Change over Time in the Abundance and Distribution of Black Ash in Nova Scotia: Effects on Mi'kmaq Traditional Use, and Recommendations for the Best Germination Technique for Province Wide Replanting Programs

by

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Dedication Page

This thesis would not have been possible without the unending support of my family, friends and my committee.

To my committee, thank you for your patience, understanding, nurturing and the sharing of your knowledge and experiences through this process. I will be forever grateful.

Thank you to Grand River Post Secondary and Confederacy of Mainland Mi'kmaq for their generous financial support.

Thank you to my mother and father who were more than once, subjected to yet another thesis based tirade. You helped me keep my sanity and if it was not for your support, I may have given up long ago. Thank you for being my inspiration.

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And to my husband who stood by my side and cheered with me through the accomplishments and handed me a spoon for the ice cream on the bad days. You were a wonderful support, I love you.

You may encounter many defeats, but you must not be defeated. In fact, it may be necessary to encounter the defeats, so you can know who you are, what you can rise from, how you can still come out of it. – Maya Angelou

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Abstract

Black Ash (*Fraxinus nigra* Marsh) (Angiospermae: Oleaceae) is located throughout the Province of Nova Scotia in riparian habitats and is the preferred species of tree for splint basketry. Black ash has been used in basket making and in the production of many other items such as furniture and barrels. The utilization of this species for material goods combined with habitat loss due to agriculture and residential/commercial development, has led to its current state in Nova Scotia. This reduction in black ash population has affected Mi'kmaq basket makers' use of black ash, but has not curtailed basket making. The craft of Mi'kmaq basket makers continues to evolve through their use of other species of wood.

Three methods of germinating black ash, including tissue culturing of excised black ash embryos, propagation of stem cuttings, and double stratification were analyzed for their suitability in the re-planting of black ash in the province. Tissue culturing of excised black ash embryos was found to have the highest success rate and the lowest cost per tree, making it the most suitable method for a province wide replanting effort in Nova Scotia

Chapter 1: Nova Scotia, the Mi'kmaq and Black Ash

1.1 Introduction

Black ash (*Fraxinus nigra* Marsh.) (Angiospermae: Oleaceae) has been used for basket making by Mi'kmaq since splint basketry began in the late 1800's, and perhaps earlier (Whitehead 1980). As basket making moved from the production of boxes and bags from birch bark and reeds to splint baskets, black ash became one of the most important source materials (Whitehead 1980, Prins 1996). The anatomical characteristics of black ash make it highly desirable for basket making when soaked and pounded, black ash splits easily into layers along the annual rings. These layers can then be further separated into individual annual layers that maintain their strength and pliability. The dimensions of these strips are determined by the basket maker and depend on the desired type of basket (Basket Maker Interview 2003).

Life for the Mi'kmaq changed radically after European contact. As the Mi'kmaq in Nova Scotia adapted to their new cohabitants, the making of baskets became one of the Mi'kmaq means of financial support. Today, basket making remains as not only a means of monetary gain but as an important part of Mi'kmaq material culture. Black ash, however, is scarce today in Nova Scotia. Less than 400 trees have been located in the Province to date. Although black ash is no longer available locally for basket production, basket makers have improvised with the use of other species such as *Fraxinus americana* (white ash) and through the importation of black ash from other regions.

In this study, forest inventories, oral interview, archival research and relevant secondary literature will be used to determine in as much detail as possible the past and present status of black ash. This research will aid in determining the current abundance and distribution of black ash in Nova Scotia; how it has changed since the late 19th century; the condition, comparatively, of current black ash in patches across Nova Scotia and various regeneration techniques for possible replanting programs. Finally, the abundance and distribution of black ash from late 19th century to present will be examined to determine the effects, if any, changes in abundance and distribution may have had on the Mi'kmaq of Nova Scotia.

1.2 The Mi'kmaq and Nova Scotia

1.2.1 Mi'kmaq Prior to Contact

Mi'kmaq are a member of the Algonquian-speaking First Nations of northeastern North America (Prins 1996). There are six traditional Mi'kmaq districts in what is today known as Nova Scotia (Figure 1).

Figure 1: Traditional districts of the Mi'kmaq in what is today Nova Scotia. (Prins 1996)

Prior to contact with Europeans, the lifestyle, harvesting, and migration patterns of Mi'kmaw people were centered on a natural cycle with the earth. The lifestyle of the Mi'kmaq can be characterized as nomadic. Ten of the twelve months per year were focused on acquiring aquatic resources (Dickason 2002). Time was spent next to rivers and the sea, in order to harvest resources such as salmon, cod and eels (Prins 1996). During the winter months, Mi'kmaq moved inland, to hunt for such species as moose, caribou and bear. Once spring arrived, movement to the edges of lakes, rivers and oceans would allow the cycle to continue. Hunting, fishing and the gathering of eggs and berries all followed a defined cycle for subsistence. The only exception was the harvesting of extra goods for trade with other First Nations (MacLeod 1995). It was not in the best interests of the Mi'kmaq to gather more food and supplies than what was needed for the near future as storing and carrying large amounts of food would have impeded them in their movements (MacLeod 1995).

The nomadic lifestyle of Mi'kmaq supported a form of basketry. However, it was not splint baskets. Rather, baskets resembled bags, and were woven from roots and other plant fibers. These bags were used to transport and store items. Mi'kmaq prior to contact did not have any need for splint baskets, since they were not engaged in agriculture other than the growing of tobacco. Thus they did not need rigid baskets for planting or harvesting (McLeod 1995)

1.2.2 Change in the Landscape of Nova Scotia and Mi'kmaw Culture

Prior to contact, the Mi'kmaq had altered the environment of Nova Scotia, but their effects on the land were minor compared to subsequent European settlement where land was cleared for homes and farms, lumber and firewood were cut, and agricultural land for animal grazing and crops production was developed (Wicken 1994). Forest fire is a major cause of environmental perturbation, causing losses of both trees and ground cover. According to Johnson (1986), in the late 17th and late 18th century lightning started many forest fires. Nicholas Denys' accounts of 1672 documented large areas of forest being burned from lightning caused fires, yet it was also during this time that forest fires were deliberately set by the Mohawks to destroy Mi'kmaw hunting grounds during conflicts. The Mohawks were paid to set these fires by the British government (MacLeod 1995).

In the late 18th century, the diary of Simeon Perkins also documents the presence of many forest fires in Nova Scotia. In 1792, Perkins described forest fires burning across the forest, threatening businesses and homes. He mentioned in June of that year that fires spread across Herring Cove, Shelburne and River Jordan. It appears that fires were common, as they were sometimes mentioned in passing, along with the news of the day and the weather. The only time concern was noted was when forest fires came close to his home, threatening his livelihood (Perkins 1969).

Titus Smith's (1802a) surveys in the early 19th century also documented large areas of land burnt across Nova Scotia. Extremely destructive fires during this period resulted in the movement of families and businesses (Johnson 1986). These fires may have had an unexpected benefit however. With burning, fast growing intolerant species would have attracted such fur-bearing animals as hares, which may have lead to a population increase and thereby improved hunting (MacLeod 1995).

The arrival of Europeans and their exponential growth in population in the 19th century compared to existing populations of Mi'kmaq resulted in additional stresses on the environment. From 1815 to 1840, an estimated 40 000 new settlers arrived in Nova Scotia (Goldsmith 1980). Timber was cut, fires were set, land was cultivated, and the transfer from Europe to North America of new plants, animals and diseases, what is referred to as portmanteau biota, occurred (Crosby 1986). These changes posed a significant threat to the land's delicate ecological web, which affected the Mi'kmaw way of life (Upton 1975). The nomadic existence of the Mi'kmaq was interrupted. No longer would they be able to move freely throughout the landscape for hunting fishing and gathering as settlement encroached on their lands and limited their ability to remain nomadic.

In fact, the 19th century was a period during which landscapes in North America were beginning to be altered greatly. Settlers selected the prime locations, for example, near waterways for fishing and in order to harness the power of water for water mills (Upton 1975). Beyond Nova Scotia, in 1839 Henry Thoreau traveled the Concord River in New England and noticed vast changes in the landscape due to settlements being concentrated on the shores of rivers and coastlines. There was less aquatic life in the river, and fewer birds in these noisy newly settled areas were noted (Steinberg 1991).

The clearing of the forests for fuel and settlement in Nova Scotia also left room for early successional species to thrive, giving newly introduced plants and seeds the opportunity to establish themselves. In some cases this rendered native plant species extinct (Wicken 1994). This is highlighted in a session of the House of Assembly in the year 1848, when it was noted that " Indigenous roots once highly prized for food, have been destroyed by domestic animals" (Gesner 1848). Some additions of species to the ecosystem were accidental, while some were deliberate, such as the planting of apple trees (Wicken 1994). An example of such an accidental introduction of a species is was that of beech bark disease (*Cryptococcus fagisuga* Lind. and *Nectria coccinea* Lohm., Wats. &Ay.) (Rose and Lindquist 1997). Probably introduced to Nova Scotia from European nursery stock in the late 19th century, it was first reported during the 1920's and today affects nearly 80% of beech located in the Maritime Provinces (Johnson 1986, Rose and Lindquist 1997). This disease has ravaged this species, leaving affected wood useless except for fuel wood (Magasi 1994).

After contact, Mi'kmaq began to use the land and its resources to join the new economy introduced to them. Additional harvesting of resources, such as fur, provided enhanced opportunities for trade with the European newcomers. This new trade in fur allowed Mi'kmaq access to purchasing or trading for many of the new tools and materials brought by the Europeans (Dickason 2002). As Mi'kmaq put their efforts more on the fur trade, less time was spent on the traditional crafts, of tool making, basketry, net making, and hunting tool manufacturing (Davis 1991). In time, the actual practice, knowledge, and manufacturing of many traditional tools and materials became obsolete and/or forgotten (Devens 1992).

Even traditional women's work was realigned to satisfy the demand in the fur industry, as women assisted the men in the stretching and tanning of furs (Devens 1992, Prins 1996). Prior to the fur trade, men's work was primarily in the collection of game, with women tending the home, preparing food and hides and raising children. With the influx of hides for trade, women's responsibilities shifted to preparing these hides for trade or sale. The shift from tending the needs of the family and home, balanced itself in the fact that many of the items once prepared by the woman (i.e. clothing) were now obtained through the trading of furs (Devens 1996).

The thriving trade in some furs had a detrimental effect, though, on the fur bearing animals such as beaver and moose populations with moose becoming rare by 1800 (MacLeod 1995). By 1850, the tremendous demand for animal pelts in Europe declined, and the once lucrative North American fur trade industry came to an end. (Conrad et al 1992) The resulting loss of trade for the Mi'kmaq forced many to move to seasonal labor and to work as hunting and fishing guides to support themselves (Conrad et al 1992, Prins 1996).

1.2.3 Early Forestry in Nova Scotia

Settlers needed forest resources. Logs were needed for the building of homes, barns and ships, as well as fuel. Lumber was also utilized for export (Clark 1968; Goldsmith 1980). Settlers were drawn early on to areas along bodies of water. Shipment of timber began from the province to Europe and in 1728, the government implemented policies, such as the Broad Arrow Policy to protect certain species of trees (Goldsmith 1980, Johnson 1986). Mi'kmaq, however, were not pleased at this new trade which was relying on their hunting grounds to support itself. To show their detestation of logging and possibly halt timber harvesting in that area, Mi'kmaq in 1749 attacked woodcutters in Chebucto (Webster 1991). However, the logging continued. In 1808, timber supplies were terminated from the Baltic States to Europe due to the Napoleonic Wars. European demand in turn, focused on North America for its needed supplies, including forests of Nova Scotia (Goldsmith 1980). By the end of the 19th century, settlement and the accompanying forest removal had resulted in the destruction of much of the forest and wild game populations. According to Webster (1991), some Mi'kmaq began the movement towards agriculture for survival; by 1871, several reservations had been established in Nova Scotia for the promotion of such ventures and to aid in the assimilation of the Mi'kmaq into Euroamerican society (Prins 1996).

Settlement had an impact on forests not only in Nova Scotia, but across North America. Jackson et al (2000) found through comparing historical and present day information in Ontario that there had been a significant reduction in the amount of yellow birch, balsam fir and eastern white cedar. Betts and Loo (2002) also found a decline in tolerant hardwood species and eastern white cedar since settlement in New Brunswick.

By the late 1800's, forestry had begun to move away from sawmill production to pulp and paper production (Donaldson 1961). In 1885 the first pulp and paper mill began production in Sheet Harbour, Nova Scotia (Johnson 1986; Coady 1988). At this point, not only were the forests of Nova Scotia being drawn upon for lumber and fuel wood, but for pulp and paper production as well with the favored method of harvesting for pulp and paper being clearcutting (Goldsmith 1980). Pulp and paper production and timber harvest continued into the 20th century, with increased demands during the First and Second World Wars.

1.3 Black Ash in Nova Scotia

1.3.1 Habitats and Distribution

Black Ash prefers poorly drained, organic soils and is most commonly found along streams and in river estuaries (Lees and West 1988). In the Maritimes the species is either found singularly or in small groups but not in homogenous stands as in Quebec (Tardif 1996).

The native range of black ash in Canada extends from Newfoundland to southeastern Manitoba (Burns and Honkala 1990). It is also located in eastern North Dakota, Iowa, southern Indiana, Ohio, West Virginia, Delaware, Maine and New Jersey (Harlow and Harrar 1979; Trial and Devine 1996). In Nova Scotia, black ash is found scattered from Digby and central Lunenburg counties, upward to Northern Cape Breton and rarely elsewhere (Roland and Smith 1969). Nova Scotia now also includes Fallgold, a seedless cultivar of black ash which has been excluded from this thesis.

1.3.2 Phylogeny

Black Ash belongs to Oleaceae (the Olive Family) and is native to North America and migrated to Asia. In Asia, black ash speciated southward into *Fraxinus mandischurica* (Manchurian ash) and westward into *Fraxinus excelsior* (Eruopean ash) (Jeandroz et al. 1997). Within the ranges of these species sympatric hybrids can occur (Jeandroz et al. 1997). An example of this hybridization was noted in Cumberland county in which one site contained what appeared to be hybridized black ash trees.

1.3.3 Morphology

Black ash is a tree of medium size, reaching a maximum height between 15 and 20 meters (Grimm 1962). The leaves are long, opposite and compound, roughly 30 to 40 cm in length and contain seven to eleven sessile, serrate leaflets 10.2 to 12.7 cm long and 3.8 cm wide (Farrar). Located along the base of leaflets are rachis tomentose (tufts of rust coloured hairs) (Muenscher 1946). These tufts can aid in distinguishing black ash from other species of ash which do not form rachis tomentose. The bark of black ash is greyish in colour and is smooth to the touch when young but can become scaly/corky with age (Muenscher 1946; Harlow and Harrar 1979). Harrar and Harrar (1962) describes the bark as having "shallow fissures with interlacing scaly ridges". The twigs are stout and smooth, contain visible lenticels and flat nodes with dark, almost black buds (sometimes brown) forming oppositely on the twig (Muenscher 1946, Harlow 1962, Harlow and Harrar 1979). These twigs appear purple in colour on young black ash, becoming gray over time with age. Flowers appear prior to the leaves and are polygamous and can appear on separate trees or as perfect flowers in the same tree, with two stamens containing large purple anthers and purple stigmas (Harrar and Harrar 1962). Seeds or fruit are 2.5 to 5 cm in length, thin with an oblong wing and are somewhat flat (Harrar and Harrar 1962). According to Harlow and Harrar (1979) the root system is very shallow and fibrous.

1.3.4 Wood Anatomy

The narrow sapwood of black ash is a light white to light brown in colour with the heartwood having a greyish-brown to brown colour. The earlywood has large pores with a width of 2 to 4 pores with an abrupt transition to latewood with small pores (Wangaard 1981). According to Brown et al (1949) black ash parenchyma is "paratracheal, rarely paratracheal-confluent in the last summerwood, and terminal; sheath of paratracheal parenchyma around the summer-wood vessels uniseriate for the most part; terminal parenchyma fairly abundant, grading into the tissue of the succeeding ring not forming a distinct line." Brown et al (1949) also describes the rays as "unstoried, 1-3-seriate, homogeneous."

1.3.5 Reproduction

Flowers that are formed are inconspicuous. Both male and female flowers may be found in the same tree (perfect) or in separate trees (Saunders 1970). Black ash seed is broad and 2.5 cm to 4.6 cm in length (Brockman 1974). The section of the seed itself is flat and covered entirely by a flat broad wing and, in some cases, with the tip of the wing slightly notched (Hosie 1969). No remnants of the flower remain on the seed (Hosie 1969). Seeds ripen from June to September, and are released from July to October on the female parent tree (Schopmeyer 1974; Lees and West 1988; Burns and Honkala 1990). Seed can lie dormant on the forest floor for up to eight years before germinating (Erdmann et al 1987). Seeds production averages between 27.7 and 36.3 kg seeds/45.4 kg of fruit (Schapmeyer 1974).

Seed collected for the purpose of germination projects is put through a double stratification process. The seed is placed in layers of moist sand or peat and exposed to varying temperatures (from several weeks at warm temperatures to several weeks of cold temperatures) to mimic several growing seasons. The reason for this double stratification is due to the seed of black ash being both immature and dormant upon seed maturation (Smith et al 2000). Double stratification allows for the embryo to mature during the warm phase, followed by a period of cold stratification to allow for necessary metabolic mechanisms to occur for seed to leave its dormant state (Vanstone and LaCroix 1975).

Regeneration in black ash can also occur through sprouting from stumps or roots. Trial et al (1994) found that 69.4% of regeneration was through sprouting, 17.1% unknown and 13.5% from seed. Smith et al (2000) also successfully germinated black ash in culture media. Embryos were extracted from black ash seed from Manitoba. Through the germination of black ash seeds in culture media, germination was shortened from several years to less than one month (Smith et al 2000)

1.3.6 Insects and Disease

The Canadian Forestry Service has developed the National Forest Health and Biodiversity Database to catalogue the various insects, fungi and diseases that have been found to infect specific tree species in Atlantic Canada. Black ash is no exception, with a database providing the names of over 30 species of insects, fungi and diseases which have affected black ash. The following tables detail these species, the affected parts of the tree and the importance rating. Missing from the table is the single notation of a single tree affected by a virus and one tree affected by a mycoplasma like organism (MLO = yellow ashes).

