Recovery and Action Plan for Black ash (*Fraxinus nigra*) in Nova Scotia.

December 2015

Recovery of this species is considered technically or biologically feasible at this time.

RESPONSIBLE JURISDICTIONS

Government of Nova Scotia:
Nova Scotia Department of Natural Resources

ACKNOWLEDGEMENTS

The Black ash Recovery Team provided much of the information for this recovery plan. A list of members and their affiliations is found in Section 6. Special thanks to Alton Hudson and Mark MacPhail, co-chairs from the Assembly of Nova Scotia Mi'kmaq Chiefs for their help in completing this recovery plan and to Donna Hurlburt, the coordinating author.

This recovery plan greatly benefited from the participation and expertise of many individuals across Nova Scotia, including Mi'kmaw knowledge holders and elders, foresters, biologists, botanists, basket makers, crafters and other experts.

PREFACE

This recovery and action plan has been prepared by the responsible jurisdiction, the Nova Scotia Department of Natural Resources in cooperation with the Black ash Recovery Planning Team. The recovery and action plan defines the recovery goal, objectives, strategies, and actions that are deemed necessary to protect, conserve, and recover Black ash in Nova Scotia. The plan does not necessarily represent the views of all of the individuals involved in its formulation, nor of the governments or organizations with which the individual participants are associated. The goal, objectives, strategies, and actions are based on the best existing knowledge and are subject to modification resulting from changed objectives and new findings. The implementation of the recovery and action plan shall take place over the next 5 years (2016-2022) and will be subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations. Therefore, some aspects of this plan may not necessarily be implemented immediately, concurrently, or in their entirety.

Recovery and action plans are not designed to provide a comprehensive summary of the biology and status of species. For more information, a copy of the Status Report on the Black ash (*Fraxinus nigra*) in Nova Scotia by Hurlburt (2013) is available at: http://novascotia.ca/natr/wildlife/biodiversity/pdf/Fraxinus-nigra-Provincial-Status-Report.pdf. Projected costs associated with many of the individual recovery actions identified in this plan cannot be calculated at the time of report writing, but relative estimates are provided.

The Black ash Recovery and Action Plan has followed a unique process of engagement that involved Nova Scotia Mi'kmaq from the earliest stages of development. This

process was initiated by the appointment of two co-chairs, Alton Hudson and Mark MacPhail, by the Assembly of Nova Scotia Mi'kmaq Chiefs, who were equal partners to the designated co-chair, Mark Elderkin, from NS Department of Natural Resources. Meetings to develop the plan were held at three locations across the province, Millbrook, Eskasoni and Bear River First Nations, to enhance a broader breadth of participants and perspectives.

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EXECUTIVE SUMMARY

Black ash (*Fraxinus nigra*), or Wisqoq in Mi'kmaq, was designated as Threatened under the Nova Scotia Endangered Species Act in 2013. It is provincially widespread but rare, with few seed-bearing individuals (only 12 documented, up to 40 may exist) and few total individuals (n~1000 trees). It is not known if the species was more common historically on the landscape than at present. Many existing trees are stunted and in poor health.

Historically, Black ash was likely threatened by overharvest from the cooperage industry and by clearing and draining of wet forested habitats along river systems for agriculture. At present, the species is threatened by habitat loss and alteration, disease and poor health. Potential ongoing threats may include the planting of Black ash (native and otherwise) in wild and urban settings, climate change and the lack of baseline biological information from Nova Scotia. Emerald ash borer is a likely future threat which is decimating populations of Ash species (not just Black ash) in Ontario, Quebec and Central and Eastern United States, and is spreading rapidly in a northeast direction.

1. BACKGROUND

1.1 Species Assessment Information

Nova Scotia Black ash were designated as Threatened in 2013 for the following reasons:

Black ash is known from 35-40 sites in 11 counties of Nova Scotia mature individuals are rare and only 12 are known to occur. Total number of known trees in Nova Scotia is approximately 1000. Black ash are wind-pollinated and flower in late May or early June. Seeds are produced at 1 to 8 year intervals and are dispersed from October to the following spring. The number of seeds produced per tree ranges from 2 -1500. Seeds stay in dormancy between 2 to 8 years and seedlings are poor competitors. Black ash can sprout vigorously from stumps after cutting; most regeneration occurs through this means. The species is slow growing, moderately long-lived with a typical longevity of 130 to 150 years. Black ash is particularly susceptible to fungal diseases, invasive species such as the Emerald ash borer, poor growth and stunting.

1.2 Description of the Species

Black Ash are broad-leafed hardwood trees belonging to the Olive Family (Oleaceae). They are generally 15 to 21 m tall (Erdmann et al. 1987) with large spreading or ascending branches (Muenscher 1946, Harlow and Harrar 1979). In Nova Scotia, Black ash reaches average heights of 2.45 to 15.5 m with a diameter at breast height (DBH) from 2.0 to 38.6 cm (Hill-Forde 2004). Most trees tend to be less than 10 m tall (Hill-Forde 2004). The leaves are opposite and compound with 7 to 11 oval to lance-shaped leaflets; leaflets have no stalk. Clusters of rusty hairs are apparent where leaflets join

petiole (Muenscher 1946). Trunk is gray in colour and smooth to corky on young trees and scaly on mature trees (Muenscher 1946, Harlow and Harrar 1979). Black ash usually produces inconspicuous flowers that appear in the spring before leaf-out in clusters at branch tips (USDA and NRCS 2006). Fruit is a winged, flatten, single seeded samara that is borne in terminal or lateral branches (USDA and NRCS 2006).

1.3 Populations and Distribution

Globally, black ash ranges from western Newfoundland west to southeastern Manitoba, and south to Illinois and northern Virginia (Benedict and David 2000, Ronald 2001, Wright and Rauscher 1965). In Nova Scotia, black ash is currently known from all counties, except Yarmouth, Shelburne and Richmond counties (Figure 1, Hurlburt 2013). Historic records exist for Yarmouth and Shelburne Counties.

Black ash is confirmed from 35-40 sites in 11 counties of Nova Scotia since 2000; other unconfirmed records exist (Hurlburt 2013). Due to the tree's sparse nature and difficulties in identification, it is likely that more sites will be discovered in the future with additional search effort. Mature individuals are poorly known and only 12 seed-bearing trees are known to occur (i.e., verified), although it is likely that more are present. Reports during the Recovery plan process suggest that numbers of seed-bearing individuals are higher, but likely to be significantly less than the threshold for Threatened. It is unknown how many trees are of adequate size and age to reproduce, i.e. are mature, outside of those producing seed. Total number of known specimens in Nova Scotia is approximately 1000 (Hurlburt 2013).

Naturally occurring rescue of Nova Scotia Black ash by New Brunswick populations is thought to be unlikely, in part due to its rarity, slow growth and poor competitive ability.

