

Seward Old-growth Hemlock Survey & Youth Training Final Report

Department of Neighborhoods Project O21019
Friends of Seward Park
CHOOSE 180
November 16th, 2021

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- CHOOSE 180
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Presentation Overview

- Contexts:
 - Western US
 - PNW
 - Seattle area mature urban forests
 - Seward trajectories
- Methods
- Data
- Microscopy
- Discussion

Over half of western United States' most abundant tree species in decline

[Hunter Stanke](#) , [Andrew O. Finley](#), [Grant M. Domke](#), [Aaron S. Weed](#) & [David W. MacFarlane](#)

[Nature Communications](#) **12**, Article number: 451 (2021) | [Cite this article](#)

6588 Accesses | **4** Citations | **80** Altmetric | [Metrics](#)

Abstract

Changing forest disturbance regimes and climate are driving accelerated tree mortality across temperate forests. However, it remains unknown if elevated mortality has induced decline of tree populations and the ecological, economic, and social benefits they provide. Here, we develop a standardized forest demographic index and use it to quantify trends in tree population dynamics over the last two decades in the western United States. The rate and pattern of change we observe across species and tree size-distributions is alarming and often undesirable. We observe significant population decline in a majority of species examined, show decline was particularly severe, albeit size-dependent, among subalpine tree species, and provide evidence of widespread shifts in the size-structure of montane forests. Our findings offer a stark warning of changing forest composition and structure across the western US, and suggest that sustained anthropogenic and natural stress will likely result in broad-scale transformation of temperate forests globally.



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PNW Forests

Joey Hulbert

Forest Health



The Concept

**Mature Urban Forests in the region of Seattle:
an informal survey**

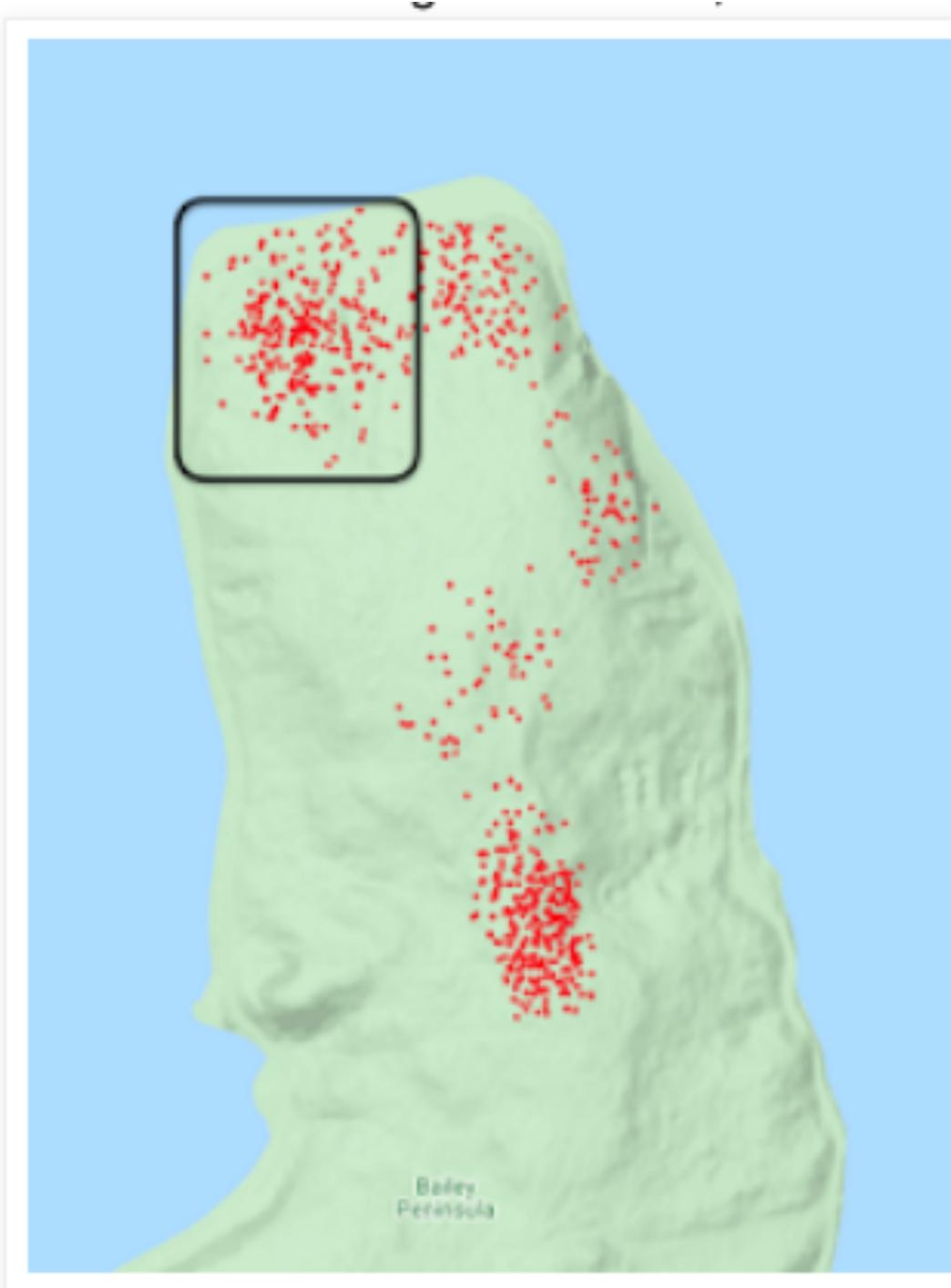
	Sword Fern Decline	Western Hemlock Decline	Year-round streams
Seward	Dramatic	dramatic decline	no
Schmitz Preserve, West Seattle	Little to none	some decline	yes
St. Edwards State Park	None observed	None observed	yes
Pioneer Park, Mercer Island	None observed	Some decline only on the upland - ravine area healthy	yes

