COSEWIC Status Report

on

Eastern Baccharis

Baccharis halimifolia

in Canada

prepared for

COMMITTEE ON THE STATUS OF ENDANGERED WILDLIFE IN CANADA

by

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Submitted [Date]

EXECUTIVE SUMMARY

Wildlife Species Description and Significance

Eastern Baccharis is a densely branched and often multi-stemmed, woody, perennial, salt marsh shrub of the Aster family, typically 1 to 3 meters tall in Canada. The species is deciduous in Canada with alternate gray-green leaves. It is dioecious (male and female flowers on separate individuals), flowering in late summer. Inflorescences of tiny flowers arranged in terminal, leafy-bracted panicles which can be very numerous on larger shrubs. Fruit are light brown achenes with a series of elongated pappus bristles to enhance wind dispersal. These bristles are brilliant white and make the female plants very showy and easy to detect when in fruit in late summer and early fall.

In Canada, Eastern Baccharis is rare, localized and 400+ km disjunct from the next nearest occurrence in northern Massachusetts, which could be associated with significant genetic divergence. Eastern Baccharis is the only native representative of its genus and subtribe in Canada and one of very few woody Aster family members native to Canada and is used horticulturally in the south and east United States. *Baccharis* species contain an array of chemicals used medicinally, including some with potential for cancer treatment, but formal investigation of their properties has been limited. American First Nations have used some species in the treatment of sores and wounds, as antibacterials and emetics. Eastern Baccharis has been introduced to and has become a problematic invasive in Mediterranean Europe and Australia and it is an agricultural weed in some American states.

Distribution

Eastern baccharis is native along the Gulf of Mexico south to Veracruz, Mexico and on the United States east coast north to northern Massachusetts. It also occurs inland, especially southward reaching Oklahoma, Arkansas, Tennessee and the Piedmont east of the Appalachians, although some of this distribution represents post-European colonization. It is also native in Cuba and the Bahamas and it has established and become invasive in Mediterranean Europe and Australia.

Canadian occurrences are restricted a 25 km stretch of coast in extreme southwest Nova Scotia and are approximately 400 km northeast of the next nearest occurrences in northern Massachusetts. Canadian populations are presumed native because: they are in a localized, highly ocean-moderated climate zone with exceptionally warm winters; they are associated with a suite of other nationally rare southern salt marsh species restricted to the same region; the areas of occurrence have few exotic species and are generally not heavily disturbed; and the species has spread over its area of occurrence despite apparently infrequent seedling establishment and is dominated by large, mature individuals, suggesting long-term establishment in Nova Scotia.

Habitat

In the United States, Eastern Baccharis generally occurs in moist habitats such as shores, swamps, marshes, wet prairies, dune swales, upper salt marshes, and open coastal forests as well as waste areas, roadsides and railways in southern areas. In Canada it is restricted to open margins of well-developed salt marshes within harbours or bays that provide protection from onshore wind and waves. It occurs in or near the transition zone to coastal forest with vegetation cover predominantly graminoids and shrubs of 0.5 m to 2 m height. Climate likely plays a major role in limiting the species' extent of occurrence. Oceanic moderation gives the coastal zone of southwestern Nova Scotia, especially the area around Yarmouth where Eastern Baccharis occurs, the warmest Canadian winters outside of southern British Columbia, with temperatures considerably milder than the coast of Maine at the same latitude.

Biology

Eastern Baccharis is a perennial, woody shrub. In Nova Scotia it flowers from late July through to mid or late September. Male plants begin flowering slightly earlier than females. Females can produce many thousands or even one million plus seeds. Pollination is reported to be by wind, but since male flowers can produce an abundance of nectar and pollen insect-mediated pollination may also be important. Mature achenes are dispersed by wind and water, aided by the attached pappus. Achenes mature in late August or September in Nova Scotia, with most having dispersed by late October. In Nova Scotia (but not in southern USA), leaves are deciduous in late October and November, later than most associated shrubs.

In Australia, the species may reproduce at two years old but it is likely much slower to mature in Nova Scotia at the limit of its climatic tolerance. Seedlings were observed during report fieldwork but occurred much less frequently than mature plants, suggesting establishment from seed is uncommon and a potential limiting factor. Large individuals in Nova Scotia can have trunks up to about 10 cm diameter, which must be at least 20 years old and could be significantly older. New shoots sprout from the bases of mature shrubs, meaning that individuals could persist for decades or longer. Eastern Baccharis was also observed spreading vegetatively in Nova Scotia via the rooting of low branches buried in wave-driven wrack, although the importance of this means of vegetative spread was not clear. Seed banking is likely not significant because seeds have limited dormancy, but seeds can survive 2+ years if buried.

Population Sizes and Trends

The total Canadian population is estimated at 2,850 and is probably quite precisely and completely documented. Four populations are known, although one of these (West Pubnico) is only marginally a population with one known individual. Other populations are: Tusket River Estuary (~1,460), Morris and Roberts Islands (~1,350) and Surettes Island (21). Two sub-populations support ~88% of the Canadian population: Johnson Cove South / Bird Point within the Tusket Estuary with ~1,400; and Morris Island East with ~1,100. The above four populations are divided in this report into 10 sub-

populations, which are in turn divided into 91 “locations”, defined as individuals or patches separated from others by 10 m or more (on the same scale as the major threat – coastal development). If “locations” were defined by land ownership, there would be about 50, the number of private landowners with the species on their property.

Population trends are not documented but are likely fairly stable. Only relatively small and localized development impacts have thus far occurred, but development is active or imminent in some populations and a future threat in others.

Threats and Limiting Factors

Habitat loss from coastal development, primarily for cottages or residences, is the only widespread, imminent threat. Development has been extensive on Nova Scotia’s Atlantic coast in the past 30 years, causing vast increases in land values. Eastern Baccharis occurs in aesthically attractive coastal habitats and most occurrences are within a few hundred metres of good roads. Its habitat along the margin of coastal forest makes it especially prone to clearance by landowners seeking water views or access. It is, however, somewhat protected from development in many sites, including the two large sub-populations, because it occurs on islands within salt marsh for which creating road access would be expensive or impossible to have approved. Development is active in the Roberts Island sub-population and is removing small numbers of individuals, and development appears imminent in part of the large Morris Island East sub-population outside the main area of occurrence in the sub-population. Most other areas of occurrence also have some development potential.

Death of individuals from apparent saltwater inundation was observed very locally and habitat loss from sea level rise may be a threat through the future. Localized impacts from cattle were also observed at one site

The extreme concentration of the population (~88% of total) into two dense areas of occurrence means that development, sea level rise or chance events could greatly reduce the total population if they impacted these two areas. Observations suggesting limited recruitment from seed also increase the significance of any threat that would remove mature individuals.

Protection, Status, and Ranks

Eastern baccharis presently has no legal protection in Canada, although a provincial status report is being prepared, which could lead to legal protection under the Nova Scotia Endangered Species Act. Eastern Baccharis is listed by NatureServe as globally secure (G5) with a national status rank of N5 (secure) in the United States and N1 in Canada. In Nova Scotia it has a subnational rank of S1 (critically imperiled) and a National General Status rank of May Be At Risk, which equates to a “Red” rank under the NS DNR provincial system. In the United States it is not considered rare at the state level anywhere, except for Rhode Island where it is listed as S2 (imperiled). No populations are within protected areas.

TECHNICAL SUMMARY

Baccharis halimifolia
Eastern Baccharis Baccharis à feuilles d'arroche
Range of occurrence in Canada: Nova Scotia

Demographic Information

Generation time (average age of parents in the population)	10-20 years is a conservative estimate
Is there a continuing decline in number of mature individuals? *Declines are not documented, but small declines because of localized development impacts are likely ongoing with potential to increase in magnitude with future development*	Unknown
Estimated percent of continuing decline in total number of mature individuals within 5 years.	Unknown
Observed percent reduction or increase in total number of mature individuals over the last 10 years.	Unknown
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years.	Unknown
Observed percent reduction or increase in total number of mature individuals over any 10 year period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	n/a
Are there extreme fluctuations in number of mature individuals?	None documented and very unlikely

Extent and Occupancy Information

Estimated extent of occurrence *EO is 49 km^2 if West Pubnico (one individual) is excluded.*	75 km²
Index of area of occupancy (IAO) (2x2 km grid) *IAO is 48 km^2 if West Pubnico (one individual) is excluded.* *Biological AO using 10m x 10m grid = 2.26 km^2.*	52 km²

Is the total population severely fragmented?	No
Number of "locations*" *"Locations" defined by the scale of the primary threat (cottage development) – tens to hundreds of metres*	91 if a separation distance of 10m is used. ~50 if number of private landowners is used.
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	No
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?	No
Is there an [observed, inferred, or projected] continuing decline in number of populations?	No
Is there an [observed, inferred, or projected] continuing decline in number of locations? *Not documented but some "locations" as defined in this report have likely been and will continue to be lost with coastal development*	Possibly
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat? *Small, continuing declines in area and quality of habitat due to coastal development*	Yes
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations*?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	**N Mature Individuals**
Tusket River Estuary	>1,460
Surettes Island	21
Morris – Roberts Islands	~1,350
West Pubnico	1
Total	>2,834

* See definition of location.

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	N/A

Threats (actual or imminent, to populations or habitats)

Habitat loss from coastal development, primarily for cottages or residences, is the only widespread, imminent threat

Death of individuals from apparent saltwater inundation was observed very locally and habitat loss from sea level rise may be a threat through the future.

