Supplemental Information for Wild Turkey Introduction

Prepared for NSDNR

16 July 2003

Introduction

This document is intended to provide additional information to the Nova Scotia DNR to assist the Minister of Natural Resources with his decision regarding the introduction of wild turkeys into the province. Per conversations with Mike O'Brien, the minister desired to have more information provided on the following topics: (1) snowfall comparison between Nova Scotia and current wild turkey range, (2) spring food availability, (3) potential habitat availability and comparison with current turkey range, and (4) disease issues. This document will address topics 1-3. The disease issue topic will be addressed separately with the assistance of IAFWA, which will work directly with NSDNR to convene a panel of experts to further investigate the potential for disease transmission.

Snowfall Comparison

While annual snowfall in the Annapolis valley region of Nova Scotia is greater than most areas within the turkey habitat of New England, there are areas with established turkey populations that receive similar amounts of average annual snowfall, and greater amounts in some years (Table 1). Because of the maritime climate in Nova Scotia, it is rare that deep powdery snow is present for long periods of time; these conditions are the hardest on wild turkeys. Despite the amount of snowfall in the Annapolis valley region, mean snow depth [6 – 25 cm (Environment Canada 2003)] in winter months is still within the generally accepted range in which turkeys will have little difficulty in surviving. The fact that this snow is generally packed and/or crusted gives wild turkeys the mobility needed to move among feeding areas and actually increases their chance of finding food and thriving.

Table 1. Comparison of average annual snowfall at selected locations.

Location	Average Annual Snowfall (cm)	Range (cm)
Kentville, Nova Scotia[a]	265.9	N/A
Greenwood, Nova Scotia[a]	276.3	N/A
Lucknow, Ontario[a]	338.9	N/A
Barrie, Ontario[a]	238.4	N/A
Portland, Maine[b]	181.4	66.5 – 381.3
Lewiston, Maine[b]	198.9	78.0 – 323.3
Berlin, New Hampshire[b]	230.6	137.2 – 332.5
Montpelier, Vermont[b]	252.5	120.9 – 382.3
Watertown, New York[b]	224.5	84.1 – 504.7

[a]Data from Environment Canada (2003)
[b]Data from National Climatic Data Center (2003)

Barrie, Ontario is in the snow belt region of Ontario, and routinely has weeks with more than 100 cm of snow on the ground. This area also consistently has a high population of turkeys and a high spring turkey harvest (Mike Malhiot, pers. comm.). The winter of 2001 was very severe in many parts of Ontario and received the most snow recorded in the past 40 years. Snow arrived in mid-December and stayed until the first week of April, thus creating extremely severe conditions. While some reports of winter mortality were received, spring 2002 wild turkey harvest in areas hardest hit were stable or actually increased (Table 2) (Bellamy and Malhiot 2003).

Table 2. Wild turkey harvest by Wildlife Management Unit (WMU) for portions of Ontario identified in Table 1. (from Bellamy and Malhiot 2003).

WMU (location)	Wild Turkey Harvest			
	1999	2000	2001	2002
76 (Barrie)	246	371	423	528
84 (Lucknow)	No Season	71	71	154
85 (Lucknow)	22	38	43	72

A concern has been expressed regarding freezing rain in Nova Scotia. The concern is that wild turkeys will not be able to feed when the snow is crusted over by freezing rain. This is not a phenomenon unique to Nova Scotia; freezing rain is common throughout the range of the wild turkey and has never been shown to negatively impact wild turkey populations. In fact, freezing rain can be beneficial to turkeys because it will form a crust on top of the snow, which allows wild turkeys to walk to food sources otherwise inaccessible if fluffy snow is present. Annual snowfall, snow depth, and freezing rain conditions found in Nova Scotia have not been shown to limit wild turkey survival throughout the northern range of the wild turkey. Consequently, winter conditions experienced in Nova Scotia are not expected to limit wild turkey survival.

Spring Food Availability

Spring food availability has not been considered a limiting factor for turkey survival in any area of restoration or introduction. Models to determine if and where wild turkeys should be released have primarily focused on landscape scale habitat parameters such as percentage of forested habitat, percentage of early successional habitat, and depth and duration of snow cover (Fleming and Porter 2000, Kurzejeski and Lewis 1985, Backs and Eisfelder 1990, Bellamy and Malhiot 2001). Spring food availability is not considered an important limiting factor and thus has not been used for habitat modeling to predict the success of wild turkey survival.

In the most comprehensive food habits study in the northeast U.S., Eaton et al. (1970) looked at the food habits of a northern population of wild turkeys in southwestern New York and north central Pennsylvania. The study area averaged 2,200 feet in elevation and was 75% forested with the primary tree species being beech, yellow birch, sugar maple, hemlock, white ash, wild black cherry, and red oak. In this study, for the period March through May, the primary food items noted (not in preferred order) were: sensitive fern and other fern species, sedges, burdock, clubmosses, black cherry fruit, beechnut husks and fragments, beech twigs and buds, and maple twigs and buds. These foods are all found in Nova Scotia.

To further illustrate the availability of foods in Nova Scotia, we compared a comprehensive list of food items, compiled from a complete review of existing literature on wild turkey food habits (Vance 2001), with a plant list for Nova Scotia obtained from the Nova Scotia DNR website (Appendix A). While this list is not seasonally separated, it shows that many recognized food sources are available for wild turkeys in Nova Scotia.

Wunz and Pack (1992) provide an excellent review of the eastern wild turkey in northern hardwood forests. Spring food availability is not mentioned in this reference as a limiting factor for the wild turkey. In the spring, the wild turkey diet is primarily composed of various green vegetation and insects, both of which are abundant in Nova Scotia. Based on the information presented here and our collective professional experience, the NWTF is confident that the wild turkey will survive all seasons in the Annapolis valley of Nova Scotia.

Potential Habitat Availability

The current range of the wild turkey extends far beyond the "historic range" as outlined by Mosby and Handley (1943) (Figure 1). This range expansion is primarily due to man's impact on the habitat and the transportation of wild turkeys by man over physical barriers (deserts, mountain ranges, and grasslands). By the time the wild turkey population was rebounding from its low in the 1930's, man had cleared portions of the forest creating more agricultural lands and brood rearing habitat in the form of fields and pastures. Access to early successional habitat in the more northern regions of North America allowed for wild turkey expansion into this area. Wild turkeys have also benefited from increased agriculture through the utilization of waste grains that remain in the field after harvest. Additionally, wild turkeys utilize waste grain found cattle manure, particularly in the northeast where dairy farming is common. Ontario Ministry of Natural Resources biologists noted man's changes to the habitat in the 1980's when they were planning for their restoration efforts. They quickly recognized that much of southern Ontario north of the "historic" line was suitable habitat for wild turkeys. Dave Reid (pers. comm.) related the following account of how the restoration area was defined in Ontario.

