Meeting the Challenge:
Preventing, Detecting, and Controlling Invasive Plants

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Direct and Indirect Impacts of Invasive Plants to Wildlife

Shawna L. Bautista, US Forest Service, Pacific Northwest Region Invasive Plant and Pesticide Use Coordinator

Abstract

Research investigating the ecological effects of invasive plant infestations often focuses on effects to plant communities or soil properties. However, there is a growing body of evidence that invasive plant infestations have serious, and sometimes deadly, impacts to wildlife species as well. General habitat loss, or loss of forage are some of the most commonly cited effects to wildlife, but recent research and anecdotal evidence have indicated more complex interactions. Some invasive plants may be acting as population sinks by impacting breeding even though native wildlife will use the non-native plants. For example, use by native birds of invasive buckthorn for nesting results in significantly higher predation rates of the buckthorn nests (Chew 1981, Schmidt and Whelan 1999). Similarly, native hummingbirds nesting in gorse in coastal Oregon may be subject to competitive interactions and direct predation by wrentits because the hummingbirds nest lower to the ground in gorse than they do in native vegetation (Saylor, pers. obs., video). While Oregon spotted frogs, a proposed threatened species, may use areas invaded by reed canarygrass during parts of the year, they strongly avoid it during the breeding season because it does not provide the needed structure for egg laying (Cushman and Pearl 2007, White 2002, Watson et al. 2003). The result may be complete loss of breeding habitat for the frogs. A less-known effect of invasive plant infestations is direct mortality to wildlife. Young moose in Achorage, AK have been killed by consuming introduced European bird cherry (*Prunus padas*) due to the cyanide concentrated in the trees shoots during winter (Grove 2011). Death of the moose occurred in as little as 20 minutes. Direct mortality to wildlife has also been reported for burdock (bats, hummingbirds; Raloff 1998), hydrilla (bald eagles, waterfowl; Wilde et al 2005), ripgut brome (*Bromus diandrus*) and foxtail barley (*Hordeum jubatum*)(red-shouldered hawks; McCrary and Bloom 1984), and on important seabird islands in South Korea from Japanese chaff flower (*Achyranthes japonica*)(Swinhoe's storm-petrels; Pearson 2010). The direct and indirect effects of invasive plants on wildlife, particularly the potential for direct mortality, are not well-known and should be further investigated and publicized. In addition, it is important to understand that use of invasive plants by native wildlife does not necessarily confer a benefit to the wildlife, and may actually pose a serious threat to individuals or populations.

Patterns and Vulnerabilities of Arctic Alaska to Non-Native Plant Invasion: Estimating Current and Future Susceptibility in the Face of Climate Change and Development

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Abstract

Non-native plant species currently are restricted to only the warmer margins of arctic Alaska. Here we explore the relationship of non-native plant establishment to climate and anthropogenic variables in arctic and subarctic Alaska, using GIS, CART, and random forest analysis for current and future scenarios. The model outputs are then used to identify vulnerable regions now and in the future. Results suggest that short growing seasons and low temperatures limit non-native plant species. However, areas with approximately 160 frost-free days are capable of supporting a small cohort of at least 25 non-native species, including plants known to be ecologically damaging. Climate projections predict that in 50 years the majority of arctic Alaska will have greater than 160 frost-free days, implying that the region will transition from resistant to vulnerable to establishment of the cosmopolitan cold-tolerant weeds. Areas susceptible to non-native plant infestations in subarctic Alaska are characterized by high road density and early thaw dates. Future scenarios indicate increasing vulnerability to invasion in both the arctic and subarctic regions due to the interaction of increasing growing season length and increasing anthropogenic disturbance.

Baseline Assessment of Invasive Species in the Puget Sound Basin and Other Activities of the Washington Invasive Species Council

Wendy Brown, Executive Coordinator, Washington Invasive Species Council
Mike Leech, Spatial Development International, LLC

Abstract

The Washington Invasive Species Council has developed a baseline assessment of priority invasive species in the Puget Sound Basin. The assessment compiles geospatial data from numerous sources and examines species location, distribution, potential pathways of spread, and resources at risk. It should serve as a resource to government and non-governmental organizations who conduct invasive species prevention, detection, and response efforts. As a means of providing for future updates to the baseline assessment, a smartphone app was also created. The app, called *WA Invasives*, provides for easy reporting of invasive species in Washington and is available for free in Apple and Android formats. These and other invasive species projects undertaken by the council will be discussed.

Twenty-first Century Issues for Invasion Biology: Managed Relocations of Rare Species and the Use of Non-invasive Cultivars of Invasive Species

Sarah Hayden Reichard, University of Washington

Abstract

We live in complex times, when conventional ways of managing landscapes being questioned and attitudes about environmental issues are evolving. For instance, conservation biologists have long claimed that reintroduction of rare species should be done as close to existing populations as possible. Now, with climate change, they are anticipating doing it hundreds of miles from those populations, as "managed relocation" or "assisted migration." Might those rare species become invasive? An evaluation of invasive and rare plants using a pest risk assessment in Florida found that the rare species were unlikely to become invasive. The methods used have been effective in many countries and could be used, or another similar method, for Pacific Northwest plants. Climate change may also alter the weighting of questions in pest risk assessment methods, as it alters the chemistry (e.g., allelopathy or pest resistance) and other factors, requiring thoughtful calibration. "Non-Invasive" cultivated varieties of invasive species are being developed, but sterility is often difficult to maintain once the plant is in widespread cultivation. It is critical that the mechanisms leading to sterility be understood before the release of the cultivar. Managing invasive plants in the 21st century requires us to carefully consider the biology of both rare and invasive plants and be adaptive in our methods.

THIRTEEN YEARS OF BAD LUCK: GARLIC MUSTARD (*ALLIARIA PETIOLATA*) IN WASHINGTON FROM 2000 TO 2013

Sasha Shaw, King County Noxious Weed Control Program (KCNWCP); Wendy Des Camp, Washington State Noxious Weed Control Board; Maria Winkler, KCNWCP; Matt Below, KCNWCP; Roy Brunskill, KCNWCP; Edward McFarlin, KCNWCP

Abstract

Garlic mustard (*Alliaria petiolata*) was listed as a Class A Noxious Weed in Washington in 2000, with considerable resources expended to contain and eradicate it since then. However, its spread in the state has increased alarmingly since 2000, and it does not appear to be slowing down. By re-tracing the spread of garlic mustard in Washington, we can see how this species has dispersed in spite of efforts to contain it, overlaid with the story of how detection of a new species relies heavily on chance, and how the resources required to effectively and rapidly respond to garlic mustard have been greatly underestimated.

In 2000, garlic mustard was thought to be limited to King County. A closer look at the spread of the plant in this county illustrates the challenges to stopping it throughout the state. Between 2000 and 2013, the King County Noxious Weed Control Program tracked all known populations, control methods used, and percent controlled. In spite of very high levels of control of known populations, and considerable public education activities, by the end of 2013 there were 384 known sites in King County covering 17.2 acres, with 69 new sites found in 2013 alone.

The story of garlic mustard in Washington alerts invasive plant practitioners and policy-makers to the considerable challenges of fully and effectively implementing an early detection and rapid response program at a state or regional level, even when resources are available and laws are in place to allow for such a program to exist.