Localized impacts from cattle were observed at one site

Extreme concentration of the population into two dense areas of occurrence means that development, sea level rise or chance events could have major impacts on the total population if they occurred in these two areas. Preliminary observations suggesting limited recruitment from seed would also increase the significance of any threat that removed mature individuals.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? *The species is secure in the United States (N5). It is not considered rare in Massachusetts (the next nearest occurrence) and is not considered rare in any state except Rhode Island (S2).*	
Is immigration known or possible? *Immigration from Massachusetts across 400+km of ocean is very unlikely*	Very unlikely
Would immigrants be adapted to survive in Canada? *Occurs in climate zone similar to north-coastal Massachusetts*	Likely yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	No

Current Status

COSEWIC: No status – new assessment

Author of Technical Summary: Sean Blaney and David Mazerolle

Additional Sources of Information: None

Recommended Status and Reasons for Designation

Recommended Status:	**Alpha-numeric code:**
Reasons for designation:	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals):
Criterion B (Small Distribution Range and Decline or Fluctuation):
Criterion C (Small and Declining Number of Mature Individuals):
Criterion D (Very Small or Restricted Total Population):
Criterion E (Quantitative Analysis):

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific Name:	*Baccharis halimifolia* Linnaeus
Original Description:	Linnaeus, 1753
Synonyms:	*Baccharis halimifolia* var. *angustior* de Candolle
	Baccharis cuneifolia Moench
	Conyza halimifolia Desf
English vernacular names:	Eastern Baccharis, Groundsel-tree (Groundseltree), Groundselbush, Sea-myrtle, Salt-myrtle, Consumption weed, Saltbush, Salt marsh elder, Silverling, Tree groundsel, Waterbrush
French vernacular names:	Baccharis à feuilles d'arroche, Séneçon en arbre
Genus:	Baccharis
Subtribe:	Baccharidinae
Tribe:	Astereae
Family:	Asteraceae
Order:	Asterales

Major plant group: **Angiosperms, Eudicotyledons**

Baccharis halimifolia is the type species of the genus *Baccharis* and the Aster family (Asteraceae) section Baccharis (Hellwig 1989). The genus *Baccharis* is one of the largest in the Aster family, comprised of 350-450 dioecious (rarely monoecious), perennial shrub and tree species, all of which are native to the New World (Sundberg and Bogler 2006). It reaches its highest specific and morphological diversity in the South American tropics, where about 90% or the species occur (Nesom 1990). All North American species are southern in distribution (Sundberg and Bogler 2006) and only four of the 22 species occurring in the United States are not also found in Mexico (Nesom 1990). Only recently discovered in Nova Scotia (Fielding 2001), *Baccharis halimifolia* is the sole Canadian representative of the genus.

The subtribe Baccharidinae is believed to have evolved along the base of the Andes mountains during the middle Miocene from the ancient subtribe Conyzinae, undergoing floral specialization towards its present dioecious condition (Small 1919). Jackson (1975) and Cronquist (1981) both suggested that *Baccharis* evolved from the closely related polygamo-dioecious genus *Archibaccharis*, which in turn likely evolved from the less-advanced monoecious and herbaceous *Conyza*.

The generic name was published by Linnaeus in 1737 and a detailed description of the genus was presented in his 1754 Genera Plantarum.

Baccharis halimifolia was first chosen as a lectotype for the genus by Hitchcock and Greene (1929). The conservation of the generic name and the lectotype was the subject of some debate in the latter half of the 20th century, when Hellwig (1989) called attention to the fact that the morphology of *B. halimifolia* is in conflict with the generic protologue. In 1993, the Committee for Spermatophyta nonetheless voted unanimously in favor of conserving the genus name with *B. halimifolia* as lectotype (Brummitt 1993).

Although all North and Central American *Baccharis* species have been placed into sections based on morphology (Nesom 1990) and recent taxonomic treatments are available for species of a number of regions (USDA 2006), much of this genus' infrageneric taxonomy is not fully understood and remains under revision (Nesom 2000, Giuliano 2005). Recent efforts by Hellwig (1996) and Nesom (1990, 2000), among others, have begun to lay the groundwork for an overview of *Baccharis* and other genera in the subtribe.

Morphological Description

The following description has been derived from Sundberg and Bogler (2006), Gleason and Cronquist (1991), Nesom (1990) and Mahler and Waterfall (1964). Figure 1 illustrates the species in its natural habitat and Figure 2 shows a close-up of upper leaves and pistillate flower heads in fruit.

Eastern Baccharis is a densely branched and often multi-stemmed woody perennial shrub, typically 1 to 3 (6) meters tall. Its stems are erect to ascending, marked with longitudinal ridges and are completely smooth or covered with minute scales. Stems and branches can also be resinous. Its leaves are arranged alternately and can be short-petioled or sessile. Thick and coriaceous, leaves are one or three-nerved, cuneate-based and can vary in general shape from elliptic to broadly obovate or rhombic. Larger leaves are typically 3 to 8 cm long and 1 to 6 cm wide, with scarious margins entire along the lower half of blades and coarsely toothed from midpoint to tip. Upper leaves are gradually reduced, becoming entire. Leaf surfaces are smooth, gland-dotted and resinous. Although the species can be evergreen throughout most of its global range, it is semi-deciduous or deciduous in the northernmost portion of its North American range (Westman *et al*.1975, Krischik and Denno 1990). Inflorescences are of several clusters of 3 to 4 discoid flower heads arranged in terminal, leafy-bracted panicles. Like most other species in the genus, Eastern Baccharis is dioecious, its staminate flowers having abortive ovaries. At flowering time in late summer, staminate heads and pistillate heads are therefore found on separate plants. Male and female plants do not exhibit differences in leaf morphology, branching pattern or shrub size (Krischik 1984).The involucres of flower heads are bell-shaped (tending towards hemispheric in staminate heads), 3 to 6 mm long and composed of ovate to lanceolate, scarious-margined phyllaries of 1 to 4 mm. Staminate heads contain 25 to 30 florets with corollas 3 to 4 mm in length while pistillate heads contain

20 to 30 florets with corollas ranging from 2.5 to 3.5 mm. Corollas are filiform with 5 minute but distinct terminal lobes and are whitish, but profuse pollen production often gives male flowers a yellow color. The achenes produced by fertile pistillate florets are light brown, 1 to 1.8 mm in length, 8- to 10ribbed and are firmly attached to a pappus of two series of 10 to 14 mm long bristles. These pappus hairs elongate and greatly protrude from the receptacle in fruit, making pistillate flower heads much showier than during flowering.

Baccharis halimifolia is a diploid with a chromosome count of n=9 (2n=18). This chromosome number is predominant in the genus and most other genera in the Astereae and is probably the ancestral basic number of the tribe (Solbrig *et al.* 1969).

Population Spatial Structure and Variability

In Canada Eastern Baccharis is found in three separate regions: (1) the Tusket River Estuary, (2) Lobster Bay including Surettes Island, Morris Island and Roberts Island and (3) Pubnico Harbour (where only one individual is known). Given the species' potential for long distance dispersal by wind and water (Westman *et al.* 1975), propagule exchange seems likely between sites in the Tusket River and Lobster Bay regions. Exchange between any of the three regions, which are separated by distances of 7 to 12 km is less likely. The total population is heavily concentrated in two sub-populations. The Johnson Cove South / Bird Cove sub-population of the Tusket River Estuary population at approximately 1,400 individuals and the Morris Island East sub-population of the Morris – Roberts Islands population at approximately 1,100 individuals collectively represent about 88% of the total Canadian population.

Morphological and genetic variability has not been investigated in Canadian populations and no studies on the subject for Eastern Baccharis were found in the literature.

Designatable Units

Since the species has a very limited range in Canada and is restricted to a small geographic area, all Canadian populations should be regarded as a single designatable unit.

Special Significance

Canadian Eastern Baccharis populations are more than 400 km disjunct from the nearest occurrence in northern coastal Massachusetts. The effects of genetic drift and natural selection in such isolated and peripheral situations can produce genetic, ecological, and morphological divergence, potentially giving populations a disproportionate significance to the species as a whole (Lesica and Allendorf 1995, Garcia-Ramos and Kirkpatrick 1997, Eckert *et al*. 2008).

Eastern Baccharis is the only native representative of the *Baccharis* genus and the Asteraceae subtribe Baccharidinea in Canada. The species is also of some botanical interest in Canada since it represents one of very few native woody shrubs in the Aster family.

Eastern Baccharis is recommended as a horticultural planting in several regions of the southeastern and eastern United States because of its. hardiness and ability to grow in a wide gradient of soil moisture, soil types, nutrient availability, pH and salinity conditions. *Baccharis halimifolia* is also at its most showy when few other species are in flower, making it attractive to both gardeners and pollen-feeding insects.

Species in the genus *Baccharis* are known to contain an array of chemicals used for medicinal purposes, many possessing properties that have not yet been investigated (Boldt 1989a). American First Nations have reportedly used some species in the treatment of sores and wounds, as an antibacterial and as an emetic (Boldt 1989a). In Argentina, many *Baccharis* species are promoted as folk medicine for wounds,fever and other ailments (Bandoni *et al.* 1978). Some species have been shown to produce substances of potential use in cancer treatments (Jarvis *et al.* 1981, Mongelli *et al.* 1997).

No evidence of local aboriginal traditional knowledge on this species was found during the preparation of this report. Given the species' rarity and extremely limited range in Canada, it is unlikely to have been of great cultural significance to Canada's First Nations beyond those in the immediate area of its occurrence.

Baccharis halimifolia was introduced in the Mediterranean region of Europe and to Australia in the 17th and 19th centuries respectively, and has become established and invasive in both areas. In association with human activity, the species has also spread considerably beyond its historic range in the southern United States into interior regions of the Atlantic Coastal Plain and beyond (Ervin 2008). It is now considered a serious agricultural weed in several states.

DISTRIBUTION

Global Range

Eastern Baccharis is a species of southeastern and south-central North America with a mostly coastal distribution and a high coastal plain affinity (Figure 3). The majority of its range is located along the Gulf of Mexico and United States' Atlantic coast from Veracruz province in Mexico to northern Massachusetts. It is also found as far inland as Oklahoma, Arkansas,

Tennessee and the Piedmont Plateau although some inland occurrences represent post-settlement colonizations (Ervin 2009). Eastern Baccharis is also native to Cuba (Wunderlin and Hansen 2004) and the Bahamas (Correll and Correll 1982). County-level distribution data (BONAP 2010) for the United States suggests that the species is most widespread from Louisiana to North Carolina, gradually becoming less prevalent and more restricted to the coast as it nears the northern limit of its continuous distribution, from Virginia to Massachusetts.

