Replanting for Resilience: A Checklist to Restore PEI's Natural Landscape

PEI Invasive Species Council

Prince Edward Island was impacted heavily by hurricane Fiona, which hit the island in September of 2022. Windstorms are not uncommon to PEI; however, the magnitude of intensity and longevity of Fiona has not been experienced in recent memory. As islanders began working to rebuild their homes, some have turned their attention to helping restore our natural landscapes, including our forests.

This checklist helps highlight some re-planting considerations for land managers as they plan to re-plant native trees, shrubs, and wildflowers to promote a resilient landscape. Planners have a lot to navigate in their decisions, and environmental goals may include selecting plants that help sequester carbon, combat borealization, promote biodiversity and increase habitat quality for wildlife.

To meet these goals, it is important to understand how invasive species impact forested ecosystems. According to the World Conservation Union, invasive species are the second leading cause of biodiversity loss globally, only after habitat loss. Limiting the success of invasive species on PEI is crucial in protecting the resiliency of our remaining natural ecosystems and the native species that have been calling this island home for millennia.

An invasive species is an organism that has all three of the following characteristics:

1. It is introduced from outside of its native range.
2. It spreads rapidly.
3. It is harmful to the economy, environment, or our social well-being.

These organisms can be anything ranging from plants, insects, and wildlife to diseases. They often can establish quickly in a wide range of environments, including disturbed-stressed habitats. They increase the pressures felt by our local species and ecosystems and so should never be intentionally introduced.

It is important to note that not all introduced species become invasive. If they do not meet all three characteristics, they are known simply as “exotic species”. The effects of introduced species are mostly unknown until they have established, so if you are introducing exotic species to your landscape, it is important to do research on the species beforehand, to monitor their success and to ensure that they do not escape into natural areas.

As an island, we benefit from both legislative and physical boundaries that limit the spread of invasives. When selecting plants for replanting, we should always aim to purchase locally sourced plants so that we limit the spread of invasives from other geographic areas. This checklist aims to increase the success of long-term planting efforts and minimize the possibility of invasive species introduction on PEI.

This checklist is not an exhaustive list for replanting projects.

If you have any questions, please reach out to the PEI Invasive Species Council at PEIinvasives@gmail.com.

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Contents

Left: Invasive Asiatic bittersweet, *Celastrus orbiculatus*, vine in Georgetown PEI girdling trees.
Right: The vine girdling an even larger vine.

1. Planning

- ☐ A. Get to know your site:
  - Soil conditions, light availability, wind, and moisture levels. Identifying the existing community of plants will help you determine the sites conditions. Planting the right tree in the right place, allows them to thrive. A healthy forest is more resilient to environmental pressures.
    - For example, a site with only tamarack trees is indicative of wet soil and low fertility. The book "Restoring the Acadian Forest" by Jamie Simpson has an excellent guide to these environmental clues in Chapter 3.
  - Identify invasive species present at the site.
    - Before getting in the field, use the distribution maps in iNaturalist and EDDMapS to gain an understand of what invasives may be adding pressures to an area.
    - In the field, during the initial walkthrough of a site, take note of any invasive species.
    - In the office, consider your findings. Include invasive species management, if necessary, to prevent these species from encroaching on your planting site and competing with the plantings.
    - TOOL: PEI Invasive Plant Profiles – PEIISC Website
  - Identify native species at the site. Biodiversity makes the forest more resilient to environmental pressures.
    - TOOL: Floral Guide to PEI Species - Illustrated Flora of Prince Edward Island (AC CDC)
  - Consider the current stage of forest succession. Age diversity, as with biodiversity, makes the forest more resilient to environmental pressure. Early successional species are overrepresented on PEI. Reforesting projects should plant in all three successional forest types and do so over a period of time that staggers a stand's age.
    - A recently disturbed forest with an open canopy would, initially, be best suited for short-lived, sun loving, hardy species. These are known as *early successional species*. Examples: red pine, grey birch, or white spruce.
    - Under the canopy of early successional forests, it is important to plant *moderately shade-tolerance* species that are longer lived. These are known as mid successional species. Examples: white pine, yellow birch, or red oak.
    - An established forest is best suited to long-lived shade-tolerant species that are underrepresented in today's forest. These are known as *late successional species*. Examples: eastern hemlock, sugar maple, or striped maple.
- ☐ B. Familiarize yourself with native plant species.
  - The Atlantic Canadian Conservation Data Center (AC CDC) has a comprehensive list of the conservation status of species in PEI. When trying to determine if a species is native to PEI, we recommend checking the "Vascular Plants" list. Use your computer's "find" feature

(control + F) to search the list for the scientific name of the plant in question and then read its "S" ranking – which is explained here.

