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MICHIGAN KARNER BLUE BUTTERFLY HABITAT CONSERVATION PLAN

Photograph by Jennifer Kleitch

Michigan Department of Natural Resources
Wildlife Division Report No. _____
_____ 2007

Printed by Authority of: P.A. 451 of 1994
Total Number of Copies Printed: XX
Cost per Copy:.....$XXX
Total Cost: .....$XXX

Michigan Department of Natural Resources

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November 2, 2007

ACKNOWLEDGMENTS

The Michigan Department of Natural Resources appreciates the valuable contributions made by many agencies, organizations and individuals during the development of this plan. In particular, we thank the U.S. Fish and Wildlife Service for providing funding and technical support. We also thank the members of the Karner Blue Butterfly Working Group and the Karner Blue Butterfly Management Partners Workgroup, who shared important perspectives and expertise during their meetings and document reviews. Finally, we thank the members of the public who helped shape the content of this plan by offering input during public meetings and public-comment periods.

A contribution of the Cooperative Endangered Species Conservation Fund Grants Program, Michigan Project E-3-HP

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1. INTRODUCTION

1.1 Purpose

This Habitat Conservation Plan (HCP) has been developed to facilitate the conservation of the Oak Savanna Ecosystem, Karner blue butterfly (*Lycaeides melissa samuelis*; KBB) and other associated species of concern on non-Federal land in Michigan. It outlines activities that will be conducted to maintain the early-successional habitat conditions necessary to support savanna species and communities. It also integrates diverse land uses with conservation objectives by outlining measures to avoid, minimize and mitigate take of KBB and other species that could be caused by activities in occupied KBB habitat. In this way, this HCP supports the issuance of an incidental take permit (ITP) pursuant to section 10(a)(1)(B) of the Federal Endangered Species Act of 1973, as amended (87 Stat 884, 16 U.S.C. § 1531 et seq.; ESA).

1.2. Background

Historically, habitats within the Oak Savanna Ecosystem were maintained in an early-successional state by a natural disturbance regime that included frequent fire, windthrow, wild herbivore grazing, and insect and disease outbreak (Nuzzo 1986, Grundel et al. 1998, Ritchie et al. 1998, Fuhlendorf and Engle 2001). The practice of widespread fire suppression that began following European settlement interrupted the primary mechanism that historically maintained this ecosystem (Haney and Apfelbaum 1990, Faber-Langendoen 1991, Abrams 1992, O'Connor 2006). The Oak Savanna Ecosystem has been reduced to fragmented and often-degraded remnants as a result of land conversion and fire suppression (Nuzzo 1986, O'Connor 2006).

Many savanna species, including KBB (Andow et al. 1994), declined or were locally extirpated as habitat was degraded or destroyed (Leach and Ross 1995). The range-wide decline prompted the 1992 classification of KBB as federally endangered (U.S. Fish and Wildlife Service 1992).

Throughout the period of widespread population decline, however, KBB populations in Michigan and Wisconsin remained comparatively robust (U.S. Fish and Wildlife Service 2003a). Many of these KBB populations survived on a public land base, where land-management practices designed to benefit wildlife like white-tailed deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*) and ruffed grouse (*Bonasa umbellus*) also benefited KBB.

Within Michigan, KBB is currently known to occur on approximately 3,900 acres within 10 counties in the western Lower Peninsula (Fettinger 2005; Figure 1). The Federal Karner Blue Butterfly Recovery Plan (U.S. Fish and Wildlife Service 2003a) divides existing KBB range within the State into four Recovery Units. Additional areas with potential to contribute to the long-term recovery of the species have also been identified (Figure 2).

Occupied KBB habitat in Michigan is almost equally divided between public (51%) and private (49%) land (Table 1). On public land, Federal land encompasses 57% of all known occupied habitat. The remaining 43% of occupied KBB habitat on public land occurs within a mix of State, county and local ownerships. Non-public land encompassing occupied KBB habitat includes ownerships by non-governmental organizations, utility companies, railroad companies,

and other private entities. The majority of non-public land with occupied KBB habitat consists of many small, privately owned parcels.