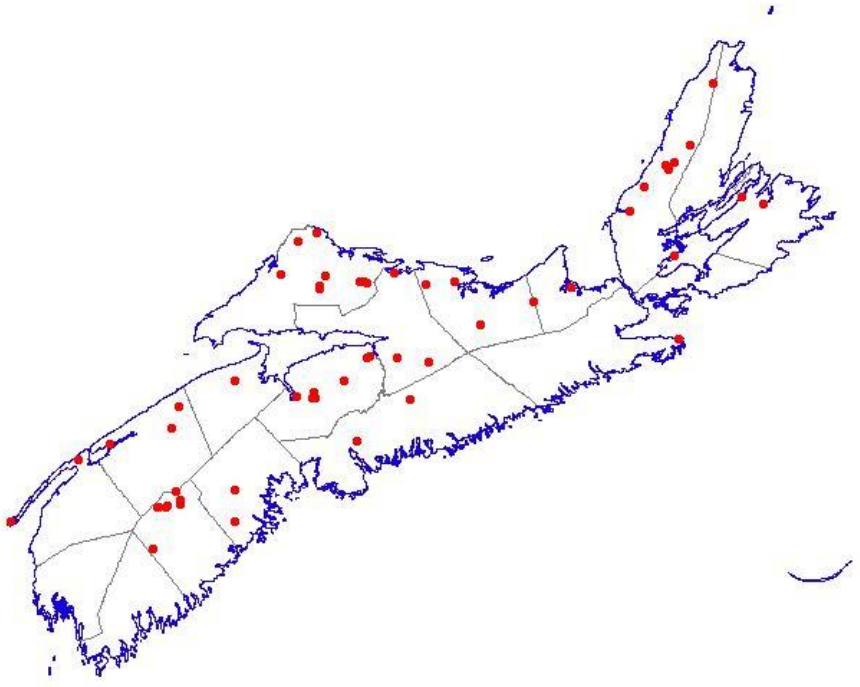

Figure 1: Distribution of *Fraxinus nigra* in Nova Scotia (includes only records for which coordinates were available).

1.4 Needs of the Black ash

1.4.1 Description of biological needs, ecological role and limiting factors

Black ash are wind-pollinated and flower before leaf-out in late May or early June (Erdmann et al. 1987). Seeds are produced at 1 to 8 year intervals (Erdmann et al. 1987) and are dispersed from October to the following spring (Schopmeyer 1974, Lees and West 1988, Burns and Honkala 1990). In Nova Scotia, total seeds produced yearly per tree ranged from 2 to 1500 (Hill-Forde 2004).

Black ash seeds stay in dormancy between 2 to 8 years (Erdmann et al. 1987, Wright and Rauscher 1965) and seedlings are poor competitors. Black ash can sprout vigorously from stumps after cutting (Erdmann et al. 1987); most regeneration in Nova Scotia occurs through this means. Black ash is slow growing, moderately long-lived with a typical longevity of 130 to 150 years (USDA and NRCS 2006, Heinselman 1981). Age or size at maturity is unknown. Black ash is particularly susceptible to fungal diseases, poor growth and stunting, which are important considerations for species recovery.

1.4.2 Description of habitat needs

Black ash is typically found in poorly drained areas that are often seasonally flooded (Erdmann et al. 1987). It is most common on peat and muck soils (Lees and West 1988), but also grows on fine sands over sands and loams (Erdmann et al. 1987). Although this species can tolerate still semi-stagnant conditions, there is a preference for swampy woodland stream and river banks with moving water. It is often associated with species such as Red maple (*Acer rubrum*), Speckled alder (*Alnus rugosa*), Balsam poplar (*Populus balsamifera)*, and Black spruce (*Picea mariana*). The species is shade intolerant, and seedlings, saplings and sprouts tend to regenerates only in partially opened forest canopies (Erdmann et al. 1987). Transplanted seedlings are reported to grow well in open areas that are relatively dry and exposed to sunlight, such is the case in Mi'kmaw communities where the tree has been planted for cultural and research purposes.

1.5 Limiting Factors and Stressors

In Nova Scotia, Black ash is approaching the northern extent of its North American range. It is a rare component of Nova Scotian forests and will likely always be vulnerable to natural and human-influenced stressors and threats for several reasons.

Black ash in Nova Scotia suffer from lack of vigor and appear to be in poor health. The trees are stunted, misshapen, and suffer from a suite of diseases and pests. It is not known if there is a genetic basis for this, but these factors likely affect species resiliency and may make it more difficult for the species to recover from historic and current threats.

Black ash in Nova Scotia are apparently limited by low rates of sexual reproduction and reproduce mostly through asexual means, i.e. suckering. Black ash can produce perfect or separate male and female flowers, and male, female, and bisexual flowers can occur on a single tree (Erdmann et al. 1987). It is unknown which is more prevalent in Nova Scotia and the rate at which sexual reproduction occurs. Given the species is typically distributed as widely separated single trees or small clusters, genetic exchange is likely limited. Geographic isolation from the rest of the North American range is also likely to play a role in restricting genetic exchange. Nova Scotia is connected to the rest of the range by a relatively narrow isthmus of mostly inhospitable habitat.

Dispersal ability, and thus genetic exchange, is also limited. Seeds are wind dispersed and seed rain usually extends less than 150 m from the tree (Sutherland et al. 2000). Seeds may be able to travel further if they land on icy surfaces and prevailing winds move them further (Curtis 1959), but the probability of landing in close proximity to another Black ash tree is apt to be quite low and insufficient for maintaining healthy levels of genetic exchange. Loss of genetic diversity, combined with habitat destruction

and alteration, reduces plant fitness and increases the risk of extirpation by disease or other environmental stressors, human actions or stochastic events.

Black ash in Nova Scotia is approaching the northerly limits of its global range. Plants on the edge of range often have lower reproductive success than plants occurring more centrally (Sexton et al. 2009). The Nova Scotia population may also be experiencing different selective pressures that have resulted in unique characteristics, including reproductive strategies, relative to elsewhere.

1.6 Threats

The key threats identified in the Provincial (Nova Scotia) Status Report (Hurlburt 2013) included habitat loss and alteration of wet habitats, historic threats including plausible overharvest for cooperage, and the potential, but escalating threat of the invasive beetle, Emerald Ash Borer. Other threats include selective harvest of mature Black ash trees for crafts, transplanting trees from non-native stock, and die back. Additional threats, not identified in the status report, but requiring assessment were identified as urban forestry, climate change and a potential ash dieback pathogen *Hymenoscyphus fraxineus* (in Europe). Table 1 identifies historic, current and future threats that have impacted population status, with the asterisk noting those of particular significance to species recovery. More detailed descriptions of threats are provided below.

Table 1: Threats important for Black ash recovery in Nova Scotia. Threats of particular significance are marked with an asterisk (*).

Threat	**Specific concern**	**Timing**
i) Habitat Loss and Alteration*	Wetland infilling Clearing for agriculture Hydrological changes	Historic; thought to be relatively minor at present
ii) Overharvest	Barrel making for shipping industry	Historic
iii) Forestry Practices*	Commercial forestry Firewood Incidental take	Current
iv) Invasive Species*	Emerald Ash Borer	Future
v) Dieback and Disease*	Dieback (mechanism not understood); potential dieback pathogen from Europe (*Hymenoscyphus fraxineus)*	Current & Future
vi) Craft Industry	Basketry Other wood crafting	Current
vii) Transplanting	Urban planting Habitat restoration	Current
viii) Climate Change		Current & Future

ix) Browsing	White tailed deer & Snowshoe hare	Current

i. Habitat Loss and Alteration – Although limited documentation that quantifies wetland loss exists for Nova Scotia, it is expected that historic practices of clearing land for agriculture would have negatively impacted Black ash to a significant degree. Clearing was prevalent along watercourses, especially those in more fertile areas such as along floodplains, where Black ash is known to occur. In more contemporary times, Black ash habitat has been altered or lost from road development, industrial activity such as mining and forestry, although this is expected to have a minor impact to populations relative to historic habitat loss and alteration.

