

Invasive Weed Management Handbook

Version 1.0

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A citizen science program aimed at educating the public to identify and report invasive species



Figure 1
Houndstongue

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Steering Committee for the Channeled Scablands Cooperative Weed Management Area:

Terry Mansfield - Landowner, Chair

Nancy Belsby – Landowner, Vice-Chair

Becky Brown – Eastern Washington University

Kevin Hupp – Lincoln County Noxious Weed Control Board

Kurt Merg – Washington Department of Fish & Wildlife

Dave Mundt – Spokane County Noxious Weed Control Board

Mike Rule – U.S. Fish & Wildlife Service, Turnbull NWR

Larry Skillestad – USDA-APHIS

Harvey Zacher – Landowner

Websites: Lincoln County Conservation District: <http://lincolncd.com/index.html>
Spokane County Weed board: www.spokanecounty.org/weedboard
Turnbull National Wildlife Refuge: <http://www.fws.gov/refuge/Turnbull>
CitSci.org: <http://www.citsci.org>

Program Director: Mike Rule, Wildlife Biologist at Turnbull Refuge

Email: mike_rule@fws.gov

Phone: 509-235-4723x226

Address: 26010 S. Smith Road, Cheney, WA 99004

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ABOUT THE PULLING TOGETHER INITIATIVE:

SCABLANDS WEED MAPPING, EDUCATION & OUTREACH PROGRAM

Welcome to the Pulling Together Initiative: Scablands Weed Mapping, Education and Outreach Program. This project was initiated in 2011 with a goal of empowering public volunteers, citizen scientist to become part of an invasive weed monitoring program to aid local land owners and public agencies in their efforts to limit the spread of established and emergent invasive weed species. The project is a partnership between the National Fish and Wildlife Foundation, Turnbull National Wildlife Refuge, Spokane County Noxious Weed Control Board, Channeled Scablands Cooperative Weed Management, Eastern Washington University, Lincoln County Conservation District and Noxious Weed Control Boards and local land owners.



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VOLUNTEERING

Welcome to our noxious weed identification and reporting program. You have taken the first step to becoming a volunteer in our citizen scientist program. You will be playing an important part in the effort to prevent and control noxious weeds within Spokane, Lincoln and Whitman counties of eastern Washington. As a volunteer you will become an advocate and educator to the public. Our training program will prepare you to identify invasive weeds specific to the region and understand their impact on the health of our natural and agricultural environments. You will execute survey and sampling techniques best suitable for the type of weed selected and learn how to report your findings. We thank you for your time and effort in supporting our citizen scientist program. Your initiative will have an important impact on our local lands.

INTRODUCTION TO INVASIVE SPECIES/WEEDS

The 2011 Presidential action plan on Invasive Species states that “invasives are dramatically altering our lands, causing more than \$100 billion in damage every year, triggering outbreaks of plant, wildlife and human diseases, and partly responsible for threatening nearly half of rare U.S. species.”

As renowned biologist E. O. Wilson states, “On a global basis...the two great destroyers of bio diversity are, first, habitat destruction and second, invasion by exotic species.”

What is a weed? – Any plant that is growing in a place where a human wants a different kind of plant or no plants at all. Any plant that crowds out cultivated plants (Biology-online.org, 2005).

What is a non-native plant? A non-native plant is a plant that has been introduced either accidentally or deliberately to an environment where it was not previously known to occur.

What are invasive plants? The U.S. Department of Agriculture defines invasive plants as an introduced species that can thrive in areas beyond their natural range of dispersal. These plants are characteristically adaptable, aggressive, and have a high reproductive capacity. Their vigor combined with a lack of natural enemies often leads to outbreak populations.

What are noxious weeds? They are non-native plants that have been introduced to an area through human actions. Because of their aggressive growth and lack of natural enemies, these species can be destructive, competitive and difficult to control.

“Noxious” is a legal designation for many kinds of weeds found throughout the state. This is determined by a weed’s potential threat: ecologically, socially or economically and may vary by county and by state (Mundt & Oxford, 2010).

Washington State Noxious Weed Law 17.10 R.C.W.

In 1969 a law was instituted in Washington to combat the negative effects of noxious weeds: Chapter 17.10 RCW. The law states that as a landowner you are responsible for funding noxious weed control and extermination on your private land. Originally, the law was adopted to reduce the economic loss noxious weeds posed to the agricultural commerce. In 1987, the law was amended to include all land areas, not just agricultural areas (Mundt & Oxford, 2010).

Spokane County's Noxious Weed Control Program

In an effort to enforce Washington State Weed Law 17.10. R.C.W, the Spokane County's noxious weed control program was founded in 1970. The program educates and supports local land owners on the weed laws and also acts as the enforcement agency for the state weed law. At the time when a weed infestation has been located, the Spokane County weed control program assists in notifying land owners and providing them with suggestions for controlling and eradicating the identified noxious weeds. The Spokane County's noxious weed control program is funded by a regulatory fee, not a tax, that is assessed all local land owners. The weed control program is available to all Spokane county landowners (Mundt & Oxford, 2010).

Lincoln County's Noxious Weed Control Program

The mission of the weed board is to educate landowners to be responsible stewards of the land and resources, to make Lincoln County a better place to live by protecting and preserving all lands and natural resources of the County from the degrading impact of invasive noxious weeds; and to provide quality, timely, and responsive service to the residents of Lincoln County.

Whitman County's Noxious Weed Control Program

Our ultimate mission is to control noxious weeds in Whitman County. We will attempt to succeed in this mission through cooperation with all landowners in the county, private as well as public agencies. We will help organize cooperative projects, both short-term and long-term. Through the use of our color photo weed booklet, we will help everyone accomplish this goal by providing every school in Whitman County booklets to use within their agriculture classes. At this level, they will teach our young people how to identify and help stop the noxious weeds from spreading. Teachers are a great asset to our program and we appreciate their work.