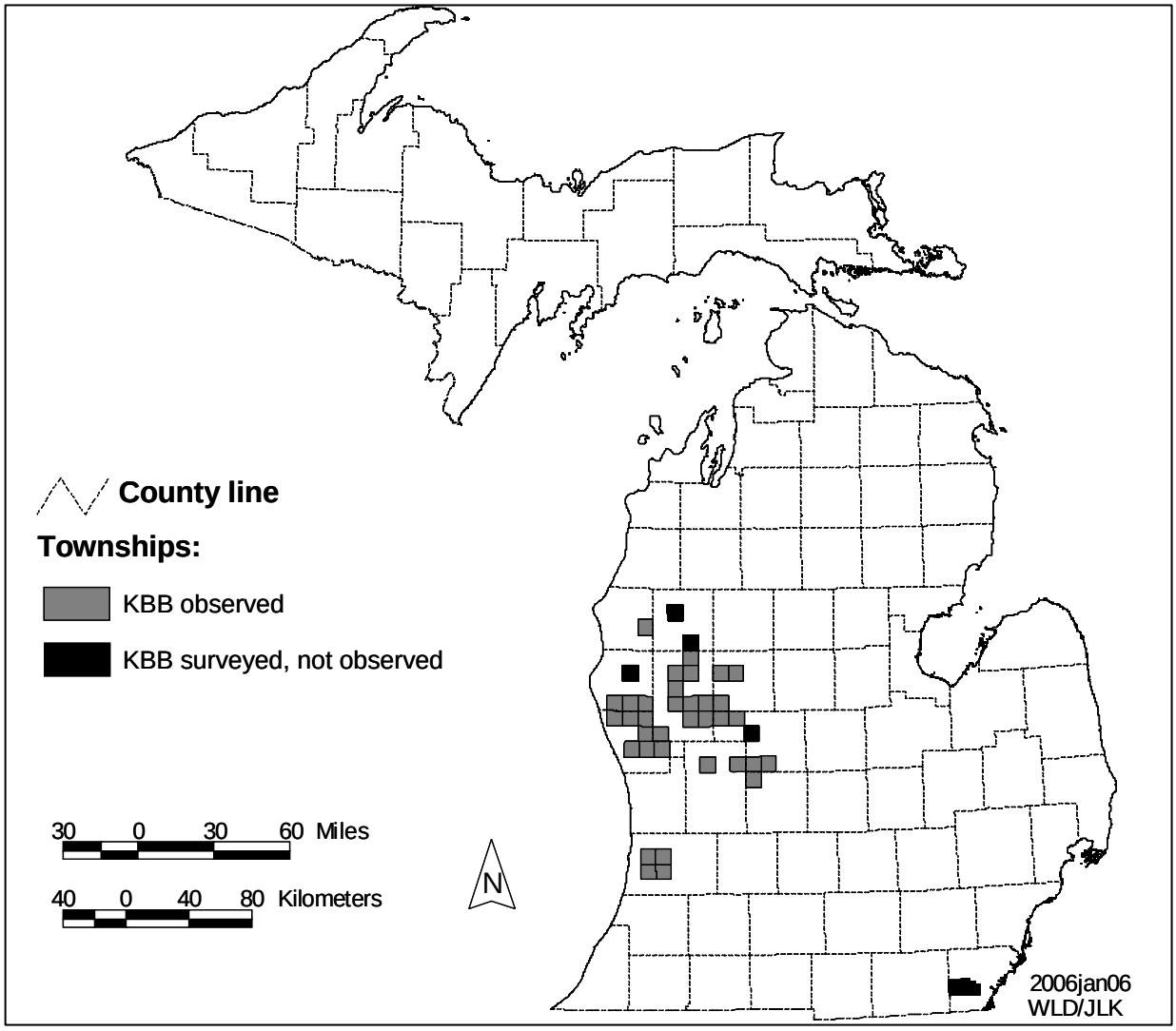

Figure 1. Townships in Michigan with known occurrences of Karner blue butterfly (adapted from Fettinger 2005).