Flowering Rush: A New Biocontrol Project for North America

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Abstract

Flowering rush, *Butomus umbellatus*, is an aggressive invasive plant that rapidly colonizes freshwater aquatic systems. It is becoming an increasing concern in many North American states and provinces and is poised to become a substantial problem in several major waterways, despite ongoing eradication efforts. Although appropriate chemical and mechanical control methods continue to be explored, they have thus far been relatively ineffective, creating concerns that the flowering rush populations will continue to expand and spread without restriction. In looking for possible control methods, we are taking a proactive approach by pursuing potential biological weed control agents and have formed the Flowering Rush Biocontrol Consortium to coordinate the project. Flowering rush is an excellent candidate for biocontrol because it is the sole genus and species in the family Butomaceae, which may increase the likelihood of finding a host-specific insect. Emphasis is currently on finding rhizome-feeding insects to maximize potential impacts on the vegetative reproducing triploid cytotype. A test plant list was developed and foreign exploration began in Europe. The literature indicates that two fungal pathogens and 18 insect species are known to utilize flowering rush. Six of these species are recorded as monophagous and include three weevil species, *Bagous nodulosus*, *B. validus* and *Donacia tomentosa* and three fly species, *Phytoliriomyza ornata*, *Hydrellia concolor* and *Glyptotendipes viridis*. Field surveys in Germany and the Czech and Slovak Republics resulted in the collection of several insect species, including the leaf- and rhizome-mining beetle, *B. nodulosus*. Host-specificity testing and additional field surveys are underway.

The performance fit using aminocyclopyrachlor herbicide blends in controlling invasive plants in the western USA.

John D. Cantlon
Government Resource Manager, EI DuPont deNemours and Company

Abstract

Aminocyclopyrachlor is a new class of chemistry known as the pyrimidine carboxylic acids which provides economical and effective control of hard to control species. It is a new generation of herbicides belonging to the family of herbicides known as synthetic auxins.

Current product registrations allow non-cropland use by selectively targeting perennial broadleaf species such as leafy spurge, knapweeds, skeletonweed, thistles, toadflax and bindweed. Brush species include rabbitbrush, greasewood and mesquite. Annual weeds controlled include kochia and Russian thistle.

Aminocyclopyrachlor is metabolized by soil microbes to numerous minor degradation products, mineralized to CO2 and other unextractable degradates. Leaching is moderated by low use rates and field degradation.

Pasture/rangeland registration expansion research continues and will be highlighted from testing with university cooperators across the western USA. Acre costs impacts are compared within IPM programs contrasting standard treatments. Stewardship guidelines are outlined with three available products (Perspective®, Streamline®, Viewpoint®) as to fit within selective, bareground and brush control programs. Label language is discussed when using within selective EDRR programs, resistance weed management, product combinations, adjuvant use and aerial application methods.

Effects of logging debris and herbicide treatments on abundance of nonnative plant species after forest harvesting in western Washington

Timothy B. Harrington and David H. Peter, U.S. Forest Service, Pacific Northwest Research Station

Abstract

Nonnative plant species often invade forest sites soon after timber harvesting, but little is known regarding effects of site preparation treatments on their abundance. At a study site near Matlock WA, two levels of logging debris (15- and 30-cm average depths) were replicated six times in a split-plot design with three broadleaf-specific herbicide treatments (triclopyr (T), aminopyralid (A), and T+A). The debris treatments were applied soon after forest harvesting in December 2011, and the herbicide treatments were applied in August 2012. Vegetation cover (%) was estimated visually by species within each plot during the summers of 2011, 2012, and 2013. In 2012, prior to the herbicide treatments, *Anthoxanthum odoratum*, *Cirsium vulgare*, and *Senecio sylvaticus* each had lower abundance under heavy debris than under light debris. In 2013, abundance of *Agrostis capillaris* was greater, whereas abundances of *C. scoparius*, *Hypochaeris radicata*, and *Leucanthemum vulgare* were lower in herbicide-treated plots than in non-treated plots. Abundance of *S. sylvaticus* was greater in triclopyr-treated plots than in aminopyralid- or non-treated plots. Abundance of *A. odoratum* was greater in herbicide-treated than in non-treated plots, and differences were greater under light debris than under heavy debris. Seedling density of *C. scoparius* was lower under heavy debris (0.5 seedling m^{-2}) than under light debris (3.3 seedlings m^{-2}), and it was lower after aminopyralid than after triclopyr or no treatment. Species' responses were determined primarily by mode of reproduction (e.g., seedling vs. rhizome) and life form (i.e., dicot vs. monocot) which influenced their susceptibility to the treatments.

Controlling Reed Canarygrass populations in the Ross Lake National Recreation Area – Adapting to Improve; a Ten Year Retrospective.

Todd Neel - National Park Service, Exotic Plant Management

Mignonne Bivin – National Park Service, North Cascades National Park

Abstract

The Ross Lake National Recreation Area, a unit within The North Cascades National Park Complex (NOCA), contains three reservoirs, the Skagit River and a section of Washington State Route 20. Ross Dam, completed in 1962, inundated a 26-mile long section of the Skagit River and over 11,000 acres of riparian habitat, and created the Ross Lake Reservoir. The production of hydroelectric power from Ross Dam creates fluctuations of the water levels of the reservoir and results in a "drawdown" zone and a shoreline that is continually disturbed. These disturbed areas are currently being colonized by reed canary grass (*Phalaris arundinacea*). The National Park Service began treating isolated sites along the lakeshore in 2004. At sites such as Dry Creek, Little Beaver, and the mouth of Big Beaver Creek, reed canary grass cover has been reduced by up to 96%. Future efforts at Ross Lake will include the control of recently discovered satellite populations located in sensitive wetlands of the Big Beaver drainage near the Park's Wilderness boundary, as well as efforts to cooperate with B.C. Provincial Parks to treat infestations at the head of the lake within the Skagit Valley Provincial Park. In 2014, the National Park Service will begin implementing a staged approach to control reed canarygrass populations at the head of Lake Chelan, combining the use of aquatic herbicides with restoration of native species, utilizing techniques refined at Ross Lake. This project will demonstrate that significant control of reed canary grass populations and restoration of native species can be achieved over a three year period, and offer a strategy that can be implemented at similar sites in the Pacific Northwest.

Garden Loosestrife: a history in King County, WA and the latest control methods

Ben Peterson – King County Noxious Weed Control Program

Abstract

Control of the emergent aquatic invasive plant garden loosestrife (*Lysimachia vulgaris*) has proven difficult in the Puget Sound region. A Class B noxious weed in Washington State, the plant has invaded waterway shorelines and wetlands. Garden loosestrife is a perennial emergent plant that spreads primarily vegetatively (by rhizomes) and also by seed.

The plants that occur in King County (Seattle area) have not responded well to the regular control methods. Attempts at controlling garden loosestrife using manual and mechanical methods such as digging, mowing, or sheet mulching have proven largely ineffective. Controlling the plant using herbicide has had moderate and mixed results: triclopyr and imazapyr seem to help prevent flower production and slow growth but the vegetation usually returns. One suspicion was that the garden loosestrife plants in King County were polyploid, which could possibly explain their particular sturdiness and large size. Plants from three disparate sites in King County were tested for polyploidy in 2012. results came back that none of the samples were polyploid.

This summer a potted plant herbicide trial was conducted to determine the effect of common aquatic herbicides on garden loosestrife. The study was run by Tim Miller at Washington State University Extension Mount Vernon with the help of the King County Noxious Weed Control Program. Time-tested the effect of glyphosate, imazapyr, imazamox, and triclopyr, along with combinations of these, on garden loosestrife.

FIGHTING THE GIANT HOGWEED: A RETROSPECTIVE OF KING COUNTY'S EFFORTS FROM 1996 TO 2014

Karen Peterson, King County Noxious Weed Control Program (KCNWCP); Sasha Shaw, KCNWCP; Maria Winkler, KCNWCP

Abstract

Giant hogweed (*Heracleum mantegazzianum*), a Class A Noxious Weed in Washington, has been one of the highest priorities of the King County Noxious Weed Control Program since it began operating in 1996. This plant was widely planted in the urban areas of King County before the program began tracking it, and it had already spread to numerous backyards, ravines and parks. Since 1996, the program has utilized a variety of strategies to achieve control and eventual eradication of giant hogweed in the county. By reviewing the number, size and geographic distribution of known sites over time, we can see how these efforts have impacted the spread of this plant in the county.

One of the biggest challenges to successfully eradicating any invasive plant from an area as large and complex as King County is the detection of all existing sites. Public education and media alerts have facilitated detection of new sites and the noxious weed program has found many sites from people self-reporting or reporting sites on neighboring properties that wouldn't have been detected otherwise.