PLANT LIFE CYCLE

Plant Life Cycle

In the most basic sense, invasive weed species are plants. As such, they follow one of three cycles throughout their lifespan as is described below. Understanding the lifecycle of a plant species is important when it comes to ways the plant can be identified, the stages when the plant is likely to be dispersed, and the stages when the plant can be controlled.

Annuals

Winter Annuals – During late fall or early winter the seed germinates, remains dormant till spring when it continues growing again, reaching maturity early summer and perishes late summer when the heat is the highest (Koski, Shonie, Whiting, & Jones, 2011).

Summer Annuals - Germination of the seed occurs in the spring; throughout the spring and summer the plant starts evolving and creates seed. The plant dies with the frost in the fall (Koski et al., 2011).

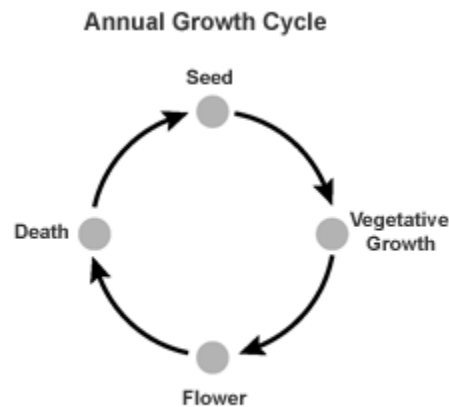


Figure 2

Biennials

The growth cycle of biennials consist of two seasons. The seed germinates in the early spring, and then remains dormant until the following season when it develops flowers. The seeds mature throughout the summer and fall and then perishes late fall (Koski et al., 2011).



Figure 3

Perennials

Simple Perennials – Its root ball creates new shoots annually and depends on seedlings to spread (Koski et al., 2011).

Creeping Perennials – Its roots grow above (stolons) and under (rhizomes) ground and are spread by seeds (Koski et al., 2011).

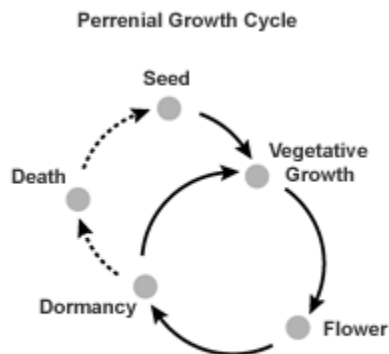


Figure 4

INTEGRATED PEST MANAGEMENT

Noxious weed management or Integrated Pest Management (IPM) as it is known in the agricultural industry is a weed management plan. A well thought out management plan takes into account the location of the land and contain two or more strategies to combat the weed problem; such as mechanical control, cultural control, chemical control or biological control. A successful IPM prevents future weed problems and provides an appropriate soil composition that is ideal for growth (Mundt & Oxford, 2010).

Mechanical Control - consist of tilling, hoeing, hand-pulling, cultivation, mulching and mowing. This is a very labor intensive strategy and needs to be applied several times during the season to be most effective.

Cultural Control – Providing cultural competition can help control noxious weeds. Combining practices, such as planting select vegetation, fertilization, irrigation and grazing are effective methods to give weeds some necessary competition.

Chemical Control – Herbicides are used to stunt weed growth and ultimately injure and kill the plant. Herbicides can be natural or artificial. The selection of a specific herbicide is determined by the noxious weed species, the location, the availability of water, desirable plants in the target area and other environmental conditions. For more information on specific herbicides please contact your local weed board.

Burn Control – Controlled burn of weeds is recommended to reseed with native plants to discourage weed regrowth. This process can take a significant amount of time. Permits are usually required for controlled burns.

Biological Control - All plants have natural ecological enemies. In the use of biological control, these enemies are used to reduce and control the noxious weed spread. These biological enemies come from the noxious weed's native ecosystem and are way to battle the undesirable noxious weeds. Biological control can be used in combination with other methods of noxious weed suppression. This is, however, a time consuming process and does not guarantee eradication (Mundt & Oxford, 2010). Refer to the Animal and Plant Health Inspection Service (USDA APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for more information.

Important Notes:

- With a few exceptions, the use of biological controls alone does not comply with Spokane County's Weed Control Board Policy or the WA State Noxious Weed Law.
- Read and follow all label instructions when applying herbicides. Information on specific herbicides can be obtained by contacting your local weed board.

IDENTIFIED INVASIVE WEED SPECIES LIST

[LEAFY SPURGE](#)

[MEDUSAHEAD WILD-RYE](#)

[AFRICAN WIREGRASS](#)

[STAR THISTLE](#)

[COMMOM BUGLOSS](#)

[HOUDSTONGUE](#)

[HOARY ALYSSUM](#)

[RUSH SKELETONWEED](#)

[DIFFUSE KNAPWEED](#)

[RUSSIAN KNAPWEED](#)

[SPOTTED KNAPWEED](#)

LEAFY SPURGE

Euphorbiaceae Family ~ Euphorbia esula



Figure 6

Characteristics

Name: Leafy Spurge

Height: 1-3 feet

(Precaution: white, latex sap can cause skin irritation and eye blindness upon contact)



Figure 7

Stem: white latex sap (single, erect stem; branches near the top)

Leaf: blue-green, alternating



Figure 8

Flower: yellowish-green, tiny, (no petals)

Bract: yellow-green, showy (broad, heart-shaped)

Control Methods

Mechanical - cultivation prevents seed production, but will create root fragments that will spread the infestation. Mowing will also prevent seed production, but will not kill the plant or prevent its spread and careful attention needs to be paid to the milky sap that exudes from the plant when cut.

