Pandora Moth Outbreak Chronology for the Eastern Cascades, Deschutes National Forest, Oregon

Jim Speer, Laary Cushman, Jose Negron, Nicole Davi, Andrew Schauer, Robyn Darbyshire

ABSTRACT

Cores extracted from ponderosa pines at two sites on the eastern slope of the Cascades were analyzed using dendrochronological techniques. Data indicates that both sites have a history of Pandora moth outbreaks. Pandora moth outbreaks may be influencing fire regimes at the sites by interrupting needle fall and delaying fires during the outbreaks. The study also suggests that Pandora moth is more widely distributed than previously known.

INTRODUCTION

The larval stage of Pandora moth *(Coloradia pandora)* severely defoliates ponderosa pine *(Pinus ponderosa),* causing little tree mortality. Larvae consume old foliage, leaving the new growth and buds undamaged. Because of loss of photosynthetic area, outbreaks leave a distinctive ring-width suppression. These suppressions are more obvious than those left by other defoliating insects; therefore, outbreaks can be confidently identified and confounding factors such as climate and other insects can be accounted for. The growth of the first year of a signature is characterized by half the normal ring width and narrow latewood, lasts 4 to 18 years, and ends when the mean ring width returns to the average/normal for the entire ponderosa pine core sample.

Dendroecological Fieldweek is an opportunity for individuals to become familiar with basic dendrochronological techniques. Dendrochronology is a powerful tool that utilizes tree rings dated to the exact year of formation to answer questions pertaining to various fields in the earth sciences. Subdisciplines of dendrochronology can fall under archaeology, climatology, ecology, etc. Dendroecology uses constructed tree ring chronologies to study various ecological topics such as air pollution, stand dynamics, and insect outbreaks. The 8th Annual Dendroecological Fieldweek was comprised of five topic areas: canopy gap reconstruction, climate reconstruction, stand age structure, fire history, and insect outbreaks. All of these studies, with the exception of canopy gap reconstruction, were conducted in close proximity to one another so as to facilitate the integration of results. This particular study has focused on the occurrence and frequency of Pandora moth outbreaks in ponderosa pine stands which are located beyond the northern documented boundary of pandora moth distribution (Speer 1997).

Prairie Farm Creek (PFC) and Forest Highway 11 (ELE) sites were sampled to look for evidence of pandora moth outbreaks in ponderosa pine. Pandora moth is endemic to the ponderosa pine forest and given the proper conditions, its population can grow to outbreak levels, leading to defoliation and to distinctive reduced ring width signatures within the growth patterns of the host. Because ponderosa pine has to recover from the loss of three to five years of retained needles, it takes about four years for normal growth rates to be attained.

MATERIALS AND METHODS

Study Sites

Prairie Farm Creek (PFC) and Forest Service Highway 11 (ELE) sites are located in the Deschutes National Forest on the eastern slope of the Cascades and ranged from 1100 to 1200 m elevation. These sites were selected because of the presence of relatively old ponderosa pines as well as a loose pumice soil. This soil type is required by the pandora moth larvae because they spend part of their life cycle buried in the soil. Soil that is too compacted makes it difficult for the larvae to burrow into the soil. Both sites were dominated by ponderosa pine. Incense cedar (*Calocedrus decurrens*), Douglas-fir (*Pseudotsuga menziesii*), and western juniper (*Juniperus occidentalis*) were also present on the PFC site. The PFC site was on a southeast-facing slope and the ELE site was relatively flat. The understory of the sites was dominated by bitterbrush (*Purshia tridentata*). The ELE site had been logged and burned and varnishleaf ceanothus (*Ceanothus velutinus*) was also common in the understory.

Field and Lab Methods

Criteria used for old tree selection included a relatively large dbh (diameter at breast height), large branch diameter, and well-developed bark plates. Old trees were desirable to obtain the greatest number of outbreaks within the chronology. Two increment cores were obtained from each of 15 trees on the PFC site and from each of 14 trees on the ELE site. Two cores per tree were oriented 180 degrees from each other and perpendicular to the slope. Extracted cores were stored in paper straws. Cores were dried overnight at 60^{o}C and mounted on wooden core mounts with white glue. Each core was sanded with progressively finer sand paper (120 to 400 grit). Additional surfacing to assist with ring dating was done with 30 micrometer sand paper.

After surfacing, skeleton plots were constructed and a master chronology was developed by identifying characteristic years of growth variances that appeared regularly throughout the series. Each core was dated by cross referencing between the master chronology and the core. Each pandora moth outbreak was visually identified and recorded. Outbreaks were characterized by a set of at least four consecutive rings where each ring is less than 50% of the mean ring width. All rings during the outbreak have thin latewood. The end of the outbreak was denoted once two successive rings regained mean ring width for the core.

