Title: Species interactions during succession in the western Cascade Range of Oregon, 1990 to present

Abstract:

The factors that contribute to plant species establishment and decline following disturbance determine the rates and patterns of successional change of a system. In this long-term field experiment, we test the commonly held assumption that competition for space or resources by dominant species determines the outcome of succession. Specifically, we examine the population- and community-level consequences of removing one or more potentially dominant species from the post-disturbance community after clearcut logging and burning of a mature/old-growth Douglas-fir forest. Experimental treatments include: (1) removal of early-seral annual, Senecio sylvaticus, or perennial, Epilobium angustifolium—or both—to test the influences of these early-seral dominants on subsequent community development; (2) removal of all species except Senecio or Epilobium, to test whether the decline of these early-seral dominants is driven by competitive displacement; or (3) removal of shade-tolerant forest species that dominate subsequent stages of succession—Rubus ursinus or Berberis nervosa plus Gaultheria shallon—to test the influences of these long-lived perennials on understory development. The experiment is a randomized block design comprising eight removal treatments plus a control replicated in each of 25 blocks. Removal (reduction in competition) is achieved by removing seedlings or vegetative stems annually from a treatment area of 2.5 x 2.5 m. Sample plots (1 x 1 m) centered within these are used to estimate cover of all vascular plant species and, for the first 8 yr of the experiment, stem density and height, facilitating estimates of above-ground biomass. Pre-harvest data were collected in 1990, logging/burning occurred in 1991, and removal treatments and post-treatment sampling were initiated in 1992. Six of the nine experimental treatments were terminated between 1996 and 1998, with loss of early-seral Senecio and Epilobium from the system. The remaining three treatments (removal of Rubus, removal of Berberis plus Gaultheria, and the control) have been sampled annually since 1992. All regeneration of trees within the experimental area has occurred naturally. In September 2018, the study site partially burned during the larger Terwilliger Fire on the Willamette National Forest. In 2019, plots were assessed for burn severity. Species' removals were terminated, but cover measurements continue in the plots.

Keywords: Clearcut logging; Clearcutting; Community dynamics; Competition; Disturbance; Long-Term Ecological Research (LTER); Primary production; Slash burning; Slash/broadcast burning; Species interactions; Succession; Trophic structure; Primary production; Long-Term Ecological Research (LTER); Community dynamics; Trophic structure; Succession; Primary production; Species interactions; Competition; Disturbance; Burning; Timber harvest; Clearcutting;

Date data commenced: 1990-07-01
Date data terminated: 2019-07-04
Principal Investigator: Charles B. Halpern

List of Entities:
1. Species Cover, Density, and Biomass Measurement Data
2. Species Removals (counts)
3. Species Cover, Density, and Biomass Measurements Original Fieldsheet Format
4. Species Cover, Density, and Biomass Measurements Modified Fieldsheet Format
5. Equations used for calculating biomass
6. Estimated biomass using measurement data and equations
7. Assessment of 2018 burn severity

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**4. Species Cover, Density, and Biomass Measurements Modified Fieldsheet Format**

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5. Equations used for calculating biomass

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- **STUDY**: N Y char(11) place
- **YEAR**: Y N numeric(4,0) range 1992.0000 2019.0000 number
- **SPECIES**: Y N char(6) taxa
- **EQUATION**: N N varchar(55) freetext
- **ALTEQU**: Y N char(1) enum

6. Estimated biomass using measurement data and equations

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- **YEAR**: Y N numeric(4,0) range 1992.0000 2019.0000 number
- **SEASON**: Y N char(1) enum
- **BLOCK**: Y N numeric(2,0) range 1.0000 25.0000 number
- **PLOT**: Y N numeric(1,0) range 1.0000 9.0000 number
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### Attributes Definitions:

- **ALTEQU**: Alternative equation within a species for calculating biomass.
- **B_VAL**: Unique biomass value for a given year, season, block, plot, tmt, species.
- **BIOMASS**: Estimated biomass.
- **BLOCK**: Sample block (1-25).
- **BURN_CLASS**: Burn class.
- **BURN_COMMENT**: Description of burn conditions.
Cover in the 1/4 plot

COVER
Cover in the 1 m² plot

DBA
Basal diameter

DBCODE
Database code

DENSITYM
Density of mature stems/sprouts (1 m² plot)

DENSITYS
Density of seedlings (1 m² plot)

ENTITY
Entity number

EQUATION
Explicit equation used for calculating biomass. mht = height, mcov= cover, mdba = bottom diameter

HT
Total height (including inflorescence if present)

HTV
Height of vegetative portion

LC
Line count

NOTES
Comments

NREMBUF
Number of stems removed from 75 cm buffer

NREMPLT
Number of stems removed from 1 m² plot

PCT_BURN
Percentage of ground surface burned or charred within the plot

PCT_BURN_ADJ
Percentage of ground surface burned or charred within 0.5 m of the plot edge

PLOT
Sample plot w/in block (1-9)

PROP_DEAD
Proportion of trees within 2.5 m of the plot that are dead (undefined if there are no trees)

RDATE
Date of species removal (yyyyymmdd)
REC_NO
Unique record number for a given year, season, block, plot, tmt, species and stratum