Currently, major threats to the Oak Savanna Ecosystem, KBB and other associated savanna species in Michigan are: 1) habitat succession due to suppression of the natural disturbance regime; 2) management and maintenance practices that are incompatible with the conservation of those natural features; and 3) habitat conversion and fragmentation due to development and other land uses. The Michigan DNR developed this HCP to help minimize and mitigate these threats on both private and non-Federal public land throughout the distribution of KBB in Michigan.

Figure 2. Karner blue butterfly Recovery Units, Recovery Unit Annexes, and Potential Recovery Units in Michigan.

Active habitat management is necessary for the conservation of oak savanna, KBB and other savanna species. However, some management practices (e.g., prescribed burning, mowing) necessary for maintaining early-successional habitats may result in take of KBB. In addition, other land uses in occupied KBB habitat may cause take of KBB. Given that section 9 of the ESA restricts take of endangered species, an ITP associated with this HCP is necessary to provide the legal authority to conduct management in occupied KBB habitat and to integrate diverse land uses with conservation objectives.

Table 1. Acres of occupied Karner blue butterfly habitat currently known to occur on public and non-public land within each Recovery Unit.

		Recovery Unit				
Ownership	**Owner**	**Allegan**	**Ionia**	**Muskegon**	**Newaygo**	**Total**
Public	Federal	-	-	1,010	105	1,115
	State	585	161	8	37	791
	County	26	-	<1	-	26
	Local	-	-	7	58	65
Public Total		611	161	1,025	200	1,997
Non-public	Power Co.	317	-	51	52	420
	Roadside	16	1	14	231	262
	Railroad	-	-	-	19	19
	NGO[a]	-	-	-	41	41
	Other private	46	121	392	554	1,113
Non-public Total		379	122	457	849	1,855
Grand Total		990	283	1,482	1,097	3,852

[a] Non-governmental organization.

In the absence of a comprehensive HCP and associated ITP, land managers and landowners would need to obtain incidental-take authorization on an individual, project-specific basis to legally conduct the activities listed above. This situation would result in a patchwork of projects conducted with little or no coordinated planning or consideration of range-wide impacts to KBB and other associate species of concern. By contrast, projects implemented under this HCP will be authorized by a single ITP. Projects will be implemented according to consistent conditions, and HCP management partners will coordinate management activities and benefit from predictable regulatory approaches. This HCP will therefore facilitate efforts to evaluate and minimize the cumulative adverse impacts of individual projects to particular KBB populations.

1.3 Permit Duration

The desired term of the ITP is 20 years. This duration reflects the approximate amount of time the Federal recovery plan projects as necessary to biologically recover KBB (USFWS 2003a). If recovery requires more time than currently anticipated, the DNR may apply for extension of the ITP.

1.4 Regulatory/Legal Framework for Plan

KBB is listed as an endangered species under authority of the ESA. Take of endangered species is restricted by section 9 of the ESA. Under the ESA, 'take' means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect a federally listed threatened or endangered species or to attempt to engage in any such conduct. KBB require early-successional habitats (U.S. Fish and Wildlife Service 2003a), and management needed to maintain these habitats may result in take of individuals. The take restriction therefore limits the options available to manage habitat

or to perform right-of-way maintenance, and it precludes public and private development activities in areas occupied by KBB.

Under certain circumstances, however, section 10 of the ESA allows exceptions from the restriction on take. An ITP under section 10(a)(1)(B) allows incidental take associated with otherwise lawful activity. An HCP, intended to minimize and mitigate take authorized by an ITP, must be submitted with the permit application. By law, the U.S. Fish and Wildlife Service (USFWS) can not issue a permit that would jeopardize the continued existence of a listed species. In consultation with the USFWS, the Michigan DNR identified an ITP as the most appropriate regulatory instrument to facilitate conservation of occupied KBB habitat in Michigan.