In addition to direct loss of habitat, clearing practices can also reduce habitat quality in indirect ways by altering runoff, nutrients or water table levels. Clear cuts on organic sites result in less natural regeneration of Black ash from rising water table levels and/or increased competition from early successional vegetation (Erdmann et al. 1987).

ii. Historic Overharvest – It has been suggested that historic harvest of Black ash in the late 1800s for barrel staves has contributed to a long-term decline of the species in Nova Scotia (Hill-Forde 2004). Few data or direct observational evidence exists to corroborate this hypothesis, although circumstantial evidence does indicate that considerable harvest of all *Fraxinus* species did occur for this purpose. Additionally, the ability of Black ash to sprout from stumps after cutting should have mitigated decline to some degree.

Other historic (and current) uses of Black ash included basketry, tool handles, canoe ribs and snowshoes (among other things), although it is expected that these harvest activities would have negligible impact on Black ash populations. At present, there are no inventories of basket makers in Nova Scotia and the extent and impact of current harvest for crafts is unknown.

iii. Forestry Practices (Commercial Forestry, Firewood & Incidental Take) – The extent and impact of current day harvesting of Black ash through commercial forestry, firewood or incidental take (i.e., unknowingly harvesting Black ash, typically through misidentification) is unknown. It is known that some trees are selectively cut for crafts or unintentionally harvested because of misidentification or lack of awareness. This is likely exacerbated by the rarity of Black ash on the landscape, its low economic value and that it often occurs as individual trees rather than as clusters of trees. It is expected that the Nova Scotia Wildlife Habitat and Watercourse Regulations may provide some protection to trees found within 20m of streams greater than 50 cm in width; however those trees along smaller streams or shrub swamps would not be afforded protection

through these regulations. If seed bearing trees are being harvested, even in small numbers, this is of concern given there are relatively few sexually reproductive trees.

iv. Invasive species: Emerald Ash Borer – Emerald ash borer (*Agrilus planipennis* Fairmaire), a phloem-feeding beetle native to Asia that kills all species of ash, was discovered near Detroit, Michigan and Windsor, Ontario in 2002. By March 2009, isolated populations of Emerald ash borer were detected in nine additional states and Quebec (Kovacs et al. 2010). As of November 2012, Emerald ash borer was confirmed in Canada from the regional municipalities of Chatham-Kent, Durham, York, Peel, Halton, Niagara and Waterloo in Ontario, eastwards to the cities of Gatineau, Laval, Longueuil and Montreal in Quebec (CFIA 2015; http://www.nrcan.gc.ca/forests/fire-insects-disturbances/top-insects/13377). The pest is expected to continue to spread and the transport of firewood is of particular concern (CFIA 2015). The areas regulated for Emerald Ash Borer as of July 2015 are provided in Figure 2. Federal regulatory measures prohibit the movement of any ash material and firewood of all species from specific areas of Ontario and Quebec. Regulated materials often include ash nursery stock and green lumber; any other ash material including logs, stumps, roots, branches, as well as composted and un-composted wood chips. All hardwood firewood is regulated. Movement of wood is not currently regulated in nearly provinces or states (i.e. New Brunswick and Maine).

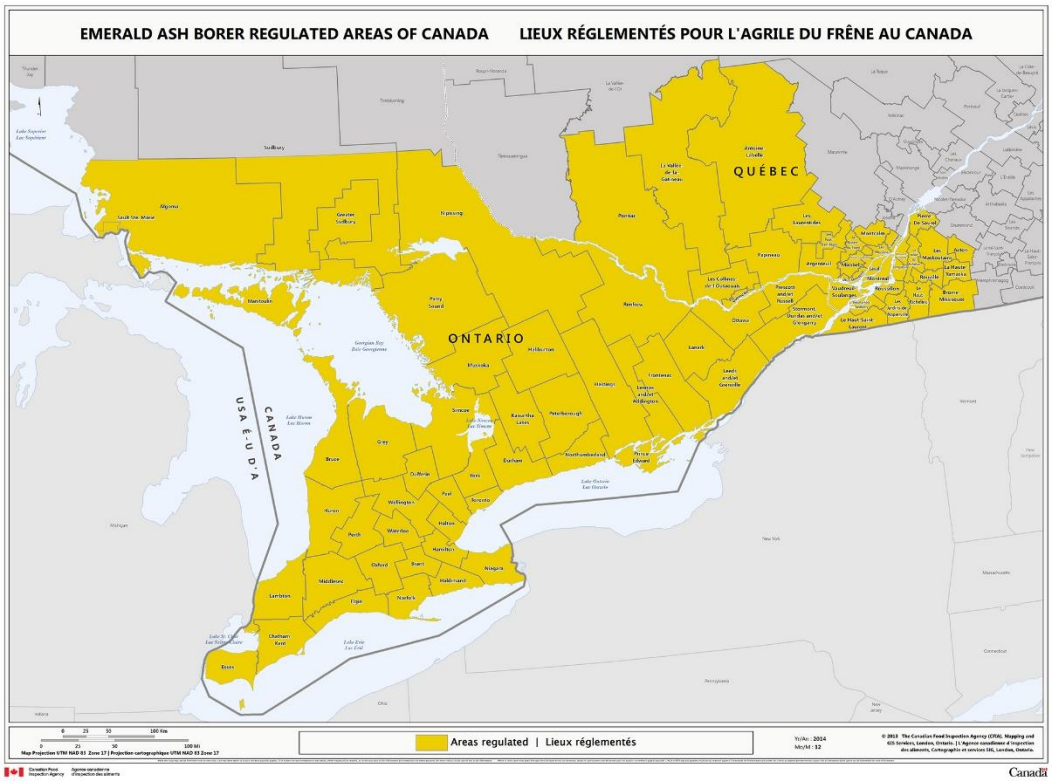

Figure 2. Areas regulated for Emerald Ash Borer in Canada (July 2015; CFIA 2015).

Research on the rate and nature of Emerald Ash Borer spread is active. Smitley et al. (2008) estimated that ash decline moved outward from a point of infestation at a rate of

10.6 km per year, which is further enhanced by the artificial movement of wood and wood products. Emerald ash borer has killed more than 50 million ash trees in both urban and forested areas in eastern North America (Poland and McCullough 2006). Since it was first detected in Windsor, ON in 2002, the emerald ash borer has killed millions of ash trees in parts of Ontario and Quebec (http://cfs.nrcan.gc.ca/pages/276). Within 250 forest monitoring plots in Ohio, Michigan, and Pennsylvania, ash mortality reached nearly 100 percent within 6 years of the arrival of Emerald ash borer, regardless of initial ash density, size, habitat, or diversity. It will kill both small ash saplings at 3-cm diameter at breast height and larger mature trees (Michlet and Ginzel 2010). Decline and mortality of black ash advanced more rapidly than that of white and green ash in Michigan during a 2004-2007 study; percentage mortality of ash increased from 51% to 93% during that time period (Smith et al. 2015). Mastro and Reardop (2004) estimated the mortality for Black ash from the Emerald ash borer to be 66-94%.