Table 1: List of insect and mite species found on black ash (Fraxinus nigra Marsh) in the Maritimes from Canada's National Forest Health and Biodiversity Database (Hurley 2003, Smith 2003, Nystrom and Britnell 1994)

Taxon		Part of tree attacked	FIDS Importance Rating [1]
Insecta			
Acordulecera sp.	sawfly	leaves	D
Alsophila pometaria (Harr.)	fall cankerworm	leaves	B
Archips argyrospila (Wlk.)	fruit tree leaf roller	leaves	D
Archips cerasivorana (Fitch)	ugly nest caterpillar	leaves	C
Archips rosana (Linn.)	European leaf roller	leaves	D
Cecidomyia pellex O.S.	ash bullet gall midge	leaves	C
Choristoneura rosaceana (Harr.)	obliquebanded leafroller	leaves	D
Corythucha sp.	lace bug	leaves	D
Eupareophora parca (Cress.) = (*Pareophora minuta* (MacG.)	spiny ash sawfly	leaves	C
Gracillaria sp.	lilac leafminer	leaf miner	D
Hyphantria textor Harris	the spotless fall webworm	leaves	C
Malacosoma americanum F.	eastern tent caterpillar	leaves	C
Malacosoma disstria Hbn.	forest tent caterpillar	leaves	B
Operophtera brumata Linn.	winter moth	leaves	B
Papilio glaucus Linn. [Layberry et al. 1998)]	eastern swallowtail		
Papilio canadensis Roth. & Jord	Canadian tiger swallowtail		G
Periclista sp.	oak sawfly	leaves	C
Psyllopsis fraxinicola Forst.	ash psyllid	leaves	C
Sphinx drupiferarum J.E. Smith	wild cherry sphinx	leaves	C
Typocerus velutinus (Oliv.)	a longhorned beetle	stem	C
Acari			
Eriophyes sp.	eriophyid mite	leaves	C

1 A: most important, death or severe injury; B: moderate importance, intermittent or restricted injury; C: minor importance, not of concern; D: positive/helpful; G: Miscellaneous, of no concern (Nystom and Britnell 1994)

Table 2: List of fungal species found on black ash (*Fraxinus nigra* Marsh) in the Maritimes from Canada's National Forest Health and Biodiversity Database (Hurley 2003, Smith 2003)

Taxon		Part of tree attacked	FIDS Importance Rating
Apiognomonia errabunda (Rob.) Höhn. = (*Gloeosporium aridium* Ell.and Holw.)	anthracnose	leaves	B
Armellaria mellea (Vahl.:Fr.) Kummer	armillaria root rot	roots, stump sapwood	A
Daedalea unicolor (Bull.:Fr.) Fr. = *Cerrena unicolor* (Bull.:Fr.) Murrill	sapwood rot and canker	stem sapwood	A
Discula quericina (Westend.) Arx.[3]	leaf spot	leaves	B
Mycosphaerella effigurata (Schw.) House	leaf spot	leaves	B
Phellinus conchatus (Pers.:Fr.) Quel. = (*Fomes conchatus* (Pers.:Fr.) Gill.)	white spongy rot	branch stubs frost cracks heartwood	A
Phellinus igniarius (L.: Fr.) Quel. = (*Fomes igniarius* (L. ex Fr.) Kickx.)	white trunk rot	branch stubs frost cracks heartwood	A
Polyphorus versicolor L. ex Fr.	white spongy rot	branch stubs, dead wood	A
Puccinia sparganioides Ell. And Barth.	ash leaf rust	leaves branches	B
Valsa fraxinina Pk.	cytospora	branches	B

1 A: most important, death or severe injury; B: moderate importance, intermittent or restricted injury; C: minor importance, not of concern; D: positive/helpful; G: Miscellaneous, of no concern (Nystom and Britnell 1994)

Through surveys completed by the First Nations Forestry Program in Nova Scotia black ash has been known to be affected by anthracnose, heart rot, ice, hail and fall webworm as well as other unknown insects affecting foliage (Hudson 2003). Predators of black ash include song and game birds and wood ducks which eat black ash seed and white tailed deer and moose which browse black ash branches and twigs (Burns and Honkala 1990).

One disease which should be monitored in regards to future replanting programs in Nova Scotia is *Puccinia sparganioides* Ellis & Barth (Ash Rust). It is characterized by causing yellowish-orange spotting on the leaves, leaf disfigurement and death and the formation of galls on the twigs (Solomon 1993). This disease uses an alternate host of marsh grasses (*Spartina* sp.) during its lifecycle. Because of this, the disease is more concentrated in areas containing marsh grasses. According to Solomon (1993), this disease does not usually cause severe damage, but can lead to dieback and in some cases death if infection continues repeatedly.

A new potential threat to black ash has recently been discovered in Michigan and Ontario. *Agrilus planipennis* Fairmaire also known as the Emerald Ash Borer has been located and concern is growing about its effects on black ash and potential movement into eastern Canada as it causes great damage and death to branches thereby limiting foliage production, the Emerald Ash Borer should be a species of concern in Nova Scotia (Haack et al 2002).

1.3.7 Dieback

Dieback, according to Allen et al (1996), is the "the progressive dying, from the tip downward of twigs, branches, tops, or roots of plants." Trial and Devine (1996) suggested that a relationship exists between decline in black ash and the habitat in which it is located. This would include changes in the water levels and drainage (Trial and Devine 1996).

In a study completed by the Maine Forest Service in 1993, it was found that many black ash were also found in a serious state of decline (Trial and Devine 1996). However, upon reevaluation of these stands in 1994 and 1995, a marked improvement was noted in the black ash. The level of dieback had reduced through the falling of dead branches. It had been replaced by new growth, leading to a smaller yet healthier crown. Overall, dieback was followed by an increase in growth and overall improved health (Trial and Devine 1996). First Nations Forestry Association in Nova Scotia also noted when identifying and monitoring black ash that the majority of the trees were in a serious state of decline; but, no cause of decline has yet been identified (Hudson 2003).

Chapter 2: Black Ash in Nova Scotia: Current Condition, Changes in Abundance and Distribution and Causes and Related Effects on Mi'kmaw Basket Making

2.1 Abstract

Black ash has been located in nearly every county in the Province of Nova Scotia throughout the last two hundred years. Evidence of black ash abundance and distribution has been detailed through the examination of forest inventories, biophysical surveys and via interviews with a basket maker and Mi'kmaw community members. Black ash habitat has not changed, according to the information from forest inventories and natural/biophysical surveys available for the last 200 years; however, since the mid 19th century, black ash abundance has declined, causing concern among Nova Scotia Mi'kmaq. The leading cause of this decline in abundance appears to be due to cooperage (wooden barrel production) and related agricultural production destined for export. Examination of these variables and the black ash of Nova Scotia shows the avenue in which black ash abundance was reduced. Although cooperage is no longer a concern, action must still be taken immediately to halt the loss of black ash in order to ensure that this species will remain in this Province into the next century.

2.2 Introduction

Basketry was and is today an important part of the material culture of the Mi'kmaq of Nova Scotia. The art of basket making is not only a tradition that has been passed down through the generations; it has also been a significant means of securing income for many Mi'kmaq. Over the years and through the generations, Mi'kmaq have transformed the art of basket making to flow with the market and lifestyle of the times.

Black ash is a highly desirable species of wood for use in production of splint baskets, because its method of growth produces easily defined growth rings. When a log is soaked and pounded its rings split easily from one ring to the next. These tough and durable splints can then be woven, or split extremely fine, for all forms of basket making, from heavy pack baskets to the smallest of fancy baskets (Basket Maker Interview 2003).

The First Nations Forestry Program – Nova Scotia began a survey of the province in 1997, by the request of the chief and councils of the Mi'kmaw communities of Nova Scotia. The purpose of this survey was to find out the condition of black ash in the province as basket makers had concerns over the lack of black ash in the province. At that point in time less than 400 black ash trees could be located in Nova Scotia. This led to questions as to what effect these low numbers of black ash presently have had on the basket makers in Nova Scotia, and how they have adjusted. The purpose of the following inquiry was to attempt to identify and offer some possible explanations as to the current condition of black ash in Nova Scotia as well as the current abundance and distribution and how it has changed from the early 19th century to the present. Possible causes for any changes were also investigated. Finally, the study sought to look at the abundance and distribution issues connected to black ash and the effects on use from late 19th century to present by the Mi'kmaq of Nova Scotia.

2.3 Materials and Methods

2.3.1 Primary Sources

Oral Interviews

A series of questions were prepared to interview basket makers from various Mi'kmaw communities in Nova Scotia. These questions covered the subjects of black ash and also basketry in general. This survey was approved by the NSAC Research Ethics Board (Appendix 1). The questions were as follows:

1. How did you become involved in basket making?

(This question was developed to determine the age at which basket makers began their craft, and who was responsible for teaching them the craft)

2. Were there specific places that you would go to collect trees for basket making?

How did you learn of these places?

(This question was developed to determine if there are specific places (i.e. habitats) that basket makers look for to collect ash, what these areas look like, and how they came to know of these areas, or what areas to look for.)

3. Was there a specific procedure used when selecting and harvesting trees?

How long was this process?

How many trees were collected at one time?

What did the process include?

How did you select the appropriate tree?

(This question was developed to determine how and where trees were selected for the basket making process.)

4. Was black ash collected for anything other than basket making?

    Was this for commercial or personal use?

    What were these items?

(This was to shed light into any other possible uses of black ash and any other possible causes of depletion.)

5. Do you recall a point where black ash was no longer used and another species was selected?

    What was that species?

    Was the quality of the new wood different?

    Did that affect the quality of baskets?

(This question was to shed light into when black ash could no longer be found, and what species they would substitute for black ash.)

It was found to be extremely difficult to locate individuals who would be interested in divulging their knowledge of basket making or of black ash. Even being First Nations (but from a different First Nations group) is not the same as being from one of the Mi'kmaw communities in Nova Scotia. I hypothesize that since I am not a community member, the level of trust and comfort in divulging information to me as a researcher was not there. I feel it would be most beneficial, then, for research to be expanded by another individual from the Mi'kmaq First Nation to expand upon this knowledge base in the future.

Only one basket maker made herself/himself available for interviewing. Still, the descriptive data from this individual was still included here as this person has had a great deal of experience in basket making. This particular basket maker also holds a great deal of knowledge conveyed to them from previous generations through their teachers and this particular basketmaker continues today to teach basket making to others, thereby representing a multi-generational view.

2.3.2 Archival Research

Fonds from the Nova Scotia Public Archives (Chief Forester's correspondence and other material RG 20, Series 'C', Vol. 187, Nova Scotia Historical Quarterly, McAlpines Directory, Halifax Board of Trade fonds # 12395-12405 and Halifax Business Directory and Acadian Recorder), the Dalhousie Archives and the personal collection of Ken Martin, Millbrook, Nova Scotia were examined to learn more about the use of black ash in basketry and basketry in general with regard to the Mi'kmaw people of Nova Scotia. The archival research and oral interview offer some insights into the distribution and abundance of black ash from 1801 to the present. Distribution is defined here as the location and habitat of black ash in the province. Abundance is defined as the amount of black ash located in each identified area.

2.3.3 First Nations Forestry Surveys

Information was collected from terrestrial surveys completed by several forestry workers over a three-year basis. Data used were collected in 2001 for all known black ash trees in Nova Scotia. The following data were collected for each tree.

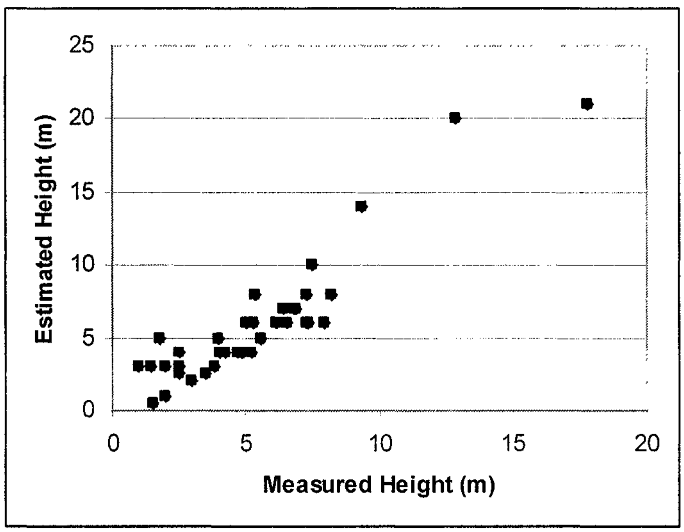
Location: The location of the stand (with regards to the county in which it is located).

Tree Number: All trees were numbered and labeled using aluminum tags.

Height: The height was recorded in 2001 through visual estimate to the nearest half meter.

Visual estimates of height were used due to difficulties in obtaining height through measurement means. A Suunto Clinometer (model number PM-5/360PC) was used to determine the height of trees in four sites, but it was difficult to use this device in other sites because of the ground cover and canopy structure. Therefore, visual estimates were used from data collected in 2001. There was a correlation of 0.92 between visual and measured heights (Figure 2).

Figure 2: Total height of black ash trees in four sites comparing measured height (m) and estimated height (m) (r= 0.92).



The following characteristics were measured to provide a detailed description of the health and characteristics of several selected black ash sites in Nova Scotia. These variables will show any similarities and/or differences between black ash in different areas in the Province. Measurements were taken in September of 2002, with the aid of a forest technician.

Diameter: The diameter was measured using diameter tape in centimeters to the nearest 0.5 cm at breast height.

Dominance (Smith 1962):

Dominant: Crown is above the rest of the canopy, full light on top, some on side.

Co-Dominant: Crown is even with the canopy, full light on top, little light on side.

Intermediate: Crown is shorter than the dominant and co-dominant, little light from above and none on side.

Suppressed: Crown below the general level of the crown, no direct sunlight from above or the side.

Dieback: Measured as the percentage of dead and/or dying crown to the total crown diameter.

Basket Quality: Length of basket quality in meters (m) straight section of tree without external visual defects, with a diameter of 10 cm or more.

Seeds: If seed was present, it was recorded. If the seed was assessable, it was harvested and counted. In cases in which seed was not obtainable, it was estimated through visual observations.

The trees were resurveyed in 2002 for their descriptive condition, and dieback. The age of the trees however is not available from tree ring analysis. Upon attempting to collect tree core samples for ring analysis and therefore aging, it was noted that several of the trees tested contained significant heart rot. It was decided that boring should be immediately halted, to avoid permanently damaging, those trees sampled or spreading an infectious agent to healthy trees. Due to this lack of data pertaining to age, growth and yield data would not be calculated for Nova Scotia. It must also be noted that those trees found to be infected with this heart rot will eventually die. Possible grafting methods (for example, grafting healthy stem cuttings of infected black ash to green ash rootstock) should be further investigated as a viable method of preserving those trees.

2.4 Results

2.4.1 Splint Basket Making in Nova Scotia –the Beginning and its Evolution

The exact date splint basketry began in the Mi'kmaq of Nova Scotia is unknown, but as early as 1801-02, one source suggests, Mi'kmaq were supporting themselves from the woods by producing baskets for sale and trade (Smith 1802b). While Mi'kmaq appear to have been fully involved in splint basketry by the 19th century, some argue that it began even earlier, in the 18th century (Whitehead 1980).

Whichever the time frame, post-contact the focus of basketry shifted to splint basketry. This new form of basketry involved the production of many shapes and sizes of baskets, useful in settlers' agricultural pursuits and household duties. Baskets were purchased by settlers' to aid in the harvesting of crops, such as potatoes. Settlers' purchases helped the Mi'kmaq financially, who were encouraged to continue basket making with agents from Indian Affairs supporting this venture as well as the production of shingles and staves (Whitehead 1980).

At the end of the 19th and the beginning of the 20th century, Nova Scotians began the shift from rural areas to urban locations. While only 1/10 of Maritimers lived in urban areas during the time of Confederation, the number rose to ¼ by the end of the 19th century, with the urban shift continuing into the 20th century (Howell 1993). Traditional baskets were still produced by the Mi'kmaq but production expanded to wooden flowers, fans and other products. Today, many basket makers are producing wooden flowers as well as fancy intricate baskets for decorative purposes. Basket makers are also experimenting with different species of wood for adding different colours and textures to their baskets (Basket Maker Interview 2003).

2.4.2 The Process of Basket Making

The selection of a tree for splint basketry took a great deal of time. A tree with all the desired characteristics for the production were assessed (i.e. height, tightness of rings) and selected for. The selection of a tree for basket making could take an entire day. For the production of pack baskets and other wide baskets, wide grained wood was selected, with narrow grain trees from wetter areas being selected for fancy baskets (Basket Maker Interview 2003).

There are several steps in the basket making process. When a tree was found that fit the required characteristics it was cut, the branches were removed and the log was then carried back to the shop of the basket maker. This process usually required two people, and sometimes would require two days of work to complete collection. The tree was then soaked and thoroughly pounded, with notches being placed in one end of the log. The notches would be made to produce a splint in the width desired. After pounding, the strip is peeled from one end to the next. This large thick splint is then further reduced, by splitting it into individual thinner strips (Basket Maker Interview 2003).

2.4.3 Other Uses of Black Ash

2.4.3.1Crafts and Household Items

Other uses of ash include the production of bows, sleighs runners, boating paddles and barrel making (Basket Maker Interview 2003). Gesner (1849a) also described uses of black ash including baskets and axe handles, as well as their use in the production of chair bottoms.

2.4.3.2 Cooperage – A Thriving Business

Cooperage was once a thriving industry in Nova Scotia, one which accommodated the needs of those shipping a variety of products worldwide. The use of ash in barrel making by both native and non-native communities was widespread, at least in Nova Scotia according to the one interviewee (Basket Maker Interview 2003). Used to ship large and small quantities of a variety of products, from flour to ale, barrels were produced in large amounts in the province. The barrel staves alone were also made for export to Europe. The Halifax Business Directory for 1863 listed thirty-seven coopers for the Halifax area alone (Halifax Business Directory 1863). The McAlpines (Nova Scotia) Directory for 1902 had a total of thirty-four coopers advertising in the entire province, from Glace Bay to Lunenburg (NS-ARM 3391).

Table 3 depicts the amount of coopers located in the city of Halifax from 1868 to 1928. It shows a peak in the amount of cooperages operating in Halifax during the 1870s and 1880s, eventually tapering off in the late 19th century only to rise slightly at the beginning of the 20th century. During the 19th century, Nova Scotia was in an economic prime, in the midst of the "golden age" of ship building. Prosperity followed the end of a global depression in 1841. However, depressions later fell upon the colonies from 1847 to 1850's (Bumsted 1992).

Table 3: Number of cooperages listed in the business section of the McAlpines Halifax City Directory for the years 1868 to 1928. (McAlpines 1868 to 1928)

Year	Number of Cooperages
1868	4
1873	18
1878	20
1883	23
1888	2
1893	0
1898	ND[1]
1903	6
1908	6
1913	5
1918	ND[1]
1923	1
1928	0

[1] No data available

Halifax was not the only post in 19th century shipping. Cape Breton alone had three main ports in Cheticamp, Sydney and Arichat from which products were transported to Halifax for re-shipment, other ports in Canada or to other countries including the US and abroad (Hornsby 1989). With so many ports shipping products to a variety of destinations, it is evident that many other cooperages must have been located throughout the province, to satisfy the needs of these ports and therefore harvesting the forest resources of the province.