The Context of Hemlock Decline at Seward

PSME-TSHE/MANE-POMU

(GSP/Seattle Parks classification of
much of Seward's Magnificent Forest)

- PSME: doug fir (*pseudotsuga menziesii*)
- TSHE: western hemlock (*tsuga heterophylla*)
- MANE: dwarf oregon grape (*mahonia nervosa*)
- POMU: sword fern (*polystichum munitum*)



Methods

- Site Selection
- Per-tree measurements
- Microscopy

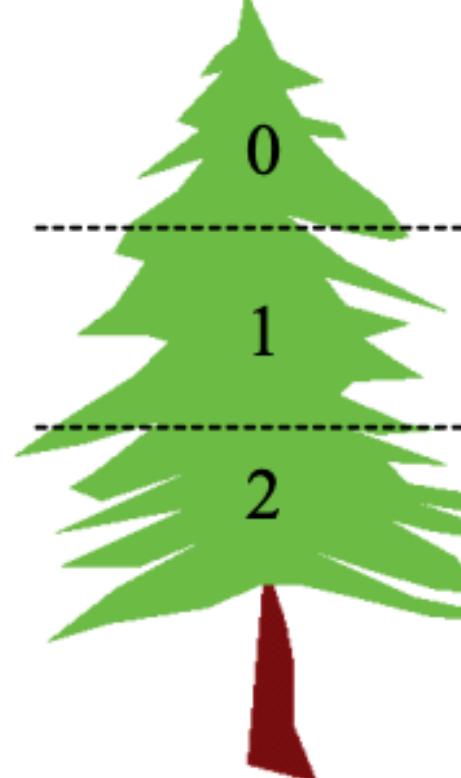
Site Selection

- Exhaustive survey of 58 hemlocks in 4.6 acre, 1.8 hectare central MF9, selected with Tim and Marianne in April 2021.
- 17 trees within 60' feet of a trail in 4.6 acre southern MF3
- 41 trees within 60' feet of a trail (all trees, as it turns out) in ~1 acre, northern MF8