In Michigan (2004-07), it was determined that forest community composition and structure did not influence the susceptibility of Black ash to EAB invasion. There was no relationship between EAB-induced ash decline or percentage mortality and any measure of community composition (tree species diversity, stand/ash density, total basal area, or relative dominance of ash). There was also no relationship between measures of EAB impact (density of EAB signs, ash decline rating, percentage ash mortality, or percentage infested ash) and forest attributes (ash/total stand density, basal area, ash importance, or stand diversity) (Smith et al. 2015).

Several studies on methods of control are ongoing, including biological control via parasitoids and insect pathogenic fungi. A systemic insecticide derived from the Neem tree, TreeAzin™ is being used to protect individual high value trees and trees in small isolated infestations. Success is high using inoculation, although treatment needs to be redone on a regular basis, and may be a viable method for protecting seed-bearing trees.

v. Dieback and Disease - Across the global range of Black ash there has been concern of a generalized decline in ash health and quality since the 1920s (Benedict and David 2000), with many potential, but as of yet unproven, causes. Crown dieback of Black ash across its range is a common occurrence, albeit with some temporal and spatial variability in intensity (Palik et al. 2011). Although widespread, there are few quantitative assessments of dieback extent or relationship to potential causes. Symptoms include thinning crowns, epicormic branching, twig and branch dieback, and occasionally small, discolored leaves (Trial and Devine 1996). Most dieback episodes are not attributable to specific disease or pest agents and environmental factors like drought, excessive soil moisture, senescence, and road influences have all been suggested as potential contributing factors. In a Minnesota study, the Black ash stands with less dieback were likely younger (i.e. smaller diameter at breast height) and located on relatively drier sites and farther from roads (Palik et al. 2011).

Similarly, in Nova Scotia, larger and older trees tend to experience more dieback and poor crown condition than the younger, smaller trees (Hill-Forde 2004). Also, ash stands

on higher, drier sites are usually in better condition than lower wetter stands (Hill-Forde 2004). Hill-Forde (2004) reported interannual variability in die-back in Nova Scotia populations of Black ash, with improvements in dieback up to 30% of affected trees between 2001 and 2002. Given the marked improvements among years, this suggested at least a proportion of die back in Nova Scotia can be attributed to interannual variation in environmental conditions, such as weather or moisture levels.

The species is susceptible to ash yellows caused by *Candiatus phytoplasma fraxini* (French et al., 1989) that can result in crown dieback (Griffiths et al., 1999). *F. nigra* is also susceptible to leaf anthracnose caused by *Gloeosporium aridum*, cankers caused by *Nectria galligena*, oystershell scale caused by *Lepidosaphes ulmi*, trunk rot caused by *Stereum murrayi*, butt rot caused by *Armillarea mellea*, and spongy white rot caused by *Polysporus hispidus* (reviewed in Wright and Rauscher, 1990).

vi. Craft Industry - Historically, Black ash was used for basketry, axe handles, canoe ribs, snowshoes, and other practical uses. These activities were expected to have negligible impact on Black ash populations in the past.

Presently, a small amount of Nova Scotia Black ash is selectively harvested for woodcrafts (including by some non-aboriginal people in recent years prior to listing under Nova Scotia's Endangered Species Act) and basketry. There is no information on the degree to which this occurs. It is expected that larger, healthier (straighter) mature trees may be targeted for crafting activities which may result in a decline in population health through high-grading, especially where trees of such qualities are highly limited (Erdmann et al. 1987). Some trees are deemed as inappropriate for basketry and may be marked in ways that are detrimental to tree health making it susceptible to disease and/or death.

Black ash strips and wood have been transported across provincial and international borders for basketry (Michelin 2013). In the last 50 years, Nova Scotia Mi'kmaq are known to have brought materials in from Quebec, New Brunswick and Maine (Mark MacPhail, pers. comm.). Such activities may be increasing due to the limited availability of Black ash and may contribute to the spread of Emerald Ash Borer. There are no data available to indicate the frequency of movement or the origin of materials.

vii. Transplanting– There is an increasing interest in planting native tree species in urban or suburban habitats. Similarly, many wild habitats are restored or enhanced using native species of trees like Black ash. Sometimes stock is derived from native seed, but the use of nursery stock from across Canada is also known to occur. Regulations to prevent the movement of nursey-derived endangered species by the greenhouse industry does not exist, nor is there an easy mechanism through which to communicate to all distributors and sellers. Commercial specimens may alter genetic diversity of native plants, take over native habitats displacing native species, and transport diseases or pests that

impact native species via the plant or its potting materials.

There are several known initiatives by Aboriginal groups and communities in Nova Scotia, Prince Edward Island and Ontario to propagate and transplant Black ash seedlings in parts of its native range, usually derived from wild seed but sometimes specimens are moved from their original locality. Often, however, trees are transplanted in more populated setting (e.g. parks or public spaces like band offices in Aboriginal communities) that are not as shaded and wet as those in which the species is naturally found. Although usually well intending, Often there is little consideration of the source of individual trees/seeds and limited awareness of conservation implications, especially from a genetic perspective.

viii. Climate Change – Black ash has been identified as a tree species that will decline with increasing climatic change. The global range of Black ash is expected to decline on average by 65.3% by 2100 under 5 different climate change modelling scenarios (Iverson and Prasad 2001; Iverson et al. 2011). In addition, models of projections of tree species changes based on future suitable habitat under climate change (USDA Forest Service, Prasad et al, 2007) have predicted that overall Black ash abundance will decline 29 to 64%. Changes in drought regimes can result in severe dieback where high water tables resulted in shallow rooting. Climate change is expected to magnify this effect (Prasad et al. 2007). The extent to which climate change has affected Black ash to present is unknown.

ix. Browsing by wild ungulates – White-tailed deer and other herbivores such as Snowshoe hares are known to browse Black ash seedlings and young trees. Anecdotal evidence indicates that herbivory is higher in areas with recent forest harvest, suggesting that this may be a threat in areas with higher or more extensive forestry activities. Unnaturally higher levels of herbivory as an indirect product of forestry practices, may be more detrimental to populations of Black ash that are stressed and occur in low numbers and densities. Little is known about the impact of browsing on Black ash in Nova Scotia.

1.7 Role of Mi'kmaq Knowledge in Black ash Recovery and Action Plan

Mi'kmaq knowledge held by community members across Nova Scotia can provide many insights that help guide management and planning initiatives in species at risk recovery, especially on cultural keystone species. Oral histories carry knowledge, experience and observations throughout multiple generations, helping to compose time series and trend information that often pre-date and/or fill-in knowledge gaps in contemporary scientific research. Many elders and resource users have remarkably detailed ecological observations from lifetimes spent on the land and on the water. This knowledge can build on and complement science in its findings. The respectful inclusion and the

meaningful participation of the Mi'kmaq can bring forth novel ideas and information that greatly enhance cooperative recovery planning and stewardship efforts.

1.8 Cultural Significance

The wood of Black ash has unique features that enable it to be pounded and peeled into thin strips. It is strongly ring-porous and easily bent, which make it ideal for basketry, barrel hoops, snowshoe frames and canoe ribs. It is also used for furniture, interior finish and as a veneer.