Before the use of metal to hold the staves of a barrel together, ash was one of the species used. Stephens (1972), in “A Forgotten trade of Nova Scotia”, discusses the use of ash in barrel making. Ash (specific species of ash was not mentioned) was one species which was cut for hoop-poles into thin pieces and shaped to fit around the barrel, in order to hold the staves in place. Another source suggests that ash was not just being used to hold staves together, but was also used for the actual staves themselves. Before 1800, oak and ash barrel staves were being cut in Pictou County and were exported (Johnson 1986).

2.4.3.1 Exports – Barrels Leaving the Port of Halifax

The following tables give the amount of barrels of a variety of products leaving just the port of Halifax from 1872 to 1900 from the records of the Board of Trade in Halifax. Only those goods packaged in barrels were recorded so as to give a glimpse into the extent of this industry and the amount of barrels that left the province.

Table 4: Exports from the port of Halifax to the U.S.A., British and Foreign West Indies, Bermuda and Bahamas in the year 1872 from the Annual Report of the Board of Trade. (Nova Scotia Board of Trade 1873)

Product	British & Foreign West Indies, Bermuda & Bahamas	USA	USA (½ Barrels)
Mackerel	45 222	35 465	
Herring	45 222	4 981	
Alewives	4 920	1 045	
Fish Enumerated	8 487	400	
Kerosene Oil	216		
Whiskey	37		
Flour	3 937		
Corn Meal	4 894		
Beans	20		
Barley	70		
Oatmeal	99		
Bread	249		
Pork	685		
Pig Heads	50		
Beef	124		
Potatoes	3 584	521	
Apples	529		
Molasses		25	
Salmon		214	
Trout		22	
Roe		54	
Tougnes & Sounds		40	4
Cod Oil		1 296	
Seal Oil		8	
TOTAL	118 345	44 071	4

Table 5: Number of barrels leaving the Port of Halifax in 1876 excluding ale and alcohol to the West Indies only in the Board of Trade Annual Report. (Nova Scotia Board of Trade 1877)

Exports	Barrels	½ Barrels
Mackerel	20 215	747
Herring	53 396	1 654
Salmon	1 200	
Alewives	2 571	
Cod Oil	7	
Pickled Fish	452	
Potatoes	10 944	
Vegetables	140	
Apples	295	
Pork	287	
Beans	29	
Peas	146	
Corn Meal	564	
TOTAL	90 246	2 401

Table 6: Number of barrels of leading products leaving Halifax from 1876 to 1879 from the Annual Report of the Halifax Board of Trade from 1879. (Nova Scotia Board of Trade 1879)

Product	1876	1877	1878	1879
Salmon	3017	3062	3750	4262
Mackerel	38158	52439	52301	70158
Herring	73458	66140	61270	48607
Alewives	2656	2141	2426	2591
Cod Oil	2656	2919	2301	5869
Pickled Fish (unenumerated)	2144	3636	10806	23785
TOTAL	122089	130337	132854	155272

Table 7: Exports of pickled fish from 1882 to 1886 as reported in the Annual Report of the Board of Trade in 1887. (Halifax, Nova Scotia Board of Trade 1887)

Year	Number Of Barrels
1882	54771
1883	51663
1884	ND[1]
1885	58465
1886	41900
1887	30905

[1] No data available

Table 8: Exports of barreled fish from 1888 to 1900 from Halifax as Reported in the Annual Reports of the Board of Trade (Nova Scotia Board of Trade 1901).

Year	Number of Barrels
1888	32088
1889	38175
1890	36983
1891	36470
1892	45773
1893	80572
1894	92273
1895	78379
1896	46294
1897	58064
1898	48317
1899	45649
1900	52897
TOTAL	691934

Cooperage continued well into the 20th century. Canada's Department of the Interior published several reports on cooperage in Canada during this time. The report "Forest Products of Canada 1909 Tight and Slack Cooperage Boxes and Box Shooks" provided information on the amount of tight (liquid tight barrels which could hold liquids and meat) and slack (not liquid tight, suitable for non-perishable goods) cooperage in Canada (Vasser 2004). For tight cooperage, ash was used to produce sawed staves in Canada with a total of 8394000 staves produced (MacMillan 1911a). Ash was also used that year to produce staves for slack cooperage with 1584000 staves being produced from a total amount of 103982000 total staves produced. It was not mentioned if ash was being used in the production of headings or hoops that year (MacMillan 1911a). In 1910, 3016000 staves of ash were produced in Canada, as well as 161000 headings and 570000 hoops for slack cooperage. For tight cooperage, 316000 sawed staves were produced (MacMillan 1911b).

There is some evidence that Mi'kmaq were also involved in coopering. In a report in 1801 titled "Indians in Colchester", James Fulton described several Mi'kmaw coopers in Colchester County, mentioning in particular Paul Chief, whom Fulton described as an "industrious" cooper. Another 1801 account from Pictou County mentions Samuel Oakum was mentioned as being "especially good at coopering" (Pictou 1801).

2.4.4 Effects of Agriculture

Beavers have played an important role in the shaping of the landscape of North America and in turn, available agricultural land for crops and/or grazing (Merchant 1989). Through the formation of dams this species helped form rich soil regions, like those in which black ash were found. Large areas were flooded through beaver activity. Large amounts of water, soil and sediments were held within these flooded areas resulting in an increase in water temperature and creating a desirable habitat for plants, fish and birds (Naiman et al 1986, 1994). Eventually, beavers would either move due to a depleted food supply or be removed through death at the hands of hunters or nature. This would result in the eventual destruction of the dam, allowing water to recede leaving large areas open, rich in soil and sediment. Grasses quickly grew in these new areas (Merchant 1989). These meadowlands, rich in soil and lush with grasses (Merchant

1989), were where settlers were able initially to graze their cattle. The survival of cattle in turn helped secure the survival of the settlers (Merchant 1989). The beneficial effects of the beaver continued to be acknowledged in Nova Scotia into the 20th century. An anonymous letter to the Chief Forester in 1928 for example, requested the end of the fur harvesting of beaver near Bridgewater, because of the beavers' assistance in producing meadowland (Anon. 1928).

Farming was initially for subsistence. But farming soon expanded for trade and bartering (Cronon 1983). This resulted in the clearing of forestlands adjacent to areas naturally or previously cleared. Too, many colonists had established roots in areas already cleared by Mi'kmaq (there were many seasonal villages used by Mi'kmaq). Colonists would assume that parcels of land were vacant or abandoned and would set up settlements, much to the surprise of Mi'kmaq, who would later find these individuals in the Mi'kmaw villages, upon arriving back for the next season (Upton 1975). From maps in Hornsby (1989) it is evident, for example, that both commercial and subsistence agriculture had begun surrounding many of the waterways of Cape Breton during the 19th century, most likely inhabiting the preferred settlement locations of the Mi'kmaw.

Cronon (1983), in describing the effects of colonization in the New England area, notes that much of the forest began to be cleared for the establishment of grazing pastures and agricultural plots. Colonists would analyze the various forest stands and noted certain characteristics of each. Certain stands were more characteristic of certain soils, with some soils being more desirable than others. Stands which contained moisture-loving trees had highly organic soil (Cronon 1983). Leaf litter combined with the rich, moist, soil allowed for the creation of rich black humus. This soil was recognized by the colonists to be highly desirable in agriculture for improved crop production (Cronon 1983). This was also the case in Nova Scotia, where tree cover was used to assess the soil. Ash was a species identified as indicating a healthy soil. (Haliburton 1829).

Colonists would clear these moisture rich stands. However, upon the removal of the trees, the soil composition was changed greatly as the soils dried and increased their temperature (Cronon 1983). The loss of the trees also greatly altered the moisture holding capacity of the soil. Once the trees were removed, areas that had once been desirable for agriculture were now prone to flooding. Therefore, the clearing of the land, at times, resulted in land that was no longer as viable for agricultural exploits.

2.4.5 Abundance and Distribution of Black Ash in Nova Scotia from 1801to the 1990's from Forest Inventories and Biophysical Surveys

To approximate the change over time, if any, in the condition of black ash in Nova Scotia, inventories and surveys from 1672 to the 1990's were reviewed. The following sections outline forest inventories, biophysical surveys and reports available for Nova Scotia for this period.

Nicholas Denys accounts of the Province of Nova Scotia during the late 17th century notes several locations of ash along rivers and waterways. Black ash is noted as being found in poorly drained swamps in Cape Breton (Denys 1968, Roland and Smith 1969).

Black ash could have been located in swampy regions of the province since the early 19th century. Titus Smith, commissioned by John Wentworth, completed a forest survey of the colony of Nova Scotia in the years 1801 and 1802 (Smith 1802a). He traveled throughout Nova Scotia, making observations and describing the land. He referred to certain areas as "ash swamps" but did not specifically mention the presence of black ash. Titus Smith's account of Nova Scotia is the earliest of its kind found.

The first area in which Titus found ash was near Falmouth, a short distance from Windsor. This area was made up of 0.805 km of swamp, identified as 'indifferently ash'. The only other place Titus Smith indicated as containing ash was near West River, Pictou County. This area was identified as having an abundance of ash, as well as hard maple (*Acer saccharum*) and hornbeam (*Ostrya virginiana*). This area was described as "being dotted with rivers", which typifies black ash habitat.

Lockhart in 1818, recorded the area alongside Charlotte Lake in Halifax County as being surrounded with wood of a high quality, including ash. It is not known if black ash is included in this observation, as there was no differentiation between species (Lockhart 1818). What is also interesting is that this record also describes possible evidence of a Mi'kmaw settlement. Since black ash was an important species to Mi'kmaq, evidence of a nearby settlement may indicate the possible presence of black ash in the nearby vicinity.

There is no description available on black ash from forest inventories or biophysical surveys from the Smith survey in 1801 until the forest survey completed by Fernow in 1912. Ash, however, was not completely forgotten during this period. In a letter to the Lieutenant Governor of Nova Scotia in 1849 published in the Acadian Recorder, several Mi'kmaw chiefs in Nova Scotia outlined a variety of complaints and concerns "Upon our camping grounds you have built towns, and the graves of our fathers are broken by plow and harrow. Even the ash and maple are growing scarce" (Gesner 1849b). Further examination of the Acadian Recorder yielded no other letters or articles with regards to black ash, or forestry in general from Mi'kmaw or any other group in Nova Scotia.

In 1912, B.E. Fernow completed a survey of the Province of Nova Scotia and noted black ash in Yarmouth County only. These trees were identified as growing in swamps. He does not however, mention the abundance of black ash in these swamps.

Between 1953 and 1957, a survey of the forest of Nova Scotia was completed in three sections, Cape Breton, Northeastern Mainland and Southwestern Mainland (Hawboldt and Bulmer 1958). The three areas were then divided into seven different inventory sections. The inventory was completed using air photos, maps and actual ground cruising. Data was reported as tree species, vigor class and stand class size. This survey fails to mention the distribution of these trees surveyed, or rather, where and in what locations they were found. Also, the raw data for this survey is not available, as it was destroyed in a fire in 1964. This inventory therefore is beneficial for the compilation of data on the abundance of black ash, but provides no information as to the distribution in the 1950's. As part of this survey the percentage of forest cover type in Nova Scotia was compared from 1910 (data from Fernow 1912) to the information they gathered in 1956 (Figure 3 and 4).

Figure 3: Comparison of Forest Cover Type for the Mainland of Nova Scotia 1910 and 1956 (Hawboldt and Bulmer 1958)

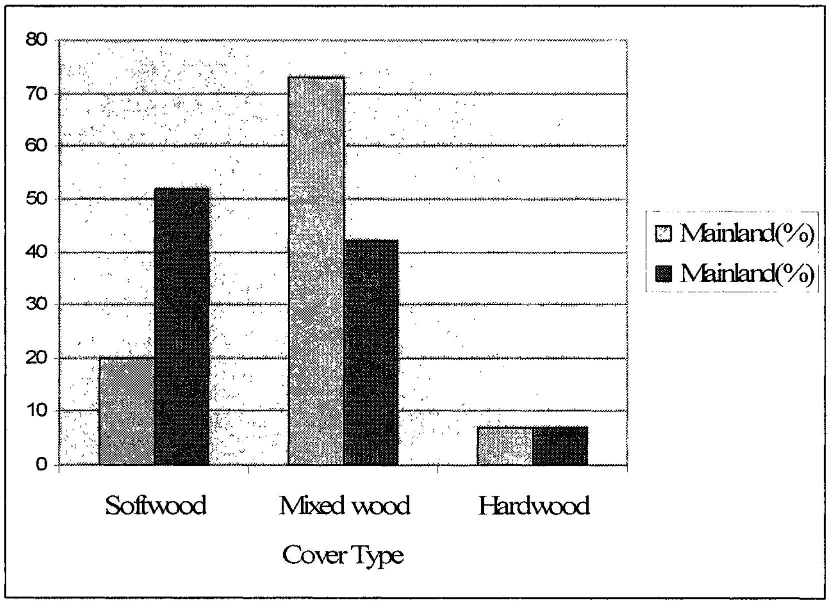
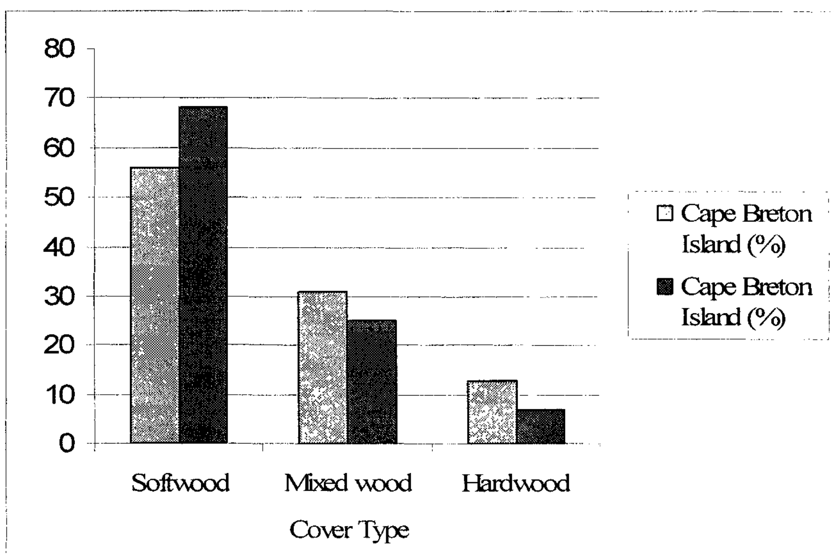


Figure 4: Comparison of Forest Cover Type for Cape Breton from 1910 and 1956 (Hawboldt and Bulmer 1958)



The following table breaks down the cubic feet and percentage of black ash in each county in the province from the data collected from 1953 and 1957:

Table 9: Cubic Meters of Black Ash in All Counties of Nova Scotia Showing a Total of 2.24% of Hardwood in Nova Scotia (Hawboldt and Bulmer 1958)

County	Merchantable Cubic Meters (m^3)
Inverness	28996.5
Victoria	15885.8
Cape Breton	8891.5
Richmond	3341.4
Antigonish	4838.5
Guysborough	16545.9
Pictou	23479
Cumberland	7261.9
Colchester	3772.3
Halifax	2769.6
Hants	1563.4
Kings	5676.8
Annapolis	18684.9
Lunenburg	5648.0
Queens	3979.7
Shelburne	22.7
Yarmouth	33.0
Digby	44.0
TOTAL	151435

Forest Classification for the Maritime Provinces was completed to provide site classification and forest management in the described regions. I.C.M. Place and H.D. Long completed the forest descriptions provided from a base of fieldwork (data collected from surveys). This fieldwork was completed from the years 1952 to 1954, and was mainly accomplished through surveying along country roads; with some surveying through low cut areas such as swamps and valley bottoms. Although many regions in New Brunswick were identified as having black ash, only one area, the Windsor-Truro district was identified in Nova Scotia. Comprised of parts of Colchester and Hants counties, this region extends into the Annapolis Valley. Black ash was identified as being located along the slow moving rivers in the district (Loucks 1962). This survey did not, however, go into detail about the relative abundance of black ash along these rivers.

Inventory reports were completed in the province of Nova Scotia during the 1980's (Forest Resources Planning & Mensuration Division 1982 to 1989). They were completed on various stands in the counties, recording the volume of sawlogs, pulpwood, non-merchantable timber and saplings for the species present. However, among the hardwoods listed, black ash was not included in the survey as a specifically measured species. There was however, another grouping, known as 'other hardwood'. It can be expected that black ash, if found in any of these counties, would be placed in this grouping, and the volume of black ash would not exceed this amount. The following table depicts the average volume of 'other hardwood' in each county, showing the absolute maximum volume of black ash that might have been located in each county in this period.

Table 10: Mean volume percentage of other hardwood (which may have included black ash) in Cape Breton and the Counties of Nova Scotia during the late 1970's, 1980's.

County	Mean Percentage of Other Hardwood
Hants	2.3
Halifax	4.1
Cape Breton	0.2
Pictou	3.3
Antigonish	1.9
Guysborough (East)	0.4
Annapolis	4.8
Kings	4.9
Digby	0.9
Yarmouth	4.0
Shelburne	5.0
Queens	1.3
Lunenburg	10.7
Cumberland	2.0
Colchester	4.4

Through permanent sample plots, it was found that in the 1990's there was $1851 m^3$ of black ash on Crown lands and $5444\ m^3$ on small woodlots in Nova Scotia

(Department of Natural Resources 2000). This was a total of 7295 m^3. Black ash was therefore 0.006% of the total hardwood in the province. The published data does not go into great detail as to the location or habitat of the black ash surveyed. This percentage of black ash in the 1990's displayed a large decrease in the amount of black ash occurring from only fifty years earlier when black ash made up 0.12% of forest inventories in Nova Scotia (Hawboldt 1958).

2.4.6 Mi'kmaw Knowledge of Black Ash from 1980 to 2003

Several patches of black ash in the province were located by Ken Martin of Millbrook, Nova Scotia in Cape Breton, Pictou, Guysborough, Cumberland, Hants and Queen's counties during the last two decades. The locations have had black ash for the past several decades and were identified through high-powered binoculars with the assistance, at times, of a forest technician.

Cape Breton:

Black ash was located along the wet areas and the bottom of hills along the Bras d'Or Lakes from Baddeck to Iron Mines and from the Canso Causeway long the Highway 104 to James River, mixed with white ash.