SDATE
Vegetation sampling date

SEASON
Sampling season (1 - 3)

SPECIES
Species acronym according to Garrison et al. 1974

STEM1BV1
Biomass parameter 1 of stem1

STEM1BV2
Biomass parameter 2 of stem1

STEM1NO
Number of stems containing the corresponding bv1 and bv2 values

STEM2BV1
Biomass parameter 1 of stem2

STEM2BV2
Biomass parameter 2 of stem2

STEM3BV1
Biomass parameter 1 of stem3

STEM3BV2
Biomass parameter 2 of stem3

STEM4BV1
Biomass parameter 1 of stem4

STEM4BV2
Biomass parameter 2 of stem4

STEM5BV1
Biomass parameter 1 of stem5

STEM5BV2
Biomass parameter 2 of stem5

STRATUM
Pre-harvest tree stratum: (O)verstory, (S)ubcanopy, (U)nderstory

STUDY
Study site location

TMT
Treatment code (A-I)

TREES_DEAD
Number of dead trees within 2.5 m of the plot
TREES_LIVE
Number of live trees within 2.5 m of the plot
YEAR
Sampling year
Enumerated Domains:
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Unknown season of sampling
1 First season of sampling per year (usually june)
2 Second season of sampling per year (usually july)
3 Third season of sampling per year (usually august)
Enumerated Domain for Attribute: DBCODE
TP103 FSDB database code TP103
Enumerated Domain for Attribute: STRATUM
O Overstory
S Subcanopy
U Understory
N post-harvest (1990) or not a tree in 1990 (only recorded for trees pre-harvest)
Enumerated Domain for Attribute: TMT
A Control
B Senecio sylvaticus removed
C Epilobium angustifolium removed
D Senecio sylvaticus and Epilobium angustifolium removed
E Senecio sylvaticus and community removed
F Epilobium angustifolium and community removed
G Community removed
H Rubus ursinus removed
I Berberis nervosa and Gaultheria shallon removed
Enumerated Domain for Attribute: SEASON
Unknown season of sampling
1 First season of sampling per year (usually june)
2 Second season of sampling per year (usually july)
3 Third season of sampling per year (usually august)
Enumerated Domain for Attribute: DBCODE
TP103 FSDB database code TP103
Enumerated Domain for Attribute: TMT
A  Control
B  Senecio sylvaticus removed
C  Epilobium angustifolium removed
D  Senecio sylvaticus and Epilobium angustifolium removed
E  Senecio sylvaticus and community removed
F  Epilobium angustifolium and community removed
G  Community removed
H  Rubus ursinus removed
I  Berberis nervosa and Gaultheria shallon removed

Enumerated Domain for Attribute: SEASON
  Unknown season of sampling
  1  First season of sampling per year (usually june)
  2  Second season of sampling per year (usually july)
  3  Third season of sampling per year (usually august)

Enumerated Domain for Attribute: DBCODE
  TP103  FSDB database code TP103

Enumerated Domain for Attribute: STRATUM
  O  Overstory
  S  Subcanopy
  U  Understory
  N  post-harvest (1990) or not a tree in 1990 (only recorded for trees pre-harvest)
2 Second season of sampling per year (usually July)
3 Third season of sampling per year (usually August)

Enumerated Domain for Attribute: DBCODE
TP103 FSDB database code TP103

Enumerated Domain for Attribute: TMT
A Control
B Senecio sylvaticus removed
C Epilobium angustifolium removed
D Senecio sylvaticus and Epilobium angustifolium removed
E Senecio sylvaticus and community removed
F Epilobium angustifolium and community removed
G Community removed
H Rubus ursinus removed
I Berberis nervosa and Gaultheria shallon removed

Enumerated Domain for Attribute: ALTEQU
1 primary equation
2 second alternative equation
3 third alternative equation
4 fourth alternative equation

Enumerated Domain for Attribute: DBCODE
TP103 FSDB database code TP103

Enumerated Domain for Attribute: SEASON
Unknown season of sampling
1 First season of sampling per year (usually June)
2 Second season of sampling per year (usually July)
3 Third season of sampling per year (usually August)

Enumerated Domain for Attribute: DBCODE
TP103 FSDB database code TP103

Enumerated Domain for Attribute: TMT
A Control
B Senecio sylvaticus removed
C Epilobium angustifolium removed
D Senecio sylvaticus and Epilobium angustifolium removed
E Senecio sylvaticus and community removed
F Epilobium angustifolium and community removed
G Community removed
H Rubus ursinus removed
I Berberis nervosa and Gaultheria shallon removed

Enumerated Domain for Attribute: DBCODE
TP103 FSDB database code TP103

Enumerated Domain for Attribute: TMT
A Control
B Senecio sylvaticus removed
C Epilobium angustifolium removed
D Senecio sylvaticus and Epilobium angustifolium removed
E Senecio sylvaticus and community removed
F Epilobium angustifolium and community removed
G Community removed
H Rubus ursinus removed
I Berberis nervosa and Gaultheria shallon removed

Enumerated Domain for Attribute: BURN_CLASS
B Burned
PB Partially burned
UB Unburned