Due to the large level of resources and public support for the control of giant hogweed, the number of populations in the county has declined since its peak in the early 2000's. However, it is indicative of the challenge of eradicating any invasive plant that the program continues to find new sites every year. Based on our past experience, we predict that we will continue to discover new sites for many years to come.

A Custom GPS Recording System for Improving Operational Performance of Aerially-Deployed Herbicide Ballistic Technology

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Abstract

Herbicide Ballistic Technology (HBT) is an electro-pneumatic delivery system designed for administering 17.3 mm herbicide-filled projectiles (e.g. paintballs) to visually-acquired weed targets. Currently, HBT is being deployed from a Hughes 500D helicopter platform in aerial surveillance operations to eliminate satellite populations of an invasive weed (*Miconia calvescens*) in remote watershed areas of East Maui (Hawaii, USA). Coordination and analysis of control operations require that the site of each HBT application be recorded with a handheld GPS data logger. This independent step, though critically important, adds significant time to the target acquisition process where flight time is extremely limited. Furthermore, herbicide use rates are calculated post-operation by rudimentary mean estimation of bulk projectile consumption relative to the number of recorded targets. In an effort to improve operations, we have integrated GPS and other sensors directly into the electro-pneumatic device for instantaneously recording time, origin, and trajectory of each projectile discharged. These data are transmitted wirelessly to a custom android application that displays target information in real-time both textually and on a map. The application also records data into a comma delimited file so that it can easily be recalled for map display, or exported to other software such as for conducting additional GIS analysis. These improved features make data collection a seamless part of the operation, facilitate logistics of applying airborne HBT, and improve our interpretations of operational HBT performance with more statistically robust measures of herbicide use rate and time-on-target. To view HBT in action please visit http://www.youtube.com/watch?v=98i6SQKSzY.

ENGLISH HOLLY *ILEX AQUIFOLIUM* IN PACIFIC NORTHWEST FORESTS: WHAT DO WE KNOW? WHAT SHOULD WE DO?

David L. Stokes, University of Washington Bothell

Abstract

A research and management symposium on English holly *Ilex aquifolium* in Pacific Northwest forests was held at St. Edward State Park (WA) in June 2014. The purpose of the meeting was to pull together the scientific and management information available on the English holly invasion in the region and to use this information to inform discussions about holly management and policy. Presentations addressed diverse topics including: prevalence of holly in forests in the region, population and spread dynamics of invading holly, effects of holly on native species, effectiveness of holly control methods, and others. I provide an overview of the major findings presented at the symposium and discuss research priorities and options for management and policy that emerged from symposium discussions.

Invasive white sweetclover affects plant-pollinator community interactions in interior Alaska

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Abstract

Pollination is a critical ecosystem service that is often required for fruit set in angiosperms. When non-native plant establishment occurs in an ecosystem the plant-pollinator network may be altered. Boreal Alaska is currently experiencing an invasion of *Melilotus albus*, a highly rewarding plant to pollinators. We observed plant-pollinator interactions using observers and video cameras at unmanipulated sites with and without naturally occurring *M. albus*, and in experimental sites where potted *M. albus* were paired with control plots without *M. albus*. Relationships among plant species and flower-visiting insects changed in the presence of the invasive plant. Pollinator guild diversity increased, and most guilds visited *M. albus*. Plant-pollinator network connectance was higher in sites with *M. albus*. Additionally, evidence suggests that visitation rates to native plant species increased in the presence of the invasive. Changes in plant-pollination networks appear to influence fruit and seed set patterns of native plants. Our results indicate that alterations of local plant-pollinator relationships by the introduction of a highly-rewarding invasive plant can influence visitation rates and subsequent fruit and seed set of native boreal species.

Impacts of invasive English holly (*Ilex aquifolium*) on understory vegetation in a maturing Pacific Northwest western hemlock zone forest

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David Stokes
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University of Washington, Bothell

Abstract
English holly (*Ilex aquifolium*) is a non-native shade tolerant evergreen tree invading Pacific Northwest (PNW) forests. Rapidly increasing, and with no structural analogue in the native forests it is invading, holly has the potential to radically alter the structure, processes, and biodiversity of native PNW forests. However, despite its apparent ability to exclude native vegetation, 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 (≥4m canopy diameter) in a native conifer dominated forest community in St. Edward State Park (Kenmore, WA). Sampling design was intended to distinguish hypothesized effects of holly shade and leaf litter. For each of the 20 trees we collected cover data in $1m^2$ quadrats north of the tree (shade effects), under the canopy on the north side of the trunk (shade and litter), under the canopy on the south side of the trunk (litter), south of the tree (control). On average, total cover of native evergreen and woody vegetation was drastically reduced underneath holly canopies, and was also lower in the shade of holly (adjacent to holly cover), compared with the control. Our findings suggest that holly has the capacity to exclude native vegetation, and poses a serious threat to the biodiversity and natural ecological processes of forests in the region if left unmanaged.

Predicting flowering times of native and non-native plants in Alaska using data from herbarium specimens and citizen science networks

Christa P.H. Mulder and Katie V. Spellman*
University of Alaska Fairbanks, *Student

Abstract

The potential for pollinator-mediated interactions between native and non-native plant species is driven in large part by overlap in flowering times. In Alaska non-native plants have only recently started moving off the human foot-print, but monitoring plant phenology in a large state with few roads is challenging. We are investigating interactions between two native berry-producing plants (bog cranberry *Vaccinium vitis-idaea* and the blueberry *Vaccinium uliginosum*) and rapidly-expanding non-native sweetclover (*Melilotus albus*). To predict to overlap in flowering times now and under continued climate change we collected phenology data from > 2000 herbarium specimens from across North America, and combined those data with geographic and climate information to build models predicting flowering phenology across Alaska. We also evaluated the extent to which inter-annual variation in weather explained phenology and developmental rates. The model predictions were validated using a high-quality phenology dataset obtained from >240 volunteers across Alaska. Flowering phenology of the two native species is much better explained by geographic location and long-term climate variables than that of *Melilotus*, and that this is driven by increases in developmental rates under shorter growth seasons. This gives an advantage to *Melilotus* as seasons lengthen in the far North but the native species cannot expand their flowering periods. Predictions from the herbarium-based models for berry species matched observed data very well, but predictions for *Melilotus* did not. We conclude that herbarium-based models can be very useful in predicting phenology in difficult-to-access locations, but identify biases can lead to poor predictability for rapidly-expanding populations.

Impacts of asymmetric phenological shifts on pollinator-mediated seed production

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Abstract

Phenological shifts in response to climate change are ubiquitous, but are not necessarily equivalent for interacting organisms. Native and exotic plants often interact indirectly though shared pollinators, influencing each other's seed production. The strength of such pollinator-mediated interactions may depend on the duration of time such an interaction can occur, yet native and exotic plants may experience different rates of phenological shifts induced by climate change, altering that duration. To determine how individualistic changes in flowering phenologies might affect plant-plant interactions through shared pollinators, we manipulated the flowering phenology of two ubiquitous exotic plants of western Washington prairies, *Hypochaeris radicata* and *Cytisus scoparius,* relative to seven native perennial forb species whose phenologies remained unmanipulated. Specifically, we advanced and delayed the flowering of exotic species, and quantified impacts on pollinator visitation and seed set by all native species relative to an unmanipulated control. Native seed set was strongly affected by changes in exotic flowering phenology in all cases, but the magnitude and direction of effects were not predicted by the nature of the original indirect interaction (facilitative vs. neutral vs. competitive) and the change in interaction duration. We speculate that changes in pollinator behavior in response to changed floral neighborhoods are responsible for the unexpected effects. In addition to other types of ecological surprises that can be expected from climate change, individualistic phenological shifts have the potential to produce large and unexpected changes in indirect interaction outcomes.