Pictou County:

Pictou County had the most ash in the province. Black ash were found along the West River, all branches and the watershed, along the East River, through Salt Springs and into the small park located there, and in the town of Pictou.

Guysborough County:

Black ash were located along the Salmon River outside the town of Guysborough.

Cumberland County:

Cumberland County had several areas of black ash. Black ash were located along the Wallace River and the branches coming from it, from Wallace Bridge through to the Wentworth Valley. Black ash was also found in River Philip from Oxford Junction to Rose as well as along the Maccan River to South Hampton and Halfway River.

Queens, Lunenburg and Shelburne Counties:

Along the south shore of Halifax, black ash has been found along the Mersey River from Liverpool to Lake Rossignol as well as in the town of Liverpool and Milton. It was also found along the Medway River from Mill Village to Ponhook Lake as well as LaHave River near New Germany.

Hants County:

Black ash was located along fields, streams and in various wet areas along Highway 114 from Milford to Ski Martock. These trees were mixed with white ash.

Although this data does not go into great detail as to the exact abundance of black ash, it provides an excellent description of the current distribution of black ash throughout the province.

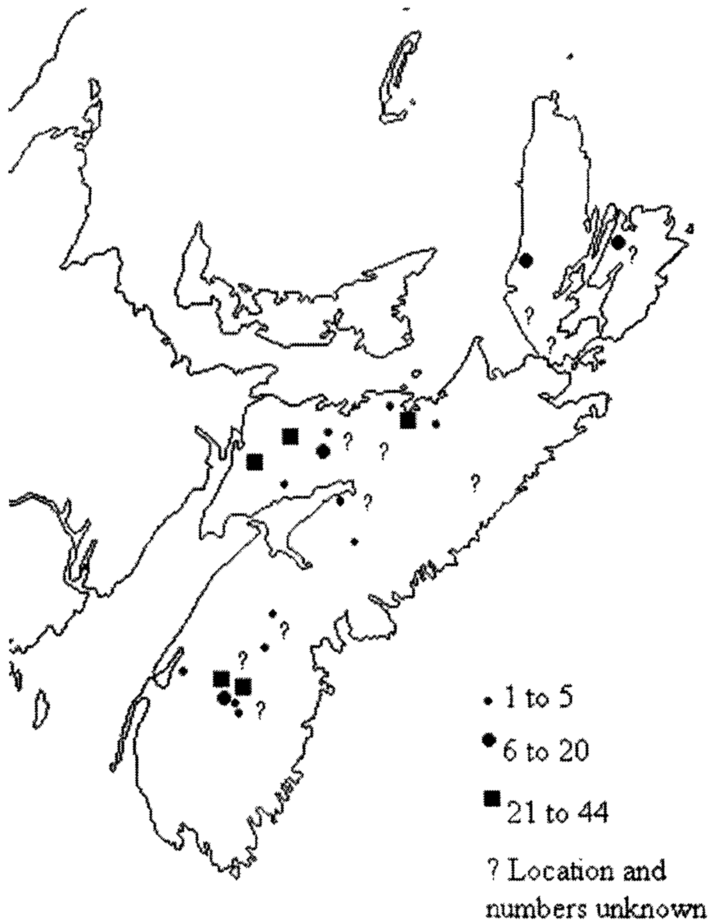
From the early 1990's through to 2002, black ash was identified by the First Nations Forestry Program – Nova Scotia throughout the Province. To date, 244 trees have been located by a survey completed by the First Nations Forestry Program – Nova Scotia from 1993 to 2002 (Table 11). All of these locations except one are characteristic of the known preferred habitat of black ash. All but one of these areas is located in a wet region, areas which retain water consistently and are located along swamps, marshes, rivers and/or streams. The one exception to this is a site in Cape Breton County. Of the 12 trees located there, 6 are located in wet regions along the river, but half of these trees are also located in a much drier region, on small inclines lacking the characteristic water retention capabilities. This data was assembled through cruising areas with known hardwood and known habitat, characteristic of black ash.

Table 11: Total number of black ash trees in each county of Nova Scotia as identified by the First Nations Forestry Program – Nova Scotia from 1993 to 2002.

County	Number of black ash trees (FNFP-NS)	Other Sources	Total[1]
Annapolis	35	0	35
Cape Breton	10	16	26
Cumberland	82	0	82
Colchester	2	12	14
Hants	2	0	2
Pictou	24	1	25
Queens	73	0	73
Lunenburg	0	2	2
Guysborough	228	31	259
Total	456	62	518

[1] There are over 50 trees excluded from this table due to destroyed data.
[2] The inclusion of Fallgold black ash is beyond the scope of this project.

Figure 5: Locations Black Ash in Nova Scotia as Positively Identified by the First Nations Forestry Program – Nova Scotia



There are various other small stands of black ash in Nova Scotia which have not been included in the above table or diagram. This information was collected by an individual working for the First Nations Forestry Program who took this information with them when they left their position. Therefore, although we know there are just under 400 trees positively identified in the province, the raw data for only 244 trees can be located.

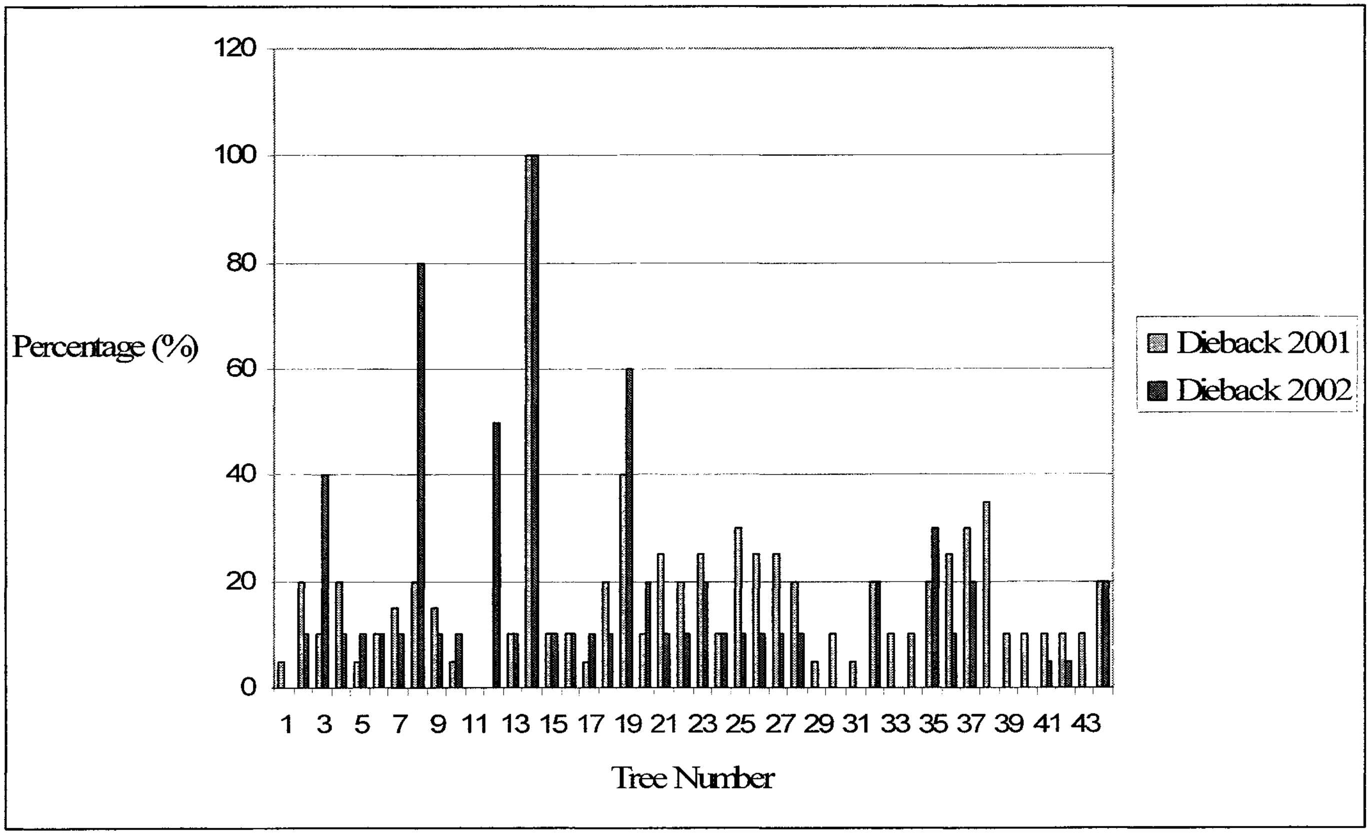
2.4.7 Description of Selected Stands of Black Ash

Queens County Site#1

This site is located in Queens County, Nova Scotia near the town of Caledonia. The site is located alongside a logging road in a small swale. The trees located in the Queens County Site #1 site are some of the healthiest black ash trees known in the province. Only one of these trees was dead in 2002 as a result of mechanical damage from another tree falling upon it. In 2001 the mean height of the trees located in this patch was 15.6m with a mean diameter of 18.5cm. 12% of the trees were dominant in nature, 50% were co-dominant and 38% were suppressed.

Sixteen percent of the 44 trees located in this area produced seed in 2002. Twenty-five percent of the trees in this patch also had some degree of basket quality wood available. The dieback decreased in this site from 2001 to 2002 with a reduction from 17% to 15%.

Figure 6: Percentage of dieback in Queens County site#1 for 2001 and 2002.



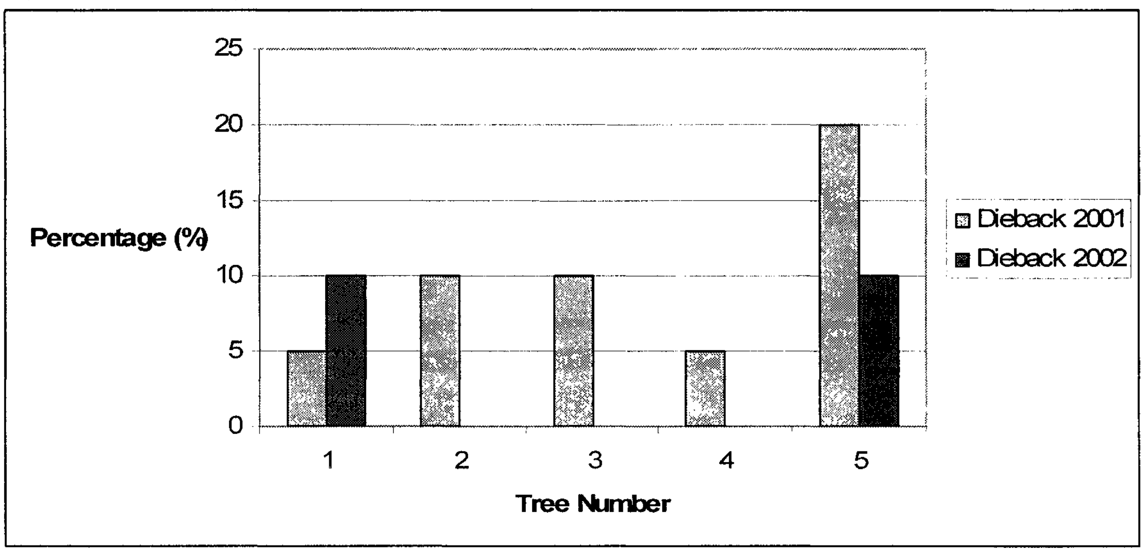
The trees that had a great increase in 2002 of the amount of dieback were as a result of mechanical damage. It was evident that much of the stem damage found was as a result of past damage of other trees in the vicinity of the trees, either from wind storms, but in most cases, from dead or dying trees and/or limbs falling on these black ash trees.

Queens County Site#2

This patch is located near the town of Caledonia in the middle of an area of homes and is comprised of five trees. The mean height of these trees is 10.2m with a mean diameter of 7.6cm. None of the trees located here are of any basket quality, with no seed production in 2002.

Sixty percent of the trees were designated as co-dominant in 2002, with 20% intermediate and 20% suppressed. Dieback decreased from 2001 to 2002 from 10% to mean of four percent.

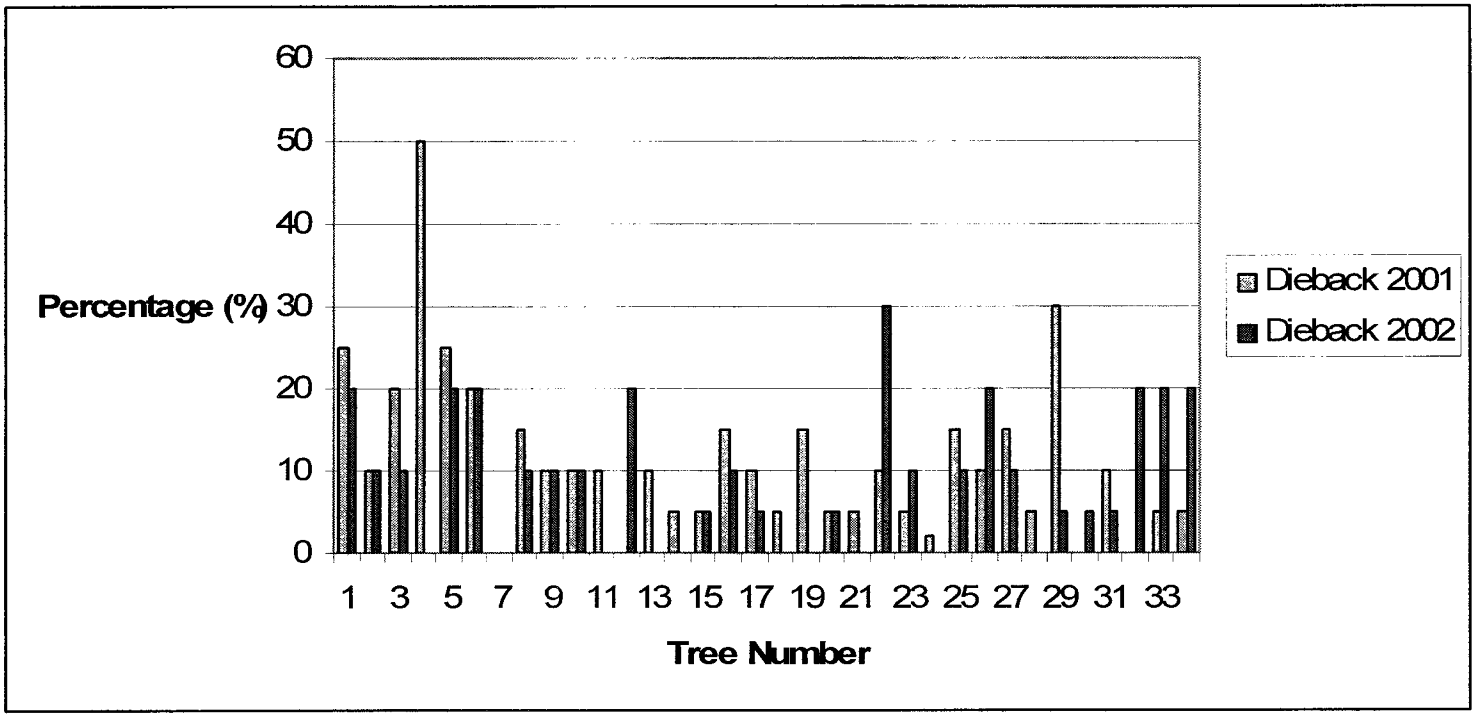
Figure 7: Percentage of dieback in Queens County Site#2 for 2001 and 2002.



Queens County Site #3

This site is located near a logging road in an isolated area of Queens County and contains 34 trees. The trees had a mean height of 5.6m and a mean diameter of 14.5cm. None of the trees were of any basket quality. Thirty-four produced seed in 2002. Dieback decreased from 2001 to 2002 from 11% to nine percent.

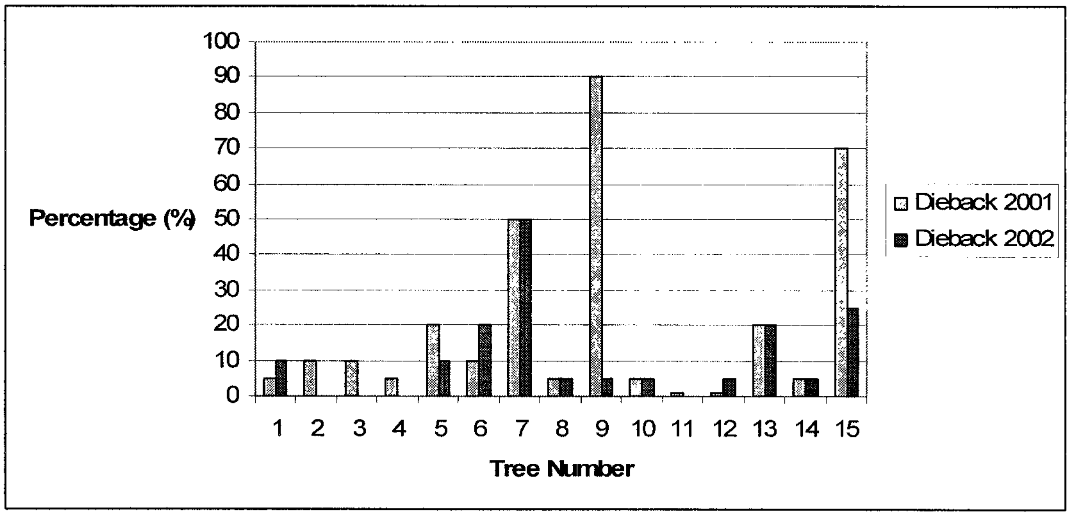
Figure 8: Percentage of dieback in Queens County Site#3 for 2001 and 2002.



Cape Breton County Site#1

This site containing ten trees is located alongside a brook in an extremely wet area near a residential community. The mean height of the trees in 2002 was 2.45m and had a mean diameter of 2 cm. None of these trees are of any basket quality. One tree in 2002 produced a small amount of seed. The dominance of the trees was 20% were co-dominant, 50% were intermediate and 30% were suppressed. Dieback decreased from 2001 to 2002 from 26% to fourteen percent.

Figure 9: Percentage of dieback in Cape Breton County Site#1 for 2001 and 2002.

