Detecting Yellow-cedar Decline at Multiple Spatial Scales in Southeast Alaska

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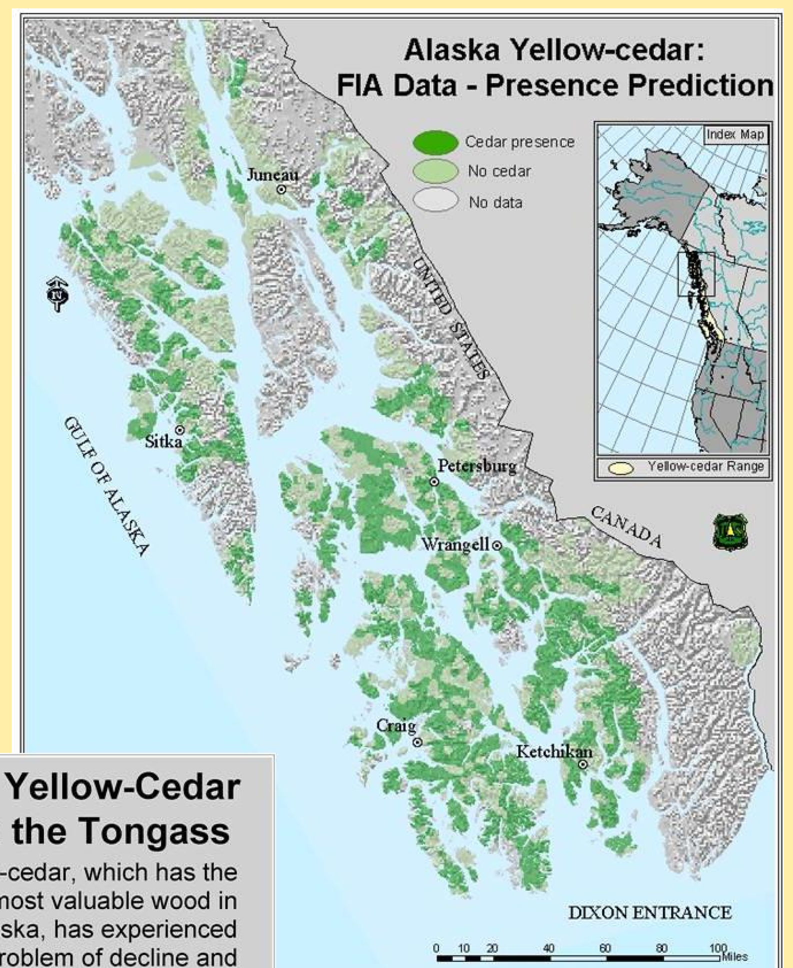
Introduction