> The WTWG [Wild Turkey Working Group] did a literature search and huddled together a couple of times, and after reviewing a long list of parameters, came up with a short list based on a KISS [Keep It Simple] approach ... this short list included snow depth, forest cover and eco-zone [see Tables 3 and 4] ... we came up with a system of scoring the three parameters, based on the literature search and our collective expertise and tested this against the already established releases, it seemed to fit and that was what we ran with. Your query regarding "how man's role in changing the habitat (from historic times) played in the development of the model" ... I believe by happenstance, our "model" took that into account as we knew that habitat conditions were suitable for wild turkey beyond what Mosby had indicated as the northern limit of the range (roughly equivalent to what is now referred to as the Carolinian Canada zone, which the foresters have always called the Southern Deciduous Forest region. Points were scored in using the model

to classify a given wildlife management unit [WMU] as class 1 (the best), class 2 (second best) and class 3 (marginal or unsuitable) ... more points were scored for forest cover in the 26 - 40% range and this had the affect of scoring WMUs higher today than when they were 100% forested before European settlement and beyond the turkeys range at that time. Similarly, the ecozone approach gave the more southerly WMUs a higher score but WMUs found further north (beyond the "historic" range) still got some points and I believe this also takes account of man's role on changing the landscape to suit turkeys.

Table 3. Criteria for assessment of wild turkey release areas in Ontario (from Bellamy and Malhiot 2001).

Factor	Category	Score
% of total area	> 75%	10
in forest cover	41 to 75%	20
	26 to 40%	30
	16 to 25%	20
	10 to 15%	10
	< 10%	0
Mean # of days with	60	30
> 5 cm of snow on the	0 to 90	20
ground	90 to 120	10
	120	0
Ecoregion	southern agricultural	15
	central agricultural	10
	eastern midlands	5
	other	0

Table 4. Classification of Wildlife Management Units for wild turkey restoration priority (from Bellamy and Malhiot 2001).

Class	Total Score and Additional Conditions
1	51 to 75
2	26 to 50
3	0 to 25 OR < 10% forest cover OR > 120 days with more than 5 cm of snow on the ground

The potential for further range expansion in the northern U.S. is severely limited as restoration efforts have largely been completed. Some efforts take place each year to fill isolated pockets of habitat located within the present range. Additionally, some range expansion opportunities are still available along the northern edge of the current range.

The NWTF has delineated potential wild turkey habitat in the eastern and maritime provinces of Canada (Figures 2-5). The potential range outlined on these maps was identified based on review of course-scale GIS data. Using our collective professional experience we determined that deciduous forest types, agricultural habitat, and average annual snowfall were the most important variables to consider. As noted in Figure 5, good potential wild turkey habitat exists in parts of Nova Scotia. Further, investigation of this habitat shows that much of the flora and fauna found in Nova Scotia are also found within the range of the wild turkey in the New England states and as far south as Virginia's Appalachian mountains.

The North American Bird Conservation Initiative (NABCI) has identified Bird Conservation Regions (BCR) throughout North America. These BCRs delineate different habitat types that support different suites of bird species. The BCR, in turn, provides a framework to improve the ecological health of that habitat type in order to benefit those species. Nova

Scotia falls within the Atlantic Northern Forest BCR along with established turkey range in Maine, Vermont, New Hampshire and northern New York (Figure 6).

Using ecoregions or ecozones is another factor that has been used to help delineate potential wild turkey habitat. For example, this was used as one of the criteria in Ontario. Ecoregions are delineated based upon the soils, vegetation types and animal species found in a given area. Nova Scotia is part of the Laurentian Mixed Forest Province ecoregion as identified by Bailey and Cushwa (1981) (Figure 7). This ecoregion includes wild turkey range in Maine, New York, Quebec, Ontario, Michigan, Wisconsin and Minnesota (Figure 7). The overlap of Nova Scotia's ecoregion and BCR with that of current and historic wild turkey range, gives further credibility to the fact that wild turkeys would survive in Nova Scotia. In fact, an introduction of wild turkeys into Nova Scotia could be considered more of a range expansion of this species, similar to the western expansion where wild turkeys were carried over physical barriers such as mountains, deserts, and treeless grasslands. Without the Bay of Fundy acting as a physical barrier, wild turkeys would likely have already expanded their range into Nova Scotia.

Summary

Although average annual snowfall is greater in the Annapolis valley of Nova Scotia than in many portions of the current wild turkey range, wild turkeys currently are doing well in areas that have similar or greater annual snowfall in Ontario and the New England states. Even after severe winter conditions, wild turkey populations have been shown to continue to thrive. The NWTF believes that, due to the generally packed and crusted characteristics of the snow and the average snow depth, snowfall amounts are not expected to limit the survival of wild turkeys in Nova Scotia.

Spring food availability has never been considered a limiting factor for wild turkey survival. Wild turkey habitat models have not included this as a factor in determining suitability for wild turkeys. A review of the food availability in Nova Scotia shows that there is an abundance of diverse food sources available for turkeys in Nova Scotia. In the spring, wild turkeys primarily feed on green vegetation and insects; there is no shortage of either in Nova Scotia. The NWTF agrees with the literature that spring food availability is not expected to limit wild turkey survival in Nova Scotia.

A review of Nova Scotia's ecoregion and BCR designations shows that Nova Scotia is included in zones which currently and historically include wild turkey range. This provides further support that the habitat and climate characteristics found in Nova Scotia would support wild turkeys. Nova Scotia, like most other areas in North America, has been drastically changed through human's influence, which has made it more suitable to wild turkeys than it may have been in the past. The combination of decreased forest cover and the resulting early successional habitat, along with the interspersion of agriculture into the northern U.S. and southern Canada, has allowed the wild turkey to thrive in areas that once would have been uninhabitable. Man has also influenced the expansion of the wild turkey range by moving wild turkeys across barriers that they were unable to cross on their own. This suggests that, without the Bay of Fundy acting as a barrier, wild turkeys likely would have already expanded their range to Nova Scotia.