- TOOL: Native Pollinator Plant Selector - Find Your Roots (Pollinator Partnership Canada)
- RESOURCE: Native Plants & Watersheds: A Natural Combination (PEI Watershed Alliance)
- Species Information – Native Plant Species (Macphail's Ecological Forestry Center)

☐ C. Consider wildlife use in your planning:

- Connect patches of forest with vegetated natural areas. These are known as wildlife corridors. The Island Nature Trust is one of the groups on PEI working to connect these types of natural areas, read more on their website.
- Consider resource availability and habitat suitability to wildlife. Plan your forest to be built up in vertical layers: canopy, sub-canopy, shrubs, herbaceous layer, and ground cover. The vertical layering of a forest increases the diversity of life that can exist within it and increases its resilience to environmental pressures.

D. Considering replanting rates. There is no hard rule, numbers are site-specific and species-specific. To help you plan, consider a stocking rate of:

- If you are carrying out opportunistic underplanting within a forest stand that has patches of open canopy you can estimate 800 trees per hectare.
- If you are aiming to afforest a large clearing, such as a field, stocking rates can increase up to 1600 trees per hectare.
- Reminder: Spacing is important, the more densely you plant an area, the higher the probability that the area will require future management actions through silviculture techniques. Avoid overplanting a site. Consider the full size, height, and width, of a mature plant.

☐ E. Plant a diverse stand instead of a monoculture. Many invasive insects and pathogens require specific host species. Planting a monoculture is like creating a highway for invasive species. It allows them to spread rapidly, reduces the window for management, and can decimate an entire monoculture stand of trees/forest.

☐ F. Plan for tree maintenance (for trees planted in well travelled areas).

- Pruning helps the aesthetics of a tree but also helps make them safer, healthier, and longer-lived as it allows the tree to achieve proper growth structure.
  - The University of Minnesota has detailed information on pruning, including a video. Visit the website to learn more: Pruning Trees and Shrubs
  - Macphail Woods Ecological Forestry Project offers seasonal workshops on pruning, which we highly recommend attending before getting started.
- Pruning can increase the risk of pest introductions when done improperly but can reduce this risk when best management practices are followed.
  - Pruning exposes the inner bark tissues, making the tree vulnerable to pathogens.

- Pruning trees is wounding the tree, which causes the plant to release volatile compounds that attract insects. These may either feed on the tree or carry diseases.
- Pruning is often necessary to ensure proper structure and health of the tree. Example: It is best to avoid allowing a tree to form co-dominant leaders (central top stem) as these are weaker than having one dominant stem and may split during a storm. Dead or broken branches should be pruned off.
- Consider the tree species you are pruning and the pests threatening them. Plan your tree maintenance to avoid the spread of insects. Example: The emerald ash borer affects true ash trees. Only the adults contribute to the spread, and they are active from May 1st – October 1st. Avoid pruning true ash trees during this time to reduce the likelihood of your trees being affected. Follow the same practice for elm trees.
- Clean and disinfect your pruning tools between plants. First, remove sap and debris and then wipe the tools with 70% isopropyl alcohol or rubbing alcohol. It is important to do so between each plant to prevent the spread of pathogens.
    - This video from Dominus Plantarum demonstrates a simple technique that may be adapted for your projects scale: How to Sterilize Pruning Shears 2/7

☐ G. Plan for monitoring efforts.

- Map plantings so that you can monitor for survival rates. The success rates of plantings can help you determine if the site is suitable for the species planted.
    - If you do not currently have a protocol in place, Alberta's Agroforestry & Woodlot Extension Society has made their protocol public, and it may provide some guidance. We recommend getting in touch with local watershed groups on PEI to ask about their monitoring efforts, as they may have established protocols of their own. If you are unsure as to what watershed group covers your area, visit the Watershed Alliance page to learn more.
    - During your monitoring look for signs of rodent damage, broken or dead limbs, dying plants, and missing plants (sometimes if the plants were small when planted they just disappear).
- Monitor for invasive species. Invasive species can greatly impact the success of a re-planting project. Familiarize yourself with the PEIISC Invasive Plant Priority List and webpage.