Activities conducted under this HCP also must comply with State law. Similar to the ESA, the Michigan Endangered Species Protection Law (Public Act 451 of 1994, Part 365) prohibits take of State endangered and threatened species, including KBB. However, section 36504 of the law allows the Michigan DNR to "establish programs . . . as are considered necessary for the management of endangered or threatened species." The same section continues: "In implementing the programs authorized by this section, the [Michigan DNR] may enter into cooperative agreements with Federal and State agencies, political subdivisions of the State, or with private persons for the administration and management of any area or program established under this section . . ." Given these provisions, the conservation and partnering activities outlined in this HCP are consistent with this law.

1.5 Plan Area

The HCP area potentially includes all occupied KBB habitat on non-Federal land in Michigan. Within the State, KBB is currently known to occur on approximately 3,900 acres within 10 counties in the western Lower Peninsula (Fettinger 2005; Figure 1); roughly 2,700 of those acres occur on non-Federal land. Counties with known occupied KBB habitat include Allegan, Ionia, Kent, Lake, Mason, Mecosta, Montcalm, Muskegon, Newaygo and Oceana. KBB was also found in Monroe County in southeastern Michigan as recently as 1986, but is now believed to be extirpated from that portion of the State.

The Federal Karner Blue Butterfly Recovery Plan (USFWS 2003a) divides the existing KBB range within Michigan into four Recovery Units (Allegan, Ionia, Muskegon and Newaygo) that are located in the western portion of the Lower Peninsula and extend from the Indiana State line nearly to Traverse City (Figure 2). These Recovery Units correspond to the landscapes defined by Albert (1995) as the Allegan, Ionia, Manistee and Newaygo Outwash Plains Subsections and contain all currently known KBB occurrences in Michigan. Acres of known occupied KBB habitat within each Recovery Unit are provided in Table 1. As a part of contingency planning, the rest of the State was assigned to either a Recovery Unit Annex or a Potential Recovery Unit (Figure 2). Any additional occupied KBB habitat created or discovered in the future would be included in the HCP area and could be covered by the ITP, regardless of whether it occurred in a Recovery Unit, Recovery Unit Annex or Potential Recovery Unit.

1.6 Species To Be Covered by Permit

The DNR requests an ITP that authorizes incidental take of KBB. This species is classified as endangered under Federal law and as threatened under Michigan law. Other species of concern addressed by this HCP but not covered by the requested ITP are discussed in Section 2.

2. GOALS AND OBJECTIVES

This HCP has been developed to facilitate conservation of the Oak Savanna Ecosystem, to help maintain populations of KBB and other associated species of concern throughout their current distribution in Michigan, and to integrate diverse land uses with conservation efforts. This plan is consistent with a Federal KBB recovery plan strategy of "maintaining extant populations" and "improving and stabilizing populations where the butterfly is imperiled" (USFWS 2003a:52). It also complements other Michigan recovery efforts such as KBB reintroduction, creation of suitable habitat, and enhancement of connectivity between suitable habitat patches. With its focus on oak savanna, KBB and other associated species of concern, this plan will help the Michigan DNR achieve its strategic goal of maintaining viable wildlife populations within healthy, sustainable ecosystems. Specific goals and objectives of this HCP are as follows.

- Goal 1: Support persistence of a functioning Oak Savanna Ecosystem in Michigan.

  Objectives:

  - Simulate the natural disturbance regime that historically shaped the Oak Savanna Ecosystem.
  - Maintain early-successional habitats that support natural savanna communities.

- Goal 2: Support maintenance of oak-savanna habitats in a condition and configuration necessary to sustain existing populations of KBB and other associated species of concern.

  Objectives (within each managed habitat patch):

  - Provide vegetation required to sustain existing subpopulations of KBB and other associated species of concern.
  - Limit canopy cover as necessary to sustain existing subpopulations of KBB and other associated species of concern.
  - Maintain connectivity among occupied patches to support dispersal among existing subpopulations of KBB and other associated species of concern.

- Goal 3: Integrate diverse land uses with the conservation of the Oak Savanna Ecosystem, KBB and other associated species of concern.