Canadian Range

Canadian occurrences are restricted to a 25 km wide coastal region of extreme southwest Nova Scotia (Figure 4). The two most important areas of occurrence are: 1) the Tusket River Estuary between Tusket and Upper Wedgeport, and 2) Lobster Bay on the shores of Surettes , Morris and Roberts Islands. A single individual is present in an outlying area of occurrence in Pubnico Harbour near West Pubnico, approximately 12 km southeast of the nearest location on Morris Island

Comment [BB1]: This highlighted paragraphed could likely be deleted since it is already presented above.

The species' presence in Canada was first reported by Fielding (2001), following his collection of several voucher specimens from Tête-à-Milie on the east shore of Morris Island, Nova Scotia. Canadian populations are presumed native because: a) they are in a localized, highly ocean-moderated climate zone with exceptionally warm winters for the Maritimes, b) they are associated with a suite of other nationally rare southern salt marsh species also restricted to the same region of southern Nova Scotia, c) areas of occurrence have few exotic species and are generally not heavily disturbed by humans, and d) the species has spread over 25 km despite apparently very infrequent seedling establishment and is dominated by large, mature individuals, suggesting long-term establishment in Nova Scotia.

Extent of occurrence including the single West Pubnico individual is 75.1 km^2, however since the species is dioecious (though vegetative reproduction can occur), the West Pubnico occurrence can only be marginally considered a population unless there were other undetected individuals present. If the West Pubnico occurrence is excluded, extent of occurrence is only 49.4 km^2. Extent of Occurrence values were calculated in MapInfo GIS using standard COSEWIC methods (COSEWIC 2007). The Index of Area of Occupancy (IAO), calculated as the number of occupied 2 km x 2 km grid boxes using the UTM NAD83 grid aligned with the 10 km grid square margins (with some adjustment because of irregular square size across the UTM Zone 19-20 boundary) is 52 km^2. If the Pubnico Harbour individual is excluded, the IAO is 48 km^2.

The distribution of the species is known completely and accurately enough that the actual area of occupancy can be fairly precisely estimated. Using a 10m x 10m grid, the total area of occupancy for the species in Canada is approximately 2.26 km^2.

HABITAT

Habitat Requirements

Throughout its native range, Eastern Baccharis occurs in a variety of habitats including open coastal forests, coppices, beaches, saline to freshwater intertidal marshes, and open or shrubby marshes (Penfound and Hathaway 1938, Allain and Grace 2001, Mahler and Waterfall 1964), open gravelly flats and palm flats (Correll and Correll 1982). In the southern United States, it can also be found in anthropogenically disturbed habitats such as fields, waste areas, roadsides and railways (Lance 2004, Boldt 1989a).

In Canada, *B. halimifolia* is strictly a coastal species and occurs in a much more restricted range of habitats. All known occurrences are in well-developed salt marshes located within harbors or bays providing some protection from onshore wind and waves. The species is most often found in the upland fringe of salt marshes, in or near the transition zone to coastal forest, where soil salinity is lower and vegetation cover is predominantly graminoids and low shrubs. These habitats are characterized by an assemblage of both halophytic and non-halophytic species commonly including Saltwater Cordgrass (*Spartina alterniflora*), Freshwater Cordgrass (*Spartina pectinata*), Tick Quackgrass [*Thinopyrum pycnanthum* (identification uncertain)], New Belgium aster (*Symphyotrichum novi-belgii*), Seaside Goldenrod (*Solidago sempervirens*), Virginia Rose (*Rosa virginiana*), Black Huckleberry (*Gaylussacia baccata*), Bayberry (*Morella pensylvanica*), Black Holly (*Ilex verticillata*), Red Maple (*Acer rubrum*) and Red or White spruce (*Picea rubens* or *P. glauca*). Eastern Baccharis frequently occurs with or near other provincially and/or nationally rare species such as Beaked Spikerush (*Eleocharis rostellata*), Big-leaf Marsh-elder (*Iva frutescens* ssp*. oraria*), Olney's Bulrush (*Schoenoplectus americanus; =Scirpus olneyi*) and Salt-marsh False-foxglove (*Agalinis maritima*).

At all known Canadian locations, individuals seem to be restricted to open and semi-open areas, where tree cover does not exceed 60%. Studies indicate that both fruit production and seed germination are considerably reduced under dense shade (Westman *et al.* 1975).

The species exhibits a high degree of habitat specificity in Canada but can reportedly tolerate a wide range of conditions with regard to pH (3.6 to 9) and available nutrients (560-5500 ppm Kjeldhal nitrogen and 4-73 ppm

phosphorous) (Westman *et al.* 1975). It is considered to be tolerant of fairly high levels of soil and groundwater salinity (Young *et al.* 1994, Westman *et al.* 1975) and can withstand salt spray (Wells and Shunk 1938), periodic flooding and drought (Westman *et al.* 1975). It typically grows in moist highly organic soils, but can thrive in a wide variety of substrates from pure sand to pure clay (Dirr and Heuser 1987).

Climate likely plays a major role in limiting the species' extent of occurrence. Through the influence of ocean currents, the coastal zone of southwestern Nova Scotia from Digby to Liverpool, especially the area around Yarmouth where Eastern Baccharis occurs, has the warmest Canadian winters outside of southern British Columbia (Environment Canada 2010), with temperatures considerably milder than the coast of Maine at the same latitudes (United States Department of Agriculture 1990, Agriculture and Agrifood Canada 2000).

Habitat Trends

A substantial majority of the habitat occupied by Eastern Baccharis in Canada is still in good condition with very low levels of anthropogenic disturbance. Recent coastline development has, however, resulted in degradation and loss of a small proportion of occupied habitat. A number of new homes, cottages, roads and waterfront lots for sale were observed within or near Eastern Baccharis occurrences in 2010 (Blaney and Mazerolle, pers. obs. 2010, Figure 5). Eastern Baccharis occurs in aesthetically attractive areas that are generally fairly close to existing roads, so shoreline development is certain to increase over time. The species occurs at the boundary between saltmarsh and adjacent upland forest, which makes its habitat especially susceptible to landowners clearing brush for water access and views.

The two large sub-populations (Johnson Cove South / Bird Point and Morris Island East) supporting about 88% of the total Canadian population both have small, existing shoreline developments and high potential for further shoreline development. In both cases, however, the areas where most of the plants occur have reduced development potential because they are on small islands within salt marsh. At these sites, developing road access would require building expensive causeways for which it might be difficult to receive government approval. Detailed site by site analysis of development threat and specific habitat alterations is given under *Population – Threats and Limiting Factors* below.

Climate change-induced sea level rise, coupled with natural land subsidence could have significant impacts on Eastern Baccharis habitat and numbers over time, especially if the apparently slow rate of establishment from seed made the species incapable of moving along with the inland migration of saltmarsh habitat. Small numbers of dead and unhealthy Eastern Baccharis

shrubs observed in lower marsh zones on Morris Island and Surettes Island could be the result of local increases in tidal flooding and salinity.

BIOLOGY

Life Cycle and Reproduction

Eastern Baccharis is a dioecious, perennial, woody shrub. In Nova Scotia flowering takes place from early August (perhaps as early as late July, Blaney, pers. obs. 2006) to late September but extends to November further south (Sundberg and Bogler 2006, Mahler and Waterfall 1964). The male and female flowers, borne separately on different plants, are clustered in discoid flower heads which are in turn arranged in loose panicles. Both sexes are in bloom during the same period, with male plants starting to flower slightly earlier than female plants (Krischik and Denno 1990).

Pollination in this species is reported to be anemophelous, the pollen carried by wind from staminate flowers on male plants to pistillate flowers on female plants (Krischik and Denno 1990). Since male flowers can produce an abundance of nectar and pollen (USDA 2006), it is possible that insect-mediated pollination may also be important.

After fertilization, white pappus bristles attached to the maturing achenes gradually elongate and protrude from the receptacles of pistillate flower heads. Mature achenes are released soon after ripening and dispersed by wind and water, aided by the attached pappus (Westman *et al.* 1975). Achenes mature in late August or September in Nova Scotia, with most having dispersed by late October (Blaney, pers. obs. 2006, Blaney and Mazerolle, pers. obs. 2010).

Seed production can be prolific, possibly exceeding a million seeds in large healthy individuals (Westman *et al.* 1975). Seed production decreases with plant age and density, but increases with available light (Panetta 1979). *B. halimifolia* achenes have a facultative light requirement for germination and lack an innate dormancy (Panetta 1979). Germination potential varies from 70% to 99% (Diatloff 1964, Panetta 1979). When forced into dormancy through burial, seeds remain viable for a minimum of two years (Karrfalt and Olson undated). The species produces abundant seeds in Nova Scotia and seed viability has been demonstrated by germination in greenhouse conditions at Acadia University (P. Mills, pers. comm. 2010). The apparently low seedling recruitment and rarity of small individuals observed in Canadian populations suggest that establishment from seed may be a significant natural limiting factor, perhaps because of low winter survival of seedlings. Westman *et al.* (1975) suggested that the spread of the species into southern Australia was limited by prolonged freezing.

In late fall, leaves generally turn yellow and plants become dormant. Eastern Baccharis exhibits a deciduous growth habit in the northernmost portions of its North American range, but can retain its foliage year-round in southern parts of its global range (Krischik and Denno 1990, Westman *et al.* 1975).

In Australia, the species reportedly reaches reproductive maturity two years after germination (Panetta 1979), but it is likely much slower to mature in Nova Scotia where it is at the limit of its climatic tolerance. Seedlings were observed at the Morris Island and Johnson Cove South / Bird Point sub-populations (Blaney and Mazerolle, pers. obs. 2010), but not elsewhere, and seedlings occurred in numbers much smaller than those of mature plants, suggesting that establishment from seed is uncommon and a potential limiting factor. Large individuals in Nova Scotia can have trunks up to about 10 cm diameter, which must be at least 20 years old and could be significantly older (Blaney, pers. obs. 2006, Blaney and Mazerolle 2010). New shoots sprout from the bases of mature shrubs, meaning that individuals could persist for decades or longer (Blaney, pers. obs. 2006, Blaney and Mazerolle 2010). Eastern Baccharis was also observed spreading vegetatively in Nova Scotia via the rooting of low branches that became buried in wave-driven wrack (Blaney and Mazerolle 2010), although the importance of this means of vegetative spread vs. establishment from seed was not clear.