At present, in Nova Scotia and elsewhere, Black ash is harvested for basketry and for the creation of a variety of tools, although it was used more extensively in historical times (Hill-Forde 2004; Brasser 1975; DeMings 2008; Diamond 2009; Diamond and Emery 2011; Speck and Dexter 1951; Whitehead 1980; Benedict and David 2003; Benedict and David 2000, Fox and George N.D; Gesner 1849a). Interactions with known stands or trees are likely to be seasonal and newly encountered trees would be noted and investigated for future harvest if they met the specifications for basket wood. Unsuitable trees were marked with an axe, perhaps in a way that was harmful to the long-term health of a tree. Today, only 1-20% of trees are suitable for basket-making (Hill-Forde 2004; Benedict and Frelich 2008; Diamond 2009). Benedict and Frelich (2008) describe an appropriate tree as a minimum diameter at breast height (dbh) of 12.5 cm (~ 5 inches), minimum length butt log of 2 m that is relatively free of structural defects, and 20 years of ring growth with a minimum ring width of 2 mm.

It has been suggested that prior to 1712, the Mi'kmaq constructed baskets from small diameter branches of Witherod, Yellow birch, Elder and Willow (Whitehead 1980) and that "The splint basket industry reached the Penobscot and Malecite shortly after 1840, and it was slowly spreading among the Nova Scotia Micmacs in the 1860's" (Brasser 1975). It is not known if this is also the pattern of use in other areas of the species' distribution. Although ATK derived from basketry may be limited to the last 250 years, it is likely that Aboriginal peoples held some knowledge of the tree prior to then.

1.9 Actions Already Completed or Underway

Some progress has been made towards several objectives and actions identified in the Recovery and Action Plan. Specific actions to meet objectives are described in "3.1 Actions Completed or Currently Underway" and summarized in Table 3.

1.10 Knowledge Gaps

Although Black ash is native to Nova Scotia and the species has been used for a lengthy period by the Mi'kmaq, little information about its population size, trends and habitat is available. Comprehensive and verifiable records are still needed to assess the distribution and abundance of Black ash in Nova Scotia; reports have been mostly incidental and surveys have not been standardized using a consistent protocol, nor in most cases, georeferenced. Existing records need to be verified, accurately georeferenced and compiled within a single database that is accessible to all partners involved in recovery. Black ash habitat has not been described in a Nova Scotia context and the preferred habitat is unclear. Anecdotally, it appears that Black ash occurs in two habitat types within the province, wooded swamps and floodplains. Growth and wood quality is reported to vary by habitat, with some habitats reported to produce better quality splints than others.

It is unclear whether Black ash was once more abundant in Nova Scotia than it is at present and speculation varies. A concerted effort to access and include Mi'kmaq Ecological Knowledge in future assessment and recovery processes may shed light on historic abundance, distribution and changes in threats over time, and assist in establishing an appropriate baseline for a viable population that also supports sustainable use for future generations.

Although there has been efforts to plant Black ash throughout the province, in part to rekindle the cultural connections with this species, it has been done in the absence of considering the genetic implications of those activities. Metapopulation genetics is lacking throughout the range of the species and could provide answers to questions surrounding resilience of NS populations, survival and lack of reproductive vigor.

2. RECOVERY

2.1 Rationale for Recovery Feasibility

Recovery for Black ash can be considered feasible if four criteria are met (Government of Canada 2009). At present, it is unknown if the potential threat of Emerald Ash Borer can be avoided or mitigated; however this threat is, as of yet, unrealized and research into methods of control are ongoing. Inoculation is proving successful and would likely be an effective form of control in a province with relatively few seed-bearing trees.

1) Individuals are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance – YES

2) Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration - YES

3) The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated – YES for most threats, UNKNOWN for Emerald Ash Borer

4) Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe – YES. If it is necessary to resort to transplanting, rather than to rely on natural reproduction and dispersal, propagation techniques exist and some seed and genetic material exist in storage.

2.2 Long-term Recovery Goal (> 20 years)

The long-term recovery goal (>20 years) for Black ash in Nova Scotia is to ensure that conditions allow for the restoration of self-sustaining and ecologically functioning populations within Nova Scotia, and that those populations support sustainable use by the Mi'kmaq and others according to the principles of Netukulimk.

Black ash populations are small with few seed-bearing trees, and there has been limited effort to verify and monitor existing trees. In the absence of baselines, it is not possible at this time to further quantify the recovery goal.

2.3 Short-term Objectives

The short-term recovery objectives (< 5 years) are:

Objective 1 - Ensure that stakeholders and rights holders are aware of Black ash ecology, identification, management and recovery
Objective 2 - Mitigate threats (where possible) that limit recovery
Objective 3 - Initiate research to address priority knowledge gaps
Objective 4 - Maintain, protect and enhance the current population and distribution
Objective 5 – Protect core habitat and seed-producing trees

The strategic recovery objectives in this plan are to restore self-sustaining and ecologically functioning populations of Black ash within Nova Scotia that support sustainable use. More specifically, over the short-term, the objectives are to compile existing information and address biological knowledge gaps needed to develop effective measures of threat mitigation and to identify key local populations of Black ash. To accomplish this, there is a need to develop outreach materials, establish standardized protocols to assess species records, research measures that prevent or eliminate Emerald ash borer or re-establish Black ash through propagation, and to facilitate and encourage stewardship.

An action plan which details the progress made and work to be done for each recovery objective is outlined in Section 3.0.

2.3.3. Discovery and Ongoing monitoring

2.4 Approaches Recommended to Meet Recovery Goals and Objectives

2.4.1 Broad strategies over the short and long term

Recovery of Black ash will involve an integrated approach involving private land owners, government, Mi'kmaq and ENGOs through application of a variety of tools, techniques and perspectives that can positively affect recovery. The recovery team should adopt a process that integrates information, management, stewardship, education and evaluation

Mi'kmaq communities have maintained local ecosystems for generations through the use of Mi'kmaq Ecological Knowledge. It is important to maintain a positive relations so that the best available information from all sources can be accessed and used for ecosystem protection and recovery. Mi'kmaq Ecological Knowledge and Science can, together, better inform assessment, monitoring, and recovery of the ecosystems that support specific species at risk.

2.5 Performance Measures

Performance measures used to determine whether Black ash recovery objectives (see Section 2.3) are being met are shown in Table 2.

Table 2. Performance measures used to determine whether Black ash recovery objectives are being met.

Performance Measure	Objective No(s).
Planning:	
Two meetings annually to discuss recovery objectives and activities	1-5
One or more meetings annually to inform Mi'kmaq chiefs on progress and to discuss matters as needed	1-5
Number of initiatives and groups involved in delivering conservation messaging	1-5

Conservation:	
Number and type of communication products that target general public, Mi'kmaq communities, and foresters	1,2
Area of habitat protected (or destroyed)	5
Number of new Black ash records	1,3,4
Number of seed-bearing Black ash trees	2-5
Research-related objectives will be considered success when at least one study has been completed to address each of the knowledge gaps and when results are used to guide recovery	1-3
Number of protection measures in place	5

2.6 Core Habitat

Black ash in Nova Scotia presents a challenge in the identification of core habitat, generally because it is wide-ranging, rare and mostly of poor health in terms of growth and disease. Most trees are small, stunted and do not produce seed (and are unlikely to do so), and typically have not been inventoried by foresters. At present, information on distribution and preferred habitat in the province is limited, and will take several years to address. These factors, plus a lack of clear understanding as to what is necessary to recover the species suggest that there is currently insufficient information to provide a complete definition of core habitat, although a more complete definition may be possible in the future.

