

English Holly symposium, June 6, 2014, St. Edward State Park

Abstracts

(Presenters underlined)

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AN INVASION'S PROGRESS: ENGLISH HOLLY (*ILEX AQUIFOLIUM*) IN A SEMI-NATURAL PACIFIC NORTHWEST FOREST

David L. Stokes, Elliott D. Church, David M. Cronkright, and Santiago Lopez,

We comprehensively surveyed English holly in an 9.2 ha area of forest at St. Edward State Park, a largely native forest in the Seattle metropolitan area. We measured, mapped, aged, and removed all holly ≥ 1 cm basal diameter or > 1 m from the nearest sampled holly, and used these data to characterize the invading population and the course of the invasion. Our sample (n = 532 known-age holly plants) ranged in age from 1 to 46 years. Trees ≥ 10 years old appeared to have very low mortality rates and exhibited accelerating rates of size increase with age. Our spatial and age data indicate that holly is proliferating and spreading rapidly at two scales: contiguous, primarily vegetative, expansion of tree clumps, and long distance dispersal via seed. Spread by both mechanisms appears to be accelerating, with population and canopy area both increasing approximately exponentially, having doubling times of approximately 6 and 5 years respectively. Projecting past spread patterns forward suggests that holly could soon become a prominent species in the park, likely at the expense of native plant diversity and forest structure. Based on these results, we offer recommendations for holly management in forested areas in the region.

This presentation is an update of results reported in: Northwest Science, Vol. 88, No. 2, pp. 75-93 (2014).

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MONITORING THE INVASION: ENGLISH HOLLY IN NORTHWESTERN FORESTS

Andrew Gray

The USDA Forest Service's Forest Inventory and Analysis (FIA) program monitors the condition of the nation's forests based in large part on a grid of permanent sample plots. Plots are spaced at one plot per 6,000 acres across all ownerships, and visited every 10 years. Western states have recorded the cover and identification of abundant understory plant species in order to classify vegetation communities. English holly was recorded on 103 plots across California, Oregon, and Washington, with the majority found in western Washington. Most records were from plots in the Puget Sound ecoregion, but there were pockets of abundance along the Pacific coast and scattered observations in the Cascades. Holly was most likely to be found at low elevations and in stands dominated by large-diameter trees. Opportunities and challenges for future monitoring will be discussed.

Andrea Watts, andwatts@live.com

AN EXAMINATION OF STAND ATTRIBUTES AND THE PRESENCE OF ENGLISH HOLLY IN A PACIFIC NORTHWEST FOREST, GRAYS HARBOR COUNTY, WASH.

Andrea Watts

The purpose of this study was to identify the forest conditions under which *Ilex* is found and to determine if there are significant differences between plots where *Ilex* is present and where it is absent. The research site is located in Grays Harbor County in Washington State, and data collection occurred from June 2011–November 2012, on 200 plots placed throughout the stand stages found on the landscape. The results yielded a significant difference in basal area and the number of shrubby understory vegetation species between the *Ilex*-absent and *Ilex*-present plots. The stand stages identified as being significant were Understory Reinitiation and Late Initiation. Reed canary grass and native grass could serve as indicators for the absence of *Ilex* while sword fern or cascara could serve as indicators of a favorable habitat. While *Ilex* appears in all forest stand stages, its presence in stands with a high basal area means that mature forests are particularly vulnerable to *Ilex* entering the stand because this stage has combination of a high SDI and light-rich conditions capable of supporting diverse understory vegetative species.

This presentation is a shortened version of Andrea Watts' Masters thesis (2013), available at the following link:

https://digital.lib.washington.edu/researchworks/bitstream/handle/1773/22915/Watts_washington_02500_11506.pdf?sequence=1

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A SPATIALLY EXPLICIT MODEL OF THE PRESENCE OF ENGLISH HOLLY (*ILEX AQUIFOLIUM*): SPATIAL RELATIONSHIPS AND IMPLICATIONS FOR MANAGEMENT

Santiago Lopez and David Stokes

Despite English holly's (*Ilex aquifolium*) possible effects on native ecosystems, little is known about the spatial factors associated with the establishment and spread of this species in the Pacific Northwest. This study analyzes some of these aspects through the integration of multiple logistic regression and geographic information analysis at a resolution consistent with site-scale local level analysis. Presence and absence data were collected at St. Edwards State Park (WA) between 2011 and 2013 and processed within a geographic information system framework, linking location and attribute information. Results show that the probability of an area becoming occupied by English holly increases with proximity to the edge of natural land cover, trails, and evergreen coniferous vegetation. In addition, the likelihood of the presence of holly is higher in south-facing slopes than in areas that have a northern aspect, but decreases with proximity to streams or areas of water accumulation. The spatial model helped to confirm some of our a-priori expectations based on field observations, but also provided further insights into the spatial ecology of English holly. A modeling framework like the one presented here, may help land managers to more effectively allocate resources and design plans for control and management of invasive plants.