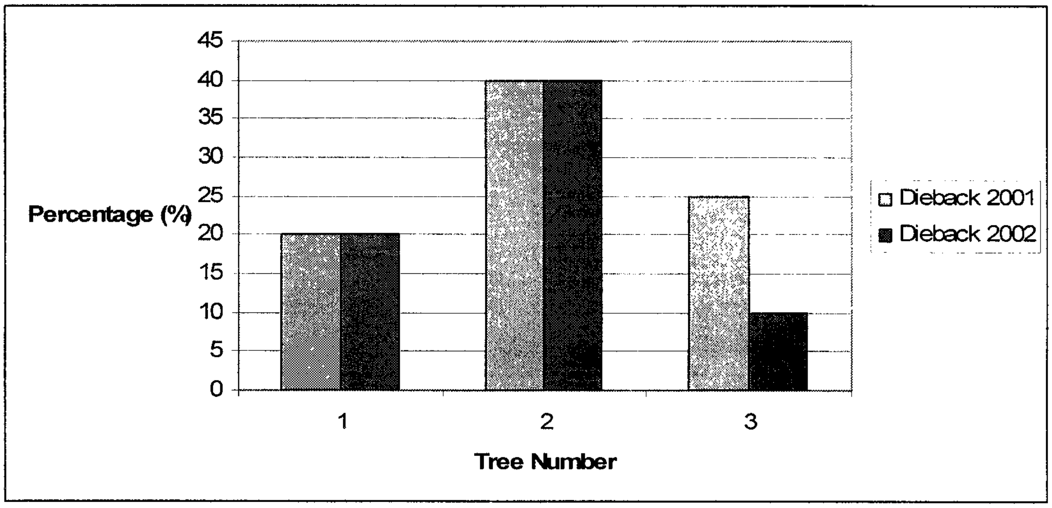


Annapolis County Site#1

This site with three trees is located in a boggy area near a river in Annapolis County. The trees in this location have a mean height of 7.3m, with a mean diameter of 14.2cm. None of the trees located in this area are of any basket quality and none of the trees produced seed in 2002. One of the trees was co-dominant with the remaining two trees being suppressed.

Dieback in Annapolis County Site #1 decreased from 2001 to 2002. In 2001 the mean percentage of dieback was 28%, which then decreased to a mean of 23% in 2002. The following graph depicts the dieback in 2001 and 2002 by tree number:

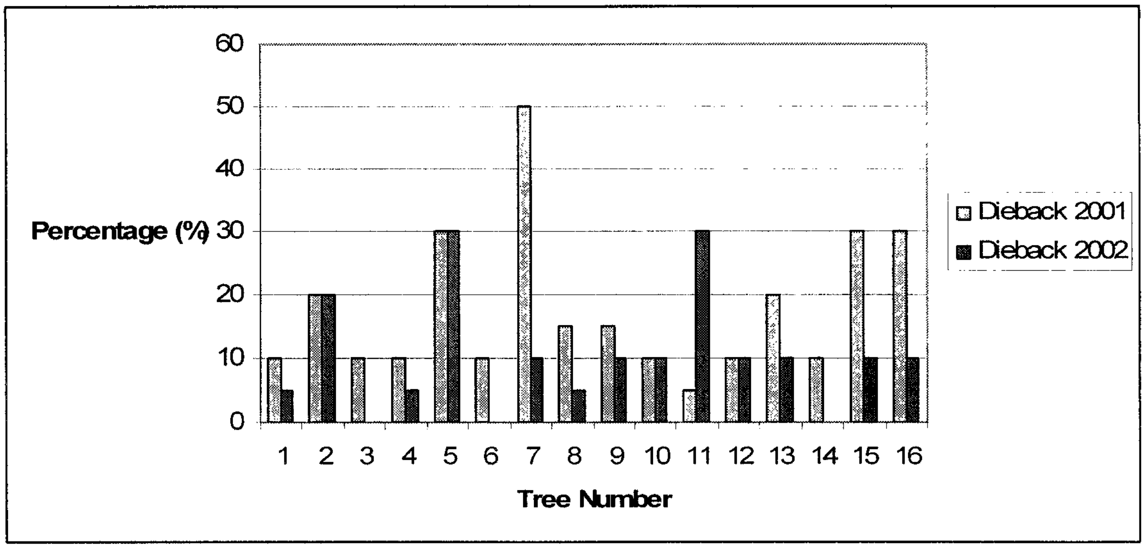
Figure 10: Percentage of dieback in Annapolis County Site#1 for 2001 and 2002.



Annapolis County Site #2

This site with sixteen trees is located in a protected area, roadside. All the trees located in this area are alive, with a mean height of 11.9m and a mean diameter of 38.6cm. Six of these sixteen trees produced seed in 2002, with two of the trees having some degree of basket quality. More than half of the trees (56%) were co-dominate, three were dominant, one was intermediate and three were suppressed. Dieback decreased from 2001 to 2002 from 18% to ten percent.

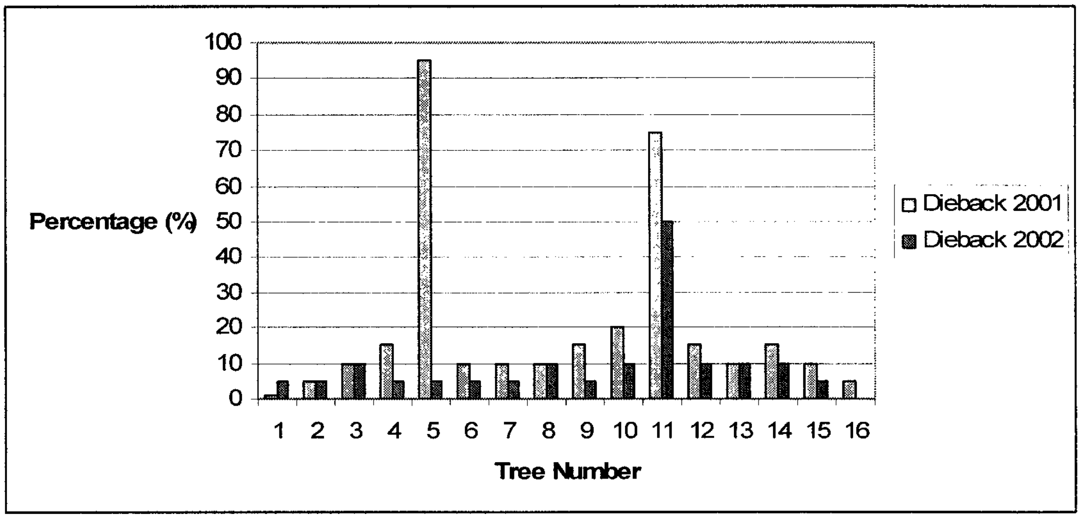
Figure 11: Percentage of dieback in Annapolis County Site#2 for 2001 and 2002.



Pictou County Site#1

This site is located nearby a logging road in an isolated area and contains twenty-five trees, with only nineteen surveyed. This site is extremely wet, with pools of stagnant water and boggy areas. The mean height of the trees in this site is 5.4 m with a mean diameter of 11.6 cm. None of the trees have any basket quality wood, nor did they produce any seed. The majority of the trees were of intermediate dominance, with 12 of the 19 trees falling into this category. Of the remaining trees, six are co-dominate with one tree being suppressed. Dieback decreased from 2001 to 2002 from 18% to nine percent.

Figure 12: Percentage of dieback in Pictou County Site #1 for 2001 and 2002.



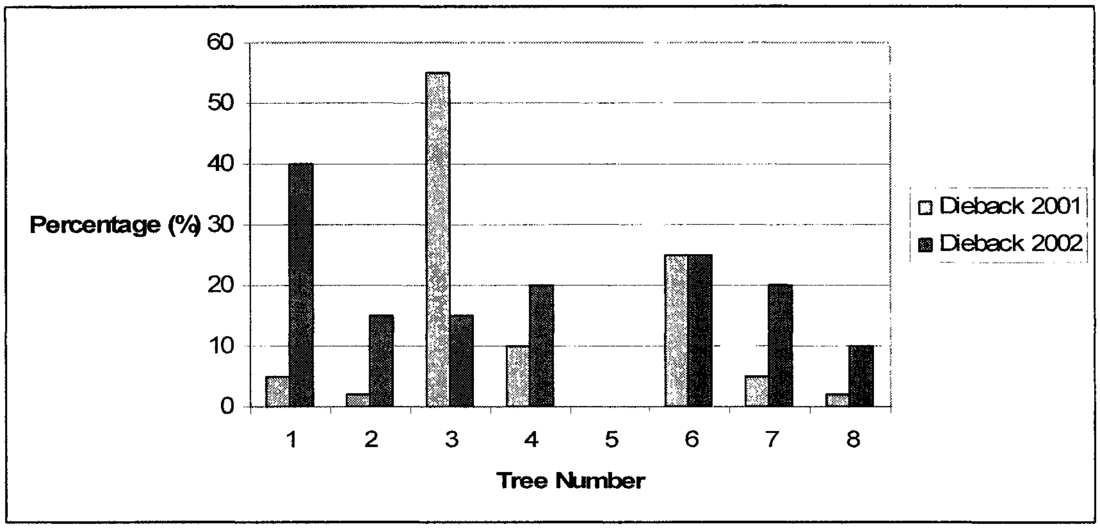
Cumberland County Site#1

This tree is located along a walking trail in a protected area. This tree is located next to a small brook in a slightly wet area. This tree has a height of 7.0 m and a diameter of 18.7cm. It is intermediate in its dominance, and has normal form. The dieback in 2001 was 50% of the tree, which decreased to 20% in 2002.

Cumberland County Site#2

This site is located roadside following a small stream. The mean height of these trees is 11.1m with a mean diameter of 35.7cm. Two of the trees are dominant, one is co-dominate, four are intermediate and one tree is suppressed. Not all of the trees could be compared from data in 2001 to 2002, as some of the trees were unable to be located in 2002. The tags, which had been placed on trees, had become lost, and these trees could not be identified. Dieback increased from 2001 to 2002 from 13.0% to 18.1%.

Figure 13: Percentage of dieback in 2001 and 2002 for Cumberland County Site#2



2.5 Discussion

2.5.1 The Abundance and Distribution of Black Ash in Nova Scotia and How It Has Changed from the Early 19th Century to Present

Through the evaluation of the forest inventories available since the early 19th century and reports produced for the province, as well as talking with a Mi'kmaw basket maker, it is possible to see that, historically, black ash has been located throughout most of the province of Nova Scotia. When evaluating the numbers and in some cases the locations of black ash in Nova Scotia, it is possible to see that black ash was found in nearly all of the counties in Nova Scotia in the last century (1912-2003). But to identify these areas and population numbers, many sources of information had to be assembled from the last several centuries. Forest inventories were not completed every year in the province for obvious reasons. These inventories were time consuming, and costly. Because of this, any information that was recorded had to be pieced together to present as full picture as possible of black ash in Nova Scotia.

The distribution of black ash has not remained stagnant over the centuries. In the past, black ash was in areas in which none have been located today. Pollen studies have indicated that areas such as Sambro, Halifax County had black ash present post-glacially (Livingstone 1958). No ash has been found in this region presently, however.

It appears that in many cases it is possible to locate black ash via the remains of old Mi'kmaw settlements and also those still inhabited today. Elders and basket makers make clear that Mi'kmaq desired black ash so strongly that some settlements were located close to areas known to have black ash. An example of this is evident in Pictou

County Site #1. This patch of black ash is located on reserve lands, near a Mi'kmaw community. Also this pattern is evident in Colchester, Cumberland, Pictou, Guysborough and Yarmouth counties, where the remains of Mi'kmaw settlements or communities today are near patches of known black ash.

This is also supported near Charlotte Lake in 1818, where ash was identified as well as signs of a Mi'kmaw settlement. Areas such as Yarmouth County in 1912 were found to have black ash through forest inventories, and today black ash is still located in the county, although the exact location is not known (Martin 2003). Many Mi'kmaw settlements were located in this county. Since settlement would take place near to areas with needed supplies, it makes sense that both are located in this area.

2.5.2 Black Ash Distribution – From 1801 to Present in Nova Scotia

When analyzing data on the distribution from 1801 to present, it is evident that black ash habitat has not changed greatly during this time. Locations of black ash, when discussed, describe a wet area as either swamp, bog, or alongside rivers and other waterways. The description of habitat has remained the same throughout the last 200 years. However, it cannot be assumed that this has been or is the preferred habitat of black ash. There is no known documentation of black ash habitat prior to the 19th century, therefore it is not known what black ash distribution or abundance was prior to the 19th century in Nova Scotia. Changes began to the Nova Scotia environment much earlier, as far back as the 17th century, with timber being harvested for agriculture, lumber and fuel wood. With these alterations to the landscape of Nova Scotia, many changes could have occurred in the abundance and distribution of black ash. Without any documentation of what was harvested and where, we are left to assume that black ash has always preferred wet, boggy areas, when that may not be entirely true. The answer to this question cannot be determined with any certainty from my research.

The archival sources suggest, however, that the distribution of black ash has fluctuated during the last 200 years from 1801 to present. For example, in the early 20th century, black ash was known to be located in swamps in Yarmouth County. Yet, inventories completed in the 1950's show no black ash in this county. Through inventories and pollen analysis black ash has been located in areas that it is no longer found, such as Halifax County for example. Evidence of black ash was found in the Sambro area, which today has no known locations of black ash (Livingstone 1958). The cause of the loss of black ash in this area is not known, but it can be speculated that both commercial and residential growth played a vital role in the decline of black ash.

In some areas, black ash continues to inhabit the area, but the abundance of ash has decreased. This is evident in Colchester county were in the1960's black ash was described as being located along slow moving rivers in Colchester county. To date, only one location of black ash has been found, and it contains only two trees. Other rivers which were surveyed, including the Salmon River and other small rivers feeding into it, revealed no stands of black ash. This sharp decline in the amount of black ash may be due to the influences of agriculture on this region. Riparian zones, which may have contained black ash, were preferred sites for the development of agricultural areas (Cronon 1983). The loss of this habitat may have taken with it significant amounts of black ash. It is not known how much black ash may has been harvested, if any, as records were not kept as to what species were removed, nor were there forest inventories for these areas with detailed accounts on the population of black ash.

Through analyzing the abundance of black ash, it is evident that black ash was located in much higher volume than what is found today. Its distribution throughout the province, however, seems to have remained stationary, being located in wet areas or along rivers and/or streams.

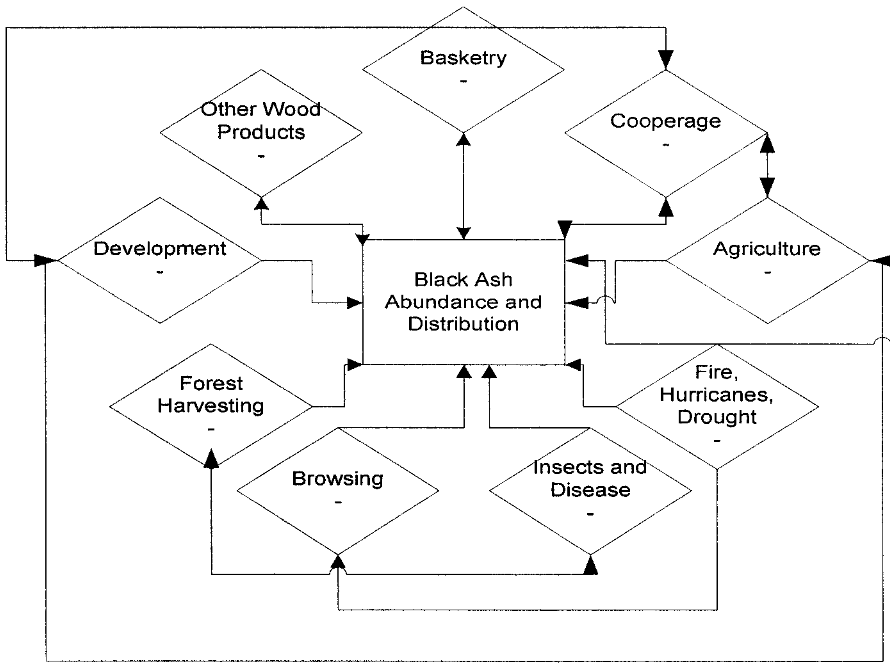
2.5.3.1 A Comparison of Abundance – 1950's to 1990's

With the percentage of hardwood numbers supplied from those surveys completed in the 1950's surveys and those in the 1990's, we can get a view of the change in species for nearly 40 years. In the 1950's black ash was 0.13% of the hardwood in the province. However, in the 1990's, black ash dropped to 0.006% of the hardwood in the province. This is nearly 20 times less black ash than was found in the province only 40 years earlier.

These inventories are not possibly completely inclusive of all possible black ash in Nova Scotia during the last two centuries. Many of these studies were not completed for the entire province, or were restricted to observations made only from roadways. These inventories therefore should be considered a glimpse at what black ash populations were during these times. Techniques chosen and possible error and omissions in data collection do not let them paint a clear and concise picture of the exact condition of black ash abundance and distribution.

2.5.3.2 Factors Affecting the Change in Abundance and Distribution of Black Ash from Early 19th Century to Present

Figure 14: Flowchart depicting the relationship between the distribution and abundance of black ash and the causes/effects thereof.



The above chart depicts the possible negative relationships between the current and historical condition of black ash in Nova Scotia and the main causes/effects of the alterations in their condition. The abundance and distribution of black ash has been affected by and has affected different variables, with the above relationships not being one-sided, but multi-dimensional.

For example, basketry affected the abundance of black ash in Nova Scotia, and in turn, black ash abundance affected basket making. There were/are, however, several other variables which have directly affected the condition of black ash. As the diagram shows, insects and disease, stand history, agriculture, development, cooperage and the growth of the craft industry in general have all in some way affected the condition of black ash in Nova Scotia. This diagram clearly shows how all of these variables have affected black ash and each other. Agriculture, for example, itself affected black ash habitat directly through the clearing of land, but also affected the species indirectly through cooperage (needed for the storage and shipment of agricultural products). Also, replanting has been included as one positive effect on black ash, with various organizations working towards replenishing black ash in Nova Scotia.

Agriculture, both residential and commercial development and cooperage may have had the most significant effects on the condition of black ash, and on other factors affecting black ash. Cooperage was in response to agriculture and fisheries, for the shipment of items harvested. Cooperage in turn not only affected the amount of black ash available, but also the level of development and increased revenue from trade (in barrels) aided in development of the colonies (and later province's) economy.

2.5.3.3 Cooperage – A Drain on Black Ash Abundance?

The one use of black ash and/or ash in general that is moderately well documented is that of cooperage. Through analysis of shipping records and cooperage listings, it is evident that barrel making in Nova Scotia was at one time quite a significant industry. As detailed in tables 4 through 8, the primary product for these barrels was aquaculture species and/or their byproducts.