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Personal Communications

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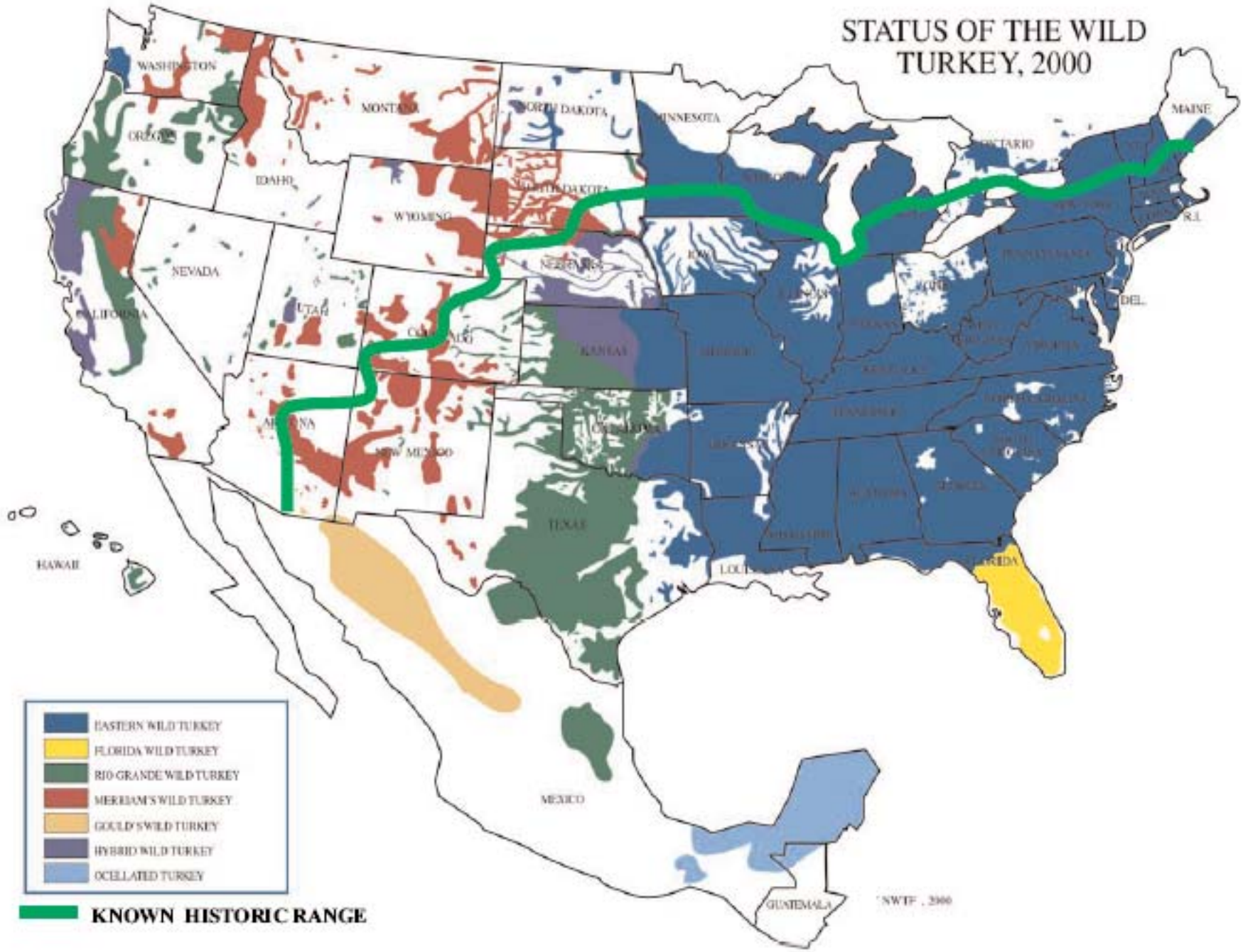

Figure 1: Wild turkey range, 2000, and know historic range (from Moseby and Handley 1943).

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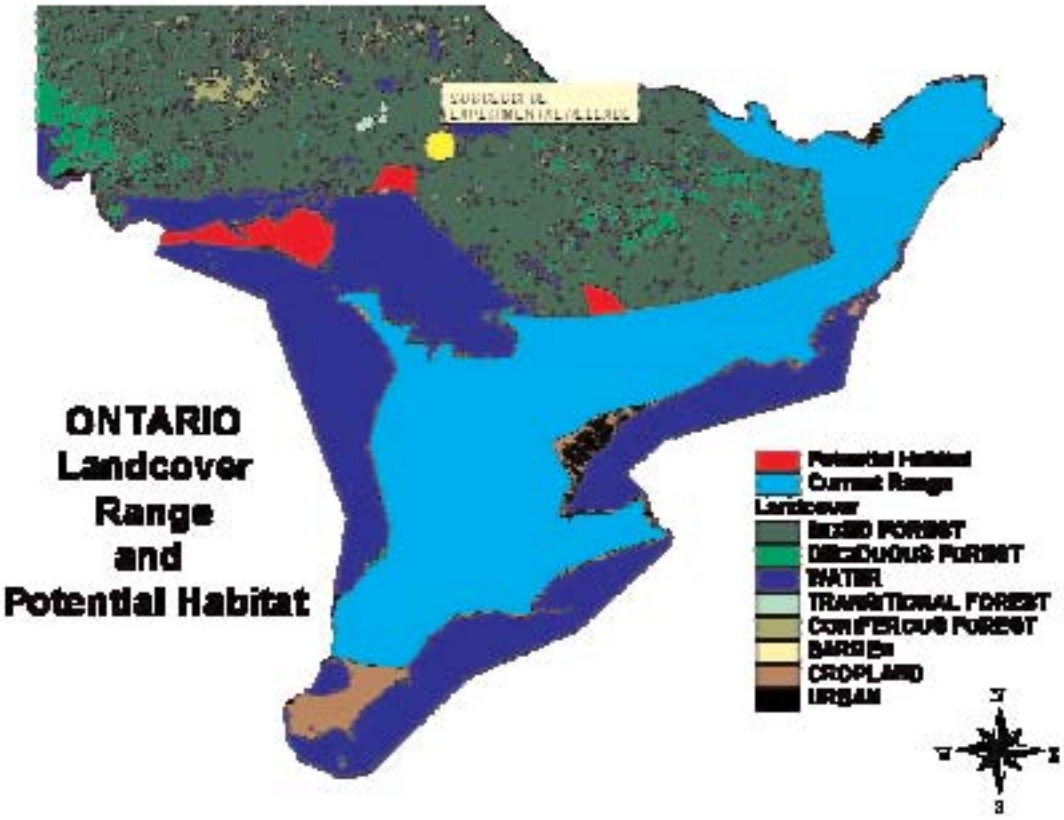

Figure 2: Ontario landcover, wild turkey range and potential wild turkey habitat.