Physiology and Adaptability

Eastern Baccharis is well adapted to harsh and dynamic coastal environments. Although it may best be described in Canada as a species of fairly stable habitats in upper salt marshes and coastal forest edges, many of its characteristics are often associated with pioneer and early succession species. These characteristics include prolific seed production, long-range dispersal by wind and water, promotion of germination by exposure to light, tolerance of a range of soil nutrient and salinity conditions and an ability to survive periodic flooding and drought (Westman *et al.*1975).

Seedlings have the ability to maintain growth under conditions of low nitrogen during their first 13 weeks and can survive in situations where all nutrients are scarce. (Westman *et al.* 1975).

In a study of the response of coastal shrub species to freshwater and saltwater flooding, Tolliver *et al.* (1997) determined that *Baccharis halimifolia* could tolerate freshwater flooding without adverse effects for nine days. During prolonged flooding by salt water (20 and 30 g L^{-1}), onset of mortality occurred after 17 days (Tolliver *et al.* 1997).

Skewed sex ratios and spatial segregation of sexes along environmental gradients have been well documented in dioecious plant populations (Bierzychudek and Eckhart 1988, Freeman *et al.* 1976). Likely due to the higher

energy cost of fruit production, populations are often female-biased in moister, nutrient-rich habitats and male-biased in xeric nutrient-poor sites (Charnov 1982, Bierzychudek and Eckhart 1988). For wind-pollinated dioecious species, Freeman *et al.* (1976) suggest this may be a strategy to maximize seed set in females and pollen dispersal in males. The ability to skew sex ratios according to available conditions may also help populations to persist in suboptimal conditions over long periods of time and maximize the use of resources when they become available.

Krischik and Denno (1990) observed strong sex-related differences in *B. halimifolia*'s tolerance of nutrient and moisture limitations, noting that plants grown at high density with low nutrient and water supply showed poor growth and a male-biased sex ratio (73%) while plants grown in optimal conditions flowered frequently and showed a female-biased sex ratio (75%). They considered skewed sex ratios to be most likely due to differential mortality rather than sexual lability; although it is not known at present if plants have the ability to change sex. Sex ratios did not appear strongly skewed in Nova Scotia, as male and female plants appeared roughly equally common in all populations except for West Pubnico, where only one individual (sex not determined) was observed (Blaney and Mazerolle, pers. obs. 2010).

Eastern Baccharis effectively deters herbivory by non-adapted insect herbivores through the production of acetone-soluble secondary chemicals secreted by resin glands on the surface of its leaves (Krischik and Denno 1990, Kraft and Denno 1982). Cardiac glycosides in the leaves and flowers make it unpalatable to most mammals and it is toxic to livestock (Van Deelen 1991).

Dispersal and Migration

Eastern Baccharis produces numerous small wind-dispersed achenes with a seed mass of approximately 0.1 mg seed^{-1} (Panetta 1977). According to Diatloff (1964), seeds borne by a steady 17 km/h wind may drift as far 140 m from a 2 m tall parent plant. Storm winds could therefore easily carry achenes over much greater distances. Seeds in this species have a mean flotation time of over 40 days (Elsey-Quirk *et al.* 2009) and can therefore be carried by water over considerable distances. Separations of 3 to 5 kilometers between populations in the species' adventive range (Westman *et al*. 1975) attest to this potential for long range dispersal.

The species can also spread vegetatively over short distances as new shoots sprout from the base of established individuals and low-arching stems produce roots (Van Deelen 1998, Blaney and Mazerolle, pers. obs. 2010).

Although animal-mediated dispersal has not been documented, achenes could be spread by small and large mammals and songbirds passing through or perching in shrubs, or secondarily by waterfowl, shorebirds or other animals via dispersal of seeds in mud.

Interspecific Interactions

At least 145 species of phytophagous insects have been documented from Eastern Baccharis (Palmer 1987, Palmer and Bennett 1988), and at least 15 of those species are considered monophagous (occurring on no other plant species) (Palmer 1987, Palmer and Bennett 1988). The dominant leaf-feeding insect over most of the range of Eastern Baccharis is the leaf beetle *Trirhabda bacharidis* (Chrysomelidae) (Johnson and Lyon 1976). Found from Texas to Massachusetts in the United States, both larvae and adults of *Trirhabda bacharidis* exhibit very high host specificity (Hogue 1970, Boldt 1989b) and the species has been introduced as a biological control agent for Eastern Baccharis in Australia (Palmer and Haseler 1992). Competitive interactions within phytophagous insect communities and the ecological effects of various phytophagous insects on Eastern Baccharis have been the subject of several studies (Kraft and Denno 1982, Krischik and Denno 1990, Hudson 1995, Hudson and Stiling 1997).

Other *Baccharis* specialists include defoliating and stem-boring lepidopterans such as *Aristotella ivae* (Gelechiidae), *Bucculatrix ivella* (Bucculatricidae) and *Hellensia balanotes* (Pterophoridae) (Julien and Griffiths 1998, Palmer and Haseler 1992, Sims-Chilton *et al.* 2009), the stem-boring long-horned beetle *Amniscus perplexus* (Cerambycidae) (Palmer and Tomley 1993) and a gall-forming fly *Neolasioptera lathamii* (Cecidomyiidae) (Hudson and Stiling 1997). None of these *Baccharis*-dependent species are yet known from Canada, but no effort has been made to look for them. Any that occurred would likely deserve consideration as Species at Risk. Bees and small butterflies use the abundant nectar produced by male flowers (USDA 2006).

Eastern Baccharis is also susceptible to infection by the macrocyclic autoecious fungus Groundsel-bush Rust (*Puccinia evadens*, Pucciniaceae) (Sims-Chilton *et al.* 2009), but no signs of disease were detected during our surveys.

Grelen (1975) listed Eastern Baccharis as a "desirable" browse species for White-tailed Deer in Louisiana, although it is elsewhere considered unpalatable to mammals because of cardiac glycosides in the leaves and flowers and it is toxic to livestock (USDA 2006). Despite abundant deer within Eastern Baccharis sites, no browsing was noted on Nova Scotia plants (Blaney and Mazerolle, pers. obs. 2010).

The presence of salt marsh grass species such as Salt-water Cordgrass has been shown to facilitate the establishment and growth of *B. halimifolia*, presumably through the alleviation of environmental stressors such as soil salinity and nutrient availability (Egerova *et al.* 2003).

POPULATION SIZES AND TRENDS

Search Effort

Both population and distribution should be quite comprehensively documented for Eastern Baccharis in Nova Scotia. As a large, showy shrub of open habitats, Eastern Baccharis is readily detectable. During October 2010 fieldwork (Blaney and Mazerolle, pers. obs. 2010), female plants with seeds were found to be detectable through binoculars from distances of 500 m to 1+ km, while male plants could be tentatively identified from that distance and fairly certainly identified from distances of 100 m to 500 m.

Rare plant records (AC CDC 2010) indicate that botanical survey effort in the Tusket River estuary and Lobster Bay had been very limited prior to the discovery of Eastern Baccharis in 1999 (Fielding 2001), which explains how it had remained undetected to that time. Since 2001, the potential range of Eastern Baccharis in Nova Scotia has been quite thoroughly surveyed for the species. In 2006, Sean Blaney, Sean Basquill and Sherman Boates further documented the species' distribution on the east side of Morris Island and on Roberts Island (AC CDC 2010). From 2007 to 2010, Pamela Mills of Nova Scotia Department of Natural Resources (NS DNR) discovered eight new populations through helicopter-based surveys that covered virtually all of the hundreds of kilometres of shoreline (including islands) from Roseway Harbour (39 km straight-line distance east of the known range) to Chegoggin River (5 km west of the known range). Areas west of Chegoggin River may not be suitable for Eastern Baccharis, since none of the rare southern salt-marsh species that co-occur with Eastern Baccharis are known from Digby or Annapolis Counties (AC CDC 2010), likely because of habitat differences created by the higher tidal amplitude along the Bay of Fundy shore and a reduction in oceanic moderation of winter temperatures.

From 2007 to 2010, Nova Scotia Department of Natural Resources has documented what is probably a complete or nearly complete distribution of the species in Canada using helicopter surveys. All known Nova Scotia occurrences are found at the southwestern tip of the province along the coast of Yarmouth County, over a 25 km (straight-line) distance between the west shore of the Tusket River estuary and the west shore of Pubnico Harbour.

Ground level field surveys for this report by Sean Blaney and David Mazerolle demonstrated that the helicopter surveys have been very effective in spotting Eastern Baccharis plants but less effective at counting numbers of individuals in larger populations. 2010 field surveys found only small numbers of new locations representing very few individuals during four person days of searching within suitable habitat but did significantly increase total number of individuals known. The demonstrated effectiveness of the comprehensive

helicopter surveys in finding Eastern Baccharis, along with the differences in climate and the absence of associated rare species to the east and west of the known distribution, suggest that the currently documented range limits of Eastern Baccharis in Nova Scotia likely represent all or almost all of the actual range.

Surveys for this report were carried out in the Tusket River Estuary, Lobster Bay and Pubnico Harbour areas in Yarmouth County, on October 14 and 15, 2010. Autumn was chosen for fieldwork because Eastern Baccharis is most detectable from August to October, when the showy pappus of mature seeds is visible on female plants. Both male and female plants are also especially visible in the fall because the species' leaves change colour and fall relatively late, remaining a dull blue-grayish green through to mid-October and contrasting with many associated shrubs which have lost leaves or have changed to yellow, orange or red by that time. Surveys included comprehensive counts of individuals at five of ten known sub-populations [Johnson Cove North, Johnson Cove South / Bird Point, Surettes Island, Morris Island East, and Morris Island (The Basin)], and nearly comprehensive counts of individuals at the Roberts Island sub-population. The West Pubnico site was not accessible but was surveyed from shore by binoculars, with the single individual originally located by helicopter relocated. The three unsurveyed sub-populations were Morris Island Southeast, Plymouth, and Arnold Point. The latter of these had 14 plants counted from helicopter, while the other two had no counts, likely indicating few individuals. Assuming that none of the unsurveyed sub-populations had more than 50 individuals (which is almost certainly the case), 2010 field surveys for this report counted at least 95% of the total number of individuals ever recorded in Canada.