2. Investigate plant availability on PEI

- ☐ A. Always select plants that are listed with their scientific name (Latin name). Common names vary and may cause confusion.
- ☐ B. Investigate native plant availability at local native plant nurseries.
    - Frank Gaudet Nursery - PEI's largest native tree seedling nursery. It does not sell directly to the public but does at participating garden centres.
    - Macphail Woods Ecological Forestry Project – Native plant nursery with trees, shrubs, wildflowers, and ferns. Plants are sold here and also used as educational tools.
- ☐ C. Investigate plant availability at local garden centres.
    - Use our garden center map to get started (it is not a comprehensive list and changes may have occurred since it was last updated in 2021).
    - When shopping in person, communicate with the retailer to discover where they source their plants. If a species was grown locally, it reduces the likelihood of spreading invasive insects and pathogens. If a plant was produced as nursery stock off-island, we suggest investigating the invasive species pressures from the area where the plant was imported from. See sections 6 and 7 in this planting checklist to help with your investigation.
    - Source native species, when possible. If you are unsure if a plant is a native species, check the scientific name on the AC CDC vascular plant list (as mentioned above). If it is an exotic plant (SNA), perform a search online to see if it is considered an invasive species in the region.
        - Visit the PEIISC page to see our invasive plant priority list: PEI Priority Invasive Species Plant List
        - Search the plants common or scientific name in google with the tag line "invasive species Atlantic Canada" to see if there are any local warnings against selecting this species.
- ☐ D. Watch out for other plant species growing in the pot with your plant. Consider the possibility of these plants being invasive. The seeds of this plant may even have an established seed bank in the potted soil which could be introduced to your landscape.
- ☐ E. Perform a health check on the plants.
    - Examine the top of the leaves, under the leaves, plant stem, where the leaf stalk joins, and in the soil for evidence of disease, worm, or insect infestations.
        - Are there molds or signs of disease present in the nursery? Look for discolored leaves, wilting, fruiting bodies, etc.
        - Do the plants have signs of advanced insect damage? Some damage is normal, but take care to investigate plants with damage further. Look for eggs, pupae, cocoons, feeding damage, boring, frass, etc.
        - Is the soil normal looking? Invasive jumping worms can be transmitted in potted plants. If they are present, the soil could look more granular. The worms replace the

soil with their waste that looks like coffee grounds. This will be true for adult worms but the eggs of jumping worms may still be present in the soil and go undetected at this time. The eggs can be difficult to distinguish from surrounding soil particles.

- ☐ F. TOOL: Choose plants that are less likely to increase the spread of disease and pests - PEST: Pollinator Enhancement Security Tool
- ☐ G. Do not plant wildflower seed mixes. Mixed wildflower seed packs often contain invasive species that require more time/energy/money to eradicate than most are able to invest. One of the biggest problems with mixed wildflower seed packs is many do not have a list of what species they contain. If the contents are listed, they are often listed by a common name instead of their scientific name. Others may list the species, but studies have found many to be inaccurate. One such study grew 19 seed packs from different brands and found 30 -100% of the plants germinated to be invasive. There are claims of “Canada Safe” seed packs, however, the PEIISC still advises against them. There are few species that overlap over a large geographical range, meaning they may be native in part of Canada but not locally, and the content description may be inaccurate. In fact, even wildflower seed mixes produced locally may contain invasives. If you would still like to use seed mixes, create your own by buying seed species individually and mixing them according to their shared growing conditions.