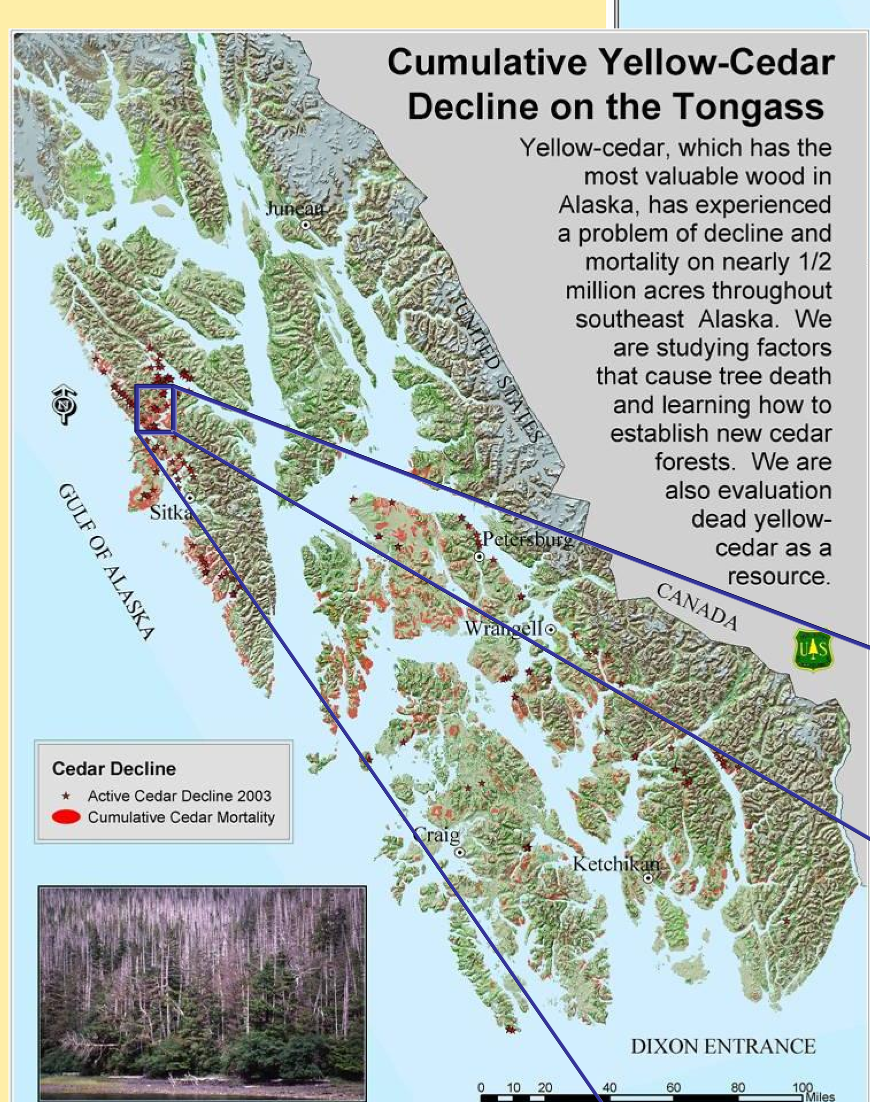
Yellow-cedar is an ecologically and economically important tree species that is dead or dying on over 200,000 ha of forestland in Southeast Alaska. We are developing methods to detect and classify this mortality at three spatial scales: regional (7x10^6 km^2), mid-scale (800 km^2), and small watershed (1km^2). Information from each scale provides clues about the cause of this mysterious forest problem, aids in salvage recovery efforts, and is useful as we help develop a management strategy for the species.

Regional Scale

Aerial sketch mapping and forest inventory plots are used at the regional scale to develop overall distributions of healthy and dying cedar forests.

Information from FIA plots paints an interesting picture of the distribution of yellow-cedar. There appear to be areas on the Tongass that lack yellow-cedar. Also, there are forests containing yellow-cedar outside of the main distribution of decline.