Chemical – establishing competitive vegetation, along with the use of herbicides and biological controls is a recommended tool for containing and preventing the spread of spurge. Contact your local weed board for information on recommended herbicides.

Biological - there are several biological control agents available that, over time, have shown to have an impact. Refer to the USDA Animal and Plant Health Inspection Service (APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for more information.

(Mundt & Oxford, 2010)

MEDUSAHEAD WILD-RYE

Poaceae Family ~ Taeniatherum caput-medusae



Figure 9

Characteristics

Name: Medusahead

Height: 6-24 inches

(Stand description: yellowish-green sheen in dense stands)



Figure 10

Stem: wiry, slender

Leaf: (few, short and) narrow, rolled in stalk



Figure 11

Flower: long-awned, (twisted) spike

Bract: covered in tiny barbs (?)

Control Methods

Medusahead is best managed with an integrated control plan, combining two or more methods (Zimmerman, 2011).

Mechanical - plowing and disking are two methods of mechanical control. Both methods can effectively control medusahead and can reduce infestation by 65% to 95% the next growing season (Zimmerman, 2011). Eradication of medusahead by mechanical control by itself is nearly impossible, but when followed by chemical control or revegetation chances for eradication increase dramatically (Zimmerman, 2011).

Burning - Controlled burns can be successful in eliminating medusahead when the seed has not reached maturity or spread yet (Zimmerman, 2011). It is also one of the more economical options compared to cultivation and chemical control methods (Zimmerman, 2011).

Chemical - Chemical treatment is most effective when applied in the early spring prior to seed production and when combined with other control methods (Zimmerman, 2011). Contact your local weed board for information on recommended herbicides.

Biological - Revegetation with competing native plants can be used after control methods have been applied (Zimmerman, 2011). Livestock can be used for grazing in early spring as a part in the integrated control method. However, at the present there are no effective biological agents available than the

aforementioned. Refer to the USDA Animal and Plant Health Inspection Service (APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for more information.

VENTENATA/AFRICAN WIRE GRASS

Family Poaceae ~ Ventenata dubius



Figure 12

Characteristics

Name: Ventenata

Height: 6-28 inches

(Stand description: silvery green initially; yellowish-tan later in year)



Figure 13

Stem: grass-like; (reddish-black nodes)

Leaf: slender(unusually long ligule)



Figure 14

Flower: like wild oats; (long, narrow seedling heads)

Bract:

Control Methods

Mechanical – Hand pulling at the shallow root can be an effective strategy for smaller infestations.

Mowing multiple times throughout the growing season can be successful in keeping the plant at bay (Pamela Scheinost et al., 2008).

Chemical – Contact your local weed board for information on recommended herbicides.

Biological – At the present there are no effective biological agents available for African wire grass. Refer to the USDA Animal and Plant Health Inspection Service (APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for more information.

STAR THISTLE (YELLOW)

Asteraceae Family ~*Centaurea solstitialis*



Figure 16

Characteristics

Name: Yellow Star Thistle

Height: 1-5 feet



Figure 15

Stem: rigid, spreading (from base), fine (woolly) hairs

Leaf: Stem leaves are pointed (and shorter), Basal leaves are (deeply) lobed (and longer); (covered in woolly hairs)

Flower: dandelion-yellow

Bract: long sharp spines

Control Methods

Mechanical – Prior to blooming, control such as tillage, cultivation or pulling have proven successful. If performed after blooming, bag the plants to prevent further seed spread (Board, 2012).

Chemical – Contact your local weed board for information on recommended herbicides.

Biological – According to the Lincoln County Noxious Weed Control Board, there are two biological agents which have shown successful. The yellow star thistle bud weevil, *Bangasternus orientalis*, and the yellow star thistle hairy weevil, *Eustenopus villosus* (Board, 2012). Refer to the USDA Animal and Plant Health Inspection Service (APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for more information.

COMMON BUGLOSS

Boraginaceae Family ~ Anchusa officinalis



Figure 17

Characteristics

Name: Common Bugloss

Height: 1-2 feet



Figure 18

Stem: robust, hairy

Leaf: lance-shaped, fleshy, covered in hairs; (rosette of basal leaves)



Figure 19

Flower: purplish-blue, 5-lobed flowers, white center (flowers can be pink)

Control Methods

Mechanical – control can be achieved with clean cultivation throughout the growing season, be sure the root is severed below the crown. Continuous mowing will prevent seed production, but will not eradicate the weed.

Chemical – the best time to spray is in the spring while it is still in the rosette stage. As the plant grows, you will need to use a higher rate of herbicide and surfactant (Mundt & Oxford, 2010). Contact your local weed board for information on recommended herbicides.

Biological - At the present there are no effective biological agents available. Refer to the USDA Animal and Plant Health Inspection Service (APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for more information.

HOUNDSTONGUE

Boraginaceae Family ~ Cynoglossum officinale



Figures 21

Characteristics

Name: Houndstongue

Height: 1-4 feet

(Precaution: bur-like seeds are easily transported via humans/animals)



Figure 22

Stem: erect, stout, unbranched

Leaf: Basal leaves velvety, up to 1 foot long and tongue-shaped w/distinctive veins; Stem leaves are similar but shorter



Figure 23

Flower: reddished purple, clustered

Control Methods

Mechanical – for smaller areas, hand pulling at the root can be an effective strategy. At a two year maturity, mowing is a good option in preventing seed spread.

Chemical – contact your local weed board for a list of the most current herbicides.