Per-tree Measurements

- DBH
- Height (from measured baseline and azimuth, sometimes estimated)
- Marianne suggested DMR

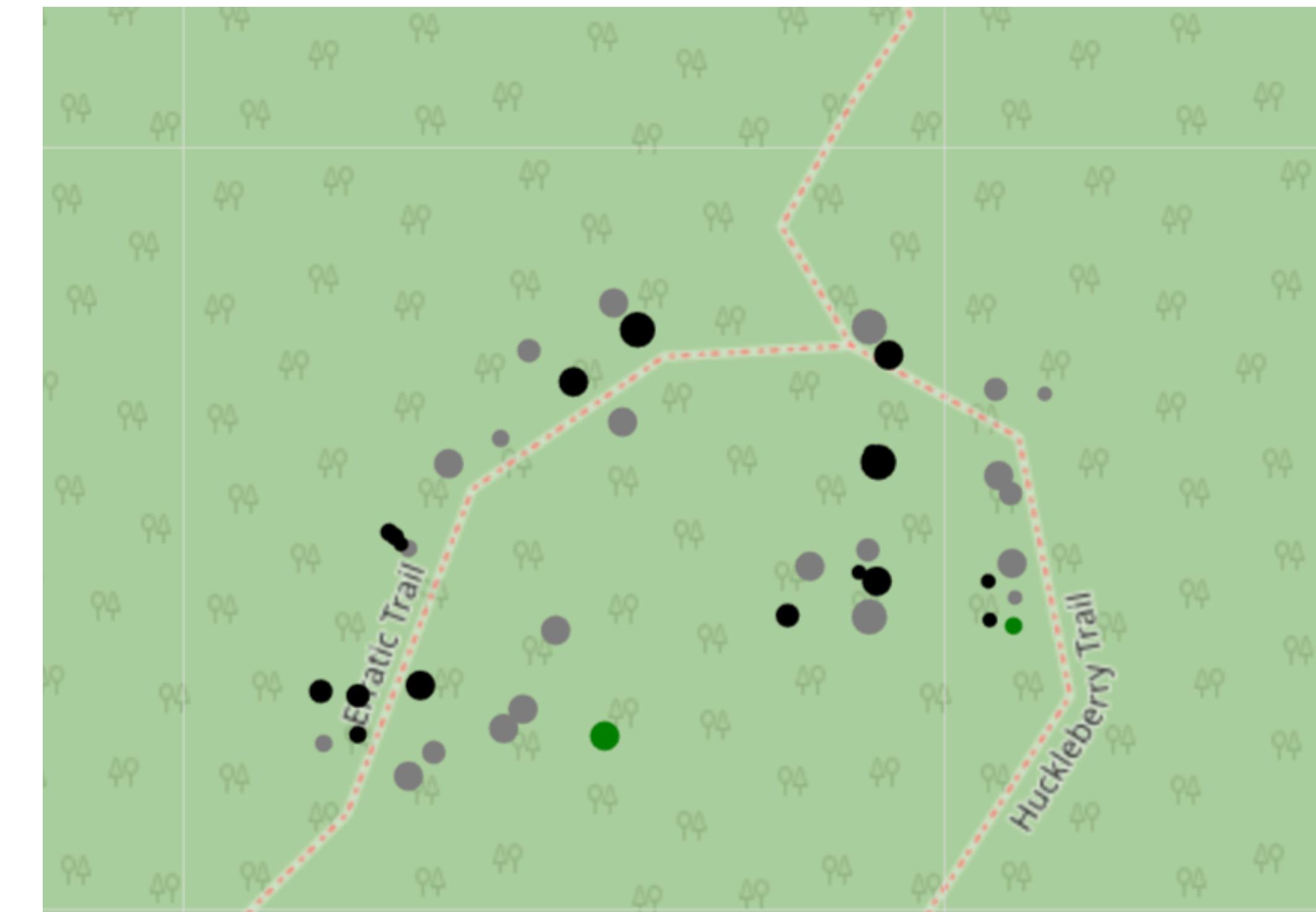
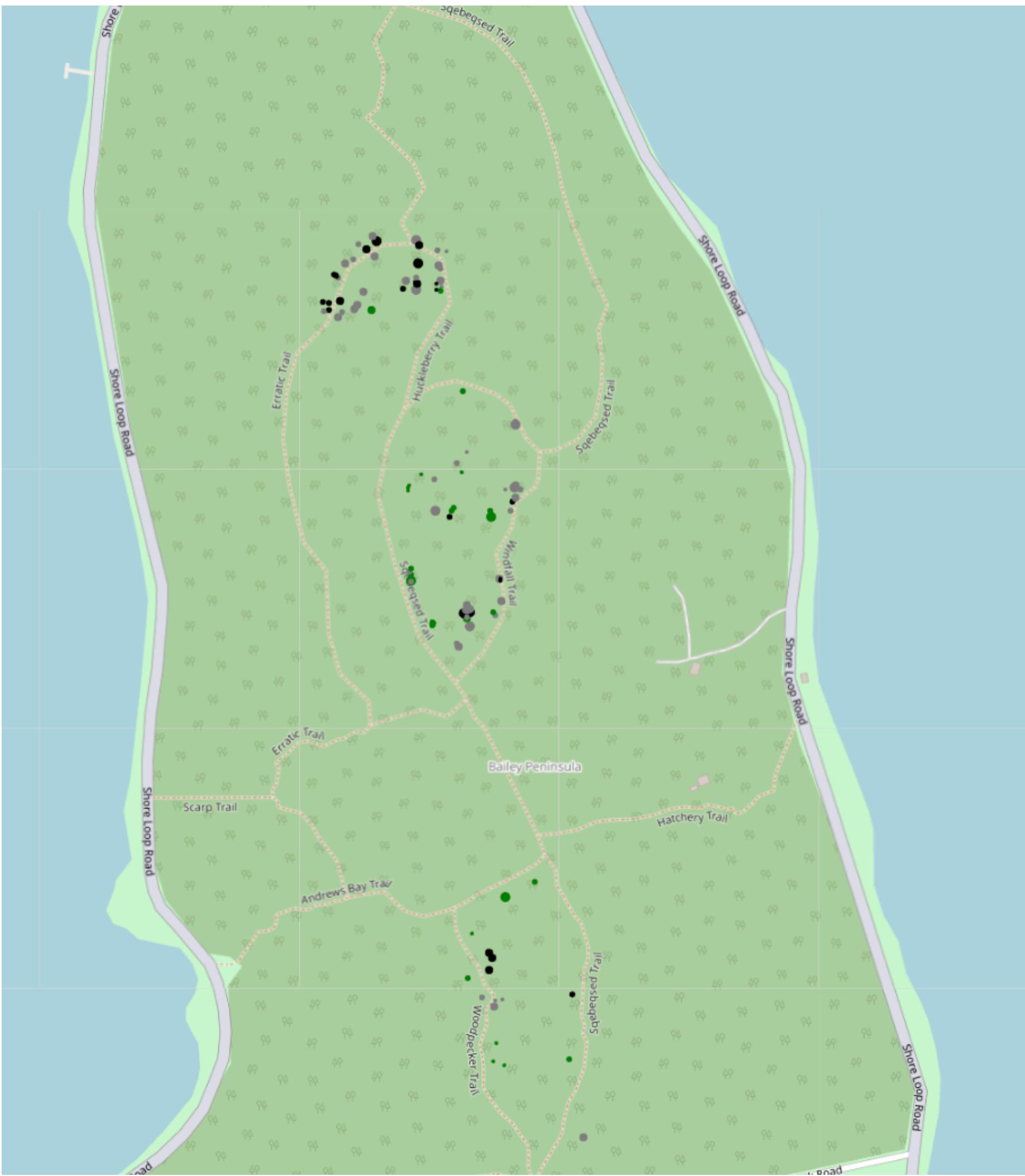
The 6-class dwarf mistletoe rating system (DMR) (Hawksworth 1977)

Instructions	Example
STEP 1. Divide live crown into thirds.	
STEP 2. Rate each third separately. Each third should be given a rating of 0, 1 or 2 as described below.	
(0) No visible infections.	If this third has no visible infections, it's rating is (0)
(1) Light infection (1/2 or less of total number of branches in the third infected).	If this third is lightly infected, it's rating is (1)
(2) Heavy infection (more than 1/2 of total number of branches in the third infected).	If this third is heavily infected, it's rating is (2)
STEP 3. Finally, add ratings of thirds to obtain rating for total tree.	The tree in this example will receive A rating of 0+1+2=3 .