3. Investigate plant availability off-Island.

- ☐ A. Familiarize yourself with federal, provincial, and municipal legislation. The movement of certain species from certain areas is prohibited based on the risk of invasive species introductions.
    - Federal regulations fall under the purview of the Canadian Food Inspection Agency (CFIA). If you are planning to import plants into Canada or move them within Canada, you should confirm the requirements of the particular species with the CFIA by contacting your local CFIA office or by visiting the list of pests regulated by Canada.
        - National "Invasive Species Policy" outlines the CFIA's approach to develop and implement phytosanitary measures to regulate the importation and domestic movement of pest plants. This policy is enabled by the:
            1. Plant Protection Act - Created in 1990 to protect Canada's forestry and agriculture sectors. It gives power to the CFIA to restrict the import, sale, possession, and movement of pest plants including weed seeds into and within Canada. While it does not directly name invasive species, it covers anything that is injurious or potentially injurious, whether directly or indirectly, to plants or to products or by-products of plants.
                - Example: Current EAB regulations restrict the movement of firewood of all species, as well as live trees, nursery stock, logs, lumber, wood packaging or dunnage, wood or bark, wood chips or bark chips of the genus Fraxinus from regulated areas in order to limit the spread of EAB.
            2. Seed Act - Created in 1985 to help ensure that seeds sold in, imported into, and exported from Canada meet established standards for quality, and are labeled so that they are properly represented in the marketplace.
        - Become familiar with CFIA regulated areas.
    - PEI Provincial Regulations
        - Weed Control Act – At this time, this is the only act that specifically mentions invasive species. It currently regulates one species, purple loosestrife. It is an offence for any person to import, propagate, sell, or swap purple loosestrife plants, or to collect loosestrife from wild populations.
- ☐ B. Always select plants listed with their scientific name (Latin name). Common names can vary, and may cause confusion.
- ☐ C. Determine where the retailer is located and where they source their plants from. Investigate the local invasive species pressures from the area and weigh the risk of introduction. See sections 6 and 7 in this planting checklist to help with your investigation.
- ☐ D. Source native species, when possible. If you are unsure if the plant is a native species, check the scientific name on the ACC CDC vascular plant list (as mentioned above). If it is an exotic plant (SNA), perform a search online to see if it is considered an invasive species in the region.

- Visit the PEIISC page to see our invasive plant priority list: PEI Priority Invasive Species Plant List
- Search the plant's common or scientific name in google with the tag line "invasive species Atlantic Canada" to see if there are any local warnings against selecting this species.

☐ E. TOOL: Choose plants that are less likely to increase the spread of disease and pests - PEST: Pollinator Enhancement Security Tool

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4. Receiving your order (from local or non-local sources)

☐ A. Perform a health check on your plants.

- Examine the top of the leaves, under the leaves, the plant stem, and where the leaf stalk joins the main stem.
  - Are there molds or signs of disease present in the nursery? Look for discolored leaves, wilting, fruiting bodies, etc.
  - Do the plants have signs of advanced insect damage? Some damage is normal, however take care to investigate plants with damage further. Look for eggs, pupae, cocoons, feeding damage, boring, frass, etc.
- Examine the soil.
  - Is the soil normal looking? Invasive jumping worms can be transmitted in potted plants. If they are present, the soil could look more granular. The worms replace the soil with their waste that looks like coffee grounds. This will be true for adult worms but the eggs of jumping worms may still be present in the soil and go undetected at this time. The eggs can be difficult to distinguish from surrounding soil particles.
  - Mustard Test from the University of Nebraska-Lincoln
    1. Mix 1/3 cup of ground yellow mustard seed with 1 gallon of water.
    2. Clear a bare patch of soil and pour slowly over the soil.
    3. Worms will move to the surface, and you can determine whether they are invasive jumping worms or common worms.

☐ B. If any concerns are highlighted during the health check, you should consider a quarantine period while the cause is investigated. This would be to prevent any harmful pathogens and insects from being spread further across the landscape.

- For small-scale operations the "Big Island Invasive Species Committee" in Hawaii has an excellent video explaining their quarantine practices set up for their garden - Share Plants, Not Pests // Ep: 1 Quarantine. This technique could be scaled up if resources allowed.

☐ C. Examine your plant for other species growing in the soil with it. Consider the possibility of these plants being weeds or possibly being invasive. They might have an established seed bank in the potted soil and could be introduced to your landscape.

5. Site cleanup

***Invasive species note:** It is important to limit the movement of firewood across PEI to prevent the accelerated spread of invasive species. When cleaning up wood from hurricane Fiona, we ask that you keep it as close to the site it fell as possible.