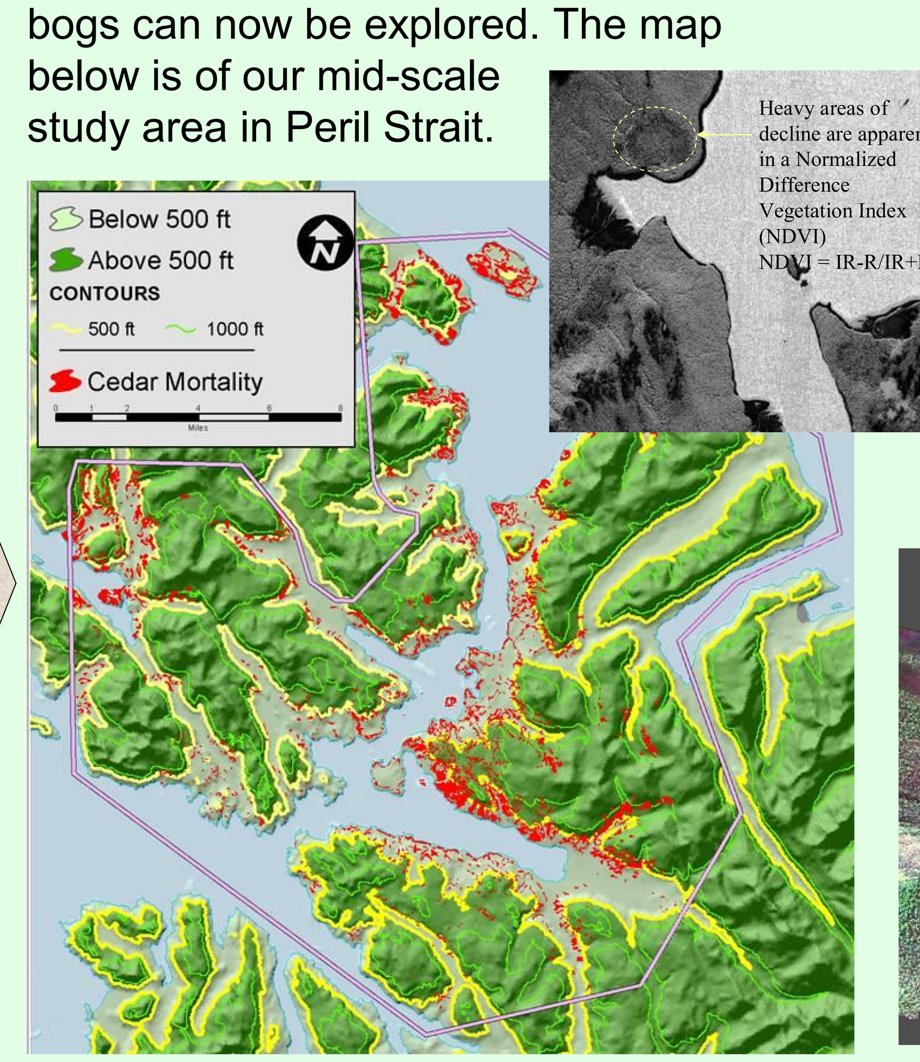


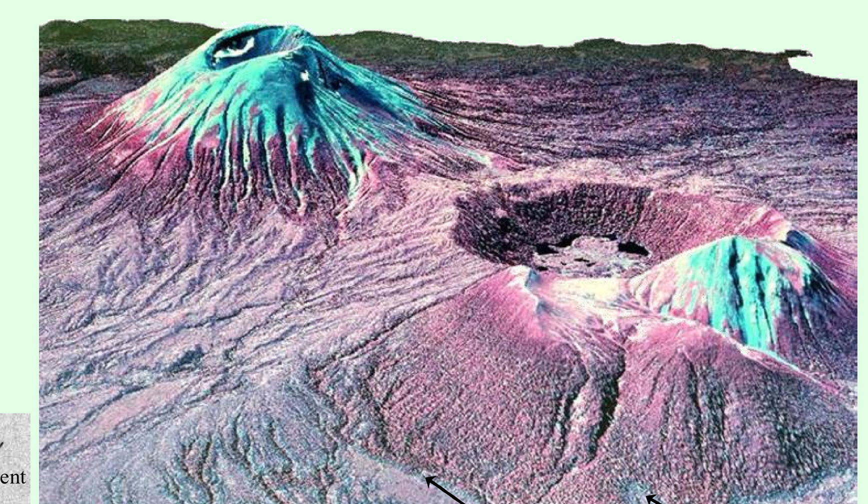
The refined classification to the right will allow us to more effectively explore the relationship of cedar decline and landscape position. The aerially sketch-mapped data are spatially too crude.

We developed the cedar decline distribution map via aerial sketch mapping techniques. Declining cedar forests are common throughout areas of southeast Alaska that have mild winters and less snowpack.