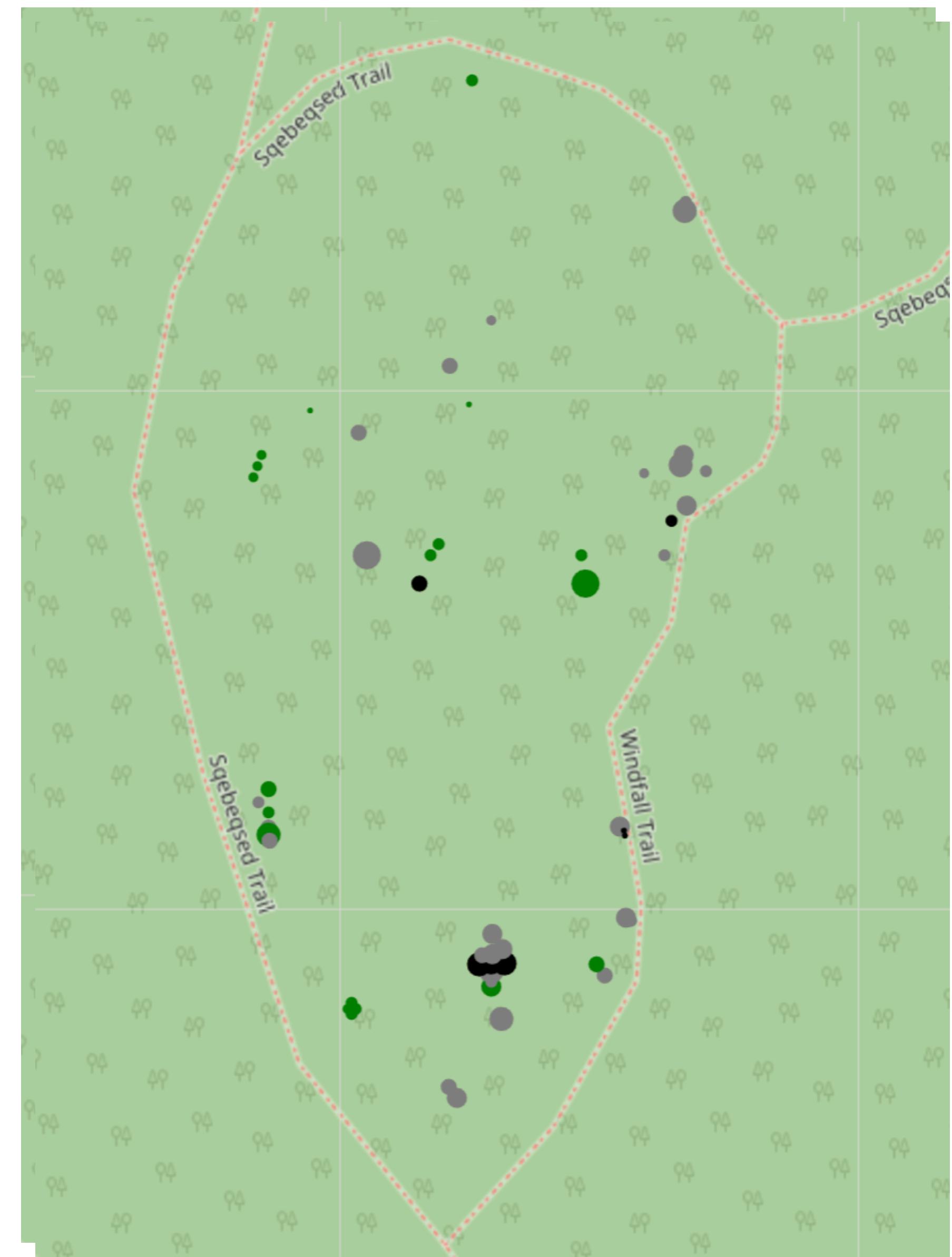
Per-tree Measurements: cladoptosis? (self-pruning)