Defining Populations and Locations

Populations are defined in this report using habitat-based plant element occurrence delimitation standards (NatureServe 2004), under which occurrences are lumped into a single population if separated by less than 1 km, or if separated by 1 to 3 km with no break in suitable habitat between them exceeding 1 km, or if separated by 3 to 10 km but connected by linear water flow and having no break in suitable habitat between them exceeding 3 km. Under this definition, there are four populations of Eastern Baccharis in Canada: 1) Tusket River Estuary, 2) Surettes Island, 3) Morris and Roberts Islands and 4) West Pubnico).

For the purposes of COSEWIC assessment, locations are defined by the scale of the most immediate threat. For Eastern Baccharis, that is coastal development for cottages or residences, which occurs at a scale of tens of metres up to hundreds of metres. Eastern Baccharis occurrences in Canada are quite completely and precisely known, and if locations are defined as

occurrences separated by 10m or more of unoccupied ground, there are 91 locations. Property boundaries provide an alternate means of determining number of locations, since development typically occurs on a property by property basis. Eastern Baccharis occurs on properties belonging to about 50 different land owners (L. Benjamin, NS DNR, pers. comm.) (imprecision GPS and helicopter-based points makes it impossible to get an exact number). The 23 locations on Crown land are afforded little protection because they generally occur just outside private properties below the legal high tide mark, and would tend to be treated as private property by adjacent landowners. Thus they would best be treated as parts of their adjacent private land locations if one was defining locations by ownership.

Abundance

The total Canadian population is estimated at 2,850 individuals in four populations. The West Pubnico occurrence has only a single plant known and can thus only marginally be considered a population. There is a small population (21 plants, less than 1% of the Canadian population) on Surettes Island in Lobster Bay and two large populations. Approximately 48% of the Canadian population is in the Morris and Roberts Islands population in Lobster Bay, which includes three sub-populations and 61 locations. The remaining 52% of Canadian plants are in the Tusket River Estuary west of Lobster Bay in three sub-populations which include 29 separate locations.

It is important to note the extreme concentration of populations into two small areas, making the species especially sensitive to any alteration of those sites. Most of the documented locations include only small numbers of plants but the margins of a few small upland islands within saltmarsh at the Morris Island East sub-population and the Johnson Cove / Bird Point sub-population in the Tusket River Estuary support large dense populations that each contain more than 1000 plants and thus represent 70%+ of Canadian plants. These areas are only 300 m x 250m at Morris Island East and 400 x 100 m at Johnson Cove / Bird Point.

Recent data are available for all known Eastern Baccharis occurrences in Canada, the great majority of them having been surveyed in detail in the fall of 2010. Numbers of locations and individuals for each known site are presented in Table 1, along with area of occupancy and land tenure. Despite some difficulties in ascertaining exact numbers of individuals in dense groupings of multi-stemmed shrubs, numbers of individuals recorded during walking surveys should be considered fairly accurate.

Fluctuations and Trends

Given the recent discovery of this species in Canada, survey data is insufficient to detect fluctuations or trends in population size. Populations would

be unlikely to fluctuate significantly on the short term because individuals are long-lived and appear to reproduce infrequently in Canada.

Cottage and home development over the past 30 – 60 years (three times a generation time of 10 – 20 years) has likely removed some individuals, probably not representing a substantial portion of the total population since most of the species' area of occurrence is still undeveloped. Development is ongoing or imminent in the two large sub-populations, but most of the plants they support are not immediately threatened. Future developments affecting small portions of the population are likely given regional development trends and the accessibility and attractive nature of most Eastern Baccharis occurrences.

Rescue Effect

Rescue effect from within Canada between the three Canadian regions of occurrence is possible but likely to be very infrequent. Despite abundant seed production, seedling recruitment seems low in Canadian populations, based on the rarity of very small individuals and the abundance of uncolonized potential habitat. This could indicate that the species' dispersal potential in Canada is lower than in other parts of its native range. The 400+ km disjunction from the next nearest population in Massachusetts means that there is very limited chance for a rescue effect from occurrences in the United States.

THREATS AND LIMITING FACTORS

Coastal Development and Habitat Alteration

Human alteration of the coastal habitats used by Eastern Baccharis is the most immediate and widespread threat to populations. Housing development and recreational activity has dramatically increased in Nova Scotia's coastal areas since the 1950s (Wood 1990, Province of Nova Scotia 2009) and coastal land prices have seen vast increases in that time. Because much of the available prime waterfront real estate has already been developed (Province of Nova Scotia 2009), future expansions may increasingly encroach into areas adjacent to salt marsh.

Construction of cottages and year-round homes over the past 10 to 20 years has influenced portions of the Roberts Island, Morris Island East and Johnson Cove North sub-populations. Additionally, the mainland portions of the largest sub-population at Johnson Cove South / Bird Point and the nearby Plymouth sub-population have very high potential for future development. Potential for future development at the Morris Island (The Basin) and Morris Island Southeast sub-populations is at least moderate. Additional recent construction observed during 2010 surveys included a large public school

addition adjacent to the Johnson Cove / Bird Point sub-population and a large mink farm adjacent to Roberts Island occurrences, neither of which was yet having much direct influence on Eastern Baccharis habitat.

At the south end of Roberts Island the 17 ha point with 1.3 km of shoreline that forms the west side of Kenny Cove is occupied by the Roberts Island Estates subdivision, which is currently under development. A sign on site indicates seven of eleven lots have been sold (Blaney and Mazerolle 2010). Real estate listings online (Victory Real Estate 2010) show this point has been further subdivided into a total of 19 lots. Only a few of these lots have yet been developed. Several additional, relatively recent cottages have also been built immediately west of this subdivision within shoreline sparsely occupied by Eastern Baccharis. Existing developments on Roberts Island have clearly reduced available habitat (see Figure 5), and have presumably eliminated some individuals (at least one shrub was seen to have been cut to the base but resprouting), but have not yet affected a high proportion of the 110 plants known on the island. The Roberts Island occurrences further northwest of the cottage areas are also in readily developable areas because of existing roads nearby and because of non-swampy uplands predominating up to the edge of the salt marsh. One additional property in this area was signed as “for sale by owner”.

At Morris Island East near Tête-à-Milie, one new cabin and one old cabin have small zones cleared of shoreline shrubs within an area of Eastern Baccharis occurrence. A new access road to the shoreline has also been constructed and a 26 ha block of properties with 500 m of shoreline frontage is for sale (as of November 2010) as a development site. These properties support four Eastern Baccharis locations with somewhere under 50 plants. Most of the remainder of the ~1,100 plants in the Morris Island East sub-population are nearby but are around upland islands surrounded by salt marsh. These would be less promising as major development sites because of the need to develop causeways for access, although ATV-accessed cabins could be developed.

Johnson Cove South / Bird Point is the largest sub-population at ~1,400 plants. About 90% of that population occurs near an island within the salt marsh which has reduced development potential because of lack of road access. This sub-population and the nearby Plymouth sub-population (few plants, not counted) occur about 400 m from the settlement of Plymouth. Because this area is along a well-maintained secondary highway (Highway 334) and only five minutes from the town of Yarmouth, there is considerable potential for future subdivision and development of waterfront lots that could impact at least the ~10% of the population that occurs on the mainland shore. Also at this sub-population, the property of Plymouth School (a public Kindergarten to Grade 9 school) borders salt marsh occupied by Eastern Baccharis and there is a well-used vehicle trail extending into the upper salt

marsh from near the school parking lot. The salt marsh around the trail supported at least 17 plants and was somewhat disturbed by vehicle traffic, although Eastern Baccharis did not appear substantially impacted. There are also active dairy farms in this sub-population, with cleared and fenced pasture locally extending into areas occupied by Eastern Baccharis and potentially reducing numbers relative to historic levels.

At Johnson Cove North, the lawn of a permanent home extends to the shoreline where 19 plants occur. Seven more plants out of the 62 total in this sub-population might also be susceptible to development because of the existence of a good access road and upland habitats adjacent to Eastern Baccharis occurrences.

Areas of occurrence within the Morris Island (The Basin) (~140 plants) and Morris Island Southeast (unknown numbers, likely few) sub-populations seem to have some potential for development, given proximity of paved roads. Other sub-populations at Surettes Island, West Pubnico and Arnold Point (which total less than 1% of the population) have lower development potential because of difficulty of access across salt marsh and open water channels.

Restricted Geographic Range

The primary natural limiting factor for this species in Canada is likely the very limited area of climatically suitable salt marsh. All occurrences are concentrated in a small region along Nova Scotia's southwest coast in an area known to have the warmest winter temperatures in Canada outside of southern British Columbia. The spread of the species outside this region is likely prevented by lower winter temperatures. Even within the small zone in which Eastern Baccharis occurs, it is highly concentrated into two small areas around the margins of small, upland islands within salt marsh. A 300m x 250m area within the Morris Island East sub-population and a 400m x 100m area within the Johnson Cove South / Bird Point sub-population on the Tusket River Estuary each support over 1,000 individuals and together make up more than 70% of the population. This concentration makes the species very susceptible to large, rapid population declines if development, storm events or other impacts were to affect the key sites.