Cooperages produced a tremendously large number of barrels to support the export industry. Tens of thousands of barrels were leaving the port of Halifax alone to many countries including the United States, Britain, Foreign West Indies, Bermuda and

Bahamas. Even through economic depressions which plagued not only North America but abroad, product continued to be exported. Post confederation and as Nova Scotia continued to experience its shift towards urbanization, exporting from the port of Halifax only intensified. Table 8 depicts this shift clearly. In 1888 only 32088 barrels of fish were exported. By 1894, that number had increased nearly three fold to 92273. By the end of the 19th century, this number had decreased to 52897, still nearly double the amount in 1888. This demonstrates the tenacity and vigor of the aquaculture export economy in Nova Scotia and in turn its reliance on barrel production in Nova Scotia. The writings of Titus Smith provide the knowledge that black ash was specifically selected in barrel production. From Smith's writings and the awareness of the growing intensity of exportation and therefore cooperage, it can be suspected that the utilization of black ash would have had the potential to be tremendous. To add all the variables together, it becomes apparent the potential adverse affects not only the abundance but the distribution of black ash in Nova Scotia. Given that development occurred greatly along waterways, the potential draw on black ash may have been elevated. Not wanting to travel great distances to gather materials for barrel production, local commodities would have been harvested with the exact amount of black ash used unknown.

Cooperage not only involved the production of staves, but also the hoops which held the staves together to form the actual barrel. Trees were cut at 2.5 cm in diameter and split in half to produce these hoops. These young black ash would have in effect been taken in their infancy along with the larger, more established trees for stave production. Neither small nor large black ash would have been spared. This can be seen as potentially significant when considering the recorded concerns over the volume of ash both before and after this high amount of barrel production. This is detailed in the letter to government, as found in the Acadian recorder in 1849, detailed the concern of Mi'kmaq with regards to ash (Gesner 1849b). Ash was becoming hard to find, and these individuals felt it important enough to bring to the attention of government. This concern for ash thus began well before the boom in cooperage in Nova Scotia and the reduction in the abundance of black ash continued into the 1880's. Mi'kmaq found the need to travel to find trees suitable for basket making (Whitehead 1980). If ash populations in Nova Scotia were already beginning to decline due to development and agriculture, it can be seen how coopering would have further aggravated an already taxed resource.

The available records on cooperage do not include the exact numbers of barrels produced by the Mi'kmaq of Nova Scotia however Mi'kmaq did participate in the cooperage industry. Because of the Mi'kmaq knowledge of black ash physical properties from basket making, it is possible that they would have also relied on this species for the production of barrels. There is no evidence, however, to support this hypothesis.

International Cooperage Company of Canada Ltd. was the largest cooperage operating in the province of Nova SCotia. According to Johnson (1986) production took place in Grand Pré (Kings County), Ellershouse (Hants County), Falmouth (Hants County), Bear River (Digby County), Princedale (Annapolis County) and South Brookfield (Queens County). All of these locations except Grand Pre are in counties which are known today to contain patches of black ash. In some cases, such as Princedale, the location of the operation is less than 10 km from where black ash stands today. In the case of South Brookfield, black ash was noted there as far back as 1801 (Smith 1802a).

2.5.3.4 The Effects of Agriculture and Twentieth Century Development

Since the settlement of Europeans after contact in Nova Scotia, the landscape has undergone significant changes not only in appearance, but also in land fertility and use. Through the clearing of lands for agriculture, settlement and timber harvest that to some degree affected black ash habitat and distribution. Considering the general areas in to which settlers were drawn, marshlands and Mi'kmaw settlements, it is evident that black ash would have been available nearby to many of these Mi'kmaw settlements, as well as located in or nearby wet areas. Although it is not possible to place a numerical value on the abundance of black ash prior to settlement and the introduction of agriculture or the amount destroyed/removed during this transformation, it can be argued that agriculture did indeed have an affect on black ash abundance and its distribution.

Agriculture also indirectly affected the volume of black ash in the province through cooperage. Many products such as fish, fish products, apples and potatoes were shipped from the province in barrels. From the 19th century to the 1950's (Johnson 1986). Not only did agriculture production and settlement take place on ideal black ash habitat, but those agricultural products being harvested needed storage, and found that in barrels, potentially produced from ash.

2.5.3.5 Black Ash Today in Nova Scotia

Through the status survey of black as in Nova Scotia through the First Nations Forestry Program and through this study, it was clear that black ash continues to occupy poorly drained wet areas, in swamps and/or along waterways in Nova Scotia. It was interesting to note that the majority of the sites were located in protected, no-cut zones.

When examining the survey data collected on the condition of black ash today, it is evident that we are indeed lacking in sufficient numbers of basket quality black ash. Many of the trees were not of a large enough diameter to be considered for basket making, or did not have the desired physical traits. Such characteristics as main stem twisting, large knots and scars prevented many trees of sufficient diameter to be considered as basket making quality.

In regards to the general health of the trees, the only major concern during the surveys was that of heart rot and dieback. Though this study only examined two years of dieback levels, it was clear from them that the mean level of dieback decreased from 2001 to 2002 (Figure 6 to Figure 12). It is not known what the initial cause of the dieback was, but it is hoped that this reduction in dieback will continue in future years. By further surveying, it will be possible to determine if this trend will continue.

The incidence and intensity of heart rot in black ash for Nova Scotia is unknown but it is present in sufficient numbers of trees samples to stop taking core samples. Sampling of the trees was halted due to concerns about killing the trees and/or spreading the infection. Because sampling was halted, the exact infection rate is not known. Future research should be completed to determine to what extent this threat is to the black ash of Nova Scotia.

2.5.4. The Effect of Abundance and Distribution of Black Ash on its Use from Early 19th century to Present by the Mi'kmaq of Nova Scotia

2.5.4.1 The Evolution of Basketry

When speaking with a basket maker and elder, it has become evident that basketry has not remained a skill without change, without evolution. From the production of pre-contact woven bags and birch bark baskets to splint basketry, it is clear that the practice of basket making has not remained stagnant. The background on Mi'kmaw basketry suggests that there have been two main influences on the evolution of basket making: the reduction of tree species, specific to various types of basket production, and the changing market involving basket making (both during the initial settlement of Nova Scotia for agriculture and again during the urban migration of the late 19th and early 20th centuries).

The reduction in abundance of both white birch and ash, have lead to new forms of basket making, allowing this occupational method to remain viable. As birch became less prevalent, basket making moved to splint basketry, using predominantly black ash. As the abundance of black ash decreased in Nova Scotia, basketry shifted its focus to fancy baskets and flowers, made from a variety of tree species. Today, basket makers are experimenting with new types of decorative baskets, made from a variety of new woods, including cherry and oak. These new woods are being used to present new texture and colour, in new products for sale.

This transition has gone hand in hand with the transition of the marketplace in Nova Scotia. Prior to contact, baskets were made more for individual/household use and storage. Post contact, with the development of agriculture, basketry moved towards splint baskets, which were sold in large quantities for not only agriculture but for use around home and farm. As black ash became more difficult to find and the marketplace in Nova Scotia also moved from a rural, agricultural based economy to that of a more urban, tourism-driven economy. The need for many types of baskets decreased greatly and basketry then began to move again towards decorative baskets and wooden flowers. These items were much smaller, for decorative purposes only, and could be made from the variety of woods available. This shift as we move into the future has aided in the maintenance of basketry as an economically viable part of material culture.

2.6 Conclusion

Through inventories and discussions with a basket maker, it is known that black ash had been found throughout most of the province of Nova Scotia. This species not only supported the Mi'kmaw basket industry, but also was used utilized in a variety of industries and crafts, including barrel making. The concern over black ash is not new, since documentation as far back as the middle 19th century shows Mi'kmaq concern for this species.

Black ash has been utilized in more that just one way, by more than just one group of individuals. The information that is available on the condition of black ash, over time, provides a picture of the effects on black ash by not one industry/organism but that of many. Black ash has been affected by settlement, agriculture, cooperage, the harvesting of timber and more recently, housing development. All of these have played a part in the present day condition of black ash in Nova Scotia. It is ironic that today black ash populations have declined much like those of fish stocks, the contents of many of those barrels leaving Nova Scotia in the 19th and early 20th century.

Although black ash condition has been affected throughout the last two hundred years, it has not stopped the art of basket making. The loss of locally available black ash has only encouraged further evolution of basketry, with the result that basketry is maintaining its place in Mi'kmaw culture.

Chapter 3: Analysis of Seed Production and Possible Germination/Regeneration Techniques for the Replenishment of Black Ash

3.1 Abstract

The population of black ash (*Fraxinus nigra* Marsh.) trees in Nova Scotia is extremely low. Few trees are suitable for Mi'kmaw splint basketry. In examining the surveyed trees, little sexual regeneration was noted in the vicinity of trees, although vegetation reproduction was noted in several trees with terminal branch damage through the production of one or more sprouts. In an attempt to assist the regeneration of black ash in the province, several germination techniques using both stem cuttings and seed were analyzed to determine which technique(s) would be the most suitable. Tissue culturing of excised seed, double stratification and stem cutting propagation were analyzed. Double stratification was inexpensive and required little labour, but had a 50% lower success rate than tissue culturing. The propagation of stem cuttings was eliminated as a potential means as it was expensive, labour intensive, and had an extremely low success rate. Tissue culturing of excised embryos was found to not only have the highest success rate but also the lowest overall cost per germinate. It is recommended that for province wide replanting programs in Nova Scotia tissue culturing of excised embryos be utilized.

3.2 Introduction

During the 1990's the First Nations Forestry Program – Nova Scotia was approached by the chiefs and council of the Mi'kmaq of Nova Scotia to inquire into the condition of black ash (*Fraxinus nigra* Marsh.) trees in Nova Scotia. Community members were at a loss to explain the disappearance of black ash in Nova Scotia, and requested the aid of the First Nations Forestry Program – Nova Scotia to look into this decline and to develop a replanting program.

Through the production of pamphlets for the identification of black ash, and many other efforts to draw the public's attention, First Nations Forestry Program – Nova Scotia was able to identify fewer than 400 trees in the province. As part of a province wide black ash location and status program, a survey was completed on the general condition and health of the trees. This program was also established to locate possible seed sources for collection and germination and a reestablishment program. This information was completed in 2000 and 2001, with new data collection in 2003 as part of this project.

Data on the amount of seed collected and observed from 1998 to 2001 will give insight into the amount of seed production in Nova Scotia. Several germination techniques will be analyzed to determine their suitability for replanting programs. The purpose of this project is evaluate several germination/replenishment technique(s) using either sexual or vegetative reproduction to determine which would be the most effective in repopulating black ash in Nova Scotia.

3.3 Materials and Methods

3.3.1 Germination Techniques

The following are techniques which have been used in the germination of black ash seed and one technique used in the propagation of stem cuttings of another species of ash, European ash (*Fraxinus excelsior*). The techniques will be compared for their labour involved, cost of production, and success rate to determine which techniques(s) would be most beneficial in black ash replenishment projects in Nova Scotia. Germinates are defined as the emergence of a seedling from either the germination of a seed or sprouting from excised material.

Double Stratification

Seed was collected by individuals from the Department of Natural Resources, Debert near Wentworth and Nappan in Cumberland County in 1998 and 1999. These seeds were collected during years in which it was extremely difficult to find black ash seed, so seeds were collected from only one tree in each site. Three hundred seeds were collected total, each year. Double stratification, the suspension of seed in moist peat (75% moisture rate) or sand for both calculated warm (four months), and then cold periods (five to six months) to break seed dormancy was then used. Seed was collected early in the season, with collection directly from the tree. This seed was then sown as quickly as possible. This would ensure that the seeds could be placed outside before October 15th, the last desirable date to have them placed under cool conditions. The main concern was to ensure the seed was fresh and viable.

The seeds were stratified in moist sand at room temperature. This involved placing the seeds amongst layers of moist sand, where they would be covered with opaque plastic and remain for 60 days at a temperature of 20°C, then covered with black plastic and placed outside (in a cold frame) under cool temperatures for 120 days. The seeds were then double sown (two seeds per tube in the trays) into solid wall container trays and placed in the greenhouse. From this germination in the greenhouse, 20% of the seeds would germinate. These germinates were then removed and planted into individual pots. The remaining seeds were then covered with a black sheet of plastic and placed outside in cool weather for 120 days. After completion of the 120 days of cold, the containers where then brought back into the greenhouse for another four months, where from the total seed, another 30% of the 300 seeds germinated, with roughly 150 seedlings being produced total for a success rate of fifty percent (Frame 2003).

Tissue Culturing of Seed

Black ash seed was obtained from Southeastern Manitoba for germination in growth media at the Nova Scotia Agricultural College by Dr. Tom Smith. The seeds were dewinged and soaked for 24 hours in sterile water. The seeds were then rinsed, washed in 70% ethyl alcohol for one minute and then placed in 50ml jars with a solution of 33% bleach in which they were shaken for 20 minutes. They were washed three more times in sterile water and then removed from the cassettes (devices used to contain samples during the sterilization process). The ends were then cut off the seed and the embryo was removed. The excised embryos were placed vertically and were fully covered and afterward placed in growth chambers. Upon the development of a sufficient root structure, the plants were placed in Quoirin and Lepoivre plant media. After the development of sufficient leaf growth, they were placed in mist beds. While in the mist beds, the leaves were protected from mist droplets, as it was found that direct contact with water to the leaves resulted in death. After one month they were transferred to the greenhouse (Smith et al 2000).

It was found that the excised embryos did indeed grow in the growth media, with only 21 days from the beginning of the process to placing the trees in the greenhouse. This time period was extremely short, with a success rate of 100% for all thirty-two seeds.

Micropropagation of Stem Cuttings

Silveira and Cottingneis (1994) detail a method of rooting sprouts from stem cuttings of European ash (*Fraxinus excelsior)* with a success rate of 6%. Since this species is closely related to black ash, this method is of great interest to regeneration projects in Nova Scotia. The following is taken from their methods.

Stem cuttings were collected in the months of January to March, during the dormant stage. These cuttings were 50 to 60 mm in length, containing an apical bud and two sets of axillary buds. The winter dormancy of these stems was then broken through the use of a 38°C water bath to increase temperature. They were then sterilized in a solution of mercurobutol (0.01g) and sodium lauryl sulfate (4.08g) in 100 ml aqueous solution for 40 minutes, followed by a 40 minute soak in calcium hypochlorite (9%). The explanted tissue was then inoculated into tubes with woody plant medium, covered and grown in 21°C at 80% humidity in a 16 hour photoperiod.

On day 15, the apical bud sprout was detached and transferred to woody plant medium with the axillary buds being removed. On day 45, the shoot tips were removed and transferred to woody plant medium with 6-benzylaminopurine and indole-3-butyric acid. Day 75, the callus was removed from the base and the explants were moved to rooting medium, without growth regulators. On the 105^{th} day, the first 4mm of roots were excised to promote rooting and each explant was transferred to a pot with sterilized peat-perlite-vermiculite soil with 40ml of one-half strength woody plant medium. The pots were enclosed and grown under greenhouse conditions with 80% humidity, 17 °C, with 16hours of light. The pots were uncovered for a longer period of time each day, until acclimatized on day 135 (Silveira and Cottignies 1994).

3.4 Results

Seed Production and Harvesting in Nova Scotia – 1998 to 2002

The following table depicts the amount of seed found on surveyed black ash in Nova Scotia from 1998 to 2002. It was not possible to count each seed as some of these trees had seed which was not accessible, and visual estimates were taken on the amount of seed present, based on the seed numbers from other trees in the area. Remnants (such as stems remaining from seed clusters) were recorded to determine which trees had left evidence of seed production in the past.

Table 12: The number of seeds produced yearly in Nova Scotia on surveyed black ash trees from 1998 to 2001

Site	1998	1999	2000	2001
Queens County #1				1500
Cape Breton#1				2
Annapolis County #1				remnants
Queens County #3				30
Annapolis County #2			56	500
Cumberland County #2	150	150	200	remnants
Cumberland County #3	150	150		
Yearly Total	300	300	256	2032
Average of Yearly Totals				722/yr

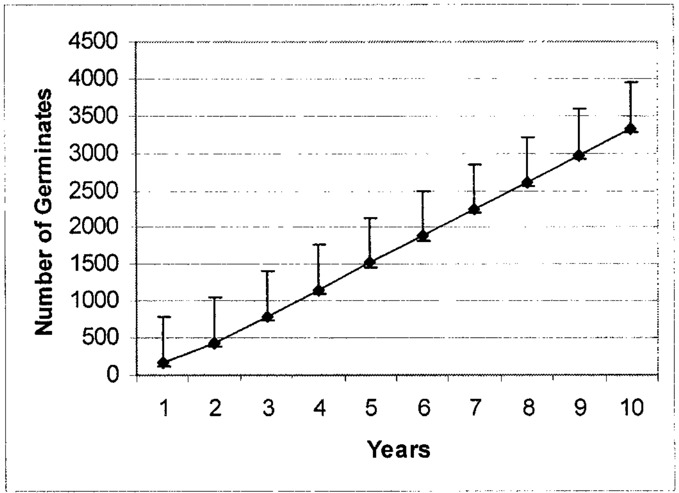
3.4.1 Potential Regeneration in Nova Scotia – A Comparison of Methods

The following graphs show the potential amount of germinates produced from each of the three regeneration methods and their respective success rates. Those methods using seeds are based on the average seed production each year, and also show the possible high and low levels of seed production. Although seed production of black ash rotates in 1 to 8 year cycles, it is not entirely clear from year to year what the seed production level will be (Erdmann et al 1987).

The amount of germinates from the double stratification method was calculated using data obtained from the Department of Natural Resources study. Using the germination success rate of 50% (20% first year and 30% in the second year for a total success rate of 50%), the average amount of cumulative germinates was calculated for 10 years in Nova Scotia. This was calculated using the average amount of seed produced each year on surveyed black ash of 722 seeds. The minimum and maximum seed production was also taken from black ash surveyed in the province.

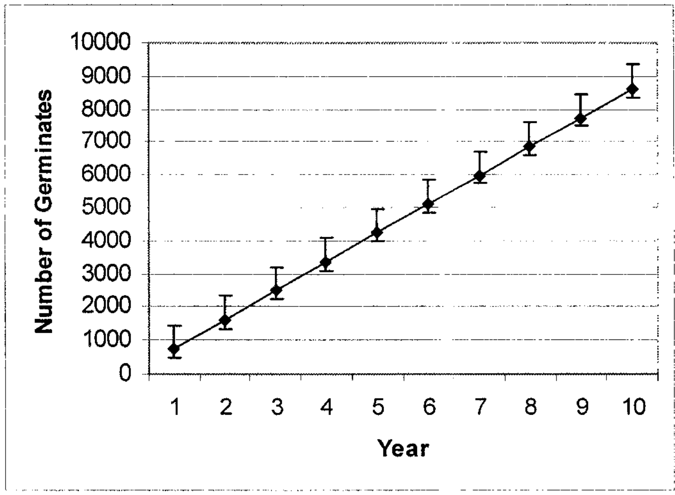
The amount of germinates increases and decreases each year due to the success rate of germinates, which fluctuates from 20 to 30%, depending on the current position of germination (each year would have both 20% germination with new seed and 30% germination from the previous years seed). After completing the two year cycle, seed which has not germinated will be discarded. The projected number of germinates was calculated over a period of ten years cumulative, to show the potential total number of black ash seedlings which could be produced in Nova Scotia. The minimum and maximum seed production was also calculated to show possible fluctuations in potential germinates over ten years.