- Ambiguous indicator
- Western hemlock trees, even in full shade, can have healthy branches in lower third, near the ground
- Some mature tall hemlocks have branchless lower trunk
- Regional reports of hemlock decline often mention “loss of lower branches”
- Tree drought effects typically first seen in tree crowns
- But a savvy tree might self-prune lower, less productive branches in drought
- Clearly distressed hemlocks, young or old, lose needles from the bottom, then steadily upward.
- We collected data of uncertain value on the 58 MF9 trees:
 - height to first dead branch
 - height to first live branch

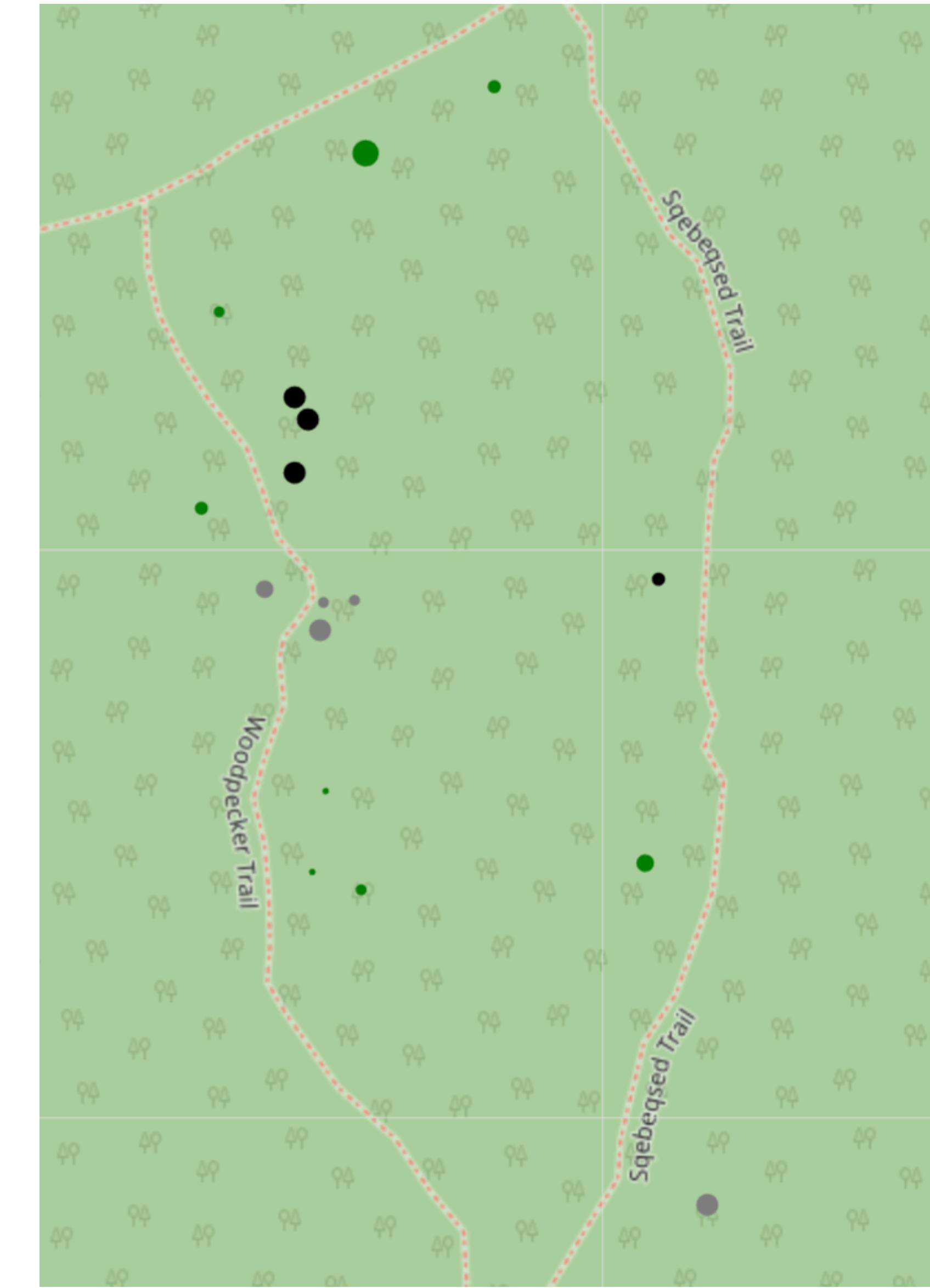
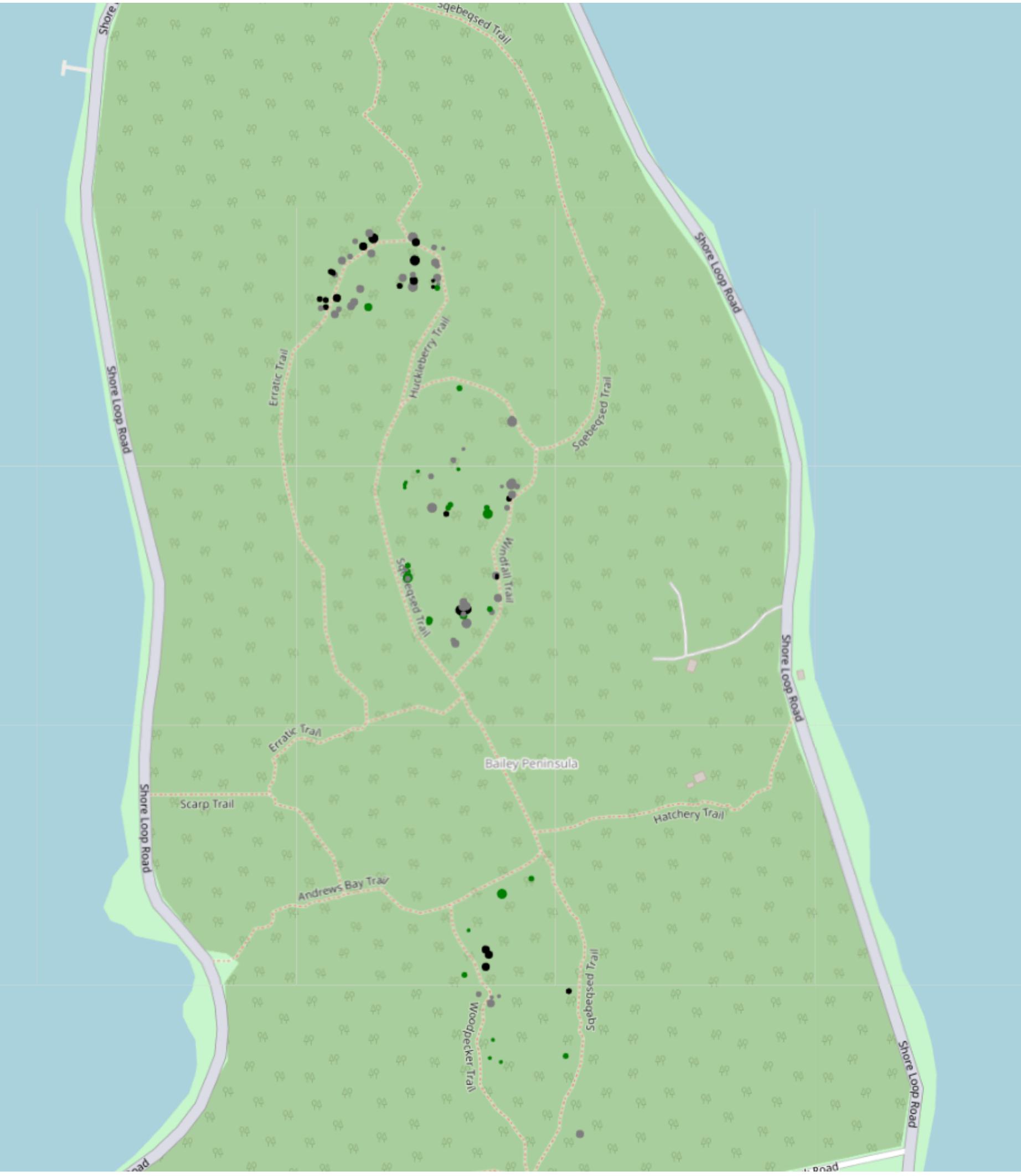
<https://paulshannon.shinyapps.io/hemlockMap/>