Climate Change and Sea level Rise

While Eastern Baccharis could see an increase in potential extent of occurrence with a warmer climate in southern Nova Scotia, human-induced climate change may not be strictly beneficial to the species. Climate change is anticipated to lead to increases in the rate of sea level rise and storm frequency and severity (Houghton *et al.* 1996, Shaw 2001, Kont *et al.* 2003, Environment Canada 2006). In Canada, the region considered most sensitive to sea level rise includes much of the coasts of the Maritimes, including Nova Scotia's

Yarmouth County shore, where Eastern Baccharis occurs (Shaw *et al.* 2008). Sea level in the province is rising at an accelerated rate, exacerbated by regional land subsidence (Shaw *et al.* 2008). While regional tide gauge data shows a rise of approximately 30 cm during the 20th century (Marine Environmental Data Service 2008), some projections indicate that global levels could rise by up to 120 cm before the end of this century (Rhamstorf 2007). Land subsidence in the region is estimated to add approximately 17 cm per century to the relative sea level rise (Forbes *et al.* 2008).

Where landforms and absence of human development permit, coastal marshes may migrate inland in response to sea level rise. For coastal wetlands to be maintained in place, however, vertical accretion of marsh soils must take place at rates matching those of relative sea level rise. In many parts of the world, including areas in the northeastern United States, differential rates of marsh accretion and sea level rise have resulted in the rapid loss of coastal wetlands (Roman *et al.* 1997, Warren and Niering 1993). In addition to loss of area due to permanent submergence, higher water levels can result in greater frequency and duration of tidal flooding in upper marsh zones, leading to increased soil saturation and salinity (Warren and Niering 1993). In New England, dramatic changes in vegetation were observed over the 1995 - 1998 period as low-marsh species rapidly migrated landward at the expense of upper marsh species in response to sea level rise (Donelly and Bertness 1998).

As a species primarily restricted to the mid- and upper zones in tidal marshes, Eastern Baccharis does not tolerate prolonged exposure to high-salinity conditions (Tolliver *et al.* 1997). Projected increases in regional sea level rise could thus lead to loss of habitat and therefore represent a threat to all Canadian occurrences. At single locations on Surettes Island and Morris Islands, dead individuals were observed in lower marsh zones, suggesting a response to recent increases in tidal flooding.

PROTECTION, STATUS, AND RANKS

Legal Protection and Status

The species does not presently benefit from legal protection. A status report is being prepared for the province of Nova Scotia, which could lead to the addition of Eastern Baccharis to the list of provincial species at risk, granting it legal protection under the Nova Scotia Endangered Species Act.

Non-Legal Status and Ranks

Eastern Baccharis is listed as globally secure (G5) with a national status rank of secure (N5) in the United States (Natureserve 2010). In Canada, it is ranked N1 (M. Anions, NatureServe Canada, pers. comm. 2010). In Canada, it

only occurs in the province of Nova Scotia, where it has been assigned a subnational status rank of extremely rare (S1) and a National General Status rank of May Be At Risk, which equates to a “Red” rank under the NS DNR provincial ranks.

Subnational status ranks in the United States, as listed by Natureserve (2010), are as follows: Alabama (SNR), Arkansas (SNR), Connecticut (SNR), Delaware (S5), District of Columbia (SNR), Florida (SNR), Georgia (SNR), Louisiana (SNR), Maryland (SNR), Massachusetts (SNR), Mississippi (SNR), New Jersey (S5), New York (S5), North Carolina (S5), Oklahoma (SNR), Pennsylvania (S3), Rhode Island (S2), South Carolina (SNR), Texas (SNR), Virginia (S5). The SNR rank indicates it has not been ranked in that state, most often because it is not considered rare.

Habitat Protection and Ownership

Approximately 74% of all known Canadian locations are situated on privately owned land, distributed on about 50 properties. Individuals found on private land represent approximately 89% of the total recorded Canadian population. The species was found on crown land at a total of 24 separate locations on Roberts Island, Morris Island and in the Tusket River Estuary. No occurrences are situated on protected land. It should be noted that occurrence on Crown land does not necessarily provide much protection for this species because in most cases, the Crown land is salt marsh with its upper boundary defined by the high water mark, precisely where Eastern Baccharis is most likely to occur. Private landowners will often not recognize these boundaries and are thus unlikely limit cutting shrubs on the Crown land sides of their property boundaries. Also, the GIS boundaries of the landward edge of salt marshes may differ from what would be defined by a surveyor so some of the above occurrences listed on Crown land might actually be on private land.

Eastern Baccharis habitat does get some measure of protection through various provincial laws and regulations concerning the conservation of wetlands and coastal zones. These include the *Environment Act*’s *Environmental Assessment Regulations*, the *Off Highway Vehicle Act* and the *Forest Act*’s *Wildlife Habitat and Watercourses Protection Regulations*.

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INFORMATION SOURCES

AC CDC (Atlantic Canada Conservation Data Centre). 2010. Rare taxa location database for Nova Scotia. Unpublished database. Atlantic Canada Conservation Data Centre, Sackville, NB.

Agriculture and Agrifood Canada. 2000. Plant Hardiness Zones of Canada. Website: http://sis.agr.gc.ca/cansis/nsdb/climate/hardiness/intro.html. [Accessed November 2010].

Allain, L.K., and J.B. Grace. 2001. Changes in density and height of the shrub *Baccharis halimifolia* following burning in coastal tallgrass prairie. Proceedings of the North American Prairie Conference 17: 66-72.

Anions, pers. comm. 2010. Email communication between Sean Blaney and Marilyn Anions, NatureServe Canada. November, 2010.

Bandoni, A., J. Medina, R. Rondina and J. Coussio. 1978. Genus *Baccharis* L. 1: Phytochemical analysis of a non-polar fraction from *B. crispa* Sprengel. Planta Med. 34: 328–331.

Benjamin, L. 2010. Email communication between Sean Blaney and Lawrence Benjamin, Nova Scotia Department of Natural Resouces. December 3, 2010.

Bierzychudek, P. and V. Eckhart. 1988. Spatial segregation of the sexes of dioiecious plants. Am. Nat. 132: 34-43.

Blaney, C.S. and Mazerolle, D.M. 2010. Unpublished personal observations of Sean Blaney and David Mazerolle made during fieldwork for COSEWIC *Baccharis halimifolia* status report.

Blaney, C.S. 2006. Unpublished personal observations of Sean Blaney made during fieldwork on Morris and Roberts Islands.

Boldt, P.E. 1989a. *Baccharis*, (Asteraceae), a review of its taxonomy, phytochemistry, ecology, economic status, natural enemies and the potential for its biological control in the United States. MP 1674, Texas Agric. Expt. Station, Texas A&M Univ., College Station, Texas.

Boldt, P.E. 1989b. Biology and host specificity of *Trirhabda bacharidis* (Coleoptera: Chrysomelidae) on *Baccharis* (Asteraceae: Astereae). Environ. Entomol. 18: 78-84.

BONAP (Biota of North America Program). 2010. North American Plant Atlas - *Baccharis*. Website: http://www.bonap.org/BONAPmaps2010/Baccharis.html. [Accessed November 10, 2010].

Brummitt, R.K. 1993. Report of the Committee for Spermatophyta: 38. Taxon 42: 687-697.

Charnov, E.L. 1982. The theory of sex allocation. Princeton University Press, Princeton, NJ.

Correll, D.S. and H.B. Correll. 1982. Flora of the Bahama Archipelago (Including the Turks and Caicos Islands). Gantner Verlag, Vaduz, Liechtenstein.

Cronquist, A. 1981. An integrated system of classification of flowering plants. Columbia University Press. 1262 pp.

Committee on Species of Endangered Wildlife in Canada. 2010. Instructions for the Preparations of COSEWIC Status Reports. 21 pp. Website: http://www.cosewic.gc.ca/htmldocuments/Instructions_e.htm. [Accessed November 2010]

Diatloff, G. 1964. How far does groundsel seed travel? Queensland Agr. J. 90: 354-6.

Dirr, M.A. and C.W. Heuser Jr. 1987. The reference manual of woody plant propagation: from seed to tissue culture. Athens, GA: Varsity Press. 239 pp.

Donnelly, J.P., and M.D. Bertness, 2001, Rapid shoreward encroachment of salt marsh cordgrass in response to accelerated sea-level rise: Proc. Nat. Acad. Sci. 98: 14218-14223.

Egerova, J., C.E. Proffitt and S.E. Travis. 2003. Facilitation of survival and growth of *Baccharis halimifolia* L. by *Spartina alterniflora* Loisel. In a created Louisiana salt marsh. Wetlands 23: 250-256.

Elsey-Quirk, T., Middleton, B.A., Proffitt, C.E., 2009. Seed dispersal and seedling emergence in a created and natural salt marsh on the Gulf of Mexico coast in southwest Louisiana, USA. Restor. Ecol. 17, Online Early, doi: 10.1111/j.1526-100X.2008.00398.x.

Environment Canada. 2006. The impacts of sea level rise and climate change on the coastal zone of southeastern New Brunswick. (Daigle, R., project lead). Environment Canada. 611 pp.

Eckert, C.G., K .E. Samis and S.C. Lougheed. 2008. Genetic variation across species' geographical ranges: the central–marginal hypothesis and beyond. Molecular Ecology 17: 1170–1188.

Ervin, G.N. 2008. Distribution, habitat characteristics, and new county-level records of *Baccharis halimifolia* L. on a portion of its present US range boundary. Southeastern Naturalist 8: 293–304.

Fielding, R.R. 2001. *Baccharis*: A genus of the Asteraceae new to Canada. Proc. Nova Scotia Inst. Sci. 41:214–215.

Forbes D.L., M. Craymer, R. Daigle, G. Manson, S. Mazzotti, C. O'Reilly, G. Parkes, R. Taylor, K. Thompson, and T. Webster. 2008. "Creeping up: preparing for higher sea levels in Atlantic Canada" Bedford Institute of Oceanography 2007 in Review, Fisheries and Oceans Canada, Dartmouth.

Freeman, D.C., L.G. Klickoff, K.T. Harper. 1976. Differential resource utilization by the sexes of dioecious plants. Science 193: 597-599.

García-Ramos, G. and M. Kirkpatrick. 1997. Genetic models of rapid evolutionary divergence in peripheral populations. Evolution 51: 21-28

Giuliano, D.A. 2005. New infragenera in *Baccharis* (Asteraceae, Astereae). Novon 15: 534-541.

Gleason, H.A. and A. Cronquist. 1991. Manual of the Vascular Plants of Northeastern United States and Adjacent Canada, Second Edition. New York Botanical Garden, New York.