Biological – there are no effective biological agent at the present. Refer to the USDA Animal and Plant Health Inspection Service (APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for the most up to date information.

HOARY ALYSSUM

Mustard Family ~ Berteroa incana



Figure 25

Characteristics

Name: Hoary Alyssum

Height: 3 (-4) feet



Figure 26

Stem: branched near top; covered by gray, star-shaped hairs

Leaf: 1-2", smooth, alternate stem leaves becoming stalkless toward top



Figure 27

Basal rosette leaves oblong, hairy, up to 3 inches long; long stalks

Flower: four white, notched petals; (elongated clusters)

Control Methods

Mechanical – Pulling the plant by the root can be an effective but a laborious alternative. Mowing is less effective on Hoary alyssum as the removal of vegetation increases the seed spread. However, repeat mowing to 6 inch stubble height combined with irrigation and nutrient management have also shown to be effective (Jacobs & Mangold, 2008). Also, proven to be effective is shallow tilling which severs the taproot below the crown (Jacobs & Mangold, 2008).

Chemical – The best time to spray is in the spring when the plant is in its initial growing stage. Contact your local weed board for information on recommended herbicides.

Biological – Currently there are no effective biological controls for Hoary alyssum. Refer to the USDA Animal and Plant Health Inspection Service (APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for current information.

RUSH SKELETONWEED

Asteraceae Family ~ Chondrilla juncea



Figure 28 **Characteristics**

Name: Rush Skeletonweed

Height: 4 feet



Figure 29

Stem: single, branching stem), milky, latex sap on stems and leaves; reddish coarse hairs on lower part of stem

Leaf: deeply-lobed basal leaves in rosette, stem leaves narrow



Flower: small, yellow, dandelion-like

Control Methods

Mechanical – it is not recommended to cultivate established stands, because tillage spreads root fragments and increases the infestation. Mowing will prevent seed production, but will not prevent the plant from spreading by its roots.

Chemical – herbicides should be applied in the rosette stage, before bolting. Fall applications will increase the success rate. Contact your local weed board for information on recommended herbicides.

Biological – Refer to the USDA Animal and Plant Health Inspection Service (APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for a complete list of biological control agents.

DIFFUSE KNAPWEED

Asteraceae Family ~ Centaurea diffusa



Figure 31 **Characteristics**

Name: Diffuse Knapweed

Height: 1-3 feet



Figure 32

Stem: Single, branched stem; stiff, bushy

Leaf: Rosette of basal leaves, finely divided linear segments; grayish-green, wooly hairs



Figure 33

Flower: (generally) white, (sometimes) rose to purple

Bract: stiff, spiny, crablike

Control Methods

Mechanical – mowing reduces seed production, but will not kill the plant. Knapweed adjusts to the level of the mower and will go to seed at only a few inches tall.

Chemical – control with a selective herbicide will greatly increase grass production, which in turn increases knapweed suppression. The best time to spray is in the spring, but this weed can be suppressed throughout the season, a higher rate will need to be used as the plant matures. Contact your local weed board for information on recommended herbicides.

Biological – Refer to the USDA Animal and Plant Health Inspection Service (APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for a complete list of biological control agents.

RUSSIAN KNAPWEED

*Asteraceae Family ~ *Acroptilon repens**



Figures 34, 35

Characteristics

Name: Russian Knapweed

Height: 1-3 (4) feet

(Stand description): can form dense colonies



Figure 36

Stem: stiff, foliage at base

Leaf: basal rosette; gray-green, lobed, fine hairs



Figure 37

Flower: purple, white, or pink; (up to 200 per individual plant)

Bract: transparent, papery edge

Control Methods

Mechanical – mowing will help reduce seed production, but is not the preferred control option because it will not kill the plant. Localized spread of Russian knapweed is primarily by its lateral root system, which is hastened by cultivation; new plants can form from root fragments.

Chemical – spring time is the best time to spray. Contact your local weed board for the most up to date herbicide list.

Biological – Refer to the USDA Animal and Plant Health Inspection Service (APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for a complete list of biological control agents.

SPOTTED KNAPWEED

Asteraceae Family ~ Centaurea biebersteinii



Figure 38

Characteristics

Name: Spotted Knapweed

Height: 2-5 (3) feet



Figure

Stem: several branched, stiff stems,

Leaf: basal rosette, deeply lobed, bluish-green



Figure 40

Flower: ring-size, pinkish-purple

Bract: stiff, black-tipped giving a spotted appearance

Control Methods

Mechanical – cultivation can be effective if done at regular intervals. Mowing reduces seed production, but will not kill the plant. It will adjust to the level of the mower and go to seed at only a few inches tall.

Cultural – pasture health and fertilization are important factors in preventing knapweed. Over-grazing allows for its spread and livestock will avoid it unless it is the only forage available.

Chemical – control with a selective herbicide will greatly increase grass production, which in turn increases knapweed suppression. The best time to spray is in the spring, but this weed can be suppressed throughout the season, a higher rate will need to be used as the plant matures. Spraying fall regrowth will help to reduce spring populations. Contact your local weed board for information on recommended herbicides.

Biological – Refer to the USDA Animal and Plant Health Inspection Service (APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for a complete list of biological control agents.

SAMPLING/SURVEYING METHODS & TECHNIQUES

Prevention

It has been widely reported and established that invasive weed species are a major concern because of their economic threat to agriculture, and their threat to diminish biodiversity for native plant and animal species. For instance, renowned scientists and biologists (i.e., E.O. Wilson) have stated that the greatest threats to biodiversity are habitat destruction and invasion of exotic species. Given these concerns, an argument could be made that the best way to deal with invasive weeds is through prevention. However, there are many invasive species which have been established, in some cases for decades, making prevention as an approach irrelevant or impractical in these instances.

