Alder Mortality in Katmai National Park and Preserve

National Park Service

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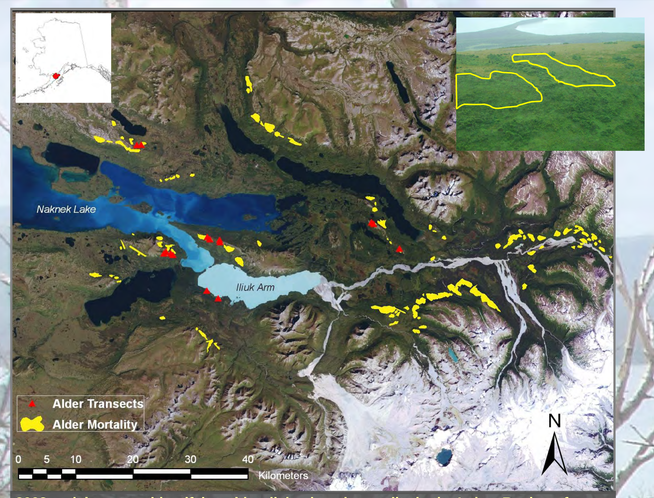


2008 aerial surveys identifying alder dieback and mortality in the Lakes Region of Katmai National Park. Impacted area is 6780 hectares.

Introduction

Dieback and mortality of alder (*Alnus* spp.) from pathogens, insects, and other factors is occurring throughout south-central and interior Alaska. Between 2001 and 2007 an infestation by the Sunira moth (*Sunira verberata*) caused defoliation of thousands of hectares of broadleaf trees and shrubs in Katmai National Park. In 2006, entomologists noted that while most species appeared to have recovered, alder stands showed signs of recent mortality where the Sunira moth outbreak had occurred (Forest Health Conditions in Alaska 2006).

In 2008 the National Park Service Southwest Alaska Network initiated a pilot study with the Alaska National Heritage Program and US Forest Service to assess alder condition in the Lakes Region of Katmai National Park. Aerial surveys were used to document the extent of the damage, and ground surveys were conducted to document conditions within impacted alder stands. The objectives of the study were to answer the following questions:

- How much of the alder in the study area has been impacted?
- Is alder still dying in the study area?
- Is resprouting or germination of new alder occurring underneath the affected alder?
- If new growth of alder is not occurring, what species are colonizing these sites?

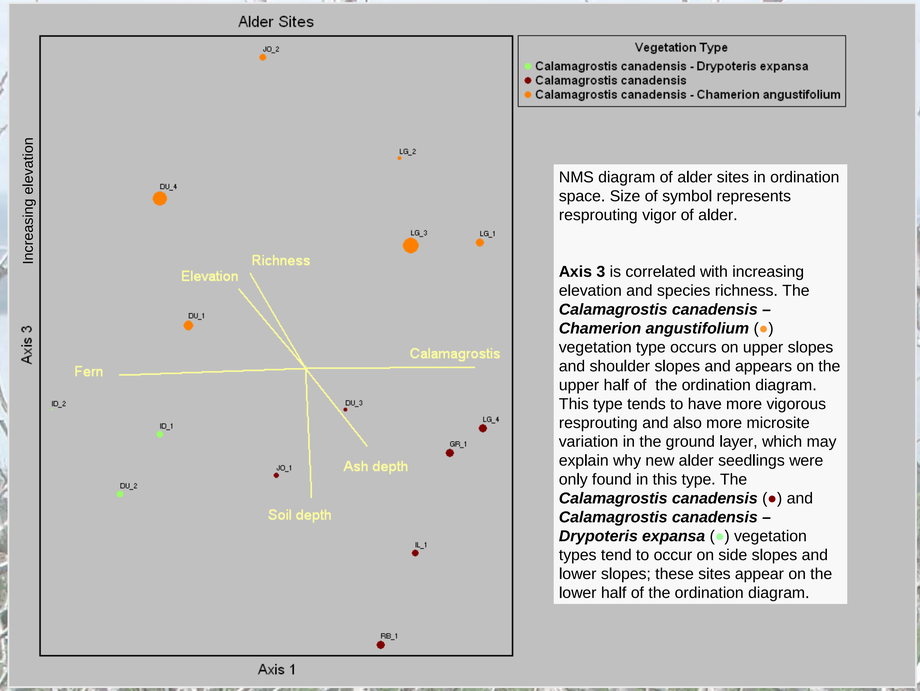
Methods

Aerial surveys were used to identify sites that appeared to have been severely defoliated (at least 75% of the alder canopy cover removed). 15 sites were selected for ground sampling:13 sites above treeline, and 2 sites at lower elevations on Iliuk Arm.

At each alder site, we measured shrub and understory characteristics along 2 50m X 2m belt transects. Along each transect, we tallied alder genets, number of live and dead stems per genet, % dieback, number of new sprouts, and new seedlings. We measured understory species composition and height using m^2 quadrats at 10m intervals. We estimated the depth of the surface ash layer and total depth of soil using a 2.54cm diameter soil probe.