Grelen, H.E. 1975. Vegetative response to twelve years of seasonal burning on a Louisiana longleaf pine site. Res. Note SO-192. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 4 pp.

Hellwig, F. 1989. (953) Proposal to Conserve 8933 *Baccharis* L. (Asteraceae) with a Conserved Type. Taxon. 38: 513-515.

Hitchcock, A.S. and M.L. Green. 1929. Standard-species of Linnean genera of phanerogamae. International Botanical Congress, Cambridge. Nom. Prop. Brit. Bot. Pp. 119–199.

Hogue, S.M., 1970. Biosystematics of the genus *Trirhabda* LeConte of .... and suitability as a biological control agent for *Baccharis* spp

Houghton, J.T., et al., eds., 1996. Climate Change 1995--the Science of Climate Change, Cambridge University Press, Cambridge, U.K., Chap. 7, Changes in Sea Level, pp. 359-405.

Hudson, E.E. 1995. Exploitative competition in the phytophagous insect community on *Baccharis halimifolia*. Thesis – Univ. of South Florida, Tampa, FL.

Hudson, E.E. and P. Stiling. 1997. Exploitative Competition Strongly Affects the Herbivorous Insect Community on *Baccharis halimifolia*. Oikos 79: 531-528.

Jackson, J.D. 1972. The evolution of functional dioecism in the genus *Baccharis* (Compositae). Brittonia 24: 121.

Jarvis, B.B., J.O. Midiwo, D. Tuthill, and G.A. Bean. 1981. Interaction between the antibiotics trichothecenes and the higher plant *Baccharis megapotomica*. Science 214:460-462.

Johnson, W.T. and Lyon, H.H. 1976. Insects that feed on trees and shrubs. Comstock Publishing Associates, Cornell University Press, London and Ithaca, NY. 464 pp.

Julien, M. and M.W. Griffiths. 1998. Biological Control of Weeds: A World Catalogue of Agents and Their Target Weeds. CAB International, Wallingford, UK.

Kont, A., J. Jaagus and R. Aunap. 2003. Climate change scenarios and the effect of sea-level rise for Estonia. Global and Planetary Change, 36: 1-15.

Kraft, S.K. and Denno, R.F. 1982. Feeding responses of adapted and non-adapted insects to the defensive properties of *Baccharis halimifolia* L. (Compositae). Oecologia 52: 156-163.

Krischik, V.A. 1984. The role of temporal and spatial variability in leaf nitrogen, water, toughness and resin content in the interaction between *Trirhabda bacaridis* (Weber) (Coleopteria: Chrysomelidae) and its host *Baccharis halimifolia* L. (Compositae). Ph.D. Dissertation, Univ. of Maryland, College Park MD.

Krischik, V.A. and Denno, R.F. 1990. Patterns of growth, reproduction, defense, and herbivory in the dioecious shrub *Baccharis halimifolia* (Compositae). Oecologica 83: 182-190.

Kraft, S.K. and R.F. Denno. 1982. Feeding responses of adapted and nonadapted insects to the defensive properties of *Baccharis halimifolia* L. (Compositae). Oecologia 52: 156-163.

Lance, R. 2004. Woody Plants of the Southeastern United States: A Winter Guide. University of Georgia Press, Athens GA.

Lesica, P. and F.W. Allendorf. 1996. When Are Peripheral Populations Valuable for Conservation? Conservation Biology 9: 753-760.

Mahler, W.F. and U.T. Waterfall. 1964. *Baccharis* (Compositae) in Oklahoma, Texas, and New Mexico. Southwest Naturalist 9: 189–202.

Mills, P.L. 2010. Email communication between Pamela Mills, Nova Scotia Department of Natural Resources and Sean Blaney, November 2010.

Mongelli, E., C. Desmarchelier, J. Rodríguez Talou, J. Coussio and G. Ciccia. 1997. In vitro antioxidant and cytotoxic activity of extracts of *Baccharis coridifolia* DC. Journal of Ethnopharmacology 58: 157-163.

NatureServe. 2004. A Habitat-Based Strategy for Delimiting Plant Element Occurrences: Guidance from the 2004 Working Group. Unpublished online document. Website: http://www.natureserve.org/library/deliminting_plant_eos_Oct_2004.pdf. [Accessed December 1, 2010].

Nesom, G.L. 1990. Infrageneric taxonomy of North and Central American *Baccharis* (Asteraceae: Astereae). Phytologia 69:40–46.

Nesom, G.L. 2000. Generic conspectus of the tribe Astereae (Asteraceae) in North America, Central America, the Antilles, and Hawaii. Sida, Bot. Miscellany 20: i-viii, 1–100.

Palmer, W.A. 1987. The phytophagous insect fauna associated with *Baccharis halimifolia* L. and *B. neglecta* Britton in Texas, Louisiana, and northern Mexico. Proc. Entomol. Soc. Wash. 89: 185-199.

Palmer, W.A. and F.D. Bennett. 1988. The phytophagous insect fauna associated with *Baccharis halimifolia* L. in the eastern United States. Proc. Entomol. Soc. Wash. 90: 216-228.

Palmer, W.A and W.H. Haseler. 1992. Foodplant Specificity and Biology of *Oidaematophorus balanotes* (Pterophoridae): A North American Moth Introduced into Australia for the Control of *Baccharis halimifolia*. Journal of the Lepidopterists' Society 46: 195-202.

Palmer, W.A. and A.J. Tomley. 1993. The host range and biology of *Amniscus*

perplexus Haldeman (Coleoptera: Cerambycidae), A candidate evaluated for the biological control of *Baccharis halimifolia* in Australia. The Coleopterists' Bulletin 47: 27-34.

Panetta, F.D. 1977. The effects of shade upon seedling growth in Groundsel Bush (*Baccharis halimifolia* L.). Australian Journal of Agricultural Research 28: 681–690.

Panetta FD. 1979. Germination and seed survival in the woody weed, groundsel bush (*Baccharis halimifolia* L.). Australian Journal of Agricultural Research 30: 1067 – 1077.

Penfound, W.T. and E.S. Hathaway. 1938. Plant communities in the marshland of southeastern Louisiana. Ecologial Monographs. 8: 1-56.

Province of Nova Scotia. 2009. Coastal Development: The 2009 State of Nova Scotia's Coast Report. Website: http://www.gov.ns.ca/coast/documents/state-of-the-coast/WEB_CD.pdf. [Accesssed November 2010].

Rahmstorf, S. 2007. A semi-empirical approach to projecting future sea-level rise. Science 315: 368-370.

C.T. Roman, J.A. Peck, J.R. Allen, J.W. King and P.G. Appleby. 1997. Accretion of a New England salt marsh in response to inlet migration, storms and sea-level rise. Estuarine, Coastal and Shelf Science 45: 717–727.

Shaw, J., R.B. Taylor, D.L. Forbes, M.-H. Ruz and S. Solomon, 1998. Sensitivity of the coast of Canada to sea-level rise; Geological Survey of Canada Bulletin 505, 79 pp.+ map.

Shaw, R.W. and the Climate Change Action Fund (CCAF A041) project team. 2001. Coastal impacts of climate change and sea-level rise on Prince Edward Island, synthesis report. Prepared for Environment Canada, Natural Resources Canada and Fisheries and Oceans Canada, Darthmouth, Nova Scotia. 74 pp.

Sims-Chilton, N. M., M.P. Zalucki, and Y. M. Buckley. 2009. Patchy herbivore and pathogen damage throughout the introduced Australian range of groundsel bush, *Baccharis halimifolia*, is influenced by rainfall, elevation, temperature, plant density and size. Biological Control 50: 13-20.

Small, J. 1919. The origin and development of the Compositae. New Phytologist 18: 1-334 + plates 1-6.

Solbrig, O.T., L.C. Anderson, D.W. Kyhos and P.H. Raven. 1969. Chromosome Numbers in Compositae VII: Astereae III. American Journal of Botany 56: 348-353.

Sundberg, S.D. and D.J. Bogler. 2006. *Baccharis* Linnaeus. *In* Flora of North America Editorial Committee (Eds.) Flora of North America North of Mexico, Vol. 20: Asteraceae. New York and Oxford. Website: http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=103317. [Accessed December 3, 2010].

Tolliver, K.S., D.M. Martin, and D.R. Young. 1997. Freshwater and saltwater flooding response for woody species common to barrier islands swales. Wetlands 17: 10-18.

USDA (United States Department of Agriculture). 1990. The USDA Plant Hardiness Zone Map. USDA Miscellaneous Publication No. 1475.

USDA (United States Department of Agriculture). 2006. Plant Guide: Groundsel Tree *Baccharis halimifolia* L. (Originally written by G. Nesom in 2001). Website: http://plants.usda.gov/plantguide/pdf/pg_baha.pdf. [Accessed December 3, 2010].

Van Deelen, T.R. 1991. *Baccharis halimifolia*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Website http://www.fs.fed.us/database/feis/ [Accessed December 2, 2010].

Victory Realty. 2010. Website: http://www.victoryrealty.ca/property.php?ID=001199. [Accessed November 30, 2010].

Warren, R.S. & W.A. Niering. 1993. Vegetation change on a northeast tidal marsh: interaction of sea-level rise and marsh accretion. Ecology 74: 96-103.

Wells, B.W. and I.V. Shunk. 1938. Salt spray: An important factor in coastal ecology. Bull. Torrey Bot. Club 65: 485-492.

Westman, W.E., F.D. Panetta, and T.D. Stanley. 1975. Ecological studies on reproduction and establishment of the woody weed, groundsel bush (*Baccharis halimifolia* L.: Asteraceae). Australian Journal of Agricultural Research 26:855–870.

Wood, K.S. 1990. Shoreline Development and Nova Scotia: Planning and Policy Issues. Oceans Institute of Canada, Halifax.

Wunderlin, R.P. and B.F. Hansen. 2004. Atlas of Florida Vascular Plants [S.M. Landry and K.N. Campbell (application development), Florida Center for Community Design and Research.] Institute for Systematic Botany, University of South Florida, Tampa, Florida. Website: http://www.plantatlas.usf.edu/. [Accessed November 2010].

