



The Land Conservancy
of British Columbia

INVASIVE SPECIES – ID, ADAPTATIONS, AND SAFE REMOVAL

Presented by

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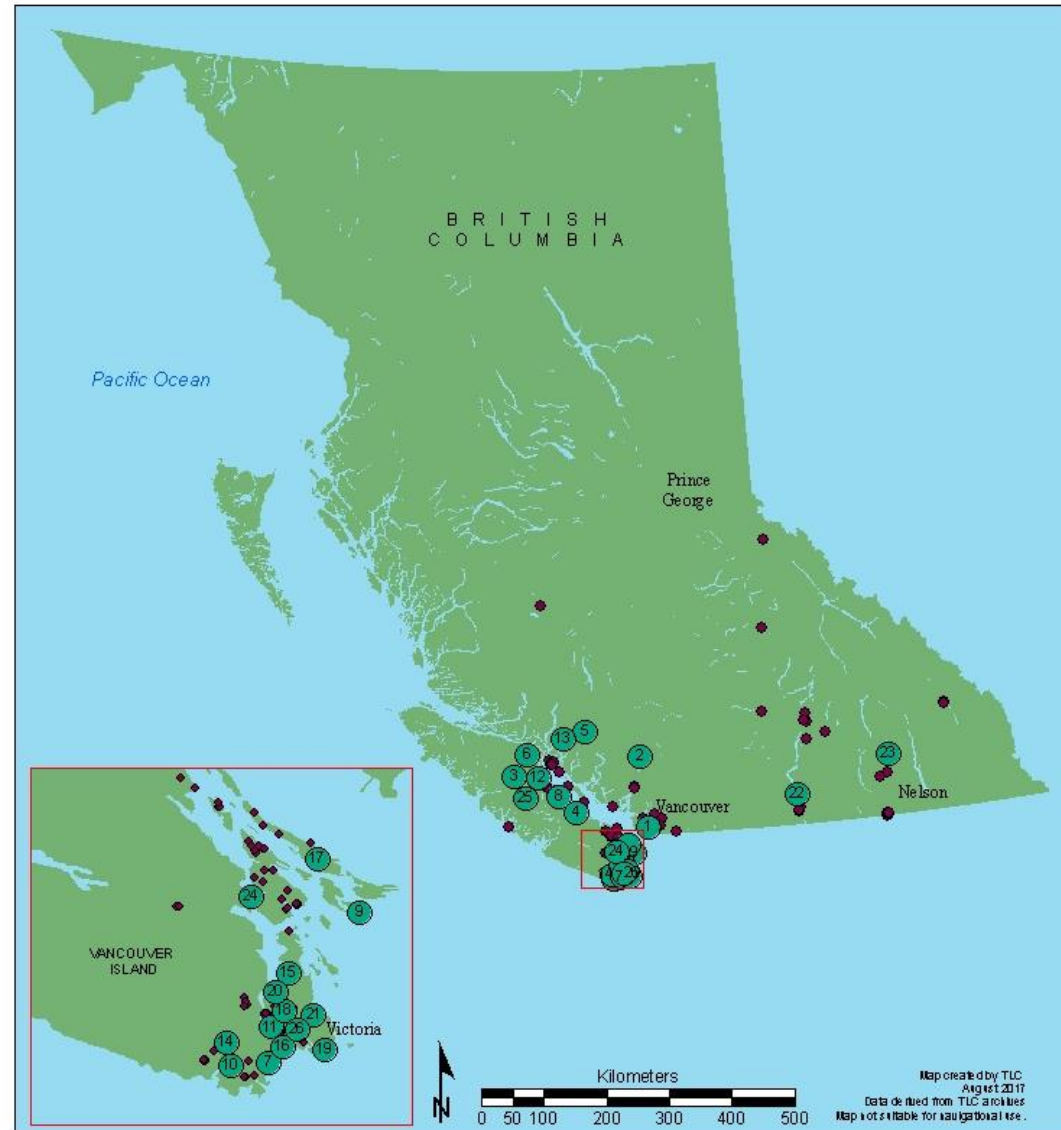
THE LAND CONSERVANCY OF BC