Effects of aquatic herbicide tank mixes on metamorphic Northern Red-legged Frogs

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****Bachelor of Science student, Department of Biology, University of Washington**

Abstract
Conflict between native amphibians and aquatic weed management in the Pacific Northwest is rarely recognized because most native stillwater-breeding amphibian species move upland during summer, when herbicide application to control weeds in aquatic habitats typically occurs. However, aquatic weed management may pose a risk for species and life stages present in wetlands through the summer. Acute toxicity of herbicides used to control aquatic weeds tends to be low, but the direct effects of herbicide tank mixes on many amphibians have remained unexamined. We exposed metamorphic Northern Red-legged Frogs (*Rana aurora*) to tank mixes of the herbicide triclopyr (Renovate 3®, 47.1 ppm TEA), a surfactant (Competitor®, 41.3 ppm) and dye (Hi-Light®, 12.9 ppm) for 96-h. The tank mix was chosen because of its use in aquatic weed control. Concentrations were those associated with labelled-rates for control of purple loosestrife (*Lythrum salicaria*) if applied to 2cm of water with no intervening vegetation, and a clean-water control. Following exposure, frogs were reared for 2mo in clean water to identify potential latent effects. Endpoints included time to complete metamorphosis, behavior, growth, liver histology, and body and liver condition. We recorded no treatment-related mortalities, no effects on behavior, and no effects on liver condition or histology. Significant effects ($p<0.05$) were observed in reduced dissolved oxygen levels in treatment solutions during the 96-h exposure and increased time to metamorphosis in tank mix-exposed frogs. Results suggest that exposure to triclopyr-Competitor tank-mixes increases stress in metamorphic frogs during exposure, but frogs are able to recover in clean water.

Elodea in Southcentral Alaska: Early Detection and Rapid Response in Action

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Abstract

Elodea, an invasive aquatic species, was first discovered on the Kenai Peninsula, Alaska, in September, 2012. The potential threat to aquatic resources was immediately recognized by a multi-agency task force that organized meetings in early 2013 to involve the public and various agencies in the process of finding solutions for control or eradication. Permitting and regulatory documentation processes were initiated quickly to allow potential treatments. Winter surveys were conducted under ice to determine the extent of the known infestation in two major recreation and residential lakes; summer surveys provided a comprehensive inventory of 68 lakes across the Kenai Peninsula. The various stakeholders agreed on an eradication goal, with anticipated pesticide treatment of all three infested lakes in summer 2014. A systematic approach to determining treatment options included expert consultation, genetic testing, bathymetry analysis, and controlled lab condition titration experiments. All survey data were incorporated into a statewide invasion database, then mapped and distributed openly. Inventory techniques, monitoring plans, and efficacy testing studies have been incorporated into a comprehensive multi-agency technical management plan. Complementary studies underway include vector analysis to determine float plane and wildlife transmission rates, advanced economic analysis of aquatic invasion consequences in Alaska, and predicted climate change range expansion models. The immediate cooperative response after initial detection and the extensive and comprehensive outreach to all stakeholders, followed by sustained action and analysis of lessons learned, serves as a model for future invasion response within the state.

Quantitative Uncertainty Analysis For A Weed Risk Assessment Model

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[c] Center for Integrated Pest Management, North Carolina State University, Raleigh, NC.

Abstract
We developed a quantitative uncertainty model for our weed risk assessment tool for the United States, utilizing the information obtained when assessors rate their uncertainty for each answer given. For each uncertainty rating (negligible, low, medium, and high) we specified a distribution for the likelihood of an answer changing. The simulation model first determines how many answers changed, and then calculates the resulting scores and overall risk rating. We evaluated model sensitivity and behavior, and how often uncertainty results differed from baseline risk ratings. We confirmed that the uncertainty analysis produced a reasonable amount of variation in risk scores and responded to varying levels of uncertainty in the assessments. For over 85 percent of our 204 test species, baseline and uncertainty analysis ratings did not differ. Species assessments with ratings that differed tended to either have risk potential scores near a threshold or greater overall uncertainty. If they differed, the risk rating indicated by uncertainty analysis was almost always greater, but rarely changed all the way from Low to High risk. Uncertainty analysis provides a responsive and informative addition to the baseline weed risk assessment, and provides useful information for analysts, reviewers and decision makers.

Volunteers Make a Difference in an Early Detection Rapid Response Citizen Science Program

Julie K. Combs, PNW-IPC (Pacific Northwest Invasive Plant Council) and Lizbeth A. Seebacher, PNW-IPC and WA State Department of Ecology

4. Abstract

After prevention, Early Detection Rapid Response (EDRR) is the most effective method to control the establishment and spread of new populations of invasive plants. Invasive species management is often constrained by time and resources. In 2012, the Pacific Northwest Invasive Plant Council (PNW-IPC) developed an EDRR Citizen Science Invasive Species Program in order to support county, state and federal management agencies working to locate and eradicate invasive species in Washington State. To date our program has trained 140 EDRR citizen scientists to identify 30 target EDRR species and conduct surveys in urban, rural and natural areas on county, state and federal public lands. Volunteers have made significant impacts in effort to detect and eradicate invasive species in WA State over the last two years. In total, volunteers conducted 115 surveys covering over a thousand acres (1,416 total acres) within 15 Washington counties. A large portion of these surveys (43% or 49 surveys) detected EDRR invasive species and in many cases infestations were small enough that volunteers were able to manually remove them *in situ* before infestations had a chance to establish and spread. The number of acres surveyed by volunteers increased 469% from 2012 (247 acres) to 2013 (1,159 acres) indicating that our program is successfully growing and has the potential to make a significant impact in the effort to search for and eradicate high priority invasive species across Washington State. Along with our programmatic successes we will present challenges and lessons learned since 2012.

Reaching Infomaniacs in a Post Brochure Era

Jennifer Grenz, Invasive Species Council of Metro Vancouver and President, North American Invasive Species Management Association

Abstract

Reaching the public has never been so challenging. In a world where we are inundated by information, how do we as invasive species managers effectively break through all the "noise"? Challenges of managing invasive species in urbanized areas presents further challenges around reaching so many people, 1.3 million in Metro Vancouver, who feel few direct impacts but do have a significant role to play in acting as a major vector of invasive species into our areas of highest conservation value. The Invasive Species Council of Metro Vancouver has effectively broken through to its constituents using innovative branding that not only effectively conveys messaging but has been instrumental in improving prevention, increased reporting, and protected herbicide control programs. The Alienbusters and Knot on My Property programs have been designed to be expanded to other jurisdictions and since their inception have quickly been recognized by the public and been used by other invasive species management organizations. These programs have helped provide a framework for further educational opportunities that will continue to ensure both the public awareness and support required to effectively prevent the invasion of new invasive species.

A Hybrid Approach to Real-Time Data Collection and Mapping of Noxious Weeds

Greg Haubrich & Landon Udo
Washington State Department of Agriculture

Abstract

iFormbuilder is an out of the box mobile data collection solution that the Washington State Department of Agriculture has been using for the past year. It features both an iOS and Android mobile application as well as a web based form creation and data management interface. iForm has proven to be highly flexible, easy to use and highly customizable using basic Javascript code. This past Summer WSDA utilized iForm for over 15 different statewide invasive weed and insect surveys and collected over 140,000 individual electronic records. iForm is a near real-time data collection system that also offers the ability to collect data when out of cellular coverage. iForm has recently formed a partnership with ESRI and their product now works very cohesively with ArcGIS Online(AGOL) and ArcMap. ESRI provided WSDA with a custom ArcMap extension that allows for the direct download of iForm data which is then automatically inserted into a geodatabase as a feature class. It also offers the ability for a completely automated way of creating a REST feature service on your AGOL account directly from a form you have created within iForm. Transitioning to this new system has allowed WSDA to be up and running within a month of purchasing the product license and cut costs and data management time by over 40% from the previous year. The software was mainly utilized by WSDA staff but due to the success of the 2013 field season we will be rolling this out to county, state and federal cooperators in 2014.