Mid Scale

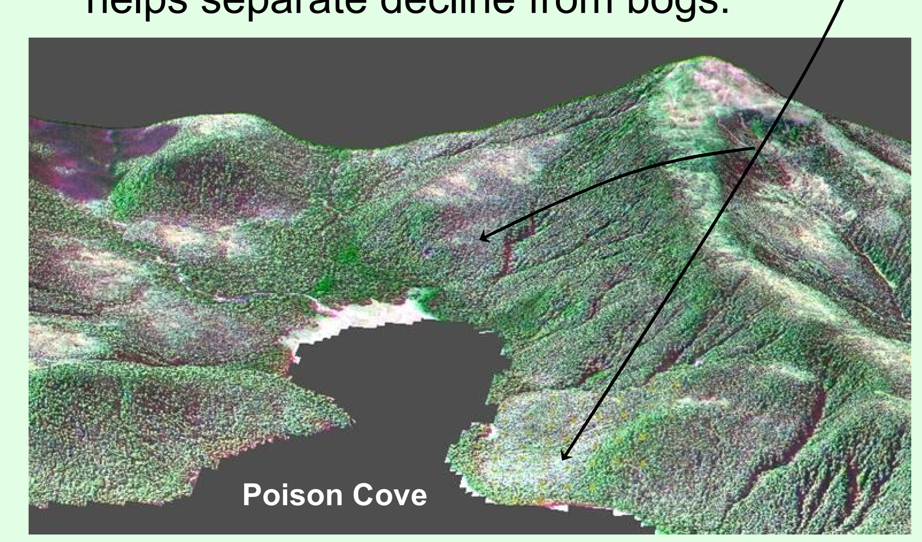
False-infrared photography (drape to the right) and SPOT satellite data are used to classify mortality at the mid scale. An association with elevation and proximity to bogs can now be explored. The map below is of our mid-scale study area in Peril Strait.





A resolution merge of 20 m multispectral SPOT data and 2 m panchromatic DOQs (shown below) clearly illustrates the decline areas. The textural component from the DOQs helps separate decline from bogs.

Decline



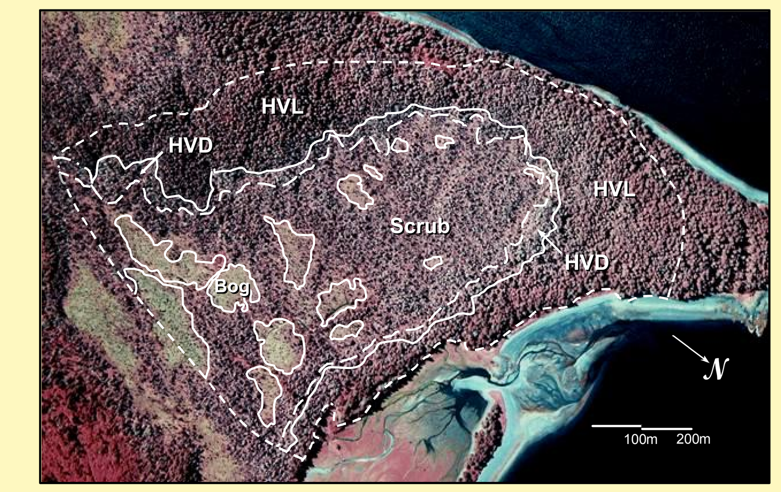
Conclusions

Information from detection can be used for many purposes, such as salvage recovery of dead cedar. Here, we use it to consider the cause of decline; each spatial scale reveals clues. At the regional scale, decline is limited to areas of warmer winters with less snow. Mid scale assessment indicates a strong association with lower elevations. Decline is found in open-canopy forests at our two small watersheds, but only at low elevation. Collectively, these clues implicate exposure as in important factor. In a separate study, we found that cedar is very tolerant of cold temperature in winter but is susceptible in early spring. We are currently measuring snow, soil and air temperature, hydrology, and soil chemistry to evaluate the complex of potential environmental factors that may cause this forest decline.

Small Watershed Scale

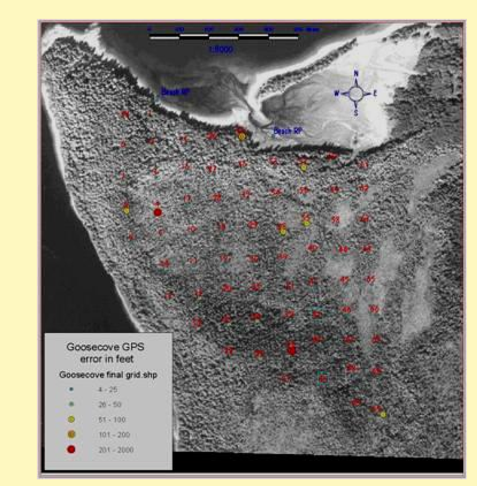
At the small watershed scale, IKONOS, various scales of color and false-infrared photography, LIDAR, image analysis, and ground vegetation plots are used to classify concentrations of dead trees. LIDAR will produce a highly resolute DEM for better future association of forest zones and decline with landscape position and micro-topography.