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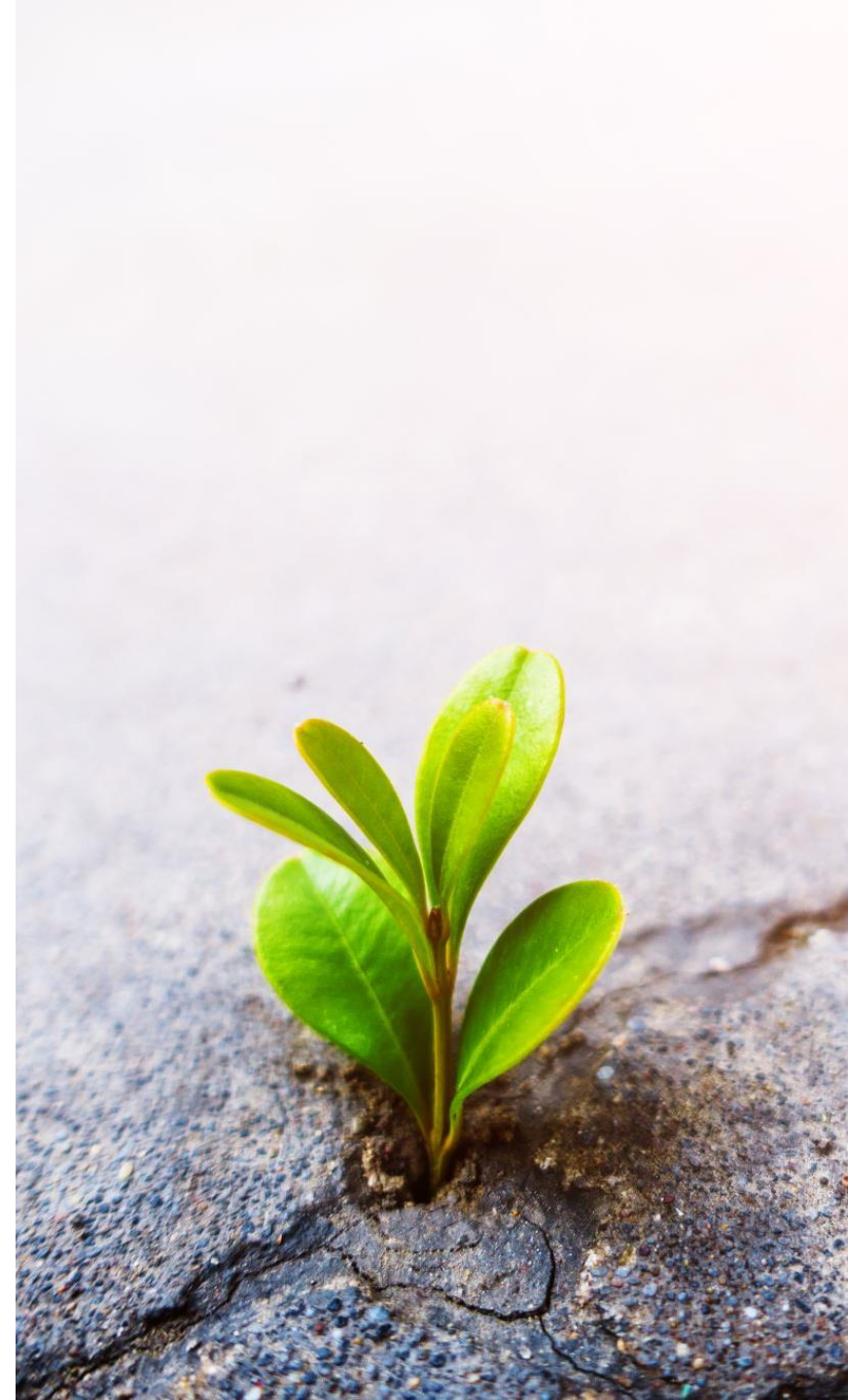


WHAT IS AN INVASIVE SPECIES

- Invasive species are plants, animals, or other organisms that are non-native to a region AND cause significant harm to native species, ecosystem processes like pollination or grazing, the economy, and human health
 - An example is purple loosestrife – pictured to the left
 - This definition is different than a non-native “exotic” species
 - Exotic species are non-native to the region but do not cause harm to humans, ecological processes, the economy, or native species.
 - These species tend to be non-competitive outside of agriculture or horticulture – such as domestic apple trees
 - OR these species do compete with native species but do not cause significant ecological, economic, or cultural harm
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WHAT MAKES A PLANT INVASIVE?

- Invasive plants tend to have a host of adaptations that allow the species to succeed in early successional, disturbed sites with empty niches.
- Some common adaptations of invasive species are:
 - Rapid Growth and Early Maturation
 - Prefers disturbed soils and low competition
 - Prolific seed producers
 - Rampant vegetative reproduction (rhizomes, propagules)
 - Sometimes allelopathic to native species (release chemicals that stunt other plant's growth)
 - Habitat Generalists



ECONOMIC IMPACTS

- Annual cumulative revenue lost due to invasive species is between \$13 – 35 BILLION CDN
 - 7.5 Billion lost in forestry and agricultural alone
- In British Columbia, the main culprits are toxic or noxious invasive species such as knapweed, hawkweed, leafy spurge, and thistles that outcompete forage crops for livestock or agriculture
- Those species noxious to humans can decrease property value and take extensive amounts of resources to contain and hopefully eradicate.
- Finally, some species are masters at deprecating human-made structures like foundations of housing or highways – increasing the annual cost of maintenance



Image retrieved from: <https://environetuk.com/Blog/Does-Japanese-knotweed-cause-property-damage>



ENVIRONMENTAL IMPACTS

- Second only to habitat loss, invasive plant and animal species have been identified as the most significant threat to global biodiversity
 - Chytrid fungus was introduced to frog populations worldwide by the illegal pet trade and animal movement aided by humans
 - Invasive species outcompete local native species, like Scotch Broom in the endangered Garry Oak Ecosystem or Canada Thistle or Oxeye Daisy throughout British Columbia
- Invasive plants can alter hydrology, change nutrient balances in soil, increase erosion, introduce pests and diseases, increase fire danger, damage roads, hinder forage for livestock, and even can be noxious to humans

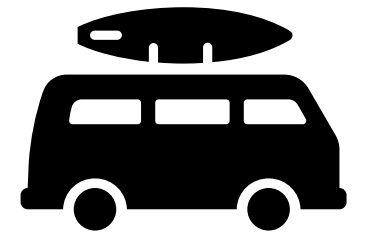
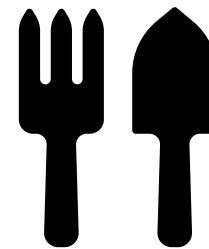
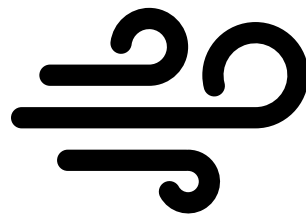


SOCIETAL IMPACTS

- Once established, invasive species can result in lost income due to removal by contractor
 - Reduced water quality and quantity can result, e.g. yellow flag iris,
 - Loss of traditional foods and medicinal plants
 - Reduced recreative opportunities
 - In worst cases, e.g. Giant Hogweed, some species can cause bodily harm and have the potential to hospitalize
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HOW INVASIVE SPECIES ARE INTRODUCED

- Pathways are the means or ways by which invasive species enter an ecosystem. Much of the spread of these species happens unintentionally by humans and can be mitigated!
- **Natural pathways:**
 - Wind dispersal of seeds, water dispersal of seeds or propagules
- **Human mediated pathways:**
 - Illegal pet or plant movement, ballast water discharge carrying aquatic invasive species, pests in imported wood products (larvae), burs or seeds clinging to pants, fur, or tires, garden escapees, and contaminated soils.