Detection and Elimination

Other approaches beyond prevention have been successful in addressing invasive weed species (e.g., mechanical, cultural, chemical, burning, biological control, and Integrated Pest Management (IPM)). These approaches can be successful so long as there is opportunity for management to detect and eliminate nascent invaders before colonies are well established (Shuster, Herms, Frey, Doohan, & Cardina, 2005). All of these approaches depend heavily on the extent to which a given invasive species has been identified, studied, and reported. Detection and elimination is a reasonable approach, however, it too is resource intensive. For instance, detecting invasive weed species is typically done with human observers who have access to a given site where an infestation or potential infestation is occurring. They may access the site either from a vehicle or from walking an identified area. Scientists and volunteers may conduct observations and survey land that may range from several acres to hundreds or thousands. One potential way to address this reality is to engage the citizenry at large in invasive species observation and detection. For instance, many local citizens can become involved with invasive species observations and educational and outreach initiatives. And, as (Crall et al., 2010) reports, citizen science programs concerned with invasive species monitoring vary considerably in their size (number of volunteers), funding, and available educational resources.

Established or emerging infestations

It is also necessary to determine whether the nature of the observations is to gather data on an established infestation or to gather data on an emerging one. Therefore, a robust sampling approach must be utilized

to maximize resources, while at the same time, recognizing validity constraints that may exist for a specific study or investigation.

Sampling/Surveying

1. Sampling Schemes

a. Random Sampling (Simple or Stratified) – requires that points are selected for surveying in a random fashion giving all possible points an equal chance of being sampled.

Simple random sampling occurs when points are selected at random without any consideration for a landscape attribute such as habitat type, landform, road type, land use type, landownership, etc. It is the most unbiased sampling type but there may be issues with accessibility.

Stratified random sampling has samples constrained by a stratification attribute such as land ownership or habitat type. Points are selected at random in proportion to the area encompassed by different classes of the stratification attribute. An example is the selection of points to be surveyed based on land use (urban development, managed forestland, grazed rangeland, protected rangeland, cropland, etc.). This is good for comparison of weed populations between land uses, other classification attributes such as distance to a transportation feature or habitat maybe underrepresented.

b. Systematic Sampling - generally utilizes a structure but non-random approach to point selection.

A grid or line transect is overlaid on a survey area and points are sampled at some standard interval in the grid or along the length of a transect such as a road.

c. Opportunistic sampling - Weed populations are mapped as encountered without the preselection of survey points.

As the name implies, this sampling scheme involves the sampling of weed occurrences as they are found without any structured design except to designate a route of travel or an area to be searched.

Observations of weeds are recorded as they are encountered when traveling either by vehicle or on foot through an area. Unlike random sampling, there are no guarantees that all potential weed populations within a survey area have an equal chance of being sampled, but such samples provide valuable information on emerging weed threats and general distributions of weed species

2. Survey Types

a. Roadside Survey The roadside method is an effective survey approach because it allows for surveying of large areas in a relatively short amount of time

Procedures:

1. Identify state, county, and township roads within the established survey area. Roads or road segments can either be numbered and selected by simple random procedures using a random number generator and/or by some type of stratification such as landform or road type) They can also be systematically selected i.e. to guarantee overall coverage of a survey area with possible constraints on road type.

2. Specify road segments, their length and start and end points before survey begins. Recommended road segments should be at least 0.5 miles.

3. Specify the distance from the roadside to be observed. A common distance is 30 feet. The distance should be deep enough to provide added dimension to the survey, yet shallow enough so that the observer can easily discern plant types.

4. Determine number of road segments to be sampled and how weed occurrences are to be recorded. Stops can be made at set intervals and the presence and abundance of all weed species present recorded. The road segment can also be traveled at 10-15 mph and a point for a weed occurrence collected when it is observed.

b. Off Road Surveys Area search and point sampling are the 2 most common sampling schemes used.

Area search involves systematically surveying a designated area, pasture, field, parcel, ¼ section, etc. and collecting points either as weeds are encountered or at set intervals along a transect or grid. The idea is to search the area as thoroughly as possible. An area search can also be less formal with weed occurrences in the search area mapped more opportunistically.

Point sampling involves navigating to preselected points in an area either using GPS or a map or collecting information at that point on the presence and abundance weed species. Points can be preselected using random, stratified, and/or systematic sampling schemes or they can be mapped opportunistically.

3. Observation Types

a. Point - A weed occurrence is mapped as a single point with the size and coverage of an infestation entered. Currently, this is the only observation type supported by the application.

b. Line - weed occurrence is mapped as a linear feature with a beginning and end point and width designated. This type of observation is not currently supported by the application.