Improving efficiency of EDRR invasive plant management operations using optimized field data workflows.

Jeff Lesh
WeedWise Conservation Technician
Clackamas County Soil & Water Conservation District

Abstract

Invasive plant management on a large scale often requires organizational sophistication, especially in urban areas, due in part to the large number of land manager relationships and invasive plant data that must be collected, maintained, and utilized. Here, data collection often involves tracking land manager permissions and preferences; outreach efforts; and plant observations, surveys, and treatments. Additionally, as the infestation size and number of staff or contractors involved increases these challenges compound. Newly developed tools connected to cloud services are increasing the efficiency and reducing costs of field data management for many applications relative to existing tools. This talk describes the use of one such tool, Fulcrum, in combination with several other tools to create an data processing workflow without manual processes for an existing invasive plant management program in Clackamas County, OR. This strategy was used to convert a fieldmap and field sheet-based process utilizing manual data entry in the office into a paperless, smartdevice-based solution supporting offline data presentation and collection with automated data integration into existing databases. This project resulted in improved field decision making and situational awareness, enhanced field day flexibility, reduced time spent on data entry and data integration into existing databases, allowed for new data tracking and reporting requirements to be integrated rapidly, allowed for easy expansion of photo monitoring, and supported expanded use of contractors among other benefits. Subsequently, this tool was expanded to include handling up to the minute coordination between landowners, contractors, and project managers regarding landowner notifications and contractor job assignments. Many challenges remain, but this solution has helped to increase the efficiency of invasive plant management operations considerably.

A spatially explicit model of the presence of English holly (*Ilex aquifolium*): Spatial relationships and implications for management"

Santiago Lopez, PhD*, David Stokes, PhD*,
*** University of Washington Bothell**

Abstract
Despite English holly's (*Ilex aquifolium*) possible effects on native ecosystems, little is known about the spatial factors associated with a successful establishment and spread of this particular invasive species in the Pacific Northwest. In this study, we analyze some of these aspects through the lens of a spatially explicit model that integrates 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. We used the coefficients of the logistic model to generate a map depicting the probability of the presence of holly, which indicates where holly invasion is more likely to occur. 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.

Fine Resolution Mapping Methodology for Land Mangers to Track Efficacy

Frances Lucero, King County Noxious Weed Control Program
Edward McFarlin, King County Noxious Weed Control Program

Abstract

Invasive plants pose many threats to high-value habitat areas and their management has become a fundamental conservation practice. However, few time efficient systems or conventions exist for accurately and quantitatively tracking their occurrences on the landscape or the management practices implemented to combat them. Land managers choose between accurate data collection and volume of on the ground work. Looking for a more reasonable balance, the King County Noxious Weed Control Program (KCNWCP) developed a simplified on the ground methodology to track and monitor work controlling several species of noxious weeds. Project sites span several hundred acres and involve nearly 1,200 landowners, both public and private. Work often occurred in remote, difficult to access sites where time and funding constraints meant treatment and surveying needed to take place concurrently. Records from one season also needed to be comparable to records from the next (or previous) seasons, regardless of staff consistency.

Using the county's available GIS layers, the program was able to define static sites, and could then track the infestation within these boundaries. Contracted crews and program staff used Garmin GPS units to collect data in the field while treating and relied on a set of pre-defined assumptions collated in the office with paper notes. Crews only collected point data and were encouraged to take one feature per square foot of treated plant whenever possible. Post processing and combining of all data collected for the season lead to maps that showed net infested area, gross infested area, and surveyed area from just this single data collection.

PIECING TOGETHER A LOW-BUDGET EARLY DETECTION VOLUNTEER PROGRAM

Sasha Shaw, King County Noxious Weed Control Program; Mark Boyar, Mountains to Sound Greenway Trust Board of Directors

Abstract

Early detection of invasive plants in remote areas is one of the biggest challenges facing public land managers. One approach being taken is to recruit and train citizens who visit these remote areas to actively watch for invasive plants and report back to the agencies charged with managing the lands. In King County, Washington a small group of public agencies and a non-governmental organization have been building such a program as part of a cooperative effort to stop the spread of invasive plants in the Upper Snoqualmie/Alpine Lakes Wilderness area. The Weed Watcher program started in a small way in 2008 and has continued every year since then in spite of minimal funding and staffing, and a changing level of participation by volunteers and partners.

When faced with limitations of budget and time, it is important to know what components of a volunteer weed watcher program are most essential and effective and then to develop ways to implement these components with minimal cost and time. It is also important to stay flexible and incorporate new ideas and new partners where opportunities present themselves. The development and evolution of the Upper Snoqualmie/Alpine Lakes Weed Watcher program illustrates how this process can work and also demonstrates some of the challenges and growing pains that can be expected in a volunteer citizen science program.

UTILIZING ECOLOGICAL PRINCIPALS OF WEED MANAGEMENT IN WETLAND AND STREAM RESTORATION DESIGN TO DISCOURAGE INVASIVES

Sarah Spear Cooke, PhD, Cooke Scientific

Abstract

Restoration of wetland and riparian habitats in urban areas almost always involves weeds. Weeds need to be considered in preparing the site for planting and also in maintaining the restoration design after planting. Most restoration designs include those two components but not a critical third, including ecological principals in the design to limit or avoid weed issues to being with.

Some design considerations that are effective in limiting weeds include: cataloguing pre-existing weeds so eradication/maintenance strategies can be coordinated by weeds of similar natural history; developing stable habitats (emphasizing shade and inundation regimes that are unfavorable for the pre-existing weeds); planting areas with high density native species in more uniform pattern so there are no voids that weeds can colonize; utilizing fast growing native plants as necessary; limiting soil disturbance; and limiting the availability of nutrients except to the localized planting pits.

Finally, it is important to anticipate what weed issues may occur and develop contingencies up front so weed invasions can be dealt with rapidly and effectively. A weed removal manual is effective because it gives directions and schedules for weed removal so maintenance is done, is done on schedule and this work is budgeted in advance.

Crows and the Recruitment of Invasive Plant Species in a Restored Freshwater Wetland

Warren Gold, University of Washington, Bothell
Ian Barlow, student University of Washington, Bothell
Holly Zox, Edmonds Community College

Abstract

The University of Washington, Bothell campus is home to a 58-acre restored freshwater floodplain ecosystem and has recently become the site of one of the largest roosts of American crows in western Washington. Casual observations suggested that bird-dispersed invasive species were increasing in diversity and density in the portions of the wetland occupied by the crow roost. We have established ongoing studies to monitor the invasion of non-native species in different plant communities within the crow roost and outside of the main roosting zone. Soil blocks were excised and monitored for germination in a greenhouse to compare the soil seedbank. Permanent 4 m^2 plots were established in the wetland communities to examine germination in the field. In the greenhouse studies, invasive dicots comprised 75% of the germinants from soils of an *Alnus rubra* forest community with a shrub understory inside the crow roost while only 22% in a comparable community outside of the roost. Germination of bird dispersed invasives such as *Solanum dulcamara* and *Sorbus aucuparia* was greater in the roost areas than outside for both greenhouse and field studies. Graminoid germination in the crow roost was markedly lower than outside of the roost. Overall species richness of germinants tended to be lower in the roost zone though high variability made definite conclusions uncertain. The creation of avian habitat in restoration sites may have implications for the eventual rate of non-native plant invasion and thus, future maintenance needs to ensure the success of restoration sites in urban / suburban settings.