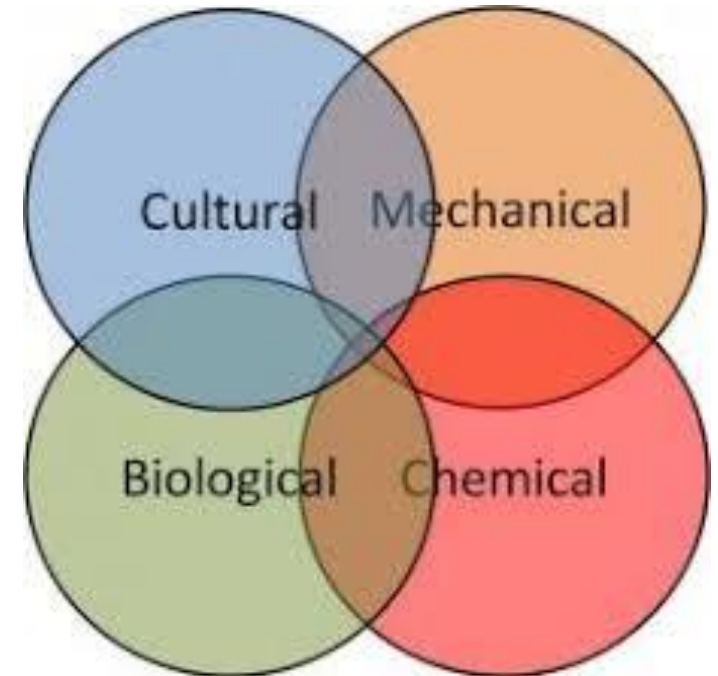
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- Invasive species, once established, are incredibly hard to remove from a region
 - This is due to a myriad of factors including:
 - Long lasting and pervasive seed bank in the soil that will continue to sprout in disturbed areas (Hawkweed)
 - The ability to regrow from a small section of root, stem, or leaf (Yellow Flag Iris, Canada Thistle)
 - Large storage reserves in roots combined with extensive root systems (Canada Thistle – Yellow Flag Iris)
 - Thus, invasive species management has become a multi-year process that actively triages sites and species to prevent ecological, societal, and economic harm

THE PROBLEM WITH ERADICATION



INTEGRATED PEST MANAGEMENT STRATEGIES

- “IPM is a decision-making process that includes identification and inventory of invasive plant populations, assessment of the risks, development of well-informed control options that may include a number of methods, site treatments, and monitoring”–Invasive Species Council of BC
- IPM strategies rely on a complete inventory of the plant species of their respective region so that they can identify and allocate resources to the control of a multitude of invasive species
- **Early detection and rapid response is the best method** to eradicate an invasive species before it becomes established. Control efforts are economically efficient and successful at eradication at this stage



CHEMICAL TREATMENT AND HERBICIDES



- Manual treatments are usually the first method evaluated when controlling invasive species as you do not need a license and it does not leach chemicals into the environment
 - However, manual treatment can be ineffective to beneficial for some invasive species
- Chemical treatment has been proven to be the most effective and resource efficient control method but has been stigmatized in popular media
- Chemical treatment is either non-selective (kills every thing it touches) or selective (down to only monocots or only dicots) and are applied sparingly at specific places on the plant and during a specific growth stage

TREATMENT METHODS



- **Foliar application is the most common** and is often applied by a backpack sprayer
- This method is very effective to use against monocultures (large fields of Canada thistle), when the plants are actively growing (ideally when they are producing buds/early flowers)
- Herbicide applicators are very careful to selectively spray plants, using the least amount of chemical required, and only spraying when the weather is not windy, below 30oC, and not rainy in the recent future
 - This limits the spread of the herbicide into the surrounding ecosystem
- **The second method is stem injection** –pictured here- which is the most selective and impacts individual stems

STAGES OF INVASION

- There are four distinct population stages when an invasive species first arrives:
 1. **Arrival:** the process by which individuals are transported to novel ecosystems. This is when invasive species are at the greatest risk of extinction.
 2. **Establishment:** Occurs when population grows and expands to the point that extinction is highly unlikely. This is the critical period in controlling invasive species. If a species becomes established, it will most likely remain in the ecosystem.
 3. **Integration:** Occurs when resident plants and animals adjust ecologically and evolutionarily to the invasive species and the invasive species adapts to its new environment.
 4. **Spread:** Depends on evolutionary adaptations and modes of dispersal.