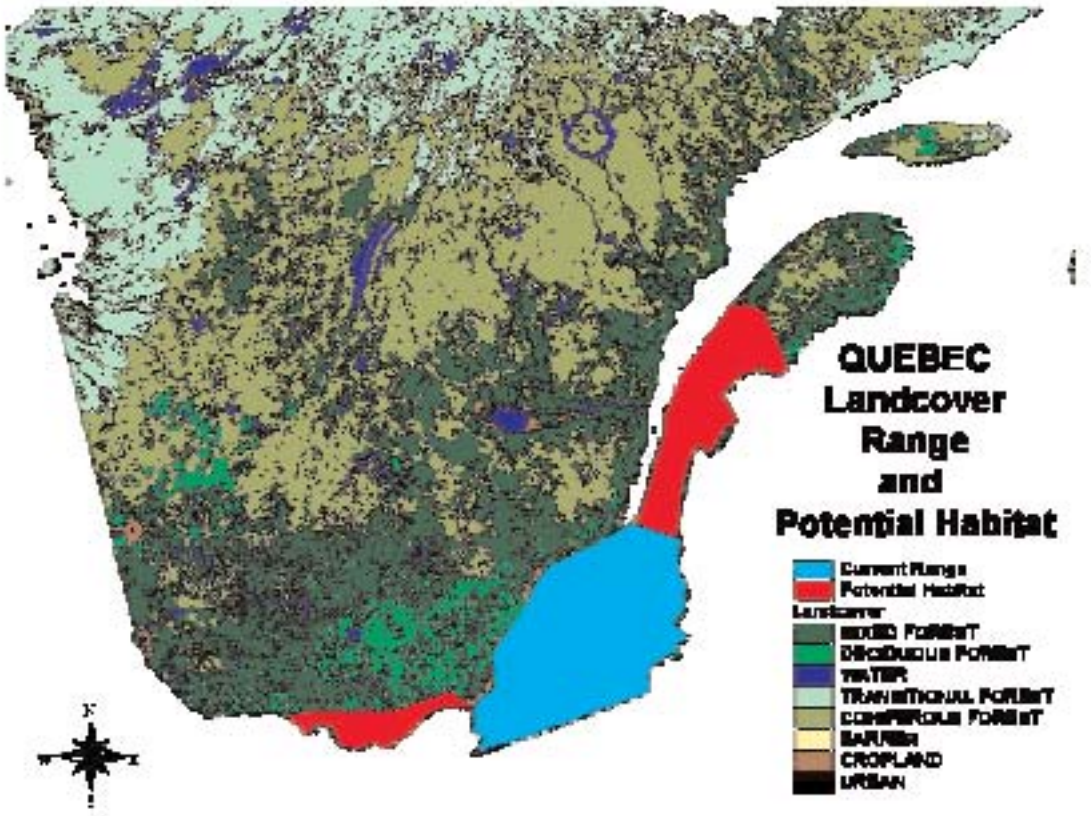

Figure 3: Quebec landcover, wild turkey range and potential wild turkey habitat.