The PlantRight Plant Risk Evaluation Tool

Lizbeth Seebacher, Christiana Conser, Joe DiTomaso, Sarah Reichard.
WA State Dept of Ecology, UC Davis, UC Davis, and UW

Abstract

Accurately predicting the potential invasiveness of a plant before the plant is introduced into a new environment can greatly reduce the overall ecological impacts of invasive plants. Weed Risk Assessments (WRA) have been refined to boast remarkable accuracy in recent years. The goal of the current project is to prevent new invasive plants from entering the state of California through the horticultural industry via the use of an efficient Plant Risk Evaluation (PRE) tool. The PRE employs screening questions based on plant traits and with the scores from the answers given, assigns a final score for that plant. Not including those species that fell into the "Evaluate Further" category, the specificity of our model for the set of species tested was 0.97 and the sensitivity was 100% with an overall accuracy of 99%. This PRE tool generates fewer false positives when compared to the frequently used Australian WRA and it is comparable to new U.S. screening tool with regard to accuracy. Yet, the PRE is easier to use than either tool and can be used by nursery professionals, academics or others to determine if a species has the potential to become invasive. The creation of a science-based tool can assist the horticultural industry in assessing plants, preventing invasive ornamental plant introductions, and educating and collaborating with local stakeholders and regulatory groups.

Milfoil Eradication by Diver Hand Pulling in Walsh Lake, Washington

Rob Zisette and Josh Wozniak, Herrera Environmental Consultants

Abstract: Walsh Lake is located in the Cedar River Watershed, which is protected for use as the primary water supply for the City of Seattle. Herbicide use is prohibited within the watershed. Eurasian watermilfoil (milfoil) was first discovered in this natural lake during a botanical inventory in 2001, but a detailed survey and removal plan was not initiated until 2005 when City staff became aware of this discovery. A total of 121 native plant species were identified in the lake and its adjacent wetlands, including 28 native submerged species, adding urgency to the need for milfoil control. Milfoil was primarily confined to a small area where a turbidity curtain was installed to contain fragments during hand removal by divers. Over 580 pounds of milfoil were removed from this site by hand pulling over a two-day period in 2005. In 2007, a new infestation site was detected deep within the cattail marsh near the lake outlet, which is located at a beaver dam 0.5 miles from the original site. Milfoil removal amounts declined each year to only five small plants in 2008, but increased in 2009 at the original infestation site and in 2010 at the outlet site. Bottom barrier was applied at the original infestation site and survey intensity increased within the cattail marsh, and no milfoil plants have been detected since 2011.

The PPQ Weed Risk Assessment

Anthony L. Koop[a], Larry Fowler[b], Leslie P. Newton[a], Barney P. Caton[a], Lisa M. Kohl[c]
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[b] Retired, TX.
[c] Center for Integrated Pest Management, North Carolina State University, Raleigh, NC.

Abstract
Plant Protection and Quarantine's weed risk assessment (WRA) process was created to evaluate the risk potential associated with plants that may be weedy or invasive. The tool was designed as a pre-border application for predicting invasiveness, however, it is also appropriate to use on species beginning to escape or naturalize. The WRA consists mostly of a series of yes/no questions organized into four risk elements: establishment/spread, impact, geographic, and entry potential. Score values from the first two risk elements are used in a logistic-regression model to evaluate the risk potential of the species. This model was developed and validated with 204 species with known invasive status from the United States. Analysis of a species' U.S. geographic potential is done separately so that resource managers can make decisions appropriate for their jurisdiction. Our WRA process provides three sets of results that help characterize a species' risk profile. The first is the species' risk scores, probabilities of invasiveness, and model conclusion. The second is the results from the uncertainty analysis that evaluates the sensitivity of the risk scores to uncertainty. Finally, we also report where in the United States the species is likely to establish. Since we developed the PPQ WRA model, we have evaluated 77 species. Some of the ones that present a high risk potential to the northwestern United States are highlighted in the presentation.

Battle Tactics from Camp Ripley; the War on Invasive Species.

Kayla Malone, Saint Cloud State University - Department of Biological Sciences
Laura Donahue, Saint Cloud State University – Department of Biological Sciences

Abstract

Camp Ripley is located in central Minnesota and is a key training location for the United States National Guard. Training units travel to Minnesota from across the country, and this high land use pressure had resulted in the need to develop an invasive species management program. A partnership between the Minnesota Department of Defense and Saint Cloud State University was formed in 2002 that included research and monitoring of invasive species populations on Camp Ripley, MN. Since the initiation of this partnership, research conducted by Saint Cloud State Graduate students has resulted in successful control methods for Spotted Knapweed (*Centaurea stoebe*), and Common Tansy (*Tanacetum vulgare*). Large-scale assessment, monitoring, mapping, control and restoration practices have been occurring Camp-wide since 2010 and include several additional terrestrial species that exist on Camp Ripley in sparse populations. These species include; Leafy Spurge (*Euphorbia esula*), Canada thistle (*Cirsium arvense*), Bull thistle (*Cirsium vulgare*), baby's breath (*Gypsophila paniculata)* as well as aquatic species, Purple loosestrife (*Lythrum salicaria*).Many of these species are infesting and altering ecosystems across the Pacific Northwest, and information regarding the mapping, control and management of these species is likely applicable across these regions. The development of a successful invasive species program is should consider on many factors ranging from site to species characteristics. The objective of this presentation is to provide land managers with information for developing an invasive species program that includes a system of prioritization for treatments, a variety of management strategies which allows for the efficient, effective, and dynamic control of invasive species.

Web Based Solutions for Invasive Species Managers

Steven Manning, President-Invasive Plant Control, Inc.

Abstract

IPC Connect is a web-based reporting, tracking and evaluation tool for invasive species and natural resource managers. Created in a partnership between the University of Georgia (EDDMAPS) and Invasive Plant Control, Inc., IPC Connect provides innovative capabilities across the entire lifecycle of a project to help organizations effectively initiate, select, plan and deliver projects on time and within budget. This web based tool can digitize contractor or in house crews daily site sheets so they can visualize, download and print reports in real time. IPC Connect also allows you to track chemical usage and costs on a daily basis or create maintenance tools on your handheld device to eliminate costly down time while in the field. The IPC Connect suite of tools also includes digitized document solutions, transforming documents and integrating them into your mobile device. You can include maps and historical references, identification guides, property boundaries or any other pertinent information. This tool allows the applicator to enter control data directly into the plan on the day of treatment. Instead of compiling notes throughout the course of the year you enter notes in real time using your mobile device. Once submitted, the plan is automatically updated and available for all specified parties. Other capabilities of IPC Connect will be highlighted including the IPC Logic decision support tool and IPC Inventory which can provide species lists, time stamps, photos, maps, individual species points, area polygons, species population area or of the entire survey area, infestation density, and other valuable data.

Mapping Invasive Species with EDDMapS West

David J. Moorhead, Charles T. Bargeron, and Rebekah D. Wallace
Professor - Co-Director, Public Service Associate, and Program Coordinator, respectively.
University of Georgia Center for Invasive Species & Ecosystem Health

Abstract
In 2005, the University of Georgia's Center for Invasive Species and Ecosystem Health (The Center) began developing a web-based Early Detection and Distribution Mapping System (EDDMapS) to accurately map distribution of invasive plants across the United States. EDDMapS' primary goal is to discover the existing range and leading edge of invasive species while documenting vital information about the species and habitat using standardized data collection protocols. The primary focus of the project is mapping invasive species distribution, with a secondary focus on mapping biological control agent releases. EDDMapS is an aggregation database sourced from many federal, state, and regional agencies, organizations, and groups to display a more complete map of the range of an invasive species. Collaboration with established and emerging invasive species mapping and management programs benefits both the programs and The Center. The programs, by the development of tools and technology built by The Center with documentation preferences and species of concern tailored to regional specifications, and The Center benefits from more complete maps, increased quality data, and promotion of use of EDDMapS nationwide. The EDDMapS West project is a collaboration of The Center with eleven states in the western U.S., including Oregon's and Washington's Department of Agriculture. Invasive species in EDDMapS West can be reported via the website, as well as through iOS and Android based smartphone applications. New features within EDDMapS West include state specific reporting lists, documenting infested areas of species as polygons, and documentation of negative survey data.