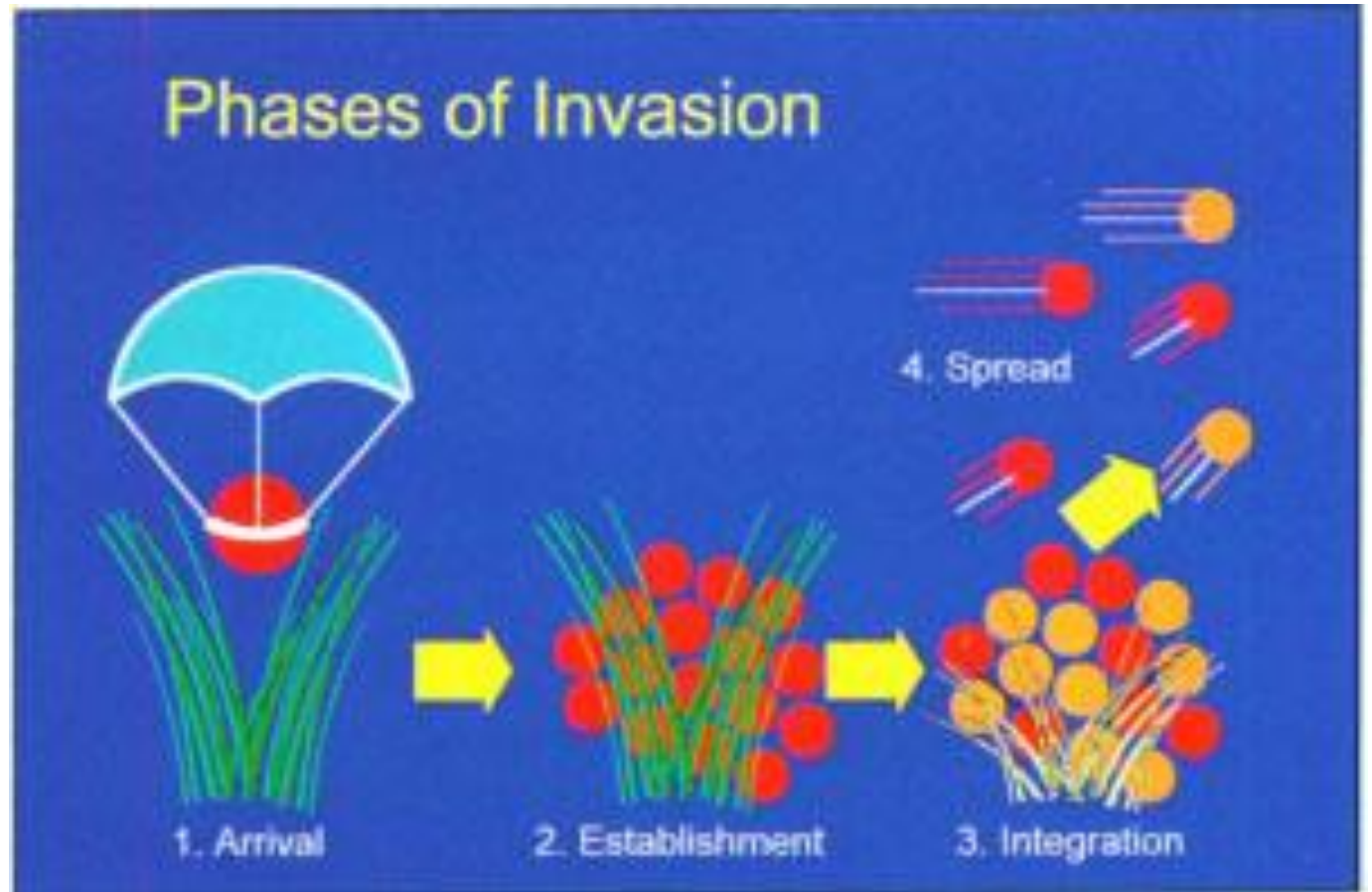


Image retrieved from: <http://calag.ucanr.edu/Archive/?article=ca.v052n02p13>

WHAT THIS MEANS FOR MANAGEMENT

- Invasive species, once established, will most likely persist in the environment unless a tremendous investment of resources, time, and political will is forced upon the species.
- Thus, most NGO and Governmental agencies seek to prevent its arrival through mitigation measures
 - *e.g.* ballast water filtering, washing your watercraft before entering a new waterbody, or removing seeds and spurs from your horse, boots, or mountain bike before leaving an infested site)
- And if prevention fails, eradicate the population before its establishment phase when the population is weak