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IMPACTS OF INVASIVE ENGLISH HOLLY (*ILEX AQUIFOLIUM*) ON UNDERSTORY VEGETATION IN A MATURING PACIFIC NORTHWEST WESTERN HEMLOCK ZONE FOREST

Elliott D. Church and David Stokes

Rapidly increasing, and with no structural analogue in the native forests it is invading, English holly has the potential to radically alter the structure, processes, and biodiversity of native Pacific Northwest forests. However little information exists regarding its effects on native plant communities. To address this knowledge gap, we documented the percent cover of native evergreen and woody plant species underneath and adjacent to 20 large holly trees ($\geq 4\text{m}$ canopy diameter) in a largely native, conifer-dominated forest in St. Edward State Park (Kenmore, WA). At each of the 20 trees we collected species cover data in 1m^2 quadrats north of the tree, under the canopy on the north side of the trunk, under the canopy on the south side of the trunk, and south of the tree (control). On average, total cover of native vegetation was greatly reduced underneath holly canopies, and was also lower in the shade of holly (north of tree), compared with the control. Further analysis will examine the effects of holly litter and shade on individual native plant species and overall species diversity. Our preliminary findings suggest that holly has the capacity to exclude native vegetation, and may pose a serious threat to the biodiversity of PNW forests if left unmanaged.

Al Smith, Friends of Seward Park and Washington Native Plant Society

HOW WASHINGTON NEARLY BECAME THE HOLLY STATE: THE STORY OF HOLLY IN SEWARD PARK. Al Smith

In a paper published in *Douglasia*, Winter 2013 Issue, Smith tells the interesting story from Seattle's history of Lillian McEwan and the Washington State Society for the Conservation of Wild Flowers and Tree Planting and their efforts to promote holly planting with the goal of making Washington the "Holly State" and to help nature in the process. Newspaper articles, old records and documents from the Seattle Parks Department reveal how this project was carried out and the resulting large numbers of holly trees that were planted in Seward Park and other places in the name of conservation. The Seattle Parks Department's role in the management of Seward Park and its trees both native and non-native is also described during this early phase of Seattle's history.

This presentation is based on Al Smith's 2013 article in Douglasia.

Sally Nickelson, Invasive Species Program Manager for Seattle's Major Watersheds, Seattle Public Utilities, sally.nickelson@seattle.gov

HOLLY DOMINATES A FOREST UNDERSTORY AT LAKE YOUNGS RESERVE, SEATTLE PUBLIC UTILITIES

Sally Nickelson

A total of 90 acres of second-growth conifer forest in the Lake Youngs Reserve is dominated by extremely dense infestations of English holly. Prior to being included in Seattle's water supply network, parts of this area were homesteaded. There are no records that the area was ever used as a holly farm or holly was ever densely planted. Smaller holly trees were grubbed out in a total of 22 acres (21 acres in 2008 and 1 acre in 2011). In the fall of 2008 and 2009 a 50% glyphosate solution with no surfactant was sprayed into small cuts in the bark created with an ax (hack and slash type treatment) on larger trees. This herbicide treatment was conducted in 2.3 acres of dense holly infestation, plus on individual trees scattered throughout the 2500-acre Reserve. The grubbing treatment appears quite effective, but is extremely costly and time-consuming. The herbicide treatment caused initial top-death in most treated trees. However, a majority of the treated trees regrew from the roots or the trunk below the treatment line. We will try a hack and slash treatment of 100% glyphosate solution with a 1% surfactant when funding allows.

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ENGLISH HOLLY ON MOUNT SI, MIDDLE FORK SNOQUALMIE, AND TIGER MOUNTAIN

Mark Boyer, Sasha Shaw, and Lisa Nelson

Data collected by the Mountains to Sound Greenway Trust, the Upper Snoqualmie Weed Watcher volunteers and the King County Noxious Weed Control Program, as part of a cooperative effort to track and control invasive plants impacting the Upper Snoqualmie Watershed in King County, Washington, demonstrates the relative impacts and distribution of a wide range of invasive plants in the watershed, including English holly (*Ilex aquifolium*). English holly has emerged as a key species of concern, especially around Mount Si, Rattlesnake Mountain and Tiger Mountain, because it invades and becomes established in mature conifer forests, even where there are few if any other invasive plants. Although the entire project area has not been systematically surveyed, the data collected show the distribution, density and size of holly populations in the areas that have been surveyed. In addition, data on fruiting trees collected in one target area reveals information on stand diversity of the population. Holly is not known to have been planted in the areas being surveyed and it appears that these populations are entirely invasive and not the result of intentional planting, and that the stands are maturing and spreading over time.