Young, D.R., D.L. Erickson and S.W. Semones. 1994. Salinity and the small-scale distribution of three barrier island shrubs. Canadian Journal of Botany 72: 1365-72.

BIOGRAPHICAL SUMMARY OF REPORT WRITER(S)

David Mazerolle completed an undergraduate degree with a major in biology and a minor in geography, and a Master's degree in environmental studies, at the Université de Moncton. For his M.Sc. he studied the geography of exotic vegetation in Kouchibouguac National Park and created a strategy for the management of the park's exotic invasive flora. David has worked as a botanist at the Atlantic Canada Conservation Data Centre since 2007. Prior to this he was coordinator for rare plant survey and monitoring projects at the Bouctouche Dune Irving Eco-Centre from 2003 to 2006, where his work focused on the rare coastal plants of New Brunswick's Northumberland Coast. He has over ten years experience working on various research, survey and monitoring projects and has authored and coauthored numerous status reports and technical reports pertaining to rare plants in Atlantic Canada.

Sean Blaney is the Botanist and Assistant Director of the Atlantic Canada Conservation Data Centre (AC CDC), where he is maintains status ranks and a rare plant occurrence database for plants in the three Maritime provinces. Since beginning with the AC CDC in 1999, he has discovered dozens of new provincial records for vascular plants and documented thousands of rare plant locations during extensive fieldwork across the Maritimes. Sean is a member of the COSEWIC Vascular Plant Species Specialist Committee, the Nova Scotia Atlantic Coastal Plain Flora Recovery Team, and has co-authored several COSEWIC and provincial status reports. Prior to employment with AC CDC, Sean received a B.Sc. in Biology from the University of Guelph and an M.Sc. in Plant Ecology from the University of Toronto, and worked on a number of biological inventory projects in Ontario as well as spending eight summers as a naturalist in Algonquin Park, where he co-authored the park's plant checklist.

COLLECTIONS EXAMINED

All known Nova Scotia specimens were already documented in the Atlantic Canada Conservation Data Centre database (AC CDC 2010) prior to the preparation of this report, so no further examination of herbarium specimens

was undertaken.

Table 1. Number of locations and individuals recorded at each known site, with area of occupancy and land ownership.

Population	Sub-population	# loc-ations	Total number of individuals *	Actual area of occupancy	Land tenu
1. Tusket River Estuary	Johnson Cove (North section)	11	62	1200 m^2	10 locations on private land (3 proper
1. Tusket River Estuary	Johnson Cove (South section) and Bird Point	15	>1400	8500 m^2	12 locations on private land (7 proper land
1. Tusket River Estuary	Plymouth	1	Not recorded, likely few	100 m^2	Crown
1. Tusket River Estuary	Arnold Point	2	14	200 m^2	Private (2 properties)
2. Surettes Island	Surettes Island	1	21	100 m^2	Private (1 property)
3. Morris – Roberts Islands	Morris Island (The Basin)	19	>140	2800 m^2	8 locations on private land (5 properti land
3. Morris – Roberts Islands	Morris Island (East shore, including Tête-à-Milie)	24	>1100	>7600 m^2	17 locations on private land (2 proper land
3. Morris – Roberts Islands	Morris Island (Southeast shore)	1	Not recorded, likely few	100 m^2	Private (1 property)
3. Morris – Roberts Islands	Roberts Island	16	110	1900 m^2	15 locations on private land (11 prope land
4. West Pubnico	West Pubnico	1	1	100 m^2	Private (1 property)

* The most recent estimate available from: Blaney and Mazerolle 2010 fieldwork, Blaney *et al.* 2006 fieldwork, Mills 2007 fieldwork.

Figure 1. Large, multi-stemmed Eastern Baccharis (*Baccharis halimifolia*) shrub at the interface between salt marsh and forest, growing in association with Black Huckleberry (*Gaylussacia baccata*), Freshwater Cordgrass (*Spartina pectinata*), Tick Quackgrass (*Thinopyrum pycnanthum* – identification uncertain) and Red Maple (*Acer rubrum*).

Figure 2. Upper leaves and fruiting pistillate flower heads of Eastern Baccharis (*Baccharis halimifolia*). Long white pappus bristles protrude from the receptacles, giving flower heads a showy appearance.

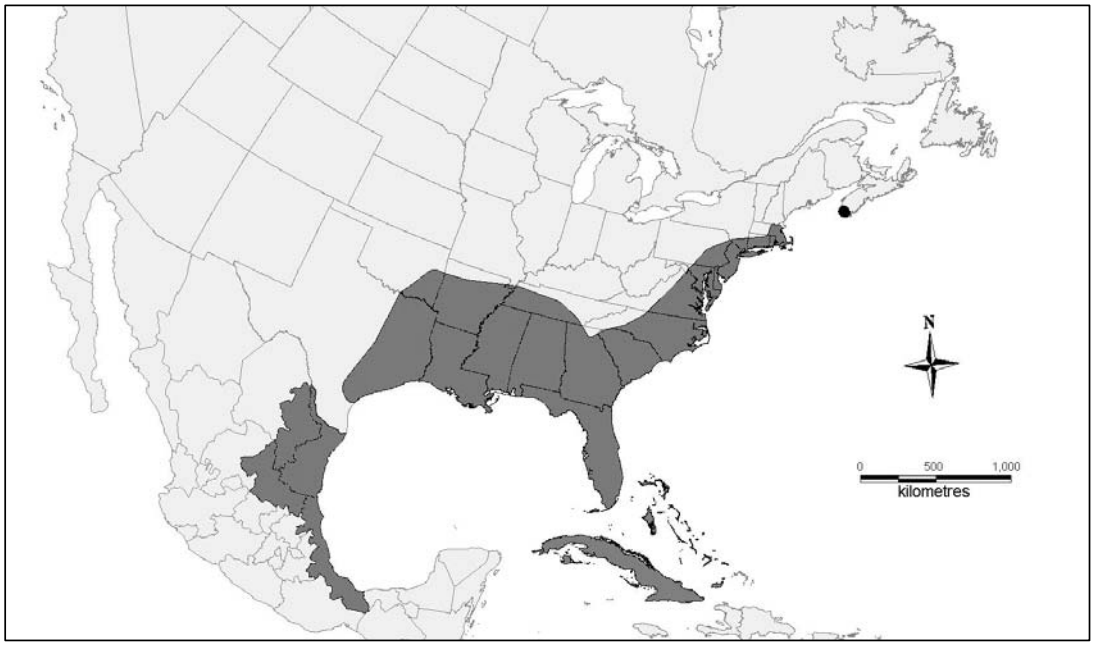

Figure 3. Known native global range of Eastern Baccharis (*Baccharis halimifolia*). Range outlined in the United States is based on county-level distribution data (BONAP 2010), range outlined in Mexico is based on provincial-level presence or absence and range outlined in the Caribbean is based on country-level presence or absence.

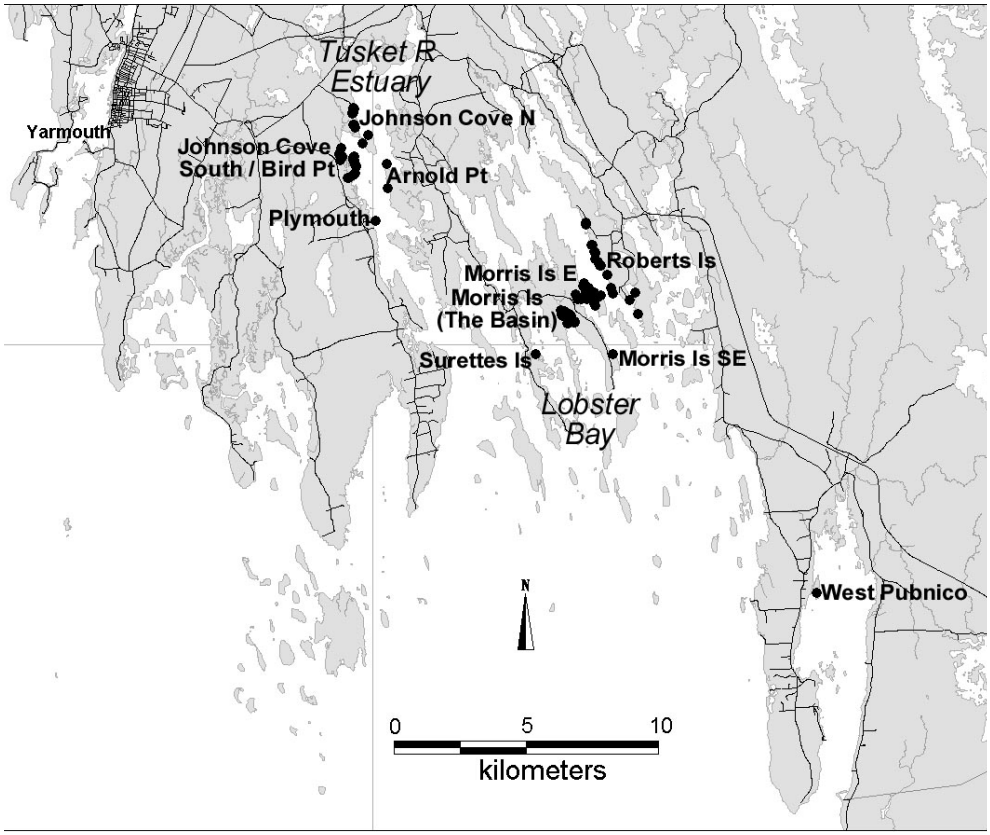

Figure 4. Canadian distribution of Eastern Baccharis, with sub-population names as noted in Table 1. The four populations are: 1) Tusket River Estuary, 2) Surettes Island, 3) Morris and Roberts Islands and 4) West Pubnico.

Figure 5. Eastern Baccharis (large shrub in centre, foreground) at Roberts Island, Nova Scotia, near recently built cottage which removed suitable habitat and probably some Eastern Baccharis individuals. Eastern Baccharis is also visible on the distant salt marsh margin in the upper left.