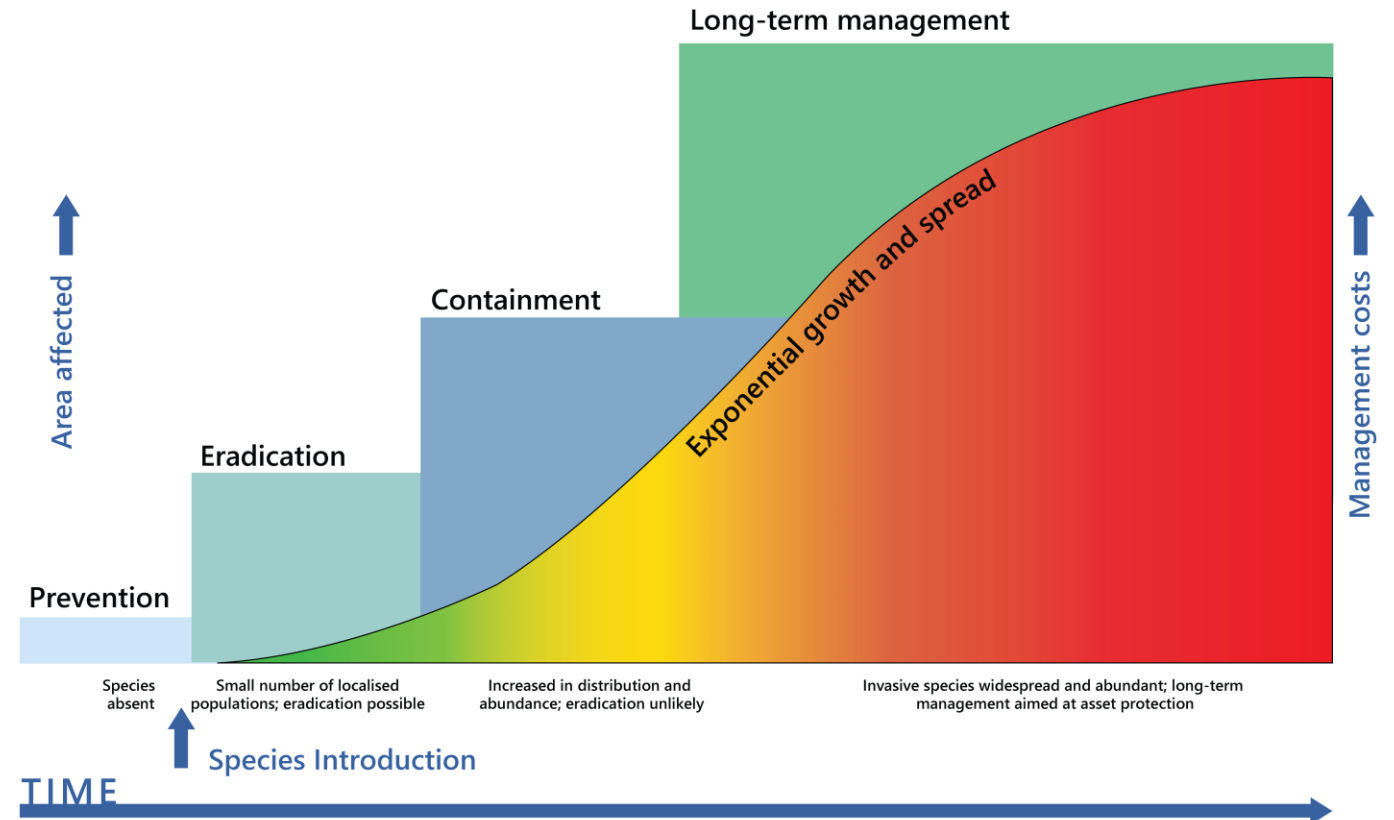
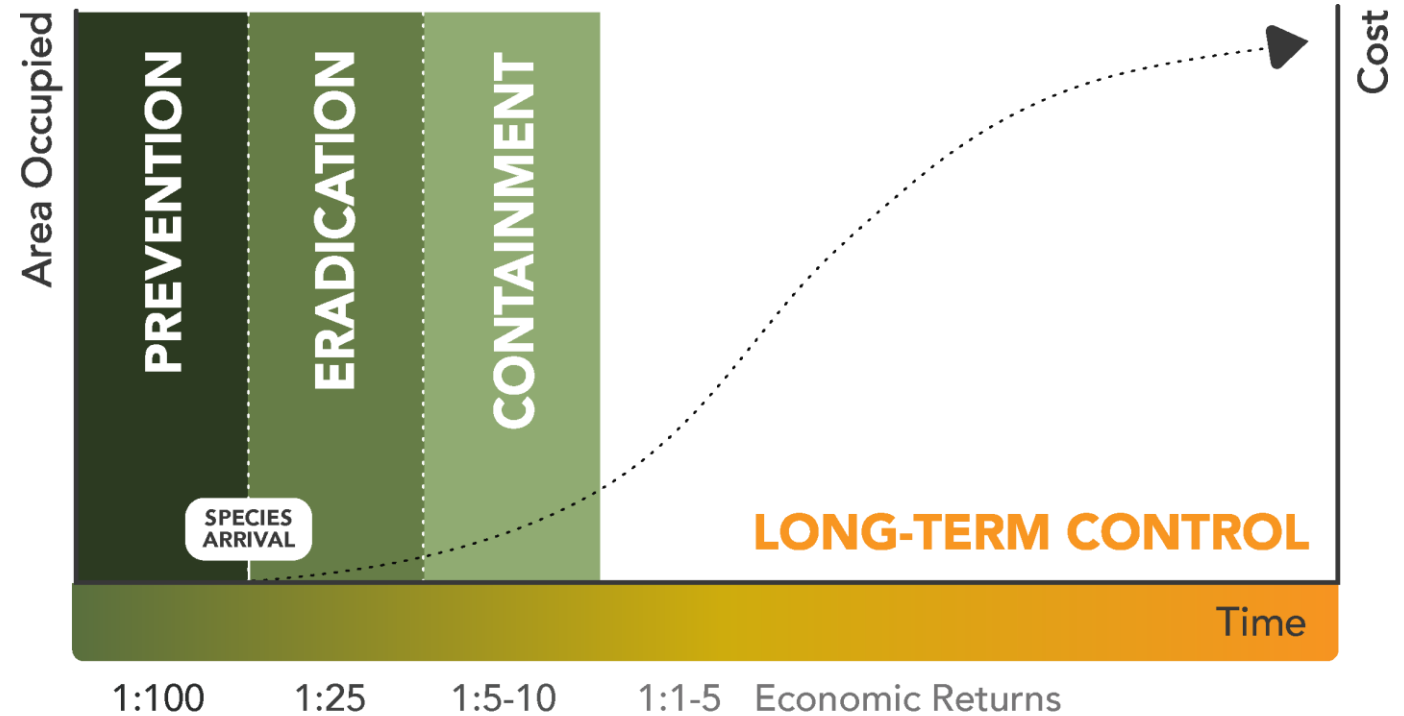


Image retrieved from: <https://invasives.org.au/invasion-curve/>

ONCE ESTABLISHED



- Once established, land managers usually have two options:
 1. **Containment** – where invasive species are accepted in one region, but their spread is limited as much as is feasibly possible
 2. **Strategic Control** – invasive species that are pervasive throughout the region are only controlled in select sites that are ecologically unique or very valuable

INVASIVE SPECIES OF BRITISH COLUMBIA

- All the information provided is from the Invasive Species Council of British Columbia (ISCBC), Sea to Sky Invasive Species Council (SSISC), the Central Kootenays Invasive Species Society (CKISS), and the Okanagan and Similkameen Invasive Species Society (OASISS)]