Figure 15: The potential cumulative average amount of black ash germinates in Nova Scotia for the next 10 years using the double stratification method including minimum and maximum potential germinates.



The cumulative average number of germinates that could be produced in Nova Scotia over the next ten years with tissue culturing was calculated using the average seed amounts produced in Nova Scotia (722 seeds), with a success rate of 100% as found in Smith et al (2000). The minimum (256 seeds) and maximum (2046 seeds) germinates are also included, to give insight into the possible lows and highs of germination numbers using this method. The minimum and maximum lines were determined using the germination success rate for both the minimum and maximum amount of seed expected each year, to display the potential maximum and minimum production for each year.

Figure 16: The Potential Average Amount of Black Ash Germinates in Nova Scotia cumulative for the Next 10 Years Using the Tissue Culture Method including minimum and maximum potential cumulative germinates.



The average cumulative amount of germinates was calculated over 10 years cumulative and based on the success rate found in Silveira and Cottingnies (1994). The average amount was calculated based on the collection of 100 stem cuttings each year, with fifty trees sampled each year, with two stem cuttings each. One-hundred cuttings on 50 trees were selected as it was thought to be a manageable number to work with and would allow at least a year between the collections of each tree.

Figure 17: The potential average cumulative amount of black ash germinates in Nova Scotia for the next 10 years using the micropropagation of stem cuttings technique.

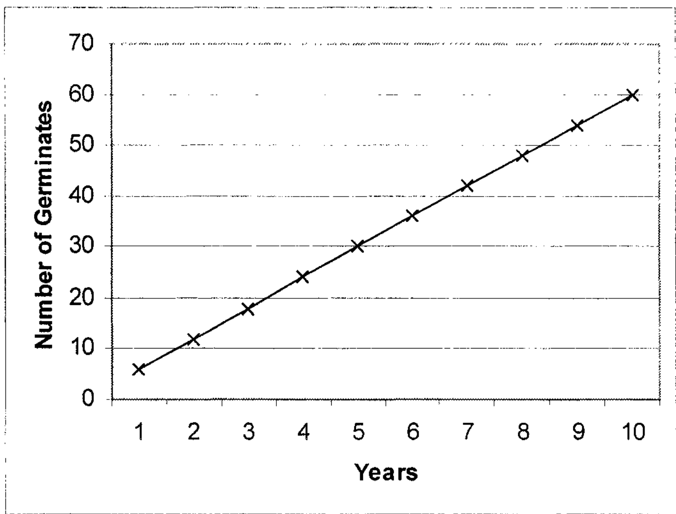
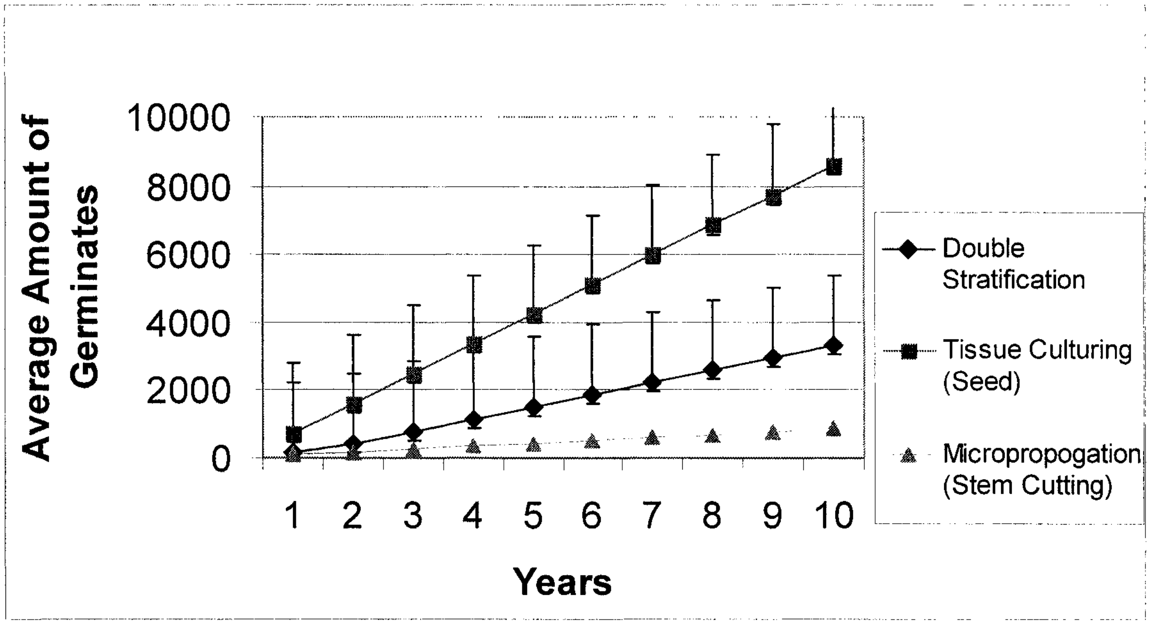


Figure 18: Comparison of the three regeneration techniques over 10 years in Nova Scotia.

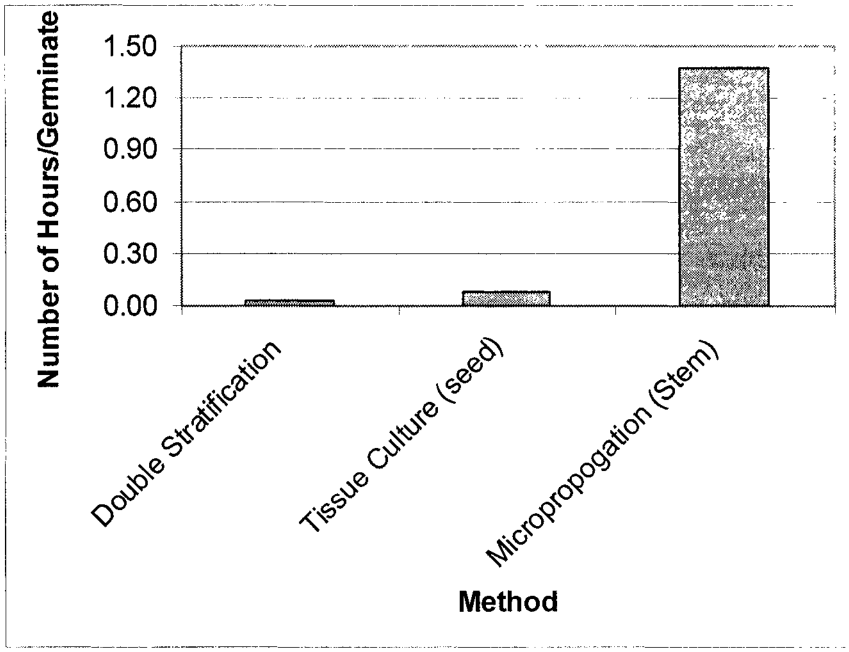


3.4.2 Labour

The amount of labour required for each method was determined by examining the number of weeks each method required and then breaking down the amount of actual lab or field work into hours. This was calculated based on the assumption that there would be one person responsible for completing the work for each method. The amount of labour needed for the collection of seed was not included, as this would alternate by the year, and the amount of seed production.

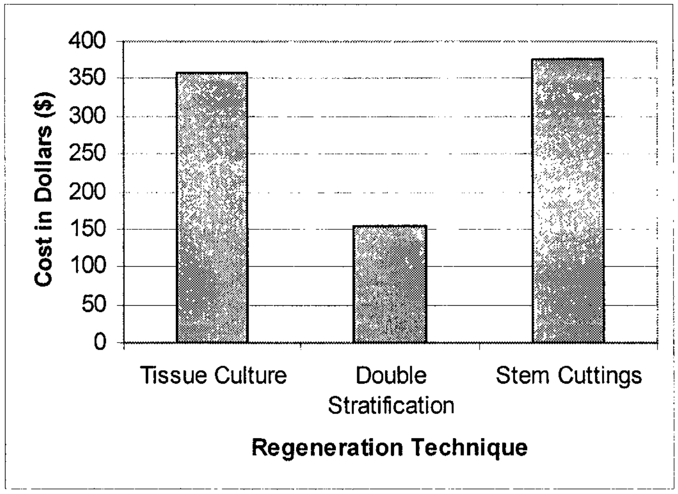
Double stratification, tissue culture and stem cutting methods were calculated to need 26, 3 and 19 weeks respectively. Double stratification required very little labour, for a total of five hours, leading to a total of 0.03 hours per germinate. Tissue culturing took a total of 3 weeks, with work being completed on a part-time basis, and therefore calculated at 60 hours, for a total of 0.08 hours per germinate. Stem cutting took 19 weeks, with an estimate of 120 hours of labour for 1.38 hours per germinate.

Figure 19: Comparison of the amount of labour per actual black ash germinates for each of the three possible techniques.



3.4.3 Cost

Figure 20: The average cost each year for supplies and equipment for each regeneration technique total.



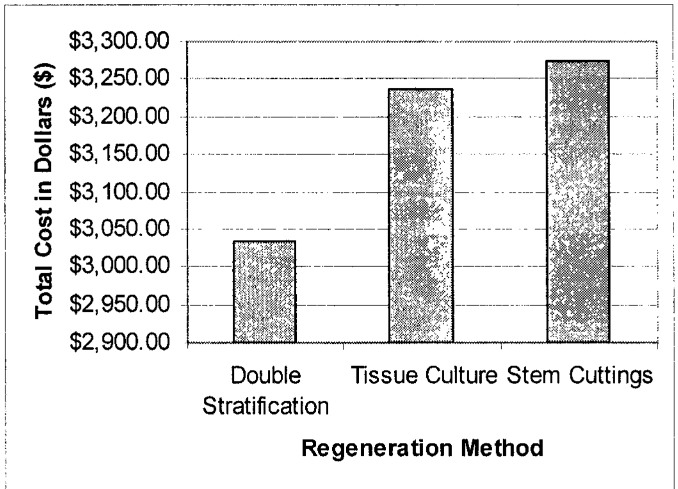
The average cost per year for supplies and equipment was calculated based on current costs in Canada. This consisted of chemicals, media, soil, pots and other supplies such as plastic for the double stratification technique. These are on-going costs, which would be incurred yearly.

Table 13: The total cost of supplies for each technique.

Tissue Culture	Cost (CAD)
MS Medium	62.68
Gibberellic Acid	49.91
EtOH	49.91
Javex	2.30
QL Medium	62.68
Soil	57.50
Pots	73.14
TOTAL	358.12
Double Stratification	
Pots	73.14
Soil	57.50
Plastic	23.00
TOTAL	153.64
Stem Cuttings	
IBA	14.26
BAP	26.80
Sodium lauryl sulfate	64.40
Calcium hypochlorite	90.39
WPM medium	50.60
Soil	57.50
Pots	73.14
TOTAL	377.09

There were other expenditures necessary for all of the techniques that were not included in these calculations. These included greenhouse space, growth chambers and cold frame storage. These items are extremely expensive with regards to start up costs and would increase the cost per technique by thousands of dollars. However, there is a viable alternative in the partnership with government or educational facilities such as at the Nova Scotia Agricultural College. Many of these institutions will partner with research/regeneration projects by donating space, such as in greenhouses. Growth chambers, mist beds and greenhouse space would be available through such partnerships for tissue culturing, as well as greenhouse space for double stratification and growth chambers and greenhouse space for the stem cutting technique.

Figure 21: The total cost for each regeneration technique for one year including chemicals, supplies and sample collection for the average germination amount each year.



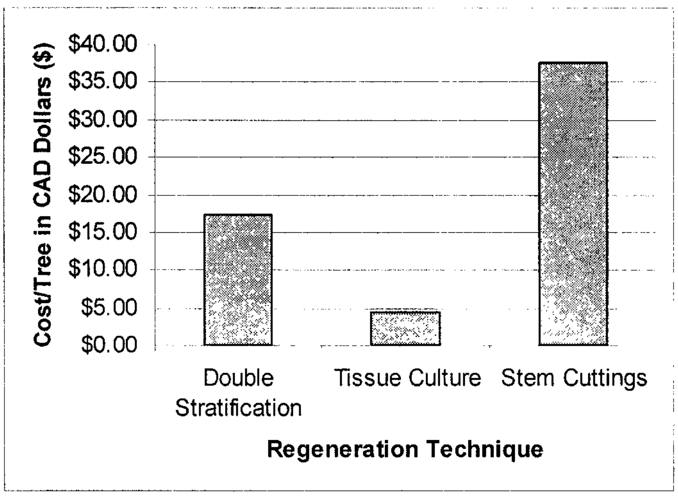
The cost of each regeneration technique for one year includes the cost of equipment and supplies for the year, the assumption that such necessities as greenhouse and growth chamber space would be arranged for free with a partnership with a research institution and the actual cost of the collection of seed and/or stem cuttings.

The cost of collection of seed and/or stem cuttings includes labour, mileage, hotel and the necessary tools and equipment (i.e. pole pruners, cooler for keeping stem cuttings cold). The cost for collection is high mainly due to the distance between the various sites in Nova Scotia. Sites in the Annapolis Valley are almost an eight hour drive from those in Cape Breton and since all sites would have to be visited each year to ensure all possible seed produced that year was collected, costs would be high.

Table 14: The total cost for sample collection for each technique in Nova Scotia.

Item	Amount	Cost	Total	Double Stratification	Tissue Culture	Stem Cuttings
Mileage	1800km	0.35/km	$630.00	$630.00	$630.00	$630.00
Hotel	2 rooms/4 nights	$100.00/night	$800.00	$800.00	$800.00	$800.00
Labour	2*5days@8 hours	$16.00/hr	$800.00	$800.00	$800.00	$800.00
Tools	Electric cooler	$109.00	$125.35			$125.35
Pruners	2 sets	$22.50	$51.75			$51.75
Pole Pruners	1 set = 24 feet	$139.00	$159.85	$159.85	$159.85	
Paper Bags	1 Box	$10.00	$10.00	$10.00	$10.00	$10.00
Total				$2399.85	$2399.85	$2417.10

Figure 22: The total cost per tree for each regeneration technique based on current costs.



The total cost per tree was calculated using the total cost of collection of the needed seed or stem cuttings and supplies. This was then compared to the average amount of germinates expected each year to get total cost per germinate.

3.4.4 Cost Comparison

Black ash seedlings can be purchased through several nurseries across Canada. Jefferies Nursery in Manitoba Canada offers black ash at $15.00/tree (one meter plus in height) when purchased wholesale lots of 100 trees. Old Ridge nursery in New Brunswick also produces black ash at a cost of $12.50 per tree (Smith 2004). The cost of these trees is comparable to the total cost per germinate in Nova Scotia. Of course, the nursery prices include a mark-up for profit by these businesses, so actual production costs would be lower than the actual cost per tree. Acquiring black ash seedlings, seed or other material from out of Province was not considered for this project. At the request of the Chief and Council of Mi'kmaq First Nation, importing black ash was temporarily not considered, as no data as to the differences genetically from region to region were available and therefore it was not know what effect these imports may have on the genetic stock native to Nova Scotia. Also, black ash identified at one location in Cumberland County would be excluded from any regeneration programs, as these black ash have signs of hybridization, appearing to be black ash, with the morphological characteristics of other species of ash.

3.5 Discussion

Pros/Cons of Regeneration Techniques

For each method of germination, there are both positive and negative aspects to consider. These must be measured before determining the most appropriate method of black ash regeneration in the Province.

3.5.1 Location of Seed/Tissue Collection vs. Seedling Planting – Issues and Concerns

Alexander et al (1984) found that the cold-hardiness of white ash (*Fraxinus americana)* was related to the latitude of the tree. Through analyzing white ash from both Northern and Southern Michigan, they found that there was a difference between the areas, with Northern white ash having a higher tolerance to cold temperatures. There was found to be a difference of nearly 10 °C between the killing temperatures for the two sites.

No literature was available on whether this is also a relevant concern for black ash, or in particular, black ash in Nova Scotia. However, seeds collected from Cumberland County by the Department of Natural Resources were germinated and planted throughout the Province in Pictou, Colchester, Annapolis and Cape Breton Counties in 2000 (Hudson 2003). The majority of these seedlings are still growing in these counties with some death believed to be related to browsing.

3.5.2 Genetic Considerations

To responsibly restore the population of black ash through regeneration techniques, genetics of the parent stock must be considered. To refrain from doing so, could lead to the production of genetically impaired stock, which should be avoided at all cost.

Savill et al (1999) discuss how European ash was found to have strong heritability in both branching and height, with low heritability in regards to forking and straightness. Since European ash is related quite closely to black ash, one can assume that the heritable variables may be similar between the two species (Jeandroz et al 1997). With this in mind, parent stock for any of the regeneration techniques should be chosen wisely. Trees with reduced branching and height therefore could be avoided.

3.5.3 Labour and Cost

The micropropagation technique detailed by Silveira and Cottignies (1994) does not only have the lowest success rate, it is also the method with the highest cost per germinate and the highest demands on labour.

The tissue culture of seeds and the double stratification methods are much less labour intensive and can be completed on a completely part-time basis, as discovered during the testing of these methods at the Nova Scotia Agricultural College and the Department of Natural Resources respectively.

The majority of the cost in double stratification is from the cost of actual seed collection. Other costs, regarding supplies are low. Pots, plastic and soil are relatively inexpensive. The cost of this method also remains low due to the ability of obtaining both greenhouse and cold frame space from institutions on a research partnership basis. To build and design greenhouses and cold frames specifically for the germination of black ash would not be cost effective. Therefore partnering with an institution with these resources would be the most cost effective practice.

If selecting a method based solely on cost and labour, tissue culturing would be the method of choice, followed by double stratification and stem propagation.

3.5.4 Poor Seed Viability

The threat of collecting black ash seed before appropriate germination time is very real. As was found in the Scott and Stewart trials (2003), black ash seed which was green and viable did not have a high success rate considering that this seed had the highest amounts of embryos present in the seed. There are several methods in which to combat this potential problem.

The use of tarps is one method of collecting seeds after ripening. As described in Benedict and David (2000), tarps can be placed around black ash trees. These tarps can then be checked regularly, and seed removed. The seed drop when ripe, therefore ensuring any seed collected this way will most likely be ripened sufficiently. These tarps would be easily set up in seed collection areas in Nova Scotia with the landowner's permission. These tarps are also relatively inexpensive, but highly effective.