Additionally, Black ash may have a significant, but as of yet unrealized threat, with the northeastward movement of Emerald Ash borer in Canada (currently near Montreal, Quebec and within 30 miles of the Maine Border). Given the rate of spread since the discovery of Emerald ash borer in Windsor, ON in 2002, it is probable that the invasive beetle may reach Nova Scotia within the next 10 years (or less). Should this threat reach Nova Scotia, the conservation of Black ash habitat, will not necessarily ensure the persistence of the species over the short-term.

This core habitat definition involves three types of trees: 1) mature trees that are capable of bearing seed, 2) young native trees that are not yet capable of reproduction, and 3) silviculture trees. On an interim basis, mature trees are those that show evidence of seed production. In the future, this will be modified to provide a suite of characteristics (e.g. dbh) that also include trees that are capable of reproducing, but have not produced seed. Silviculture trees are those that have been transplanted after being artificially propagated.

On an interim basis, the definition of core habitat needs to balance the immediate need for Emerald ash borer management and the long-term need for core habitat to support species recovery. To this end, it is recommended that individual seed-bearing trees be protected with a 150m buffer from forest harvest and industrial activity that may harm the tree or its surrounding habitat. Long distance dispersal distances for ashes is up to 150 m in the direction of the prevailing winds (e.g., Schmiedel et al. 2013), so the buffered area should support recruitment if it occurs and maintain localized habitat conditions. Given the proximity of some of these trees to streams and wetlands, some consideration should be also given to the maintenance of watercourses near seed trees.

To prevent net loss of individual Black ash trees (non-seed-bearing trees), activities that may result in mortality (e.g. forestry, road construction, infilling of swamps) should plant replacement trees in suitable relatively undisturbed habitat. Replacement rates should be related to seedling survival (e.g. transplant 5 seedlings to 1 lost tree). Benedict (2003) suggests that the desired plant density at emergence in 30 to 45 plants/m^2 or 10 to 15 seedlings/ft^2. Seedlings should be planted 3 to 4.5 m (10 to 15 ft) apart for reforestation and basket materials projects.

Ex situ planting of Black ash will be coordinated through the recovery team and provincial government in cooperation of the Mi'kmaq. Existing ex situ plantings will be considered experimental stands and be used to evaluate propagation techniques and to explore habitat tolerance. These plants will be exempt as core habitat.

2.7 Effects on Other Species

Black ash seeds are consumed by song birds, game birds, wood ducks, and small mammals. Black Ash is also food plant for the larvae of several species of Lepidoptera.

White tailed deer and moose browse black ash leaves, branches and twigs (Burns and Honkala 1990) and the species can tolerate heavy clipping (Erdmann et al. 1987). The bark of young trees is occasionally used as food by beaver, porcupine, and rabbits. Beavers are known to cut down larger black ash in areas where poplar is sparse.

3. ACTION PLAN

3.1 Actions Completed or Currently Underway

Table 3. Summary of progress to date on actions identified in the Recovery Plan for Black ash (*Fraxinus nigra*) in Nova Scotia.

Action Item	Progress to date	Status
Objective 1 - Ensure that land and resource users are aware of Black ash ecology, identification, management and recovery		
1.1 Develop outreach products on the identification, conservation status, conservation mechanisms and management of Black ash	Numerous products exist or are in the process of being completed on the identification and status of Black ash in Nova Scotia. Examples include: Wisqoq in Mi'kma'ki Colouring Book (Mi'kmaw Conservation Group - MCG), Identification pamphlets (First Nations Forestry Program), Black ash poster (MCG), Awakenings Book (Confederacy of Mainland Mi'kmaq), Webpage with biology, info on threats & link for reporting sightings (initiated; funded via Prevention Fund), Basket maker interview videos (MCG; need permission to share for other purposes), Education modules compatible with NS curriculum (MCG)	Partly completed; Ongoing – limited material available on conservation mechanisms and management; information for resource users on identification needed
1.2 Develop outreach products on the identification, assessment and management of dieback and Emerald ash borer	Some minor mention of Emerald ash borer in recent products of Mi'kmaw Conservation Group. More comprehensive documents, especially on preventative management need to be produced.	Not yet underway
1.3 Establish a Mi'kmaq Code of Practice that allows for sustainable use of Black ash	Preliminary discussion occurred during recovery plan development, but thorough discussion of action has not yet taken place.	Not yet underway
1.4 Facilitate and encourage a) knowledge-sharing across generations and sectors, b) training, and c) mentorship of future	The involvement of youth and elders common practice in some Mi'kmaw communities, but not yet commonplace with regards to Black ash recovery	Not yet underway

generations of stewards		
1.5 Develop Communications plan with standard messaging for all partners		Not yet underway
Objective 2 - Initiate research to address priority knowledge gaps		
2.1 Determine historic and current black ash occurrence across Nova Scotia	Records for current and historic locations of Black ash are located in several databases, although data may not be complete, nor specimens verified as to species	Partly completed
2.2 Identify the Silvical characteristics of Nova Scotia Black ash and its habitat to develop a predictive spatial model		Not yet underway
2.3 Assess genetic diversity of Black ash in Nova Scotia		Preliminary study – Not yet underway
2.4 Determine and assess all historic and contemporary threats	In some cases, threats are identified for individual records. Hill-Forde (2004) identifies some current and some historic threats.	Ongoing
Objective 3 - Mitigate threats (where possible) that limit recovery		
3.1 Develop and implement management tools and policy to prevent the spread of Emerald ash borer to Nova Scotia and protect Black ash		Not yet underway
3.2 Document and monitor transplanted Black ash to learn about effectiveness of techniques and inform propagation methods for Nova Scotia	Numerous Black ash transplants occurs across Nova Scotia, many are in known locations. Some monitoring currently occurs using different monitoring regimes. Some information is anecdotal in nature.	Not yet underway
Objective 4 – Maintain, protect and enhance the current population and distribution		

4.1 Compile existing information on Black ash into a single database		Not yet underway
4.2 Develop species verification and data collection process for existing and new records		Not yet underway
4.3 Identify key local populations of Black ash across its native range and maintain them through stewardship programs	Locations of some trees and clusters of trees are already known and georeferenced	Not yet underway
Objective 5 – Protect core habitat and seed-producing trees		
5.1 Identify native seed-bearing Black ash and maintain them through stewardship programs	Locations and ownership of properties with seed-bearing trees are mostly known	Not yet underway
5.2 Investigate methods to protect seed-bearing trees from Emerald ash borer		Not yet underway

3.2 Priority Tasks and Actions

The actions and tasks affiliated with each recovery objective and their associated steps, rationale and deliverables are described in Table 4. Priority tasks, that is those to be completed in the next five years and their associated costs are identified in the action table listed under each task.

Table 4: Description and rationale for actions and tasks needed to achieve Recovery Objectives.