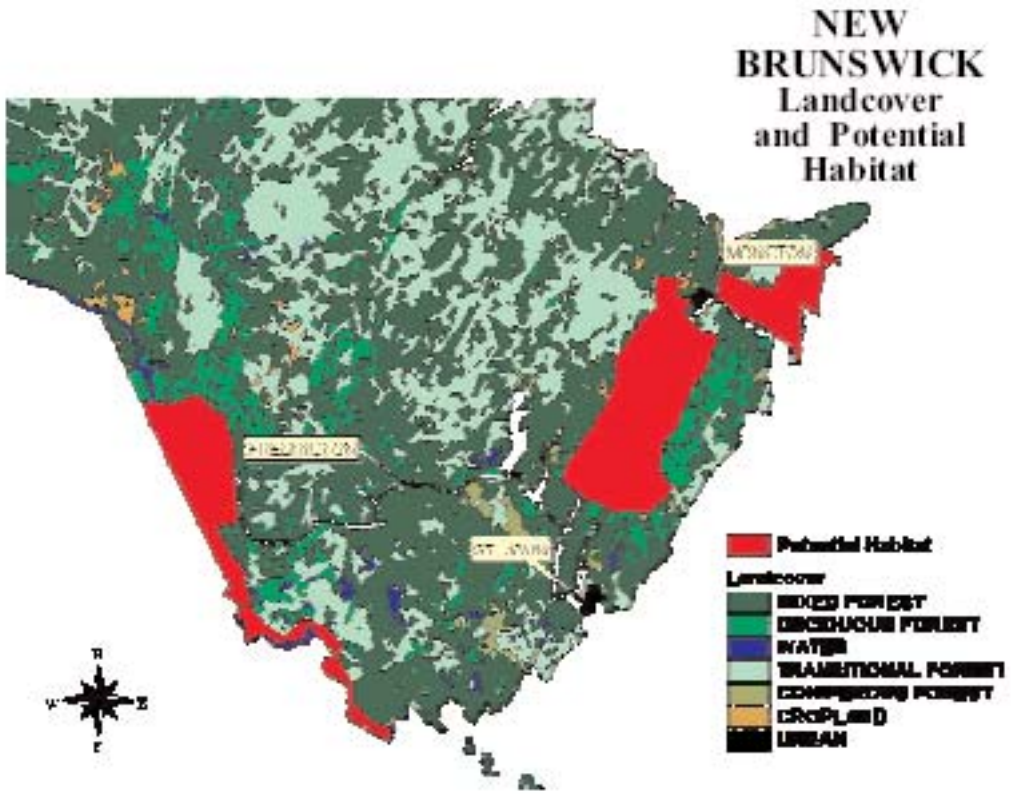

Figure 4: New Brunswick land cover and potential wild turkey habitat

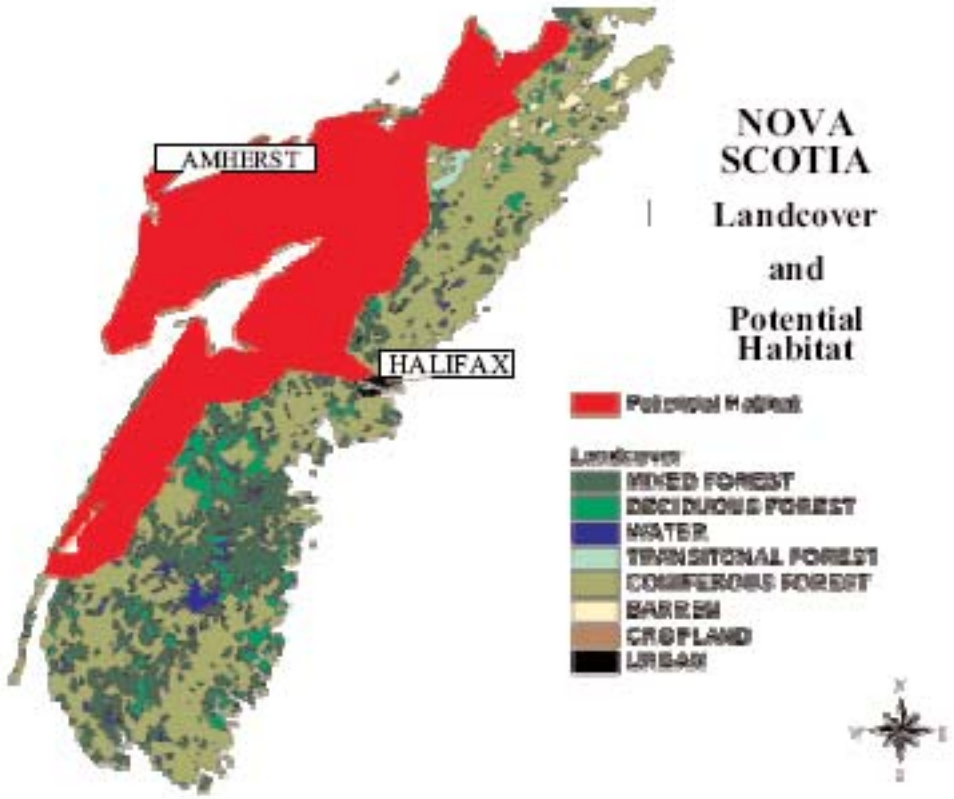

Figure 5: Nova Scotia landcover and potential wild turkey habitat

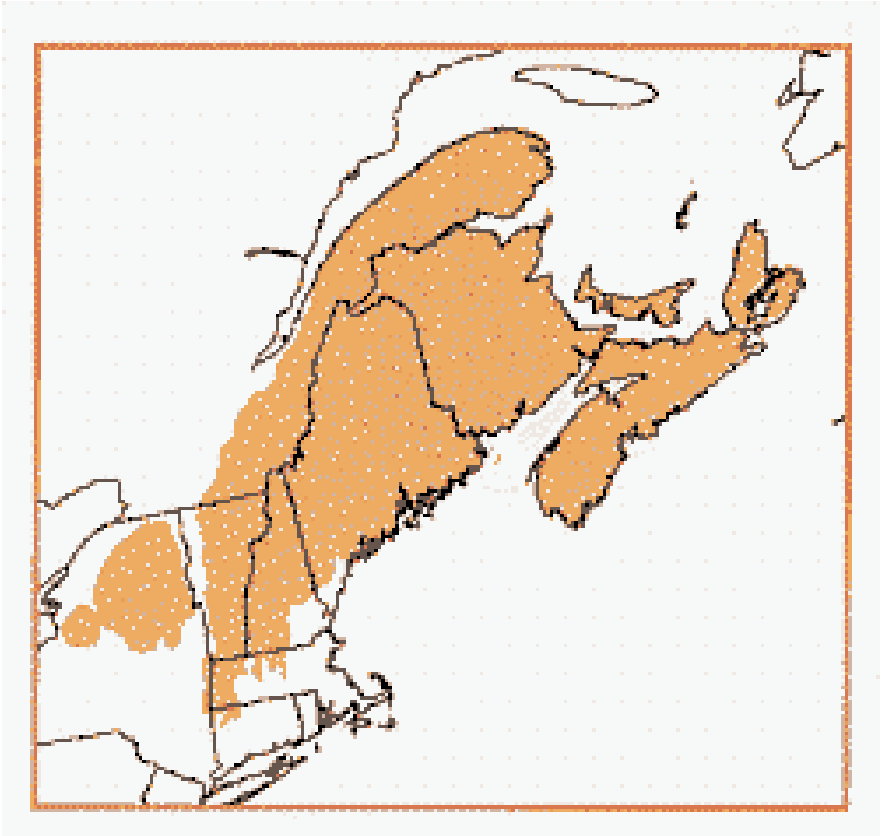

Figure 6: North American Bird Conservation Initiative (NABCI) Atlantic Northern Forest Bird Conservation Region (BCR).

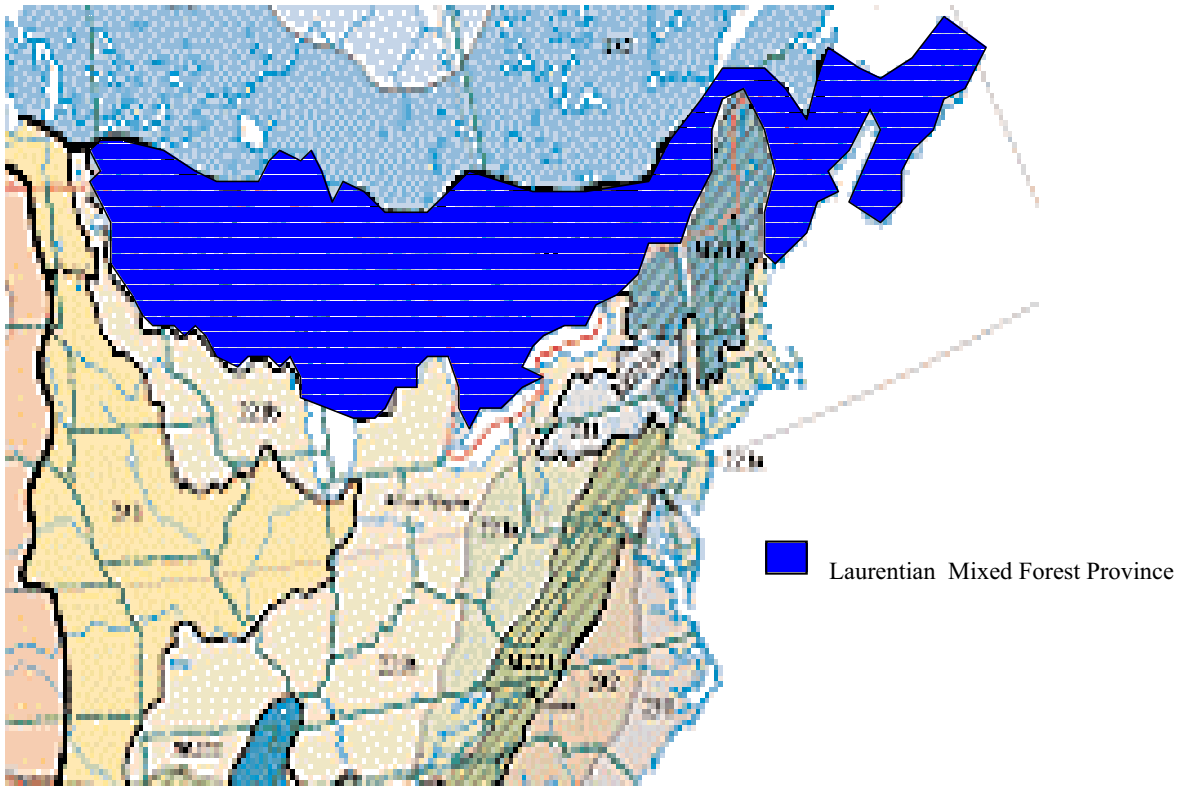

Figure 7: Location of the Laurentian Mixed Forest Province Ecoregion in North America as identified by Baily and Cushwa (1981).

Appendix A

Following is an extensive wild turkey food items list (from Vance 2001). We compared this list of known food items across North America to a list of plant species found in Nova Scotia (from NS DNR website). We struck through the food item species that we could not confirm to be present in Nova Scotia. For the remaining plant species, our review indicated that either the species listed or a closely related species was present in Nova Scotia. Although this list is not geographically or seasonally specific, it does illustrate the diversity of potential food items available in Nova Scotia.

Hard Mast
Acorns (*Quercus* sp.)
Beech (*Fagus grandifolia*)
~~Blue beech (*Carpinus caroliniana*)~~
~~Chestnut (*Castanea dentata*)~~
~~Chinquepin (*Castanea* sp.)~~
Laurel oak acorn (*Quercus laurifolia*)
Live oak acorn (*Quercus virginiana*)
~~Pecan (*Carya* sp.)~~
~~Pecan Hickory (*Carya illinoensis*)~~
Pines - seeds (*Pinus* sp.)
~~Shagbark hickory (*Carya ovata*)~~