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<https://paulshannon.shinyapps.io/hemlockMap/>



Tabular Data

(excel spreadsheet available on request)

Hemlock Survey

Show entries

Search:

Showing 1 to 15 of 116 entries

Previous 1 2 3 4 5 ... 8 Next

	id	gpsID	lat	lon	height	dbh	firstDead	firstLive	dmr1	dmr2	dmr3	date	observer	note
1	hemlock.001	140	47.558333	-122.250825	45	10.5	11	21	2	1	0	2021-07-05	pshannon	
2	hemlock.002	144	47.55855	-122.25139	31	10	12	16	2	0	0	2021-07-14	all	
3	hemlock.003	145	47.558316	-122.250828	121	35	47	52	2	1	0	2021-07-14	all	
4	hemlock.004	146	47.55785	-122.25077	42	8	8	20	2	2	1	2021-07-14	all	
5	hemlock.005	147	47.557763	-122.250862	70	12			2	2	2	2021-07-14	all	
6	hemlock.006	148	47.55779	-122.250823	104	27	11	39	2	1	0	2021-07-14	all	
7	hemlock.007	149	47.55788	-122.25083	123	22	10		2	1	0	2021-07-14	all	
8	hemlock.008	150	47.557862	-122.250839	123	31			2	1	0	2021-07-14	all	
9	hemlock.009	151	47.557847	-122.250935	31	6			2	1	0	2021-07-14	all	
10	hemlock.010	152	47.55812	-122.25134	31	4			2	1	0	2021-07-14	all	
11	hemlock.014	153	47.55804	-122.25145	74	15	9	32	2	2	1	2021-07-15	all	left, sn
12	hemlock.015	154	47.55792	-122.25169	78	19	6	24	2	1	0	2021-07-15	all	left, lai

<https://paulshannon.shinyapps.io/hemlockDataTable/>

<https://www.inaturalist.org/projects/seward-park-western-hemlock-study>

Microscopy - perhaps a clue to proximal cause?



Microscopy - perhaps a clue to proximal cause?



Microscopy - healthy low branch tip, Schmitz Preserve



**Microscopy - diseased
lower branch tip, Seward**



Microscopy

n=19

healthy and affected lower branch tips

- **9 healthy:** <https://www.youtube.com/playlist?list=PLWNzMz4QSBovTOI78ufPiWlaEtzqELRWE>
- **10 affected:** https://www.youtube.com/playlist?list=PLWNzMz4QSBovsX24wuE2_TGcuWmu2cHpF

Anecdotal report

The day before we brought representative samples to Joey Hulbert's Puyallup lab, the summer heat wave broke, daytime temperatures fell by 20 degrees F, the black substance on affected branch tips disappeared.

Discussion: some possibilities to consider

- Highly likely that hemlock seasonal water relations play a role
- Actual mechanism/s not known.
- Summer heat & drought amplify destructive well-known fungi (Bob?)
- Conjectured: black substance seen on affected twig ends may provide insight.
- Seward's early old-growth forest: two important species in dramatic decline, perhaps some shared, some distinct causes
- Chances for detailed mechanistic understanding?
- Seward as an early warning system for the region?