English holly has been identified as a significant threat to the natural ecosystems of these natural areas and holly control is a high priority for the Greenway and the Washington State Department of Natural Resources. Although not all control work has been documented, available data on control demonstrates the scale of effort that has already been expended and shows in part what remains to be done. The Greenway and Weed Watcher volunteers have plans to increase and expand this effort in the current and future years, using a combination of injection and manual removal methods, depending on the size of the trees and availability of tools.

Michael Yadrick, Seattle Parks and Recreation Natural Resources Unit, michael.yadrick@seattle.gov

THE LIFE AND DEATH OF ENGLISH HOLLY IN SEATTLE'S FORESTED PARKLAND

Michael Yadrick, Oliver Bazinet, Lisa Ciecko, and Mark Mead

The City of Seattle and its citizens created the Green Seattle Partnership (GSP) ten years ago to jumpstart the restoration of 2500 acres of forested parkland. From vegetation surveys, we know that English holly is pervasive. In 2000, holly comprised 40-60% of the naturally-occurring trees on public land citywide (Seattle Urban Nature Project). Another citywide assessment in 2012 suggested that holly is present in equivalent counts on residential property and parks property (Green Cities Research Alliance). We use a combination of field methods, work log reporting, and field monitoring to eliminate the tree from restoration sites. With over 1,200 acres of 2,500 total acres in restoration, our data indicates that holly is present in 13% of the sites and cover of the species has decreased to 0.3%. The results of this program emphasize the importance of continued monitoring during the latter phases of restoration to drive any necessary follow-up treatment as well as continued methodical eradication of regenerating invasive trees in new restoration sites.

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ENGLISH HOLLY CONTROL TRIALS – STEM TREATMENT METHODS COMPARED

Nelson Salisbury

This paper provides a summary of the results of a study designed to test the effectiveness of different herbicide treatment methods to control invasive English holly (*Ilex aquifolium*) trees in the Puget Sound region. The study compares the results of using three different treatment methods (frilling, cut-stump, and lance stem injection) with three different herbicides (glyphosate, triclopyr, and imazapyr) applied in both the spring and fall seasons. Data was collected from five sites within the Puget Sound region of Washington. Herbicide applications occurred in the fall of 2010 and the spring of 2011. Post-treatment data collection occurred after one year following each treatment.

The most effective and time-efficient method to control English holly examined in this study was stem injection with imazapyr. This combination was very effective at killing the tree in both fall and spring seasons and resulted in the fewest number of trees with additional stump sprouts. Furthermore, stem injection with imazapyr was also the most time-efficient application method studied, even without taking into account the additional time necessary to mix, clean, handle, and store liquid chemical herbicides required with the other treatments. Using the stem injection treatment method reduces exposure risk to the applicator and reduces non-target herbicide effects to adjacent plants. Frilling or cut-stump treatments with triclopyr also provided an effective control, although cut-stump treatments were more likely to result in increased stump sprouting. Frilling and cut-stump treatments with glyphosate treatments were the least effective methods of control looked at in this study.

This presentation is based on N. Salisbury 2013; report available at: <http://bit.ly/ECHolly>.

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THE EFFECTIVENESS OF COMMON REMOVAL METHODS FOR THE ERADICATION OF ENGLISH HOLLY (*ILEX AQUIFOLIUM*)

Ariel Williams and David Stokes

To determine the effectiveness of common methods for English holly removal in Pacific Northwest forests, we looked for evidence of holly survival at sites in St. Edward State Park where holly was removed one and two years previously by one of three methods: uprooting (n = 34), cutting at ground level (n = 14), and cutting at ground level plus stump treatment with 18% glyphosate herbicide (n = 26). We found that the rate of success (i.e., no live sprouts present) for all methods combined was 53%. The methods differed in their effectiveness, with uprooting (59% success), and cutting plus herbicide (62%) more effective than cutting alone (21%). Along with greater likelihood of re-sprouting, cutting (only) also led to greater numbers of sprouts and larger sprouts. Logistic regression analysis indicated that in addition to control method, tree size and date of removal were significant predictors of removal success. Smaller trees and trees removed in winter were more likely to be successfully eradicated than larger trees and trees removed in spring. Our results indicate that holly can be controlled, but that management persistence is needed. Control success will likely be improved with earlier intervention and concentration of removal activities in winter.