PEI is subject to Federal regulations that prohibit the movement of certain firewood materials off-island to certain areas. This is because PEI has several invasive species that are not ubiquitous in other provinces. Read more here: https://inspection.canada.ca/plant-health/forestry/don-t-move-firewood/firewood/eng/1330963478693/1330963579986

6. Invasive insects on the horizon

Common & Scientific Name	Detected in:	General Host
Asian spongy moth, *Lymantria dispar var. asiatica* (the European invader is established in PEI)	BC	500 species including maples, birch, aspen, and willows
Balsam twig aphid, *Mindarus pinicolus*	NB	Balsam Fir
Box tree moth, *Cydalima perspectalis*	Ontario	Boxus spp.
Brown spruce longhorn beetle, *Tetropium fuscum*	NS	Spruce spp.
Browntail moth, *Euproctis chrysorrhoea*	Maine, NS & NB	Many hardwood species, including oak, apple, serviceberry, Virginia rose, and willow
Common pineshoot beetle, *Tomicus piniperda*	NB, Ontario & Quebec	Eastern white pine, jack pine, and red pine
Elm zigzag sawfly, *Aproceros leucopoda*	Quebec	Elm spp.
Emerald ash borer, *Agrilus planipennis*	NS, NB, Ontario & Quebec	White ash, black ash, and red ash
European Rose Chaffer, *Cetonia aurata*	Not yet observed in Canada	Virginia rose, shining rose, and Carolina rose
European spruce bark beetle, *Ips typographus*	Not present in NA	Spruce spp., balsam fir, tamarack, eastern white pine, jack pine, and red pine
European pine sawfly, *Neodiprion sertifer*	NFLD, NS, NB, Ontario & Quebec	Eastern white pine, jack pine, red pine, Austrian pine, mugho pine, and Scots pine
Hemlock woolly adelgid, *Adelges tsugae*	BC, NS, Ontario	Eastern hemlock and Carolina hemlock
Mountain Pine Beetle, *Dedroctonus ponderosea*	Native to BC. Detected in AB & SK	Eastern white pine, jack pine, and red pine
Nun moth, *Lymantria monachal*	Not present in NA	Many species, including spruce spp., tamarack, balsam fir, maple, birch, mountain ash, pine, northern red oak, elm, and black ash

Pale winged grey, *Iridopsis ephyraria*	Native from NS to Alberta	Willow spp., chokecherry, currant spp., balsam fir, paper birch and mountain ash
Sirex wood wasp, *Sirex noctilio*	Ontario & Quebec	Spruce spp., tamarack, balsam fir, eastern white pine, jack pine and red pine
Southern pine beetle, *Dendroctonus frontalis*	Not yet observed in Canada	Eastern white pine, jack pine, and red pine
Spotted Lanternfly, *Lycorma delicatula*	Not yet observed in Canada but near the US border	Many species, including maple spp., aspen spp., pin cherry, chokecherry, eastern white pine, jack pine, red pine, grapes, plums, cherries, pine, and oak.
Western Spruce Budworm	BC & AB	Spruce spp.

7. Invasive pathogens on the horizon

Common & Scientific Name	Detected in:	General Host
Beech bark disease, *Neoectria faginata*	Ontario, Quebec, NS & PEI	American beech
Beech leaf disease, Litylenchus crenatea	Ontario	American beech
Butternut canker, *Ophiognomonia clavigignenti-juglandacearum*	NB	Butternut
Chestnut blight, *Cryphonectria parasitica*	Ontario and BC	American chestnut
Dogwood anthracnose, *Discula destructiva*	Ontario and BC	Dogwood spp.
Laurel wilt, *Raffaelea lauricola*	Not yet observed in Canada	Laurel spp.
Needle cast, *Isthmiella faullii*	Eastern Canada – exact unknown	Balsam fir
Oak wilt, *Bretziella fagacearum*	Not yet observed in Canada	Oak spp., with highest damage to the Northern red oak
Peach leaf curl/leaf curl, *Taphrina deformans*	Not yet observed in Canada	Peaches, nectarines, almond trees
Pitch canker, Fusarium circinatum	Not yet observed in Canada	Pine spp. and fir
Scleroderris canker, *Gremmeniella abietina*	NB & NFLD	Spruce spp., eastern white pine, jack pine, and red pine
Sudden oak death, *Phytophythora ramorum*	Not yet observed in Canada	Oak spp.
Thousand cankers disease, *Geosmitia morbida*	Native to western US, not yet observed in Canada	Black walnut and butternut
White pine blister rust, *Cronartium ribicola*	NB, Ontario & Quebec	Smooth gooseberry, currant spp., eastern white pine

8. Invasive plant list

View an up-to-date copy of our list here: PEI Priority Invasive Plant List

Or our website to view plant profiles: Invasive Species Profiles