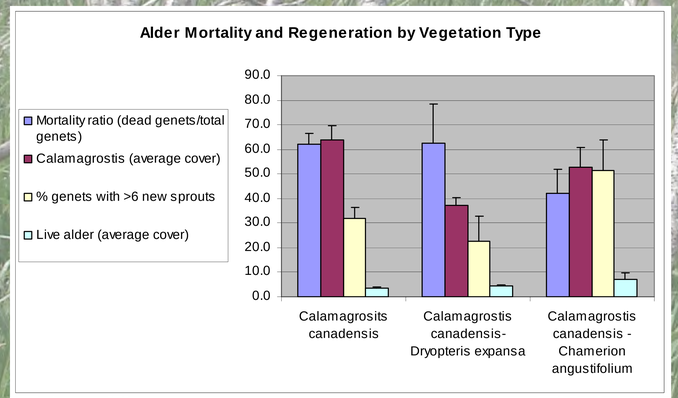
Plant community composition was evaluated using nonmetric multidimensional scaling (NMS). Vegetation types were grouped based on the results of two-way indicator species analysis (TWINSPAN) and NMS.

Alder dieback and mortality on Dumpling Mt.
Photo: Michael Shephard, 2007.



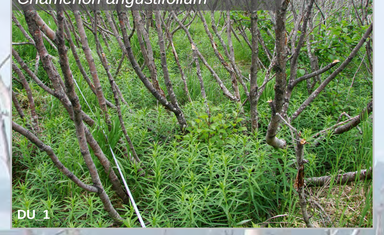
NMS diagram of alder sites in ordination space. Size of symbol represents resprouting vigor of alder.

Axis 3 is correlated with increasing elevation and species richness. The ***Calamagrostis canadensis – Chamerion angustifolium*** (●) vegetation type occurs on upper slopes and shoulder slopes and appears on the upper half of the ordination diagram. This type tends to have more vigorous resprouting and also more microsite variation in the ground layer, which may explain why new alder seedlings were only found in this type. The ***Calamagrostis canadensis*** (●) and ***Calamagrostis canadensis – Drypoteris expansa*** (●) vegetation types tend to occur on side slopes and lower slopes; these sites appear on the lower half of the ordination diagram.



Vegetation type	Calamagrosits canadensis	Calamagrostis canadensis - Dryopteris expansa	Calamagrostis canadensis - Chamerion angustifolium
	n=6	n=3	n=6
Dominant slope position	sideslope and lower slope	sideslope	shoulder slope and upper slope
Alder seedlings present	No	No	2 sites
Species richness (SE)	8.7 (1.0)	10.7 (0.3)	13.8 (1.3)
Ash depth cm (SE)	15.5 (2.7)	5.7 (2.2)	4.5 (2.0)
Soil depth cm (SE)	45.3 (4.4)	42.2 (11.1)	28.7 (6.8)

Calamagrostis canadensis – Chamerion angustifolium



- Occurs on shoulder slopes and upper slopes
- Highest species richness
- Two sites had new alder seedlings
- Highest proportion of vigorous resprouting

Seedbed microsite within *Calamagrostis canadensis – Chamerion angustifolium* vegetation type. (DU_4)

Calamagrostis canadensis – Dryopteris expansa

- Occurs on side slopes
- Species richness is intermediate between the other two vegetation types

Calamagrostis canadensis

- Occurs on side slopes and lower slopes
- Lowest species richness

Results

Live alder were identified as *Alnus viridis* ssp. *sinuata;* dead alder could not be identified to subspecies. Alder genet density (live and dead) ranged from 600/ha to 1850/ha, suggesting that sites had substantial shrub cover prior to infestation. In general, upper elevation sites had higher genet density, while lower elevation sites had a lower density. All of the 15 sites sampled had converted from alder shrublands to herbaceous meadows since the onset of the infestation.
Of the total number of genets sampled across all sites (366 genets), 54% were dead with no evidence of resprouting. Of the 15 sites sampled, the highest genet mortality ratio was 94% (ID_2), and the lowest was 12% (LG_3). New alder seedlings were present on 2 of the 15 sites (both sites were on Dumpling Mountain: DU_1 on an upper slope and DU_4 on a shoulder slope).

We did not observe ongoing defoliation of alder by the Sunira moth during our survey; however, many impacted alder genets showed poor resprouting vigor and other signs of stress such as chlorotic foliage and small leaf size. The future survival of these genets is uncertain, and they may be susceptible to secondary stressors. In order to quantify resprouting potential across sites, we considered genets with 6 or more new sprouts as viable and likely to survive and calculated the percentage of viable genets per site.

27% of the sites (4 sites) showed poor resprouting potential with less than 30% of the genets having at least 6 new sprouts. These sites all had high canopy cover of *Calamagrostis canadensis* (71% to 94%).
20% of the sites (3 sites) showed strong resprouting potential with 54% or more of the genets having at least 6 new sprouts (two of the sites had over 80% vigorous resprouting).
On the remaining 8 sites, between 30% and 44% of the genets showed vigorous resprouting. Whether these sites will remain herbaceous meadows or return to shrublands is unclear.

Discussion

The life form shift from shrublands to herbaceous meadows may be long-lasting on sites with low resprouting vigor and high cover of *Calamagrostis canadensis.* Most of the alder regeneration observed was vegetative, therefore resprouting vigor is a good indicator of the recovery potential of a stand. New recruitment of alder is not likely to occur on sites with little or no suitable seedbed, thus slope shape, slope position, and competing vegetation appear to be important factors for seedling establishment.

The extensive dieback and mortality of alder appears to be directly influenced by repeated insect defoliation. The episodes of severe defoliation by Sunira moth in Katmai NP has likely lead to depletion of energy reserves and a subsequent predisposition of the plants to further injury or attack by opportunistic insects, pathogenic fungi, or environmental stress. Infection by native canker diseases may have been a secondary and minor cause of dieback and mortality, however no cankers have been directly linked to this episode. Environmental factors that may stress alder, such as shifting annual moisture and temperature patterns or changing water table, are likely part of the Katmai NP situation.

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