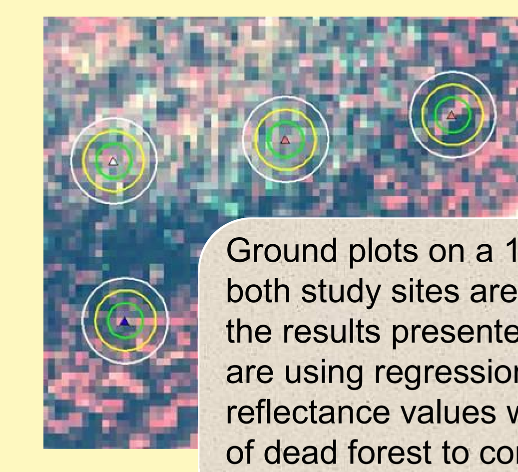
Goose Cove

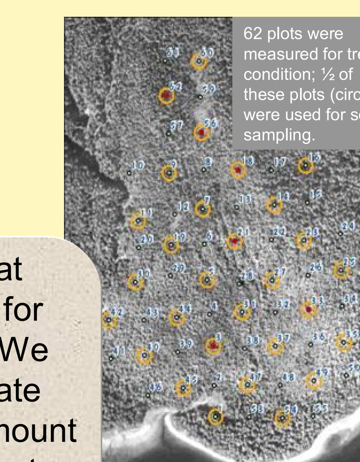


Poison Cove

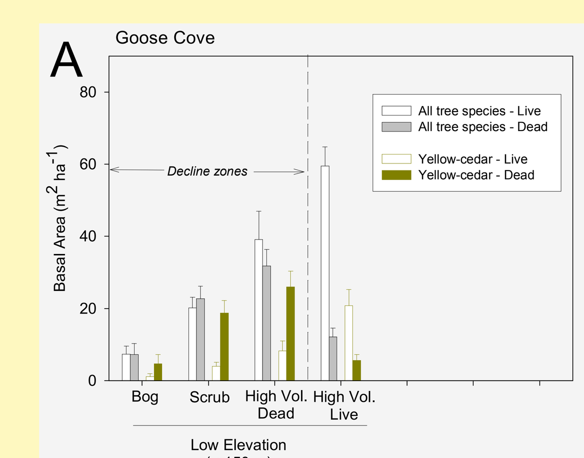
We classified the landscape at two small watersheds in Peril Strait according to canopy cover and tree mortality. Areas at the Peril Strait site are further classified by elevation because tree mortality appears to be limited to <150m elevation. HVD=High volume dead, HVL=High volume, live.