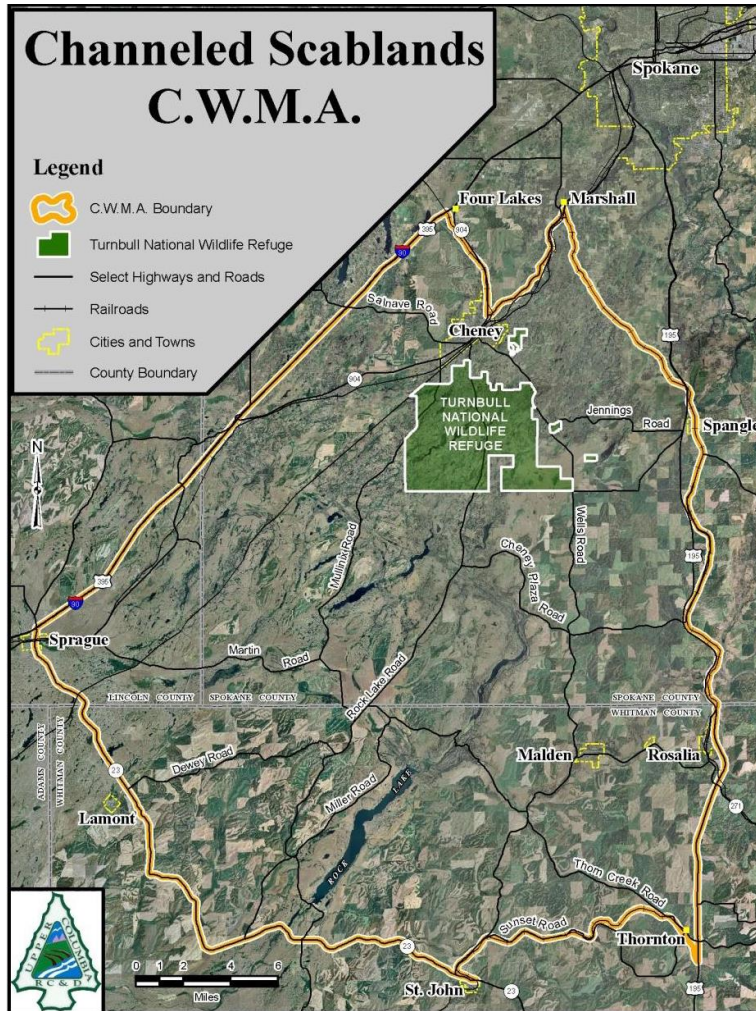
c. Area - Weed infestation is mapped as an enclosed polygon. This is an observation type that is not currently supported by the mapping application, cannot capture, and we should hold off including it until we have the capability of actually capturing a polygon data type)

Cooperative Weed Management Areas (CWMA)

This project invokes an established and proven concept for identifying conservation districts which focus on invasive species detection, eradication, management and prevention. These areas are called Cooperative Weed Management Areas (CWMA). CWMA's are 'grassroots' organizations where local partners and communities voluntarily combine their resources to manage noxious weeds across ownership boundaries ("Lincoln County Conservation District," 2013)

Channeled Scablands (CWMA)

The survey area identified for this project is the Channeled Scablands Restoration Area. This area (Figure below) is located in Eastern Washington. It comprises the counties of Lincoln, Spokane and Whitman; and the towns of Cheney, Rosalia, St. John, and Sprague. The boundaries of the Channeled Scablands CWMA are: North of Highway 23; South of I-90; and West of Highway 195. This CWMA also comprises Turnbull National Wildlife Refuge shown in the figure below.



Mission

The entities and individuals that have come together to form the Channeled Scablands CWMA did so voluntarily in the spirit of cooperation in order to more effectively and economically realize our collective goals to manage invasive plants that degrade the productivity and ecological health of all lands under our influence ("Lincoln County Conservation District," 2013).

Public and Private Land Determination and Access

Determining ownership using township maps (Shuster et al., 2005).

Source for township maps for CWMA

Public and private lands are governed by different rules and regulations. It is important to recognize the differences and be respectful of private landowners' rights. When deciding on an area to sample it is crucial to obtain permission. For public lands, contact the local agency managing that particular area of land. In some instances, public land managing agencies require permits to be obtained. The local public agencies usually welcome assistance so therefore permission to access this land is generally more easily obtained than to private land.

As a representative of our program, it is important that we respect private land owner's rights and only access private land after obtaining specific permission.

Field Preparation

1. Bring a cellular phone, which is fully charged and have GPS capability.
2. Bring a camera if your cellphone is unable to take pictures.
3. Bring the required documents for proper sampling, data sheet, clipboard, etc.
4. Bring sampling equipment and make sure it is in proper working order. Check batteries and bring extra if needed.
5. If a permit is required, ensure you have a copy on your person.
6. Bring a map of the area.
7. Bring your invasive weed handbook.
8. Make sure to check the weather, so you may dress and pack appropriately.
9. Bring a hat and sunscreen.
10. Bring water and a snack for longer hikes.
11. Bring a first aid kit.
12. Before you depart, let someone know where you are going and when you are expected to return.
13. When hiking, try to avoid heavy vegetation as animals might be hiding.

Be sure you park your vehicle in a safe and legal spot and so it is not impeding traffic.

(Council, 2005)

The screenshot shows the CitSci.org website interface. At the top left is the CitSci.org logo. To the right, it says 'Welcome guest Login | My Profile | July 11th 2013'. Below this is a dark green navigation bar with white text for 'Home', 'About Us', 'Projects', 'Species', 'Maps', and 'Get Started'. The main content area is titled 'Tutorials' and contains a section 'Let's Get Started...' with three numbered links: (1) Why Invasive Species?, (2) Introduction, and (3) Registration. Below this is an 'Additional Information' section with links for How You Can Help, Selecting A Site, Doing Field Surveys, and Using GODMSurveyor. At the bottom, it says 'More tutorials and resources are forthcoming' and 'ScienceForCitizens.net - As a start, see ScienceForCitizens.net for great resources and other projects!'.