Maximum Flex: UW-ONRC Meets the Evolving Challenges of Washington's *Spartina* Eradication Program

Miranda Wecker, UW Olympic Natural Resources Center
Keven Bennett, UW Olympic Natural Resources Center

Abstract

The removal of *Spartina alterniflora* from Willapa Bay stands as one of the greatest success stories in our nation's invasive species control history. Designated an "environmental emergency" by the Washington Legislature, the infestation has been reduced from a peak in 2003 of 9,000 net acres distributed over 25,000 acres of Willapa Bay to its current total of less than 1/2 net acre. The UW Olympic Natural Resources Center provided a range of supporting technical services in order to meet the evolving physical, legal, and political complexities encountered during the *Spartina alterniflora* eradication program. ONRC's role in the success of the eradication effort has been recognized as crucial. Among the services rendered were those related to: the overall mapping and analysis of the infestation; public education and outreach regarding control options and the impacts of the infestation; identification of optimal spray windows through development of spatial tidal predictions; feasibility studies of biological control options; comprehensive planning of agency coordination approaches; and fine-scale monitoring of the end stage of the eradication program to determine when eradication is achieved. Each phase of the eradication program gave rise to new challenges. Each year from 1997 onwards, UW ONRC staff worked to define the unique contribution it could make to the success of the effort. Collaborative real time brainstorming sessions were held among collaborators to decide how best to meet the newly emerging complexities and divy up the important tasks among partners. No individual agency alone was able to provide the range of technical analyses and supporting services needed to succeed. Only a collaborative and flexible approach produced the full assemblage of necessary political, legal, and physical components to achieve success.

Demography, Distribution, and Reproduction of the Nonnative Tree, *Prunus padus* in Subarctic Alaska: Evidence for Rapid Recruitment

Lindsey Flagstad[1], Helen Cortés-Burns[1], and Matthew L. Carlson[1,2]

[1]Alaska Natural Heritage Program and [2]Biological Sciences Department, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska 99501.

Abstract

Prunus padus L. (European bird cherry) is a shade-tolerant ornamental tree that is invading subarctic Alaska. In semi-natural parklands of Anchorage, the state's most populous city, this species is reaching high densities and is associated with lower foliar cover of native species. Annual seed rain is high, yet variable, with an average of 17 seeds/m^2 and seeds largely maintain viability over two winters. Stand age structures are skewed towards a high proportion of seedling and young saplings and few large trees, suggesting a pattern of recent introduction and rapid spread and likely self-thinning. In the absence of control efforts, it is likely that *P. padus* will increase in dominance and biomass at the expense of native vegetation.

Going to the Dogs: Detection Dogs have a Role in Invasive Weed Management

Pete Coppolillo, Aimee Hurt, Alice Whitelaw, Deborah Woollett, Megan Parker, Ngaio Richards
Working Dogs for Conservation

Abstract

Monitoring landscapes for early incursion of invasive species, or rooting out the few remaining undesirables during an eradication effort, requires intensive manpower. In some cases, simply finding the plant evades even the most experienced field scientist. Since our inception in 2000, Working Dogs for Conservation has been in a dozen countries seeking over 35 species of interest by partnering with detection dogs we have selected and specially trained —called Conservation Dogs—who sniff out both invasive and imperiled plant species, wildlife fecal matter and sometimes the animals themselves. This poster will summarize the highlights from our ongoing (entering 4th year) work to eradicate Dyer's woad (*Isatis tinctoria*) in Montana, and our monitoring of spotted knapweed (*Centaurea maculosa*) in Montana, Chinese bush clover (*Lespedeza cuneata*) in Iowa, and the endangered Kincaid's lupine (*Lupinus oreganus*) in Oregon. We briefly detail how we trained dogs to detect ash wood and ash wood infested with emerald ash borer (*Agrilus planipennis*) in Minnesota, to assist managers in reducing the spread of this damaging insect. We also discuss how dogs are trained to detect these targets and detail other factors relevant to managers, such as their ability to seek multiple targets simultaneously.

Coordinated Invasive Plant Control for Prairie-Oak Habitat in Western Cascadia

Nathan Johnson and Elspeth Hilton Kim, Center for Natural Lands Management

Abstract

The Center for Natural Lands Management facilitates the Cascadia Prairie Oak Partnership (CPOP). The mission of CPOP is to bring together the people, entities, and information surrounding prairie-oak conservation in western Cascadia to enable and support efficient and effective conservation and recovery of prairie-oak habitat and species. CPOP provides increased coordination and communication to allow individuals and entities to increase the quality and quantity of their work, providing benefits to the individual entities, as well as to the greater prairie-oak conservation community.

Controlling invasive plants is a major component of habitat restoration undertaken by the CPOP community. CPOP currently supports the control of invasive plants by sharing best management practices among the community through a list-serv, document library, and a coordinated bi-state multi-partner restoration project. CPOP is working with key members of the community to develop a Cooperative Weed Management Area (CWMA) for prairie-oak habitat throughout western Cascadia. There are extensive control efforts underway and establishing a CWMA will not only improve control efforts but will allow for coordinated education, prevention, early detection and monitoring. This CWMA will formalize existing efforts to combat invasives in prairie-oak habitat and by doing so will lead to more effective actions and better outcomes, ensuring that the best techniques are being employed in a coordinated fashion, maximizing resources.

This poster will outline the biggest threats to prairie-oak habitat and present ongoing efforts to support the coordinated control of invasive plants in prairie-oak habitat in western Cascadia.

Assessing the geographic potential of invasive plants

Leslie P. Newton[a], Roger D. Magarey[b], Steve Hong[b], Yu Takeuchi[b], Anthony L. Koop[a]

[a] United States Department of Agriculture, Plant Protection and Quarantine, Plant Epidemiology and Risk Analysis Laboratory, Raleigh, NC.

[b] Center for Integrated Pest Management, North Carolina State University, Raleigh, NC.

Abstract

USDA's Plant Protection and Quarantine has developed an additive, raster-based model (Proto3) in ArcGIS to predict where a weed may be able to establish in the United States. The process consists of determining the weed's global distribution and creating three maps representing plant hardiness zones, mean annual precipitation (in 10-inch bands), and Köppen-Geiger climate classes. We then overlay these maps to create a layer of joint distribution. In this study, the Proto3 model was validated using species naturalized in the United States. Using the same data, we also compared the accuracy of the Proto3 model to two other species distribution models that are more complex (MaxEnt and CLIMEX [Match Climates]). We analyzed ten weed species (five major and five minor invaders) Some tests were conducted blind to ensure the user would not be subconsciously biased by the species' known distribution. The three models were used to make predictive distribution maps for four species under non-blind and six under blind test conditions. Each model produced a suitability score in a grid (raster) format. The maximum suitability score was extracted and converted to a predicted suitability class (Yes or No), and this suitability class was used for statistical analysis. The results from this initial study showed that Proto3 performed as well or better than two widely used modeling systems and can be used for assessing geographic potential. It also showed that blind testing is important to adequately test the performance of species distribution modeling.

Does aquatic weed management promote habitat restoration for fish communities?

Julian Olden, Lauren Kuehne, and Erika Sutherland
School of Aquatic & Fishery Sciences, University of Washington, Seattle, Washington

Abstract

A principal goal of aquatic weed control is to improve habitat conditions for fish and wildlife, but limited resources can preclude evaluation following removal of noxious weeds. The aquatic nuisance species parrotfeather (*Myriophyllum aquaticum*) has spread along the Chehalis River in Washington State since its initial discovery in 1994, raising concerns about potential impacts on habitat condition and quality for native fishes, including economically important salmon (*Oncorhynchus spp.*) populations and Washington State's only endemic fish, Olympic mudminnow (*Novumbra hubbsi*). Parrotfeather is the subject of ongoing control efforts in the Chehalis River.