Data Analysis

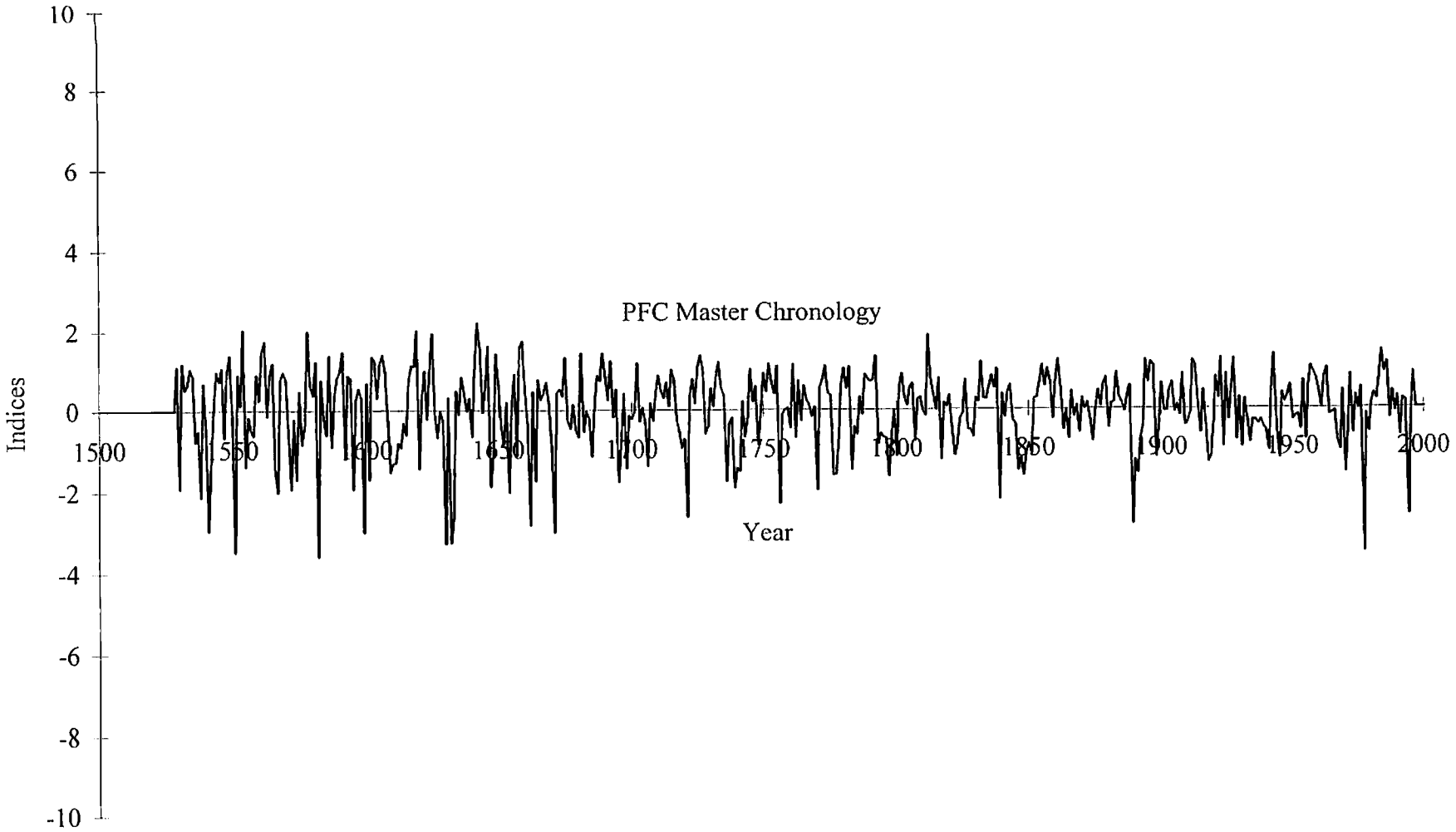
Annual growth increments of the cores were analyzed using COFECHA (Holmes 1986), ARSTAN (Cook and Holmes 1986), and OUTBREAK (Holmes and Swetnam, unpublished) computer programs. COFECHA was used to check the dating of each core; ARSTAN standardizes each core and averages the two cores from one tree. OUTBREAK identifies insect epidemics using user-specified parameters such as ring width and periodicity.