Objective 1 - Ensure that stakeholders and rights holders are aware of Black ash ecology, identification, management and recovery
Action Description and Rationale
Black ash is difficult to identify, rarely receives attention from the forest industry because of its low economic value and rarity on the landscape, and is relatively unknown by the Nova Scotia public. Lack of awareness is detrimental to the survival of the species and to date, there have been little outreach beyond Mi'kmaw communities. Given the species mostly occurs on private lands and is of high significance to the Mi'kmaq, the development and maintenance of productive, healthy relationships with landowners, resource used and the Mi'kmaq is essential.

Specific Steps			
Action	Tasks	Highest Priority	Cost[1]
1.1 Develop outreach products on the identification, conservation status, conservation mechanisms and management of Black ash	Prepare outreach material for foresters and other industries	√	$
	Prepare outreach materials for the Nova Scotia public	√	$
	Prepare outreach materials for Mi'kmaw communities	√	$
1.2 Develop outreach products on the identification, assessment and management of dieback and Emerald ash borer	Prepare outreach material for foresters and other industries	√	$
	Prepare outreach materials for the Nova Scotia public	√	$
	Prepare outreach materials for Mi'kmaw communities	√	$
1.3 Establish a Mi'kmaq Code of Practice that allows for sustainable use of Black ash	Host workshops in Mi'kmaw communities to discuss best practices for harvesting and using Black ash in the context of recovery goals and objectives	√	$$
	Produce a manual in English/French and Mi'kmaq highlighting best practices for harvesting and using Black ash		$$
	Consider a certification system that certifies Mi'kmaq handicrafts that arise from sustainable		$

[1] Estimated Cost: $ - $10,000 or less, $$ - $10,000-20,000, $$$ - $20,000-50,000, $$$$ - $50,000-100,000, $$$$$ - > $100,000

	practices that support recovery		
1.4 Facilitate and encourage a) knowledge-sharing across generations and sectors, b) training, and c) mentorship of future generations of stewards	Involve youth in Black ash recovery activities	√	$
	When sharing Mi'kmaq Ecological Knowledge for Black ash recovery, ensure that youth and elders (among other age stages) are present	√	$
	Provide opportunities to train youth in conservation activities	√	$
	Provide mentorship opportunities during recovery activities	√	$
1.5 Develop Communications plan with standard messaging for all partners	Host discussion with Nova Scotia Mi'kmaq chiefs and communities to determine what is acceptable harvest for food, social, ceremonial purposes.	√	$
	Prepare a communications plan that includes key facts about Black ash, major needs to accomplish recovery and common messages for all partners	√	$

Deliverables

- Communications strategy for use by partners
- Media articles and interviews
- Mi'kmaq Code of Practice identifying best practices
- Increased reporting of Black ash
- Educational materials on Black ash
- Educational materials on Emerald ash borer

Links to Recovery Strategy
• Raise public awareness • Engage partners in recovery activities • Engage landowners in stewardship of Black ash and its habitat • Decrease incidental take due to failure to identify species • Improve knowledge on distribution and habitat
Threats addressed
Historic Overharvest & Incidental Take
Audience and partners
Target audience: public (including youth), partners, industry Partners: Nova Scotia Government, Industrial forest companies, private land owners, Mi'kmaw organizations and groups, ENGOs, hunting and recreation organizations

Objective 2 - Initiate research to address priority knowledge gaps

Action Description and Rationale

Other than some records of individual, or small clusters, of Black ash trees, there has not been a comprehensive inventory, nor has there been significant effort to describe the species and its life history characteristics in Nova Scotia. It is unknown if Black ash has unique attributes or habitat considerations in the province relative to the rest of its global range, which makes it difficult to identify effective steps to enhance and preserve a viable population of the species without inventory and habitat descriptions. At present, it is also unknown what the desired baseline for recovery would be.

There is preliminary evidence that the Nova Scotia population of Black ash may be less genetic diverse than the nearest populations in New Brunswick, but the impact on long-term persistence in the province is unknown. The Nova Scotia population has retained high levels of heterozygosity, but has lost some of the less common alleles due to its small population size (Simpson et al. 2008). It is plausible that introducing trees from other parts of the range may be beneficial by improving genetic diversity, but data are insufficient to assess this need.

Although evidence is sufficient to identify significant threats, little is known about how these threats will behave in time and space, or synergize with one another, because there has been little comprehensive or standardized assessments of threats to date.

Specific Steps

Action	Tasks	Highest Priority	Cost**
2.1 Determine historic and current black ash	Develop a predictive model that identifies habitats with a higher likelihood of Black ash presence	√	$$

occurrence across Nova Scotia			
2.2 Identify the silvic characteristics of Nova Scotia Black ash	Prepare habitat description, including plant community, soil type	√	$$
	Describe biological characteristics of Black ash in Nova Scotia, including reproductive rates, growth rates, growth forms by habitat.	√	$$
2.3 Assess genetic diversity of Black ash in Nova Scotia	Assess genetic diversity of Black ash in Nova Scotia, including relationship with geography (local vs. province vs. global range) and habitat (wetlands vs. floodplains)		$$-$$$
2.4 Determine and assess all historic and contemporary threats	Assess impacts of forestry practices		
	• Assess the impact of cutting in buffer/riparian zones	√	$
	• Determine extent and assess impact of targeted harvesting vs incidental take	√	$
	Assess the impact of invasive alien species		
	• Monitor science related to rate and proximity of spread, early detection methods, and control of Emerald ash borer	√	$
	Evaluate rate and significance of die back		

• Assess inter-annual variability of die back		$
• Monitor rates of die back and general crown condition using standardized methods and identification of probable causes	√	$$
Assess and monitor impacts of minor threats, such as urban forestry and browsing,		$
Assess impact of climate change on Black ash		$
• Review literature for expected change in distribution and health		$
• Explore expected impact of climate change of threats, including Emerald ash borer		

Deliverables

- Predictive model and search sites
- Publications in refereed journals
- Review of threats and reassessment of impact
- Regular communication and timely updates to all recovery practitioners on results

Links to Recovery Strategy

- Improve knowledge on distribution and habitat
- Identify desired population size baselines/targets of recovery
- Gain knowledge on the quantity of suitable habitat for ex situ planting if required

Threats addressed
Habitat loss and alteration, Emerald ash borer, Climate change
Audience and partners
Target audience: Nova Scotia Government, recovery team, academics, research institutions, industry Partners: NS DNR, recovery team, others

Objective 3 - Mitigate threats (where possible) that limit recovery			
Action Description and Rationale			
Specific Steps			
Action	Tasks	Highest Priority	Cost**
3.1 Develop and implement management tools and policy to prevent the spread of Emerald ash borer to Nova Scotia	Consider and develop (if deemed appropriate) preventative EAB policy preventing wood and wood products from crossing provincial border	√	$$
	Provide signage and informative materials about the risks of transporting firewood and wood products across border	√	$
	Coordinate outreach and dialogue with garden centres and forestry planting businesses to prevent disease and pest transmission by moving plants about	√	$

3.2 Document and monitor transplanted Black ash to learn about effectiveness of techniques and inform propagation methods for Nova Scotia	Georeference and take baseline measurements of known transplanted saplings Identify optimal conditions for transplants based on growth and survival rates	√	$ $