The only possible concern with the use of tarps to collect seed on the ground would be the possible ingestion of seed by mice and other small mammals. Hulme and Hunt (1999) found that small mammals consumed the seed of European Ash (Fraxinus excelsior). This was found to be particularly true of the wood mouse (*Apodemus sylvaticus).* The literature does not indicate if the collection of seed through tarp methods would have to be also be monitored for browsing from birds and small mammals.

Benedict and David (2000) also discuss the assessment of elevation in relation to the ripening of seed. They found that seed in higher elevations ripened and were released at a later date than lower elevation areas. Therefore, seed collection areas could be assessed in the province, through the use of a topographical map, to aid in predicting the time in which seeds will ripen. Seed ripening occurs from September to October in Nova Scotia. This method will help determine which sites should be assessed in September, and which should be left until October.

3.5.5 Variables Affecting Success after Germination

Growth Conditions

After the production of germinates in any of the techniques, time must be spent preparing the young seedlings for their placement in the outdoors. Time must be given to the young seedlings to grow and become strong enough to be placed into a natural environment, with the ability to survive the many elements working against their survival, such as extreme cold, browsing, etc.

Bridgen and Benedict (1995) completed a trial from 1992 to 1994 assessing the effect of extended photoperiod on black ash seedlings in New York State, U.S.A. Black ash seedlings were planted both in a field nursery and placed in growth chambers with a 1000 watt metal halide lamp for four months. The seedlings in the growth chambers were then refrigerated for six months, and then placed back into growth chamber conditions for another two months.

When the seedlings from the growth chambers were compared to those having been planted in a nursery field, the seedlings grown in growth chamber conditions were 2 ½ times larger than those trees placed directly into the field. Also, they noted that those seedlings grown under growth chamber conditions had additional leaves, which were larger in size, with larger buds than the open field grown seedlings. The use of this method of growing black ash under the growth chamber conditions would not only provide larger seedlings, it would increase their chance for survival. Being larger in size, they would be able to establish themselves better when planted in their final destination and best of all, would produce mature trees at a faster rate than planting seedlings without this size advantage. However, concern for the root structure of these seedlings may be warranted as they were planted in 10 cm pots. These pots could be responsible for the restriction of root growth and the negative morphological effects from doing so. To prevent the possible negative consequences, care must be taken to select potting which not only supports the juvenile seedling, but enables growth and development through to the point in which it will be transplanted.

Browsing

Browsing by small and large mammals alike is a very real threat to black ash seedlings and saplings. Severe browsing was noted in seedlings which were planted from the Nova Scotia Department of Natural Resources trials (Hudson 2003). In order to combat this destruction, tree covers were placed around the trees. Plastic sheeting with roughly a one inch grid was placed around the trees and held in place with the use of a bamboo pole. These tree guards were very effective during the first two years of life, providing excellent protection from browsing deer and rabbits. Because the trees were planted in such wet areas, prints from deer hooves and rabbits were extremely visible in the wet and mud like soil around the seedlings and indicated their presence.

Browsing by deer of ash in general is not only a concern in Nova Scotia. In the Czech Republic, European ash (*Fraxinus excelsior)* was found to be browsed 100% by deer. In fenced off study areas, they determined that in 15-25 years, European ash would be one of the species dominating the stands (Modry et al 2004).

Deer may also be attracted to planted black ash seedlings for another reason. Black ash seedlings are placed in fertilized soil from germination through their growth in greenhouse conditions. This fertilized soil results in the seedlings having a higher amount of nitrogen in their tissue, when compared to unfertilized seedlings. Although the fertilizer aids in the growth of the seedlings and the excess nitrogen helps the young tree during changes in light conditions, it also attracts deer to the seedlings. Tripler et al (2002) found that *Fraxinus americana* (white ash) seedlings which were fertilized had a higher level of browsing than those not fertilized.

There are various methods to protect black ash seedlings once they are planted in the ground. As stated previously, tree shelters were used to protect the black ash seedlings planted from previous germination projects. These shelters however were limited in their effectiveness after two growing seasons. After this period, the guards became too small and restricted the growth of branches and leaves. Some branches were able to force themselves through the holes in the guarding, but were browsed off from what was suspected to be deer. The guards were then removed, to allow for the proper growth of the trees.

Tree shelters are not the only methods of deterrent to deer. Large scale fencing, hunting and repellents (both taste and smell) can also be used (Hall 2000). The success rate of these deterrents with regards to black ash is not known from literature.

Shade

Erdmann et al (1987) describes intolerant black ash as being much more tolerant of shade during the beginnings of its life with intolerance increasing with age and states that the most likely amount of sunlight needed for growth and development is between 45 and 50%.

Several methods can be implemented to ensure that the appropriate amount of light is available. Shade is not only created by large established trees, but also from competition with other seedlings and grasses. Prevention of shading from large established trees is as simple as planting seedlings in an appropriately illuminated area sufficient distance away from the larger, established trees. However, a more invasive method could be used in an attempt to control the amount of competition from grasses and other seedlings. Planting fabric can be placed in the soil surrounding black ash seedlings. This would prevent the establishment of other vegetative material in the immediate vicinity of the seedling. Therefore, the risk of shading from competition would be greatly decreased in the immediate area of the seedling.

3.5.6 Patches of Black Ash: Comparison and Differences

In European ash height and the amount of branching is heritable to a degree from the parent tree to the offspring (Savill et al 1999). It is not known if this also applies specifically to black ash also, but due to the genetic closeness of these two species of ash, it would be sensible to assume this relationship could also exist.

With this in mind, the condition of parent stock should be assessed before collection and germination methods applied to prevent genetically degraded stock. This could easily be avoided by selecting trees for harvesting with normal height and degree of branching. This can be determined by examining and comparing black ash trees located in the area and elsewhere, to determine whether a specific tree falls within the range of normalcy for this region.

If a tree seems to be growing normally under the conditions in which it is located, then harvesting of seed or stem should take place. If for some reason a tree appears to not be achieving the height and degree of branching relevant to the amount of light and environmental conditions then that tree should be removed from the collection process. This would help eliminate concerns with regards to genetic degradation.

One of the possible variables affecting the tree form is dieback. Dieback decreased from 2001 to 2002 in every patch except Cumberland County Site #2. The cause of this increase in dieback was not apparent physically, although mechanical damage would explain several areas of dead and dying crown on several trees. Nearby trees had/were rubbing against the black ash, causing the death of small patches of crown. With the noted reduction in the amount of dieback, a clearer and more accurate picture of the degree of branching will be shown and parent stock can be selected more carefully and accurately.

3.5.7 Germination Techniques – All Considerations

When comparing the success rates of the various techniques and the amount of germinates produced, the culturing of excised embryos is by far, the most effective and successful technique for the germination of black ash seedlings. This was followed by double stratification and lastly by stem cuttings.

Germinating excised embryos, the most successful method of germinating black ash from seed also had the lowest cost per tree. The cost of supplies was between that of double stratification and stem cuttings (Figure 20). These costs were mostly incurred from the cost of media and other laboratory supplies and such greenhouse staples as pots and soil. This method also was between the others for the cost of collection (which was extremely for all methods) and the amount of labour involved (Figure 19).

Double stratification, was the method with the least needed amount of labour. Also, it had the second highest success rate when compared to the other methods. Stem cuttings however needed the highest amount of labour, highest costs and the lowest success rate amongst the three methods.

3.5.8 Re-planting of Black Ash – A Plan of Action

It was known through black ash surveys that in nature, black ash has not been successful at producing offspring. This is evident from the lack of trees in the province, and the lack of seedlings/saplings in locations of black ash. This may be caused by seeds being consumed or seedlings falling victim to browsing and/or shade.

In order to prevent the premature harvesting of seed, topographic maps would be analyzed to determine the elevation of the surveyed black ash sites as described in

Benedict and David (2000). Since they found that areas with higher elevation methods released seed later than lower elevated areas, seed harvesting could be planned not only time wise, but also geographically with the aid of these maps. Areas of black ash at lower elevations could be inspected and if seed present harvested first then moving on for inspection and potential harvesting of higher elevated areas.

The use of tarps for seed collection was also mentioned as a potential method of seed collection by Benedict and David (2000). However, this method would not be plausible for the currently known locations of black ash in Nova Scotia. Many of the sites are on private land or protected areas, making getting permission to place tarps extremely difficult. Relying on these tarps to collect seed would be plausible if permission was granted from all land owners, and more importantly, if these sites were located closer together. Checking the tarps periodically during the months of September and October would be extremely expensive in both time and travel costs.

Another method of reducing the costs involved in the harvesting of cuttings and/or seed would be the recruitment of local individuals to collect needed seed and cuttings which could be shipped to the research facility for subsequent germination. However, this method of harvesting would expose the harvest to a large possible margin of error.

Through conversations with many forest technicians, forestry personnel and the interested general public, it is evident that confusion can and does exist with regards to the proper identification of black ash trees. Morphological similarities between black ash and other species of ash combined with the fact that in most cases in Nova Scotia, various species of ash are intermingled in stands, including black ash, leads to confusion with regards to which species they are observing. It was not uncommon to have leaf and seed samples sent to me from across the Province from individuals interested in locating and assisting with germination projects, only to receive the samples and to discover they were white or European ash. To minimize the probability of error in the collection of seed/stem, this method of harvesting should simply be avoided.

The most cost effective and least labour intensive method would be for harvesting seed in October, checking lower elevation areas first, moving on to higher elevation areas later in the month, as suggested by Benedict and David (2000). During this time seed may drop from the tree, but a trained eye would be able to harvest that seed from the ground.

Excising the embryo for germination in media culture was the most successful method found. Embryo culture was not only the most successful of the techniques; it was also the least expensive per tree (Figure 22). The labour involved was also manageable; with roughly 60 hours spanning three weeks from disinfecting the seed to the movement of germinates into the greenhouse. Even if it was a high seed producing year, all seed could be processed and placed in the greenhouse by the end of three weeks. This method would only take several weeks of part-time work, as compared to the other methods which take more time in the long run, over many months, as opposed to only three weeks. Had the success rate been higher and labour and costs been lower, the stem cutting technique would have been useful in those years with little to no seed production. However, the costs alone make this technique very undesirable, as the high amount of work and costs leaves the guarantee of very few germinates. Therefore this method would not be suggested for this region and for this species at this time.

In conjunction with germinating excised black ash embryos, the extended photoperiod of growing black ash seedlings in growth chambers as described in Bridgen and Benedict (1995) is also suggested. This would produce seedlings with increased height and leaf production. This would also be combined with the use of landscaping fabric to vegetative competition and tree covers, to prevent the browsing and would be planted in areas similar to those in which black ash is found today. The assurance of the implementation of these variables would greatly increase the success rate of their survival.

3.6 Conclusion

The use of tissue culturing of excised black ash embryos would be the most successful technique at producing viable germinates for replanting programs in Nova Scotia. Costs and labour are relatively low. Through the use of planting fabric to prevent vegetative competition, tree shelters to deter browsing and the planting of seedlings in open areas with full quadrants of light, seedlings will have the opportunity to establish themselves, and hopefully become healthy viable trees in the future, for not only future parent stock but for the Mi'kmaw basket making trade.

Chapter 4: Conclusion

The black ash population in Nova Scotia has been greatly affected by settlement itself and specifically through agriculture, forestry and other activities related to colonial settlement and later Canadian development. This has led to great changes in splint basketry among the Mi'kmaq of Nova Scotia, from traveling great distances to find viable wood in the Province, from importing logs in from other provinces and countries, to switching to other species of trees for basket production.

Tissue culturing of excised black ash seed with its high success rate and low cost per germinate is the most effective regeneration method available to date in Nova Scotia for replanting programs. In just five years, over 4000 germinates would be produced for replanting in the province.

While replanting programs take shape and begin in Nova Scotia, the art of Mi'kmaw basketry will continue to evolve and flourish in Nova Scotia. As in the past, basket makers will adjust and alter their craft for the current circumstances, carrying this important cultural art form into the future.

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Appendix A

REB Submission Form for
Faculty Member and Graduate Student Research
Involving Human Subjects

This form is designed to assist NSAC researchers in the preparation of submissions to the NSAC REB which are complete and contain the relevant information for an ethics review. When the research is conducted by a faculty member assisted by research assistants, it should be completed by the faculty member. Alternatively, when a graduate student will use the research as part of his/her thesis, the submission should be completed by the graduate student in consultation with the faculty supervisor.

Explanatory comments are available with this file. To view these comments, click View / Zoom / Page Width. Click on the comment balloons appearing in the lefthand margin to see the explanatory notes.

I. **Primary applicant**:
a) Name:
Sara Hill
b) Position:

Graduate Student
c) Department:
Environmental Sciences/Business and Social Sciences

d) Campus telephone number: Email:
(902) 899-5645 smhill@nsac.ns.ca

II. **Collaborators:**

Dr. Deborah Stiles, Departments of Business and Social Sciences, NSAC

Dr. Vilis Nams, Department of Environmental Sciences, NSAC
Dr. Tom Smith

III. Note the **context of the proposed research**:

Graduate student thesis research.

IV. **Project description:**

a) Identify the overall purpose:

To collect information on black ash (Fraxinus nigra) use in basket making by Mi'kmaq in Nova Scotia historically to the present.

b) Note the societal value of the proposed project:

This information when compiled will be of great use to the First Nations communities for further research and education.

c) Outline the methodology that will be used:

Each participant will be contacted by phone, email or in person and given a copy of the consent form, detailing the purpose of this interview and a list of the questions that will be asked. If they agree to participate, they will be asked to sign the provided consent form. They will then be read each question (5) and given time to answer. The interviewer will record the information provided by the participant by hand. If at any time a participant would like to skip a question or quit the interview altogether, their wishes will be granted.

d) Specifically include details on the selection of participants:

Basket makers will be contacted in each of the thirteen Mi'kmaq communities and given the information as stated above and asked to be involved in the interviews. They will be contacted by telephone, email and in person. There will be a maximum of 35 participants.

e) Type of initial contact and information provided to potential participants:

Potential participants will be contacted by phone or in person where possible. They will be provided through mail, email, or in person a copy of the consent form, which details the purpose of this study and a list of the interview questions.
(Please see attached consent form document)

f) Method(s) used to ensure consent:

Please see consent form attached.

g) Risks and benefits:

Does the researcher consider this proposal to:

X be minimal risk   exceed minimal risk

Note in detail any foreseeable risks and benefits to the participants and any benefits to society:

There is the possibility of light fatigue, which will be avoided, with the interview ending at any time the participant wishes. Society will benefit from the collection of this data which can be used in education for both Mi'kmaq and non-Mi'kmaq and for further research.

h) Note of any incentives offered to participants:

There will be no incentives, but a copy of the completed thesis will be provided by request to participants.

V. **Survey, Interview, Questionnaire form(s):**

1. How did you become involved in basket making?

2. Where there specific places that you would go to collect trees for basket making?
   How did you learn of these places?

3. Was there a specific procedure used when selecting and harvesting trees?
   How long was this process?
   How many trees were collected at one time?
   What did the process include?
   How did you select the appropriate tree?

4. Was black ash collected for anything other than basket making?
   Was this for commercial or personal use?
   What were these items?

5. Do you recall a point where black ash was no longer used and another species was selected?
   What was that species?
   Was the quality of the new wood different?
   Did that affect the quality of baskets?

VI. Data Security and Confidentiality Considerations:

Uses of the data

Data will be used in collecting more detail of traditional uses and population of black ash. This information will be used to determine change over time in Nova Scotian black ash population/ distribution and use of black ash as well.

Retention, storage, and destruction

Data will be kept locked in a filing cabinet, with the graduate student and research committee being the only individuals with access. After completion of the thesis, all data will be destroyed through shredding of the notes taken during the interviews and also the consent forms.

Disclosure and dissemination:

The graduate student and committee members will be the only individuals with access to the raw data. The compiled data and results will be included in the graduate thesis.

VII. Continuing Ethics Review - If the risk to participants exceeds minimal risk, please detail the provisions that have been made for a continuing ethics review

VIII. What peer review, if any, has this proposal been subjected to?

This proposal has been reviewed by the graduate student committee and the Confederacy of Mainland Mi'kmaq.

IX. What other institutional REBs will be reviewing the proposal?

First Nations Research Ethics Board

Please submit an electronic version (in WordPerfect or RTF) to Coordinator, Research and Graduate Studies.

CONSENT FORM FOR INTERVIEW PARTICIPANTS

Study Title: Change Over Time in the Distribution of Black Ash in Nova Scotia And its Effects on Mi'kmaq Traditional Use

Principal Investigator: Sara Hill (Graduate Student)

Research Coordinator: Sara Hill (Graduate Student)

Research Committee: Dr. Deborah Stiles
Dr. Vilis Nams
Dr. Tom Smith

Black ash is and has been an important species to the Mi'kmaq of Nova Scotia for basket making and other traditional crafts. However, the population of black ash in the province is incredibly low, with less than 400 known trees in Nova Scotia. This study is part of a Master's of Science thesis, looking into the traditional uses of black ash, and how it has evolved with the changing size of the black ash population in the province. By obtaining further information about black ash through interviews with basket makers, it is hoped to discover more about its use historically and today. This information is important for further research and for helping educate Mi'kmaq and non-Mi'kmaq about this culturally significant species and its uses.

You have been invited to participate in an interview as part of this study. I, Sara Hill would like to interview you about your knowledge of black ash, its location and uses. Please be advised that this information is for educational research only, and that to gather this information you will be asked five (5) questions. The interview should take approximately half an hour.

The interview will be recorded on paper by hand. Every effort will be made to ensure that your identity will remain confidential. When the thesis is prepared dealing with this and other research data on this project, the responses will be presented collectively.

Your participation in this project is very much appreciated. It is our hope that, in conducting this research we will come to a better understanding of how black ash was used and how its location and population numbers have affected this.

Please feel free to ask me questions about the project when you meet with me, or to contact me at any time you would like more information on the project or the questions being asked. I can be reached at You can also contact Dr. Deborah

Stiles of the Department of Business and Social Sciences at the Nova Scotia Agricultural College, a member of this research committee at . The Research and Ethics Board of the Nova Scotia Agricultural College can also be reached at Chair, NSAC REB: Dr. Gary Grant, Dept. of Business & Social Sciences, NSAC, P.O. Box 550, Truro, N.S. Email

Please be assured that either agreement or refusal to participate will not, in any way, affect your current or future relationship with any of the research team or the NSAC. Participation is completely voluntary. Also, you may refuse to answer any question that makes you uncomfortable, and you may also end the interview at any time. Thank you very much for sharing your knowledge.

Sara Hill

I,______________________________have read the above and agree to be interviewed for this research project.

[ ] I agree to be interviewed with my information and identity to remain confidential and remain known only to the graduate student and research committee

__________________________Signature of Participant ____________Date