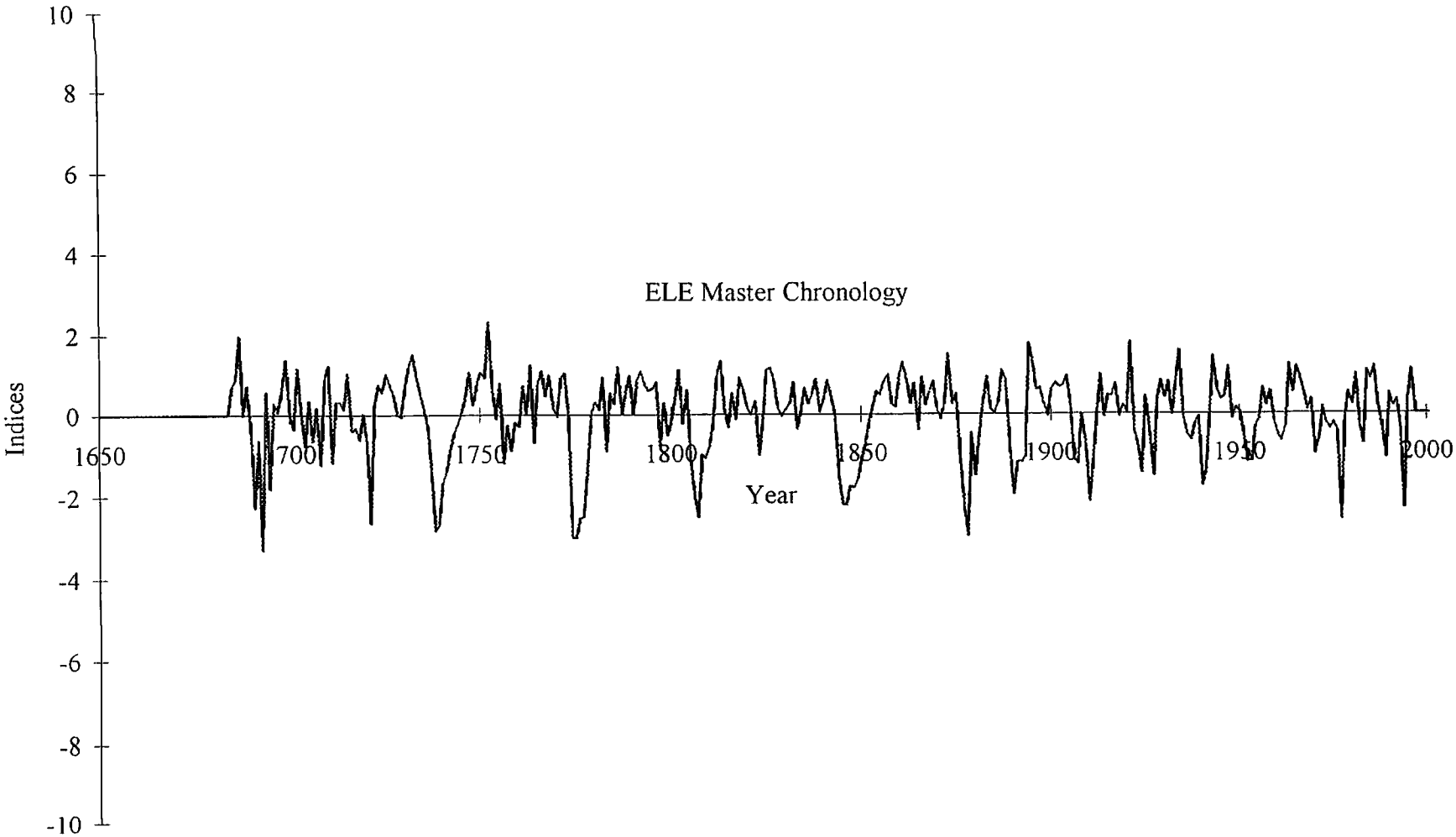
RESULTS AND DISCUSSION

The outbreak signatures observed in this study exhibited thin late wood and suppressed growth for six to twelve years. The study area is located about 50 miles north of the known distribution of pandora moth in Oregon. This data suggests that the geographic distribution of pandora moth extends beyond the previously reported range of pandora moth in Oregon. Pandora moth outbreaks were identified at the PFC site from 1843 to 1850 and from 1889 to 1893. These outbreaks lasted eight and five years respectively. The mean periodic growth reduction was 31.52%. Other growth suppression periods were also visually detected; OUTBREAK did not identify these as pandora moth outbreaks because they did not satisfy the criteria stated above.

At the ELE site, pandora moth outbreaks occurred from 1610 to 1619, 1634 to 1642, 1675 to 1692, 1738 to 1743, 1773 to 1779, 1806 to 1812, 1847 to 1854, 1877 to 1883, and from 1888 to 1895. These outbreaks had a mean duration of 9 years and the growth reduction averaged 30%.

Fire history data collected at the PFC site indicates a lack of fire activity during the outbreaks (1840s and 1880s). This may relate to pine needle consumption by the pandora moth, which leads to a reduction in fine fuels. Also the stand age structure study documented clusters of establishment dates. A possible mechanism for this grouping of occurrence of multiple stand factors could be explained by pandora moth defoliation interrupting needle fall and delaying fire which could allow survival of young trees to a fire resistant age.


PFC Master Chronology
Indices
Year
10
8
6
4
2
0
-2
-4
-6
-8
-10
1500
1550
1600
1650
1700
1750
1800
1850
1900
1950
2000


ELE Master Chronology
Indices
Year
10
8
6
4
2
0
-2
-4
-6
-8
-10
1650
1700
1750
1800
1850
1900
1950
2000