Deliverables
• Database of transplant saplings, survival and growth • Policy reducing threat of emerald ash borer by managing transport of wood and wood products across provincial border • Best practices for Black ash propagation
Links to Recovery Strategy
• Evaluation of potential measures to mitigate or prevent significant threats from occurring in Nova Scotia
Threats addressed
Potential need for propagation in response to habitat loss and alteration, preventive measures to prevent or reduce Emerald ash borer in Nova Scotia
Audience and partners
Target audience: Nova Scotia Government, recovery team, Mi'kmaq communities, research institutions, industry Partners: NS DNR, recovery team, Mi'kmaw communities and organizations, other Aboriginal communities with experience in propagating and planting Black ash

Objective 4 - Maintain and enhance the current population and distribution
Action Description and Rationale
Data are incomplete and are located in multiple databases across government, agencies and community organizations. This precludes a complete analysis and evaluation of Black ash population health, preferred habitats and planting techniques. An initial priority is to compile all existing data into a single database that is accessible to all partners. This database will require the development of a standard research protocol to be used by all research partners. Access to the database will also require the establishment of data-sharing agreements. Known reports of Black ash need to be verified through a variety of means. Sites of public lands need to be visited to document plant health, silvic measures and habitat (description and threats). When unable to visit sites in person, photographs, GPS coordinates and leave/twig materials should be submitted. Routine sample submission should also be considered as a means of collecting samples for genetic analysis.

Protections under the Nova Scotia Endangered Species Act should be implemented as soon as possible with the provided definition of core habitat for Black ash, with consideration to young trees, mature trees (those that may be capable of reproducing sexually, but have not necessarily done so), and those that are seed-bearing.			
Specific Steps			
Action	Tasks	Highest Priority	Cost**
4.1 Compile existing information on Black ash into a single database	Establish data-sharing agreements across partners, including access to the Atlantic Conservation Data Centre	√	$
	Compile existing and new data into a single data management system based on variable within standardized research protocol	√	$
4.2 Develop species verification and data collection process for existing and new records	Evaluate methods of verifying species records, including the submission of photos and leaf samples (that can also be used as genetic samples).	√	$
4.3 Conduct inventory and monitoring to document new locations and track health, resilience and reproduction.	Complete records for existing species reports and newly reported trees, especially geo-referencing and species verification	√	$$
4.4 Maintain all trees through stewardship and with site protection of seed producing trees.	Implement core habitat protection to protect seed producing trees	√	$-$$
	Develop best practices to ensure persistence of Black ash on private lands and start to liaise with landowners		$

Deliverables
• Database of transplant saplings, survival and growth • Policy reducing threat of emerald ash borer by managing transport of wood and wood products across provincial border • Best practices for Black ash propagation
Links to Recovery Strategy
• Evaluation of potential measures to mitigate or prevent significant threats from occurring in Nova Scotia
Threats addressed
Potential need for propagation in response to habitat loss and alteration, preventive measures to prevent or reduce Emerald ash borer in Nova Scotia
Audience and partners
Target audience: Nova Scotia Government, recovery team, Mi'kmaw communities, research institutions, industry Partners: NS DNR, recovery team, Mi'kmaw communities and organizations, other Aboriginal communities with experience in propagating and planting Black ash
Objective 5 – Protect core habitat and seed-producing trees
Action Description and Rationale
Given the rarity and small population size of Black ash and that only a few seed-bearing trees are known, protection of mature trees is essential to ensuring the species persists within Nova Scotia. Seed-bearing trees have been identified as a critical life history stage to recovery and are a key component of core habitat. Only twelve seed-bearing trees are currently reported in provincial Black ash records, however, there are anecdotal records of more (not exceeding 40). Inventory of these trees must be completed and land ownership determined. Some of those trees occur on provincial or federal crown lands, but most occur on private lands where good stewardship will be vital to protect the trees. Seed-bearing Black ash should be protected by core habitat with a 150 m conservation zone that corresponds with seed dispersal patterns. Ideally, all mature trees would realize this same degree of protection; however, at present, neither science nor Mi'kmaw Ecological Knowledge does not permit us to distinguish a mature non-seed bearing tree from a young immature tree, and trees can produce seed at relatively small sizes. Further, young trees are difficult to identify to species and it is unclear whether small trees are mature but unhealthy and stunted. The relationship between size, tree characteristics and reproduction needs further study. Protection measures must further be resolved through consultation 1) to determine what activities, such as those associated with food, social or ceremonial practices by the Mi'kmaq should be permitted and in what locations, and 2) whether 'orchard' trees planted on reserve land require protection. Protection measures much consider

young trees, mature trees/seed bearing trees and orchard trees with the protection of young trees achieved through Special Management Practices.

Specific Steps			
Action	Tasks	Highest Priority	Cost**
5.1 Identify native seed-bearing Black ash and maintain them through stewardship programs	Complete inventory of seed-bearing trees and determine land ownership	√	$
	Identify priority seed-bearing trees for stewardship programs	√	$
5.2 Investigate methods to protect seed-bearing trees from Emerald ash borer	Liaise with researchers working with Emerald Ash Borer	√	$$
	Evaluate effectiveness and feasibility of inoculation against Emerald Ash Borer for seed-bearing trees	√	$
5.3 Develop and implement management tools and policy to protect Black ash	Endorsement of a Black ash Recovery Team by Nova Scotia Government and Mi'kmaq	√	$
	Nova Scotia Government, in conjunction with Nova Scotia Mi'kmaq chiefs, to determine parameters and exclusions around permitting for aboriginal food, social or ceremonial purposes	√	$
	Develop Special Management Practices to identify allowable activity around young trees, mature trees, seed-bearing trees and Black ash orchards	√	$

Deliverables
• Inventory of seed-bearing trees • List of landowners with known seed-bearing Black ash on their properties • List of seed-bearing trees needing priority protection
Links to Recovery Strategy
• Evaluation of potential measures to mitigate or prevent significant threats from occurring in Nova Scotia
Threats addressed
Preventive measures to prevent or reduce Emerald ash borer in Nova Scotia
Audience and partners
Target audience: Nova Scotia Government, recovery team, Mi'kmaw communities, research institutions, industry Partners: NS DNR, Parks Canada, landowners as potential stewards, recovery team, Mi'kmaw communities and organizations

3.3 Benefits of Implementing This Action Plan

Implementing this action plan will have positive immediate benefits for the Nova Scotia public, some land users, partners and the Mi'kmaq, as rights holders. Positive impacts include direct economic benefits (e.g. increased revenue for research institutions), indirect economic benefits (e.g. skills development for those individuals and organizations involved in research projects), as well as social benefits. Over the longer term, populations of Black ash may be enhanced so that they support viable industries for tools, basketry, custom sawmilling, art carvings, furniture production, and ecotourism, all opportunities that recently existed within the Atlantic region.

The recovery measures outlined in this document are expected to positively impact ecological integrity in the region by encouraging stewardship and sustainable management. There is also some value associated with the mere existence of the species within the province (existence value), or to maintaining the species for use by future generations even if the use is not yet clear (option value).

Black ash is a cultural keystone species that play a unique role in shaping and characterizing the identity of the Mi'kmaq who rely on them. Not only is the species crucial for providing necessities of life (e.g. income, fuel, medicine, tools), it is also embedded in the cultural traditions, stories, songs, and discourse of the Mi'kmaq. Maintaining Black ash in Nova Scotia and sustaining long-term use by the Mi'kmaq also supports the persistence of Mi'kmaq culture.

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