We took advantage of removal efforts planned by state and local agencies in summer of 2013 to assess the impacts of invasion and removal of parrotfeather on fish habitat characteristics and fish community responses. Prior to removal, we sampled 18 sites (half with parrotfeather) in the Chehalis River for native plant community composition, fish diversity and abundance, and habitat quality and condition. Parrotfeather was removed from half of the infested sites to allow post-removal sampling in summer 2014. We present our results describing the effects of removal on changes in habitat condition, water quality, native plant and fish communities.

Landscape-Scale Knotweed (Polygonum spp.) Control on the Cedar River

Judy Blanco, Forterra
Cyndy Holtz, Seattle Public Utilities
Frances Lucero, King County Noxious Weed Control Program

Abstract

While many invasive plants threaten valuable habitat, few are as aggressive, damaging, or difficult to control as knotweed (*polygonum spp*.) once it enters riparian areas. Originally from Asia, this once popular ornamental was widely planted throughout King County, Washington in the first half of the 20th century. It is now well established on most river systems causing increased erosion, changes in nutrient profiles, destruction of native habitat, and disruption to foodwebs. Due to an extensive rhizome system, the ability to spread vegetatively, and rapid spring growth, early control attempts both with chemicals and through manual methods were unsuccessful. New chemical formulations in the 1990's and a better understanding of the plant's biology lead to the development of more effective control options, though knotweed remains one of the more technically difficult plants to work with, and the cost can be prohibitive once the required follow up time is factored in.

Since it is so well established and wide spread, taking on new projects is often beyond the scope of the resources most land managers have available. In an effort to disperse this burden and drawn on the strengths of multiple agencies, the King County Noxious Weed Control Program, Seattle Public Utilities, Forterra, and the Friends of the Cedar River Watershed (FCRW) have developed a wholistic approach to controlling knotweed called Stewardship in Action (SiA) that they have been successfully implementing on the Cedar River. This program hinges on 5 key principles: using a top-down approach to treat from the upstream side of the infestation; applying appropriate control techniques; comprehensively working across both public and private land; one-on-one liaison with landowners; and tailored replanting plans that fit the needs and uses of residents.

Citizen Science Weed Mapping Program for the Channeled Scablands of Eastern

Michael Rule, Wildlife Biologist, US Fish and Wildlife Service, Cheney, WA
Kevin Pyatt, Regis College, Denver, CO
Bob Hansen, KioMio, LLC, Newport, WA
Greg Neuman, CitSci.org, Fort Collins, CO

Abstract

The Channeled Scablands CWMA received a National Fish and Wildlife Foundation Pulling Together Initiative grant in 2012 to develop a citizen science weed mapping program for early detection and rapid response. The CWMA worked with CitSsci.org of Fort Collins, Colorado and KioMio, LLC to develop a smartphone application (android and iOS) to capture the location, abundance, habitat and disturbance regime of occurrences of several noxious weed species. Observations are uploaded to the citsci.org database. The application allows capture and uploading of images of the site and the individual weed species with the occurrence data for validation. The CWMA also developed a weed mapping handbook and field guide application to accompany the mapping app. The handbook provides information on sampling techniques, data collection and weed identification tips. The CW MA is also developing training materials and lesson plans incorporating the weed mapping handbook and smart phone application to be provided to local high school science teachers and FFA groups.

Quantifying the eradication of *Ludwigia peploides* from the Blue Heron Wetlands of Portland, OR

Alex Staunch
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Abstract

Ludwigia peploides ssp. *montevidensis* is an exotic emergent weed expanding in range throughout Northwestern Oregon. An established population of *L. peploides* has undergone eradication within the three acre Blue Heron Wetland complex of Portland, Oregon since 2012. A monitoring program was established to assess the efficacy of 3% glyphosate and hand pulling in the eradication of *L. peploides*. Fifteen 6 m x 6 m test plots were constructed in areas that experience year-round soil saturation. Biomass sampling and cover class maps were used to assess eradication efforts one year after chemical application occurred on September 26, 2012. High density areas (>50% cover) of *L. peploides* were reduced by 63%, moderate density areas (5-50%) were reduced by 60% while sparse density areas (<5%) increased by 330%. Heaviest infestations of *L. peploides* remained where flowering occurred earlier in the season in response to soil drying. Chemical application was repeated on August 8, 2013 in an attempt to yield better control on bank areas. On September 20, 2013 monitoring plots yielded mean biomass samples of 24.0 g DM/m^2, compared to 498.5 g DM/m^2 in controls. Application of 3% glyphosate in early fall resulted in suitable control for dense infestations of *L. peploides* in perennially wet areas of the wetlands. Hand pulling or chemical application earlier in the growing season may increase control within environments in which *L. peploides* flowers earlier. Information gained within the Blue Heron Wetlands will be shared with local land managers in the control of *L. peploides* in Northwestern Oregon.

The Invasive Plant Program of the Deschutes and Ochoco National Forests

Christina Veverka, Botanist, Crescent Ranger District, Deschutes National Forest
Krista Lopez, Botanist, Paulina Ranger District, Ochoco National Forest

Abstract

This poster will highlight the challenges and accomplishments of the Invasive Plant Program on the Deschutes and Ochoco National Forests within central Oregon. The main challenge of these two forests is to control invasive plants within the context of the 'multiple-use', sustained yield' philosophy of the Forest Service, where there is continual disturbance in the landscape from recreational activities, logging, fire, and livestock grazing.

To meet this challenge, the Deschutes and Ochoco Forests apply national Forest Service policies that require the use of weed prevention practices in all Forest Service projects. These practices include required cleaning of equipment entering the Forest, the use of weed-free hay and mulch, the use of native plants in restoration practices, and weed wash stations during wildfire incidents.

The two forests also use an integrated pest management strategy for controlling weed infestations, which includes techniques such as manual removal, biological controls, and herbicides. Because of the sheer magnitude of invasive work that is required, both the Deschutes and Ochoco Forests have developed numerous partnerships with local organizations that provide assistance with weed work. These partnerships include the Oregon Department of Agriculture, county weed control programs, county inmate crews, and youth conservation groups. With these partners, the Deschutes and Ochoco Forests treated 7,333 acres for weeds in 2013, targeting 27 State listed noxious weeds. Despite the challenges, both Forests are positive examples of invasive plant prevention and control on public lands.

Using fixed-wing aircraft and digital Sketchmapper technology to map the occurrence of gorse (*Ulex europaeus*) in southwestern Oregon.

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Abstract

Gorse (*Ulex europaeus*) is an invasive shrub native to Europe that was intentionally introduced to Oregon in the 1870s. It is related to the well-known forestry weed, Scotch broom, and has similar biology and impact. Like Scotch broom, seeds of gorse survive decades in the soil and are easily transported via heavy equipment. Unlike Scotch broom, gorse has thick, sharp spines and is very prone to fire due to high natural oil content. In March, 2014, we mapped the occurrence of in southwest Oregon using a fixed-wing aircraft flying the software system, Sketchmapper . Aerial surveys by ODF staff are conducted annually to assess forest insects and disease on 28 million acres in Oregon, but this marked the first time the agency mapped an invasive plant using the Sketchmapper technology. The yellow flowers create a clear signature that is easily detected at a survey elevation of 1,000' above the surface. Polygons of gorse were recorded on tablet computers in ArcMap and gorse populations were estimated as either < 50% or ≥50% cover. Since no other plant produces yellow flowers in the early spring, misidentification was unlikely; still, 15% of the polygons were surveyed from the ground to assess accuracy of the aerial survey. Overall, we recorded 181 polygons and 6,231 acres of gorse within the 300,000 acre survey area. Gorse polygons ranged from 0.2 to 720 acres with an average of 34 acres. Fifty percent of the polygons and 4,350 acres of mapped gorse were in the high-density category. The systematic ground survey revealed that very few non-target plants (i.e. Scotch broom) were captured during the aerial survey, and overall, the accuracy of polygon size and location was very good. We provided our cooperators with a GIS layer of our results along with a report of our findings and various paper map products. In summary, we used a collaborative approach to map a damaging forest invasive species with aerial survey technology. Oregon Department of Forestry welcomes similar projects from cooperators in the future.