Getting Started with CitSci.org @

<http://citsci.org/cwis438/websites/citsci/Tutorials.php?WebSiteID=7>

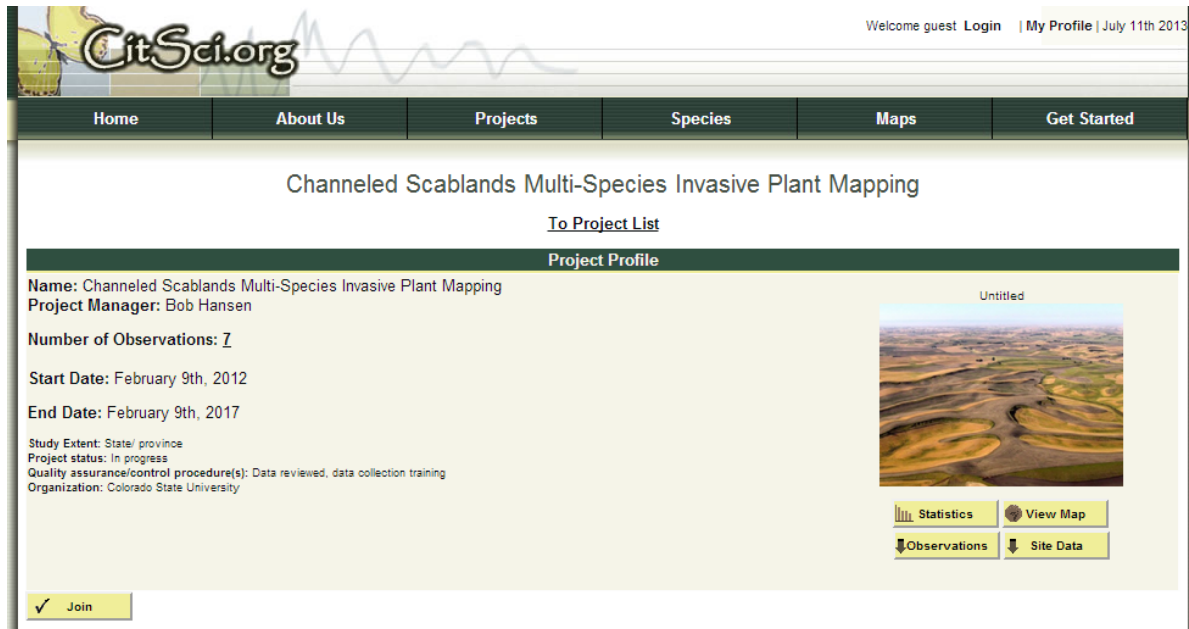
Why Invasive Species

DATA ENTRY TUTORIAL

Introduction to CitSci.org

Registration

Channeled Scablands Multi-Species Invasive Plant Mapping



The screenshot displays the CitSci.org website interface. At the top, the CitSci.org logo is on the left, and the text 'Welcome guest Login | My Profile | July 11th 2013' is on the right. Below the logo is a navigation menu with buttons for 'Home', 'About Us', 'Projects', 'Species', 'Maps', and 'Get Started'. The main content area features the title 'Channeled Scablands Multi-Species Invasive Plant Mapping' and a link '[To Project List](#)'. A dark green header for the 'Project Profile' section is followed by the following text: 'Name: Channeled Scablands Multi-Species Invasive Plant Mapping', 'Project Manager: Bob Hansen', 'Number of Observations: 7', 'Start Date: February 9th, 2012', and 'End Date: February 9th, 2017'. Below this, smaller text provides details: 'Study Extent: State/ province', 'Project status: In progress', 'Quality assurance/control procedure(s): Data reviewed, data collection training', and 'Organization: Colorado State University'. To the right of the text is a placeholder for an image labeled 'Untitled' with a landscape photo. Below the image are four buttons: 'Statistics', 'View Map', 'Observations', and 'Site Data'. At the bottom left of the profile section is a 'Join' button with a checkmark icon.

TERMS & DEFINITIONS

Aquatic Weed – a plant that grows in water or in water-saturated soil.

Allelopathic substances – chemical compound produced by a plant that affects the interactions between different plants.

Alternate – leaves that are arranged singly up the stem, not opposite each other.

Annual – a plant that completes its life cycle in one year.

Basal – refers to the base of the plant.

Biennial – a plant that completes its life cycle in two years.

Bract – a small leaf-like structure below a flower.

Clasping Leaves – leaves that appear to be wrapped around the stem at the base.

Crown – the structure formed where leaves, stems and roots grow together.

Germination – the beginning of growth of a seed, bud or other vegetative segment of a plant.

Perennial – a plant that lives more than two years.

Rhizome – a creeping, underground stem.

Rosette – compact cluster of early leaves of a plant, before bolting.

Stolon – a creeping, above ground stem.

Surfactant – a material, that when added to a herbicide, improves the spreading properties of the liquid.

Taproot – a thick, central root with minimal branching.

Wing – a thin, membranous extension of a leaf blade.

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APPENDIX A: TABLE OF FIGURES