Soft Mast
American holly (*Ilex opaca*)
Arrowwood (*Viburnum* sp.)
Baneberry (*Actaea rubra*)
~~Barberry (*Berbis* sp.)~~
Bearberry, kinnikinnick (*Arctostaphylos uva-ursi*)
~~Bitterbush (*Purshia tridentata*)~~
Blackberries (*Rubus* sp.)
Blackhaw (*Viburnum prunifolium*)
Blueberry (*Vaccinium* sp.)
Buffaloberry (*Shepherdia* sp.)
~~Cabbage palm (*Sabal palmetto*)~~
~~Cactus fruit (*Opuntia* sp.)~~
~~California laurel—fruit (*Umbellularia californica*)~~
Cedar (*Juniperus* sp.)
~~Chinaberry, umbrella tree (*Melia azedarach*)~~
Cleavers, goosegrass (*Galium aparine*)
~~Common pawpaw (*Asimina triloba*)~~
Cherry (*Prunus* sp.)
Coffeeberry (*Rhamnus* sp.)
Currant (*Ribes* sp.)
Dewberry (*Rubus* sp.)
Dogwoods (*Cornus* sp.)
~~Dwarf saw palmetto (*Serenoa repens*)~~
Elderberry (*Sambucus simpsonii, S. caerula*)
Gooseberries (*Ribes* sp.)
~~Goosefoot (*Chenopodium* sp.)~~
~~Gums (*Nyssa* sp.)~~
~~Ground cherries (*Physalis* sp.)~~
~~Hackberries (*Celtis* sp.)~~
Hawthorns (*Crataegus* sp.)
Hollies (*Ilex sp.*)
Huckleberry fruit (*Gaylussacia sp.*)
~~Icaco coco-plum (*Chrysobalonus icaco*)~~
Inkberry, bitter gallberry (*Ilex glabra*)
~~Ironwood, hornbeam (*Carpinus caroliniana*)~~
Jack-in-the-pupit (*Arisaema* sp.)
Juniper (*Juniperus sp.*)
~~Lantana (*Lantana horrida, L. veluntina*)~~
Ludwigia (*Ludwigia* sp.)
~~Madrono (*Arbutus texana*)~~
Manzanita (*Arctostaphylos pungens*)
~~Marbleberry (*Ardisia escallonioides*)~~
~~Moonseed (*Menisperum canadense*)~~
~~Mulberry (*Morus rubra*)~~
~~Muscadine grape (*Vitis rotundifolia*)~~
~~Myrsine—? guiana rapanea (*Rapanea guianensis*)~~
~~Myrtle holly (*Oreophila myrtifolia*)~~
~~Nightshade (*Solanum* sp.)~~
~~Oregon grape (*Mahonia* sp.)~~
~~Swamp cabbage berries (*Sabal palmetto*)~~
Partridgeberry (*Mitchella repens*)
~~Pawpaw (*Asimina* sp.)~~
~~Pear—fruit (*Pyrus* sp.)~~
~~Persimmon (*Diospyros virginiana*)~~
~~Raccoon grape (*Ampelopsis cordata*)~~
~~Rattan vine (*Berchemia scandens*)~~
~~Redbay (*Persea borbonia*)~~
Sand plum (*Prunus* sp.)
~~Snowberry (*Symphoricarpos* sp.)~~
~~Spicebush (*Benzoin benzoin*)~~
Strawberry—fruit (*Frageria* sp.)
Sumacs (*Rhus* sp.)
~~Toyon—fruit (*Photinia arbutifolia*)~~
Wax myrtle (*Myrica cerifera*)
Wild cherries (*Prunus* sp.)
Wild geranium (*Geranium maculatum*)
~~Wild Grape (*Vitis* sp.)~~
Wild plum (*Prunus americana*)
Wild roses (*Rosa* sp.)

Seeds
American elm (*Ulmus americana*)
Ash (*Fraxinus* sp.)
Asters (*Aster* sp.)
~~Bahia grass (*Paspalum notatum*)~~
Barley (*Hordeum vulgare*)
~~Barnyard grass—seeds (*Echinochloa crus-galli*)~~
~~Beautyberry (*Callicarpa americana*)~~
~~Beard grass (*Polypogon monspeliensis*)~~
Begger-ticks (*Bidens* sp.)
Beggerweed (*Desmodium tortuosum*)
Blackberry seeds (*Rubus* sp.)
~~Blackgum, sourgum (*Nyssa sylvatica*, also blackgum var. *N. biflora*)~~
Black haw (*Viburnum* sp.)
~~Black medic (*Medicago lupulina*)~~
Blue-eyed grass—seeds (*Sisyrinchium* sp.)