SCOTCH BROOM (*CYTISUS SCOPARIUS*)

- Native to the Mediterranean and Europe, this shrub was introduced to Sooke, Vancouver Island in the 1850's by Captain Walter Grant. Unfortunately, it quickly established and spread where it quickly spread throughout the island as it was planted to stabilize highway and road developments due to its robust root system
 - Currently, its distribution is concentrated in the lower mainland and Vancouver Island, but has smaller populations in the Kootenays, North Okanagan, and Haida Gwaii.
- **Identification:**
 - Yellow **papilionaceous** (butterfly-like) flowers
 - Green-brown woody stems
 - Small three leaflet lower leaves and unstalked upper leaves are entire
 - Fruits are a green seed pod that transition into black as seeds are released



SCOTCH BROOM ECOLOGY

- **Ecology:** Shade intolerant and prefers rapidly drained soils (like rocky bluffs)
- **Reproduction:** Perennial, can produce 3500 pods, seeds stay viable for 30 years within the soil
- **Dispersal:** Seed pods dry and explode – releasing seeds up to 5 m away
- **Impacts:**
 - **Economic:** Invades rangeland and replaces forage crops and competes with conifer seedlings – stifling regeneration.
 - **Social:** Heavily increase fire risk, increase allergens, harbour ticks
 - **Ecological:** Outcompetes native species and is a major driver in the extirpation and decline of already endangered Garry Oak Ecosystem Associated Species like shooting star, *Camassia* species, and chocolate lily



Image Retrieved from: <https://conservationdistrict.org/2018/invasive-scotch-broom-is-blooming-get-out-and-pull.html>

SCOTCH BROOM REMOVAL

- Due to the pervasive seed bank within the soil, the key to removing scotch broom and preventing regeneration is to minimize soil disturbance
 - Removal is best before in flowers – in early winter to early spring to prevent seed maturation
 - Hand pull any seedling that is smaller than pinky width, make sure to get as much of the root as possible
 - For larger specimens – take a pair of secateurs or loppers, carefully dig beside the root until you can find the first lateral root – then snip the root below the first lateral root
 - This adversely impacts the ability for the plant to sprout a new shoot while minimizing soil disturbance
 - Chemical options are available but not recommended unless a specific ecological goal can be maintained with the application.
 - After removal, re vegetate the site with a seed mix or native grasses
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YELLOW FLAG IRIS

IRIS PSEUDACORUS



- Yellow flag iris was introduced to North America as an ornamental water garden plant in the 1800's where it has escaped and spread to various wetland habitats.
 - Currently distributed in the Southern Interior – Okanagan – North Thompson- Shsuwap – Central Caribou – Similkameen – West Kootenays – Vancouver Island – Lower Mainland
 - **Identification:**
 - Bright yellow flowers that are 7-10 cm across with three sepals – borne on top green stems 1 – 1.5 m
 - Thick root ball that form dense mats – withstands drought and clogs hydrology
 - Grows exclusively in wetlands – they like wet feet!
-

YELLOW FLAG IRIS

ECOLOGY

- Their primary mode of reproduction is cloning via root fragments that break off and drift downstream.
- Their thick root ball and rhizome mat can form impenetrable thickets
- **Impacts:**
 - **Economic:** Clog ditches and irrigation channels quickly, as well as stream hydrology. Toxic to livestock.
 - **Ecological:** Outcompetes native wetland species like cattails, sedges, and rushes that are primary nesting material and habitat for a variety of songbirds and amphibians. Reduces capacity for water storage as well as changes hydrology regimes



YELLOW FLAG IRIS REMOVAL

- Prevention, as always, is the best policy as yellow flag iris is almost impossible to remove once established due to its overwhelming capacity to spread, re-sprout, and inaccessibility of its habitat
 - Chemical control is not feasible in most cases as there are few aquatic approved herbicides
 - Manual removal is a delicate process! The results are often erratic because risk of fragmentation is high. If you are removing manually – dig slowly and carefully and try to remove as much root as possible. Repeat every spring before flower set.
 - Laying a rubber mat as a benthic barrier to smother the plants under water has proven to spend their energy reserves – this requires 70 continuous days
-

GIANT HOGWEED

HERACLEUM MANTEGAZZIANUM

- Giant Hogweed was introduced from Asia as an ornamental plant, from where it has escaped, and spread rapidly throughout Vancouver Island and the Lower Mainland. Recent political and education investments have been made into eradicating this species as it poses significant health hazard to humans, contaminates produce, and outcompetes native species.
 - Distribution is concentrated in the Vancouver Island- Lower Mainland regions but has spread into the West Kootenays
- **Identification:**
 - Flowers are borne from a compound terminal umbel that can measure 80cm across – white petalled
 - Roots are branched and can reach 40-60 cm deep
 - Single hollow green stem 2- 5 m tall and has purple blotches and covered in bristles
 - Leaves are dark green, coarsely toothed, alternate on stem, and divided into large lobes
 - Fruits are green, lobed, and have swollen brown resin canals



GIANT HOGWEED

ECOLOGY

- **Habitat:** Prefers rich and deep soil but is a soil generalist, cannot tolerate longer drought periods
- **Reproduction:** By seed only and requires 2-5 years to accumulate the reserves to grow a flowering stem – 5,000 – 100,000 seeds per plant that remain viable in soil for 15 years – winged seeds can float for 3 days or travel by air
- **Impact:**
 - **Economic:** this cost is mainly due to control efforts. In Germany, annual control efforts total 17.5 Million CDN!
 - **Social:** Poses a serious health risk due it is bristly hairs that contain furanocoumarin loaded sap that can result in watery blisters, full chemical burns, or recurrent dermatitis if skin contacts the sap. Further, it diminishes recreative value of the land.
 - **Ecological:** Outcompetes native species and reduces biodiversity.