Figure	Name	Reference
1	Houndstongue	Mundt & Oxford 2010
2	Annual Plant Life Cycle	fl1504051.edublogs.org
3	Biennial Cycle	www.fws.gov
4	Perennial Life Cycle	fl1504051.edublogs.org
5	Leafy Spurge Hawk Moth (caterpillar larvae)	Mundt & Oxford 2010
6	Leafy Spurge	Mundt & Oxford 2010
7	Leafy Spurge	Mundt & Oxford 2010
8	Leafy Spurge	Mundt & Oxford 2010
9	Medusahead Wild-Rye	http://herbarium.usu.edu/Triticeae/Genera/images/Taeniatherum/Taeniatherum_caput-medusae.jpg
10	Medusahead Wild-Rye	http://www.fs.fed.us/database/feis/plants/graminoid/taecap/stand.jpg
11	Medusahead Wild-Rye	8 - http://botany.cz/foto/taeniaherb3.jpg http://www.google.com/imgres?imgurl=http://www.fs.fed.us/database/feis/plants/graminoid/taecap/plant.jpg&imgrefurl=http://www.fs.fed.us/database/feis/plants/graminoid/taecap/all.html&h=401&w=274&sz=14&tbnid=zZFtMXq9ajCxLM:&tbnh=90&tbnw=61&zoom=1&usq=__8rQKQnlwYqzMhg1m519c9b1saLM=&docid=JwhbeXCtMMU9GM&hl=en&sa=X&ei=em5gUcfQJ9TOqQHAu4DYDQ&ved=0CDsQ9QEwAw&dur=1478
12	Ventanata/African Wire Grass	http://www.rockymountainrider.com/articles/0412_Aggressive_Awn_Grass-Ventenata_dubia.htm
13	Ventanata/African Wire Grass	http://hayandforage.com/grasses/fighting-timothy-hay-foe
14	Ventanata/African Wire Grass	Richard Old, www.xidservices.com
15	Star Thistle (Yellow)	http://www.cal-ipc.org/ip/management/ipcw/images/5759.jpg by John D. Gerlach Jr
16	Star Thistle (Yellow)	http://www.sepulvedabasinwildlife.org/images/Yellow%20Star%20Thistle%20large.jpg
17	Common Bugloss	Mundt & Oxford 2010
18	Common Bugloss	Mundt & Oxford 2010
19	Common Bugloss	Mundt & Oxford 2010
20	Houndstongue	http://www.mtweed.org/images/client/houndstonge/weed-id-3659252643_e9be54283a_b.jpg
21	Houndstongue	http://www.weeds.slco.org/images/idLarge/houndstongue1.jpg
22	Houndstongue	http://www.weeds.slco.org/images/idLarge/houndstongue3.jpg
25	Hoary Alyssum	http://www.mtweed.org/hoary-alyssum/ photo credit Brian Ostwald

26	Hoary Alyssum	http://www.mtweed.org/hoary-alyssum/ photo credit: Kellieann Morris
27	Hoary Alyssum	http://www.mtweed.org/hoary-alyssum/ Closeup on Flowers, photo credit Matt Lavin
28	Rush Skeletonweed	Mundt & Oxford 2010
29	Rush Skeletonweed	Mundt & Oxford 2010
30	Rush Skeletonweed	Mundt & Oxford 2010
31	Diffuse Knapweed	Mundt & Oxford 2010
32	Diffuse Knapweed	Mundt & Oxford 2010
33	Diffuse Knapweed	Mundt & Oxford 2010
34	Russian Knapweed	Mundt & Oxford 2010
35	Russian Knapweed	Mundt & Oxford 2010
36	Russian Knapweed	Mundt & Oxford 2010
37	Russian Knapweed	Mundt & Oxford 2010
38	Spotted Knapweed	Mundt & Oxford 2010
39	Spotted Knapweed	Mundt & Oxford 2010
40	Spotted Knapweed	Mundt & Oxford 2010

APPENDIX B: DIFFUSE KNAPWEED BIOLOGICAL CONTROL AGENT LIST

Biocontrol Organisms - Invertebrate Herbivores of Weeds

Regulated Article	Life Stage(s)	Intended Use Shipment	Origins	Originally Collected Culture	Designation
Agapeta zoegana	Any	Release - Biocontrol	Continental U.S.	Originally Collected from Foreign Locations	
Bangasternus fausti	Any	Release - Biocontrol	Continental U.S.	Originally Collected from Foreign Locations	
Chaetorellia acrolophi	Any	Release - Biocontrol	Continental U.S.	Originally Collected from Foreign Locations	
Cyphocleonus achates	Any	Release - Biocontrol	Continental U.S.	Originally Collected from Foreign Locations	
Larinus minutus	Any	Release - Biocontrol	Continental U.S.	Originally Collected from Foreign Locations	
Larinus obtusus				Originally Collected from Foreign Locations	
Metzneria paucipunctella	Any	Release - Biocontrol	Continental U.S.	Originally Collected from Foreign Locations	
Pelochrista medullana	Any	Release - Biocontrol	Continental U.S.	Originally Collected from Foreign Locations	
Pterolonche inspersa	Any	Release - Biocontrol	Continental U.S.	Originally Collected from Foreign Locations	
Sphenoptera jugoslavica	Any	Release - Biocontrol	Continental U.S.	Originally Collected from Foreign Locations	
Terellia virens	Any	Release - Biocontrol	Continental U.S.	Originally Collected from Foreign Locations	
Urophora affinis	Any	Release - Biocontrol	Continental U.S.	Originally Collected from Foreign Locations	

(Service, 2013)

Refer to the Animal and Plant Health Inspection Service (USDA APHIS), www.aphis.usda.gov or call Spokane USDA APHIS PPQ (509) 353-2950 for more information.

CARTOONS



"Who would have thought that a few weeds would ruin our favorite spot? I guess we should have done more to STOP AQUATIC HITCHHIKERS!"

www.fs.usda.gov

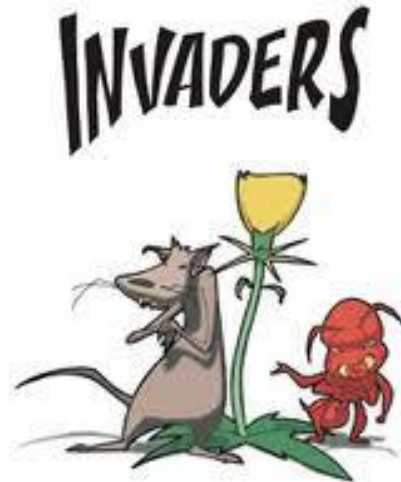


"We never should have waited this long ... Now the weeds have completely taken over."

parkcountyweeds.org



www.bigislandchronicle.com



invasivespecies.blogspot.com

Invasive Species Movie: <http://www.funny-games.biz/cartoon/invasive-species.html>