Bluegrass (*Poa* sp.)
~~Bristle grasses, foxtail grasses (*Setaria* spp.)~~
Broad-leaved dock (*Rumex obtusifolia*)
Brome grasses (*Bromus* spp.)
~~Buckthorn (*Bumelia* sp.) also false buckthorn (*B. languinosa*)~~
~~Buckwheat (*fagopyrum sagitattum*)~~
Bulrush (*Scirpus* sp.)
~~Burdock (*Arctium minus*)~~
Buttercup—seeds (*Ranunculus* spp.)
~~Buttonweed (*Diodia teres*)~~
~~California laurel—seeds (*Umbellularia californica*)~~
Canary grass (*Phalaris minor*)
~~Carpet grass (*Axonopus compressus*)~~
Cedar elm (*Ulmus crassifolia*)
Common poison-ivy (*Toxicodendron radicans*)
Corn (*Zea mays*)
~~Cornfield grass (*Tricachne patens*)~~
~~Crabgrasses (*Digitaria* sp.)~~
~~Crotons (*Crotoni* sp.)~~
~~Crownbeard, crownbread (*Verbesina enceloides, V. microptera*)~~
~~Crowfoot grasses (*Chloris* sp.)~~
~~Cowpea (*Vigna sinensis*)~~
~~Daisy (*Compositae* sp.)~~
~~Dallis grass (*Paspalum conjugatum*)~~
~~Dayflower (*Commelina elegans*)~~
~~Douglas fir—seed (*Pseudotsuga menziesii*)~~
~~Doveweed (*Croton* sp.)~~
~~Dropseed grasses, rushgrasses (*Sporobolus* spp.)~~
~~Dutchman's-pipe (*Aristolochia macrophylla*)~~
Eastern hophornbeam—seed (*Ostrya virginiana*)
~~Elegant microseris—seeds (*Microseris elegans*)~~
Everlasting pea (*Lathyrus* sp.)
~~False brome (*Brachypodium distachyon*)~~
~~False buffalo grass (*Munroa squarrosa*)~~
Fescue grasses (*Festucai* sp.)
Figwort (*Scrophularia* sp.)
~~Filaree—seeds (*Erodium* sp.)~~
~~Finger grass (*Digitaria* sp)—?~~
Fleabane (*Erigeron* sp.)
~~Goosefoot (*Chenopodium* sp.)~~
~~Gramas (*Bouteloua* sp.)~~
~~Grape (*Muscadinia munsonaria*)~~
Greenbriar (*Smilax* sp.)
~~Guajillo—seeds (*Acacia berlandieri*)~~
~~Hackberry (*Celtis laevigata*)~~
Hemlock (*Tsuga canadensis*)
~~Hoary pea (*Tephrosia virginiana*)~~
Hoary vervane—seeds (*Verbena stricta*)
Hog peanut—seeds (*Amphicarpaea bracteata*)
Horseweed, hogweed, butterweed (*Erigeron canadensis*)
~~Huisache—seeds (*Acacia farnesiana*)~~
Indian ricegrass (*Oryzopsis hymenoides*)
~~Italian rye grass (*Lolium multiflorum*) also add (*Lolium perenne*)~~
Japanese brome—seeds (*Bromus japonicus*)
~~June grass (*Koeleria* sp.)~~
~~Korean lespedeza (*Lespedeza stipulacea*)~~
~~Lespedeza (*Lespedeza* sp.)~~
~~Leatherweed (*Jatropha spatulata*)~~
Leopard lily (*Lillium catesbaei*)
Liverleaf (*Hepatica triloba*)
~~Locust—seeds (*Robinia* sp.)~~
~~Longleaf bluet (*Houstonia longifolia*)~~
~~Lovegrasses (*Eragrostis* sp.)~~
Ludwigia (*Ludwigia* sp.)
Meadow foxtail (*Alopecurus* sp.)
~~Mesquite (*Prosopis juliflora*)~~
~~Millet (*Setaria italica*)~~
~~Milk thistle (*Silybum marianum*)~~
~~Milo—seed (*Sorghum vulgare*)~~
~~Morning glory (*Ipomoea* sp.)~~
Mouse-ear chickweed (*Cerastium vulgatum*)
~~Mountain dandelion (*Agoseris* sp.)~~
~~Needlegrasses (*Stipai* sp.)~~
~~Nut-rush (*Scleria* sp.)~~
Oxalis—seeds (*Oxalis* sp.)
~~Swamp cabbage—seeds (*Sabal palmetto*)~~
Panic grasses (*Panicum* sp.)
~~Paspalum (*Paspalum ciliatifolium*)~~
~~Partridge peas (*Cassia fasciculata*)~~
~~Pepper vine (*Ampelopsis arborea*)~~
~~Pine dropseed (*Blepharoneuron tricholepis*)~~
Pines (*Pinus* sp.)
Plantain (*Plantago* sp.)
Poison ivy (*Rhus radicans*) (*Toxicodendron vernix*)
Poison oak—seeds (*Rhus diversiloba*)
~~Popcorn flower—seeds (*Plagrobothrys nothofulvus*)~~
~~Prairie coneflower—seeds (*Ratibida columnifera*)~~
~~Prickly ash seeds (*Zanthoxylum* sp.)~~
~~Prickly pear cactus—seeds (*Opuntia* sp.)~~
~~Prickly sow thistle—seeds (*Sonchus asper*)~~
~~Purple ironweed (*Vernonia* sp.)~~
~~Quakinggrass (*Briza maxima*)~~
~~Queenroot seeds (*Stillingia* sp.)~~
Ragweeds (*Ambrosia* sp.)
~~Rattlebox (*Crotalaria spectabilis*)~~
~~Red pimpernel—seed capsules (*Anagallis arvensis*)~~
~~Rocky mountain bee plant (*Cleome serrulata*)~~
~~Sassafras (*Sassafras albidium*)~~
~~Saw palmetto (*Serenoa repens*)~~
Sedges (*Carex* sp.)
~~Scurf pea (*Psoralea tenuiflora*)~~
Sheep-sorrel (*Rumex acetosella*)
Smartweeds, knotweeds (*Polygonum* sp.)
~~Smooth cat's ear—seeds (*Hypochoeris glabra*)~~
~~Snowberry—seeds (*Symphoricarpos* sp.)~~
Solomon's seal—seed (*Polygonatum* sp.)
~~Spangletop grass—seeds (*Leptochloa panicoides*)~~
Spikenard (*Aralia racemosa*)
Spurge (*Euphorbia* sp.)
~~Stargrass seeds (*Hypoxis leptocarpa*)~~
~~Stinkseed (*Lappula redowskii*)~~
~~Storax—seeds (*Styrax americana*)~~
~~Sunflowers (*Helianthus* sp.)~~
~~Swamp privet—seeds (*Forestiera acuminata*)~~
~~Sweetgum—seeds (*Liquidamber styraciflua*)~~
~~Tansy mustard (*Descurainia* sp.)~~

Tear thumb (*Polygonum sagittatum*)
~~Thistle (*Cersium* sp.)~~
Thoroughwort (*Eupatorium* sp.)
Tick-trefoils (*Desmodium* sp.)
~~Vasey's grass (*Vaseyochloa sp.*)~~
~~Vetch (*Vicia* sp. and *V. americana*))~~
~~Virginia creeper (*Parthenocissus quinquefolia*)~~
Violet (*Viola* sp.) seeds, pods
~~Water millet (*Zizanopsis miliacea*)~~
~~Water tupelo—seeds (*Nyssa aquatica*)~~
Wedgegrass (*Sphenopholis sp.*)
Western thistle—seeds (*Cirsium occidentale*)
~~Wheat (*Triticum aestrivum*)~~
~~Wheat grass (*Agropyron* sp.)~~
Wild barley (*Hordeum* sp.)
~~Wild buckwheat, dog-tongue (*Eriogonum* sp.)~~
Wild cherry—seed (*Prunus* sp.)
~~Wild lupine (*Lupinus* sp.)~~
~~Wild millet (*Echinochloa* sp.)~~
~~Wild mustard (*Cruciferae*)~~
Wild oatgrass (*Danthonia spicata, D. intermedia*)
~~Wild oats (*Avena fatua, A. barbata*)~~
Witchhazel (*Hamamelis virginiana*)
Wood-betony, lousewort (*Pedicularis canandensis*)
~~Woolly yarrow (*Archilea lanulosa*)~~
Yellow-eyed grass, hard-head grass (*Xyris* sp.)
~~Yellow foxtail (*Setaria glauca*)~~
Yellow sedge (*Cyperus rotundus*)

~~(*Aneilema nudiflorum*) seeds, pods~~
~~(*Vitis rotundifolia*) seed~~
~~(*Serinea oppositifolia*) seeds~~
(*Potentilla* spp.)
~~(*Onosmodium occidentale*)—seed~~
~~(*Uniola sessiliflora*)~~
(*Osmorhiza* sp.)
~~(*Eriogoneum pharnaceoides*)~~

