launched in September 2006 with a mission to assess the socio-economic and biophysical impacts of climate variability in Alaska, make this information available and useful to local and regional decision-makers, and help Alaskans adapt to a changing climate.

A collaboration between UAF and UAA, this program is the newest of a group of Regional Integrated Sciences and Assessments (RISA) programs nation-wide. The initial focus of ACCAP is on the transportation sector with three pilot projects: terrestrial water balance affecting tundra travel and access to resources (Daniel White, PI), the synergistic effects of climate change and land use in the Upper Yukon River Watershed (Craig Gerlach, PI), and sea ice conditions affecting Alaskan coastal communities, marine ecosystems and offshore transportation (John Walsh and Hajo Eicken, PIs).

ACCAP aims to build partnerships between scientists and engineers, state, local and federal agencies, Alaska Native tribal governments and non-profit organizations, industry, non-governmental organizations and anyone whose decision-making is influenced by climate-related events.

If you are a scientist that studies any aspect of climate variability or a decision-maker that can use information about climate change, please contact ACCAP coordinator Sarah Trainor to become part of this information and research network: (907) 474-7878, fnsft@uaf.edu. ❖