GIANT HOGWEED REMOVAL

- The best strategy for human, animal, and plant populations is to prevent the establishment of this species
 - Look twice before buying any ornamental plant in the carrot family and clean your clothes/tires/vehicles after travelling through an infested area
- Other than prevention, digging is the most effective for small populations that are 1-2 years of age. Digging is not effective against large specimens because it can regrow from a small portion of its taproot
- Mowing the plant every 2 weeks is another method to starve the plant of its resources. USE CAUTION and wear proper protective gear that covers ALL of your skin
- Cutting flower heads is effective at reducing seed production but can be impossible for large specimens. CAUTION is needed again
- **We recommend hiring a professional or contacting your local invasive species council for removal.**



Image Retrieved from: <https://www.cbsnews.com/pictures/giant-hogweed-8-facts-you-must-know-about-the-toxic-plant/>

KNOTWEEDS

REYNOUTRIA, FALLOPIA OR POLYGONUM GENUS

- There are 4 species of knotweed in British Columbia:
 1. **Japanese knotweed**
 2. **Giant knotweed**
 3. **Bohemian knotweed**
 4. **Himalayan knotweed**
- Knotweeds were introduced into BC as a horticultural garden plant and due to the combination of extensive reproductive capacity with no predators or diseases, knotweeds can dominate all wetland areas as they can survive in variable sunlight and soil conditions
- Currently, they are established in Vancouver Island, Central Coast, Sunshine Coast, Lower Mainland, Haida Gwaii, Nechako, Cariboo, Thompson-Okanagan, and Kootenays



Japanese Knotweed damage and alternate leaves

KNOTWEED

ID AND ADAPTATIONS

- **Identification:**
 - **Flowers:** Showy- plume-like branched white-ish flowers that are borne on stalks in late summer
 - **Stems:** HOLLOW, upright and segmented with reddish brown speckles (resembles bamboo)
 - **Leaves:** Vary from heart shapes and 20cm across (Giant) to more lance-like and narrow (Himalayan)
- **Habitat:** Prefer moist (adjacent to water bodies) and disturbed soils
- **Reproduction:** Spread rapidly through root systems that can extend up to 20 m away from the parent plant. One knotweed was even seen crossing the Trans-Canada Highway. These plants can propagate from a root fragment as little as 0.7 grams. Infestation can double every 5 years.



Japanese Knotweed (top) flowers and
Himalayan Knotweed (bottom) flowers

KNOTWEED IMPACTS

- **Impacts:**
 - **Economic:** Knotweeds can grow through concrete and asphalt, including foundations. This results in significant repair, maintenance, and control costs. Knotweed also reduced property value.
 - **Social:** Impede access to waterbodies of all types, cause significant damage to home foundations, increasing flood risk. They also impact sight lines of cars and reduce the stability of train railway beds.
 - **Ecological:** Knotweeds rapidly form monocultures that limit resources for native plants. They do not have true root hairs and do not stabilize riverbanks, increasing sediment run off into waterbodies.
-



KNOTWEED REMOVAL



- As the spread of knotweed is mostly by water flow or movement of soil, knotweed can be partially mitigated by human action including:
 - Do not plant knotweed and report any new bamboo like plants in your area to the local conservancy
 - Do not use transported soil or gravel unless it can be certified as free of ANY organic material
 - Do not manually remove knotweeds – as you are helping them spread
 - Knotweed control is a multi-year intensive process that can only be effectively done by chemical control via foliar spray or stem injection of herbicide
 - Herbicide injection and use should be done by a local professional – contact your local conservancy
 - There is NO effective manual or biological control currently
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KNAPWEEDS

CENTAUREA (BIEBERSTEINII OR DIFFUSA)

- Spotted Knapweed and Diffuse Knapweed are native to Europe and Asia and were introduced by various means – including soil contaminant in agricultural seed and through soil discarded by ship ballast. It is free from a host of pest microorganisms that have contained it in Europe and Asia.
- **Identification:**
 - Spotted knapweed has purple aster flowers with black tipped bracts below the flower giving it a spotted appearance.
 - Diffuse knapweed has white or lavender flowers that are urn shaped and bracts are spiky and yellow
 - Leaves are multi divided: more so in spotted than diffuse



Spotted Knapweed (top) – notice the black tipped bracts
Diffuse Knapweed (bottom) – spiky bracts and more pale flowers

KNAPWEED ADAPTATIONS

- **Habitat:** Both species prefer open areas with well drained (sandy more than clay) soils and have become well established in grassland, open forests, and along roadsides. Spotted knapweed is more intolerant of shade
 - **Reproduction:** Both are biennial or short-lived perennials and only reproduce by seed. However, they are prolific seed producers and dormant seeds can remain viable for up to 15 years.
 - **Dispersal:** aided by humans carrying infested hay or grass products and by animals
 - **Impacts:**
 - **Economic:** Invade pastureland and reduce forage crop value. Can be harmful to livestock, but mainly outcompete forage species.
 - **Ecological:** Large infestations increase erosion of soils , increasing sediment loads into waterbodies. Displace native species, reduce biodiversity, and increase risk of fire. They are also allelopathic and can alter soil chemistry forever.
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KNAPWEED REMOVAL

- With all invasive plant species, prevention is key to prevent establishment and spread.
 - **Mechanical control is effective prior to seed set** and requires root removal. If flowers and seeds are present, they need to be bagged.
 - 12 Biocontrol agents have been released – seed and root feeders that together have shown promise in the Okanagan
 - Chemical control is recommended for large patches and selective spraying is best
 - Regardless of control type, persisting ongoing effort must be done on a yearly basis as knapweeds have an incredible seed bank.
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BABY'S BREATH

GYPSOPHILA

PANICULATA

- Perennial tumble-weed look alike. Lives for 3+ years and has a slender-twiggy appearance. When in bloom, it has small white star-shaped flowers. Leaves are opposite, silver-green, and the plant grows to 1.2m in height.
- Commonly a garden ornamental or in bouquets
- Can roll long distances, spreading over 10,000 seeds



BLUEWEED

ECHIU

VULGARE

- Toxic to horse and cattle, blueweed reduced forage quality in rangelands
- Grows 30-80 cm tall, terminal and unique blue-purple funnel flowers. Leaves on lower half only. All the plant is very hairy, with spiky hairs near flowers.
- Once familiar with the plant, it has no similar native species.