Herbaceous (leaves, flowers, stems)
~~Amaranth (*Amaranthus* spp.)~~
Barley (*Hordeum vulgare)*
Bearberry, kinnikinnick—flowers (*Arctostaphylos uva-ursi*)
Blueberry—leaves (*Vaccinium* sp.)
Bluegrass—leaves (*Poa* sp.)
~~Bluestem (*Andropogon* sp.)~~
Boneset (*Eupatorium* sp.)
~~Brake fern (*Pteris aquilina*)~~
~~Bristly ox-tongue—leaves, flowers (*Picris echioides*)~~
Brome grasses (*Bromus* sp.)
~~Broom sedge (*Andropogon virginicus*)~~
~~Bur clover (*Medicago hispida*)~~
Buttercup—leaves (*Ranunculus* sp.)
Canary grass (*Phalaris minor*)
~~Carpet grass (*Axonopus* sp.)~~
~~Chicory (*Agoseris* sp.)~~
Christmas fern (*Polystichum acrostichoides*)
~~Clovers (*Trifolium* spp.)~~
Club moss—leaves (*Lycopodium* sp.)
Coneflower (*Rudbeckia laciniata*)
~~Crownbread, crown beard (*Verbesina enceloides, V. microptera*)~~
~~Cypress twigs (*Taxodium* sp.)~~
~~Daisy (*Compositae* sp.)~~
~~Dandelion—leaves (*Taraxacum* sp.)~~
~~Dayflower (*Commelina elegans*)~~
~~Dutchman's-pipe (*Aristolochia macrophylla*)~~
~~Dwarf dandelion (*Krigia oppositifolia*)~~
~~Elegant microseris—flowers (*Microseris elegans*)~~
Elm (*Ulmas americana*)
~~False brome (*Brachypodium distachyon*)~~
~~False dandelion (*Pyrrhopappus* sp.)~~
~~Ferns and mosses—Pteridophyta~~
~~Filaree—leaves, stems (*Erodium* sp.)~~
Fleabane (*Erigeron* sp.)
~~Gramas (*Bouteloua* sp.)~~
~~Gaura (*Gaura* sp.)~~
~~Goosefoot (*Chenopodium* sp.)~~
~~Hackberry—flowers (*Celtis occidentalis*)~~
Hemlock—leaves, stems (*Tsuga canadensis*)
Honeysuckle (*Lonicera japonica*)
~~Indian mustard—flowers (*Brassica juncea*)~~
~~Italian rye grass (*Lolium multiflorum*)~~
Juniper—stems, leaves (*Juniperus* sp.)
Leopard lily (*Lillium catesbaei*)
~~Lespedeza—flowers, leaves (*Lespedeza* sp.)~~
Lettuce (*Lactuca* sp.)
~~Mariposa lily—flowers (*Calochortus* sp.)~~
~~Milk thistle (*Silybum marianum*)~~
~~Mullein (*Verbascum* sp.)~~
~~Mushroom (*Basidiomycetes*)~~
Nimble-will (*Muhlenbergia* sp.)
~~Orchard grass (*Dactylis glomerata*)~~
~~Orchids (*Orchidaceae*)~~
Oxalis—flowers (*Oxalis* sp.)
Panic grass leaves (*Panicum sp.*)
Paper birch—leaves (*Betula papyrifera*)
Pasque flower—flower (*Anemone patens*)
Pennywort leaves (*Hydrocotyle* sp. and *Centella repanda*)
Pine—needles (*Pinus* sp.)
~~Pine grass—florets (*Blepharoneuron tricholepsis*)~~
Plantain (*Plantago* sp.)
Poison ivy—flower (*Toxicdendron rydbergii*)
Poison oak—stems (*Rhus diversiloba*)
~~Popcorn flower—flowers (*Plagiobothrys nothofulvus*)~~
Prickly lettuce—stems, flowers (*Lactuca scariola*)
~~Prickly sow thistle—flowers (*Sonchus asper*)~~
~~Purslane (*Portulaca oleracea*)~~
~~Quaking grass (*Briza maxima*)~~
Ragworts (*Senecio* spp.)—groundsel (*S. ampullaceous*)
~~Red-stem filaree—leaves (*Erodium cicutarium*)~~
Rocky mountain iris (*Iris missouriensis*)
~~Russian olive—flowers (*Eleagnus angustifolia*)~~
~~Salsify—leaves (*Tragopogon* spp.)~~
Sedge—leaves, stems (*Carex* sp.)
Sensitive fern (*Onoclea sensibilis*)
Sheep-sorrel, sourgrass (*Rumex acetosella*)
Silene (*Silene* sp.)
Skunkbrush, skunkberry, fragrant sumac—flowers (*Rhus*

aromatica)
Smartweed (*Polygonum* sp.)
~~Smooth cat's ear—leaves, flowers (*Hypochoeris glabra*)~~
~~Spear-leaved agoseris—flowers (*Agoseris restrorsa*)~~
Spring beauty (*Claytonia caroliniana, C. virginica*)
Sumac—flowers (*Rhus* sp.)
~~Sweet clover (*Melilotus* sp)~~
~~Tall Purpletop (*Trilodia flava*)~~
~~Thistle (*Cersium* sp.)~~
Tick clover—flowers (*Desmodium rotundifolium*)
~~Vetch—leaves (*Vicia* sp.)~~
Wampee (*Pontederia cordata*)
Western thistle (*Cirsium occidentale*)
~~Wild mustard (*Cruciferae*)~~
Wild roses—flowers (*Rosa* sp.)
Wild rye (*Elymus* sp.)
Windmill pink (*Silene gallica*)
Wood-betony, lousewort (*Pedicularis canandensis*)
Wood fern (*Dryopteris spinulosa*)
~~Woolly yarrow (*Archillea lanulosa*)~~

Roots and Tubers
Allium sp.—bulb
Arrowhead tuber (*Sagittaria sp.*)
Chufa (*Cyperus esculentus*)
Cyperus sp.
Groundnut tubers (*Apios apios*)
Hog peanut (*Amphicarpea bracteata*)
Hog potatoe
~~Red root (*Cyrotheca tinctoria*)~~
Rocky Mountain iris (*Iris missouriensis*)—bulb

Invertebrates
Acrididae—adults, nymphs (grasshoppers)
Amblyomma americanum—adults
Anthribidae—adults
Arachnida
Arctiidae—larvae
Beetles (Coleoptera)
Belostomatidae—adults
Blattidae—adults
Braconidae—adults
Buprestidae—adults
Caliphoridae—adults
Carabidae—adults
Cantharidae—adults
Cerambycidae—adults
Cercopidae—adults
Chrysomelidae—adults
Cicadellidae—adults
Cicadidae—adults
Citheroniidae—adults
Coenagrionidae—adults
Coreidae—adults
Coreimelaenidae—adults
Curculionidae—adults
Cycnidae—adults
Elateridae—adults
Formicidae—adults
Fulgoridae—adults
Gastropoda
Geometridae—larvae, pupae, adults
Hesperiidae—larvae
Hirudinea (leech)
Histeridae—adults
Hydrophilidae—adults
Ichneumonidae—adults
Labiduridae—adults
Lepidoptera (butterfly)
Libellulidae—nymphs, adults
Lygaeidae—nymphs, adults
Mantidae—adults
Myriapoda
Myrmeleonidae—adults
Noctuidae—larvae, pupae
Nymphalidae—adults
Oligochaeta
Pentatomidae—nymphs, adults
Pieridae—larvae, pupae
Pulmonata—adults
Pyralidae—adults
Reduviidae—adults
Reptilia—bone fragments
Saldidae—adults
Scarabaeidae—adults
Scutelleridae—adults
Stratiomyidae
Syrphidae—adults
Tabanidae—adults
Tenebrionidae—adults
Tenthridinidae—cocoons
Tetrigidae—adults
Tettigoniidae—adults
Vespidae—adults

References:
(Powell 1965, Schorger 1966, Smith and Browning 1967, Korschgen 1967, 1973, Blackburn et al. 1975, Hurst and Stringer 1975, Scott and Boeker 1975, Petersen and Richardson 1973, Scott and Boeker 1973, Williams 1981, Mackey and Jonas 1982, Zeedyk 1982, Tabatabia and Kennedy 1984, Schemnitz et al. 1985, Laudenslager and Flake 1987, Williams and Austin 1988)