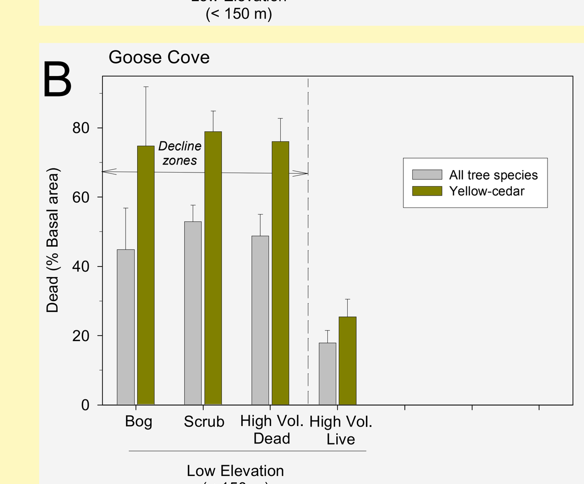




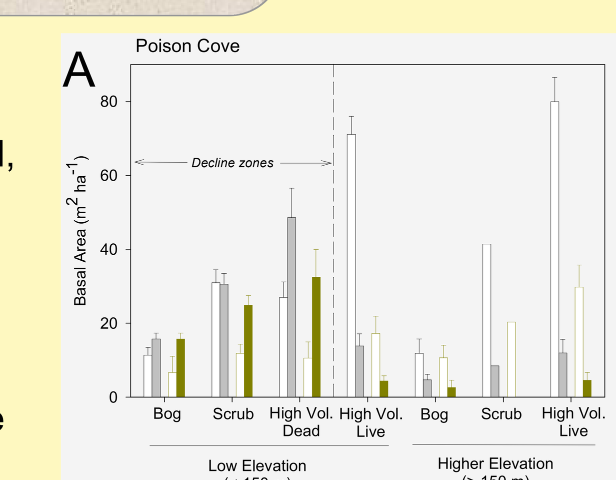


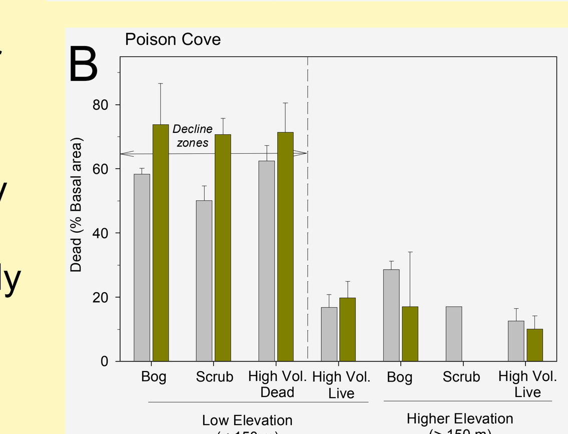
Ground plots on a 100m grid at both study sites are the basis for the results presented below. We are using regression to correlate reflectance values with the amount of dead forest to compare remote sensing methods.



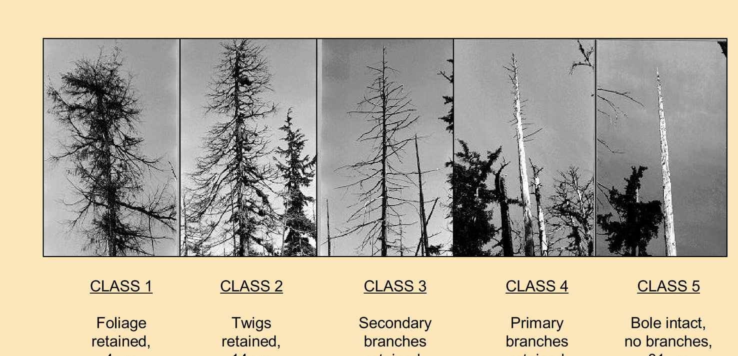


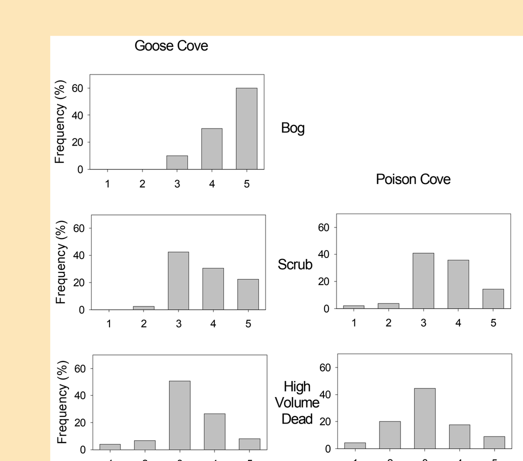
The basal area dead, for all tree species, and for cedar alone, increases from bog, scrub, and high volume dead zones (A). The percentage basal area dead is high >70% and relatively constant for yellow-cedar in the dead zones, but the roughly 20% mortality that we found in healthy forests is likely sustainable (B).





Snag classes – temporal scales





Examining the frequency of snags gives us a glimpse of the epidemiology of cedar decline over the last 80 years, which appears to differ somewhat by our forest classes.