CANADA AND BULL THISTLE

CIRSIUM ARVENSE AND *CIRSIUM VULGARE*

- Both thistles prefer disturbed soils and prefer open habitat with lots of sunlight
- Canada thistle is rhizotomoua and can form dense stands rapidly, crowding out native species and forage crops. Grows 0.2-2 m tall, shiny green leaves with spiny edges and white hairs underneath. Smooth stem.
- Bull thistle has a taproot, is a biennial, that grows to a similar size. Flowers are much larger, bowl-like, and are solitary and terminal. Leaves are lobed and have spines on the top side. Unique from Canada thistle by its spines and flower heads.



CYPRESS AND LEAFY SPURGE

EUPHORBIA CYPARISSIAS AND ESULA

- Both species are toxic to humans, livestock, and wildlife when consumed or when its sap interacts with the skin. The sap can cause nausea, vomiting, and other symptoms when eaten, possible blindness if eyes are contacted, and can cause dermatitis if it contacts the skin.
- Both species have escaped as an ornamental. Prefers open and disturbed sites like meadows, pastureland, and roadsides. Both species are allelopathic and suppress plant growth around it.
- Cypress: flowers are yellow-green, red at maturity
- Leafy: taller and more robust than cypress, flowers are greener
- Manual control can be done at early stages – however repeat pulls are needed



COMMON TANSY AND TANSY RAGWORT *TANACETUM VULGARE AND SENECIO JACOBAEA*

- Common tansy is a large perennial that has numerous yellow “button flowers” and has highly dissected, dark green leaves
 - Contains neurotoxins and can be toxic and caustic to humans and livestock if eaten or touched, and spoils milk
 - Tansy ragwort has bright yellow daisy-like flowers with black tipped bracts
 - Leaves are a low rosette and are lobed on purple-ish stems
 - Alkaloids taint honey and are toxic to cattle, deer, horse, and goats, causing liver damage.
 - For both species, preventing is best. Both species are stimulated to vegetatively reproduce when manual removal is performed. Control is a multi-year process that is most effective when biological, chemical, and manual control can be performed
 - As a last resort, mow at a low setting multiple times throughout the growing season to prevent seed production
-



BURDOCK

ARCTIUM MINUS

- Known for its clinging burrs that attach to the hair of livestock, horses, and wildlife. Attachment of burrs impacts the quality of life of these animals, lowering market value of livestock and general health of wildlife populations
 - Its burrs were the inspiration for Velcro, but birds and bats have met their demise at the stickiness of the burrs.
 - Each plant can produce 16,000 seeds. Leaves are large and simple, forming a rosette.
 - Controlling burdock can be done by mowing vegetative parts and limiting seed production, or by herbicide.
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EURASIAN WATER MILFOIL

- The only pure aquatic plant covered in this presentation, milfoil has been introduced from aquariums and prefers slow moving water and sandy bottoms.
- Spreads rapidly by fragmentation of buds, stems, or roots. Quickly spreads and clogs waterways where it creates an anoxic environment and increases mosquito production.
- Reddish brown stems, with very thin feather-like leaves – flowers are small and red or yellow



DISPOSAL AND NICHE

- When an invasive species is removed, there are two crucial steps:
 1. **The invasive species must be properly disposed of**
 - a. As untreated plant parts (rhizomes, buds, flowers, or fruit) can reinfest the site or cause an infestation elsewhere
 - Burning plant parts following safety regulations and municipal bylaws or haul plants in sealed containers to your landfill's burn pile
 - Do not compost invasive species to use on your garden
 - **When in doubt: contact your local municipality**
 1. **The ground must be re-seeded with a cover crop or a native seed mix**
 - a. Removing the invasive species creates an open area of disturbed soil that other invasive species tend to thrive in
 - b. By seeding the disturbed soil, you are creating an environment that is less conducive of invasive species success



RESOURCES

Vancouver Island has many local authorities on invasive species:

Greater Victoria: <https://www.crd.bc.ca/education/concerns/invasive-species>

Lower Mainland: <https://iscmv.ca/>

Kootenays: <https://ckiss.ca/>

Okanagan: <http://oasiss.ca/>

- **A good tip is to google search your local authority and add “invasive weeds” after**
 - Example. Capital Regional District invasive weeds



REFERENCES

- <https://www.invasivespeciesinfo.gov/subject/pathways>
 - <https://www.dcr.virginia.gov/natural-heritage/invspinfo>
 - <https://bcinvasives.ca/>
 - https://www.nrs.fs.fed.us/units/invasivesecology/focus/invasive_species/biological_invasions/
 - <http://calag.ucanr.edu/Archive/?article=ca.v052n02p13>
 - <https://ckiss.ca/>
 - <http://oasiss.ca/>
 - https://extension.unh.edu/resources/files/resource000988_rep1135.pdf
 - <https://invasivespeciescentre.ca/learn/invasion-curve/>
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QUESTIONS