  Objectives:

  - Ensure no long-term net reduction in the area of oak-savanna habitat due to land-use activities conducted under this HCP.
  - Ensure no long-term net reduction in the population sizes of KBB and other associated species of concern due to land-use activities conducted under this HCP.
  - Ensure no net loss of connectivity among oak-savanna habitat patches due to land-use activities conducted under this HCP.

3. ENVIRONMENTAL SETTING/BIOLOGICAL RESOURCES

3.1 Environmental Setting

Activities in occupied KBB habitat in Michigan will be conducted within the Oak Savanna Ecosystem. An oak savanna is a sparsely treed plain supporting drought-tolerant plants. In oak savannas, the number of trees per acre ranges from 4 to 50, and canopy cover ranges from 5% to 60% (O'Connor 2006). In Michigan, savannas often occur as discrete openings linked through a network of corridors within a forest matrix. Savannas occupy areas that are generally more fire-dependent, subject to greater summer temperature extremes, less fertile, and droughtier compared with the habitat types immediately surrounding them. In Michigan, the Oak Savanna Ecosystem consists of a complex of oak barrens, oak–pine barrens, pine barrens, oak openings, lakeplain oak openings and bur oak plains (O'Connor 2006).

Savannas in the continental interior reached their greatest extent 4,000 to 6,000 years ago during the hypsithermal period and have declined in extent since that time (Cohen 2004). In the early 1800s, more than two million acres of grasslands, including oak savanna and tall grass prairie, still occurred in Michigan (Comer et al. 1995, O'Connor 2006). Most of these grasslands occurred in the southern portion of the State. Following European settlement, conversion to agriculture and fire suppression severely reduced the area encompassed by these habitats (Abrams 1992, O'Connor 2006). More recently, residential and municipal development has increasingly threatened this community type. As a result of these practices, more than 99% of high-quality, native Michigan savannas have been lost (Comer et al. 1995, Cohen 2004). Remnant savannas generally persist on the landscape in small, isolated patches.

3.1.1 Climate

The climate in Michigan is strongly influenced by its mid-continental location, the Great Lakes, and latitude (Dickman and Leefers 2003). The Great Lakes moderate inland temperature fluctuations, and Michigan experiences cooler summers and warmer winters than do other States at similar latitudes. Snowfall declines, growing seasons shorten, and the range of extreme temperatures becomes larger with increasing distance from Great Lakes shorelines (Dickman and

Leefers 2003). Changes associated with increasing latitude include shorter growing seasons, cooler mean temperatures, longer periods of snow cover, reduced average relative humidity, lower temperature extremes, and fewer heating-degree days (Albert 1995). Table 2 provides more-specific climatic information for each of the four Recovery Units.

3.1.2 Topography and Soils

Topography of KBB range in Michigan includes flat expanses and moderately rolling relief of glacial outwash plains and end moraines (Cohen 2000, 2001, 2004). Soils of KBB habitats are typically well-drained, infertile or moderately fertile, slightly acidic or neutral sands or loamy sands with high water infiltration rates (Cohen 2000, 2001, 2004). The combination of flat to moderate slopes and well-drained soils results in little surface runoff from KBB habitat. Table 2 provides more-specific information for each of the four Recovery Units.

Table 2. Physical aspects of the Oak Savanna Ecosystem within each Recovery Unit (adapted from Albert 1995).

	Recovery Unit				
	Allegan	**Ionia**	**Muskegon**	**Newaygo**	**Combined**
Growing Season (days)	150–170	130–150	140–150	120–140	120–170
Average Annual Precipitation (inches)	32–38	30–32	32–34	32	30–38
Average Annual Snowfall (inches)	70–100	50–70	100–140	70–140	50–140
Extreme Minimum Temperature (º F)	-22 to -34	-26 to -30	-32 to -42	-32 to -48	-22 to -48
Dominant Landform	Flat lakeplain	Sloping ground moraine	Sand lakeplain	Outwash plain	Outwash plain/ lakeplain
Dominant Soils	Sands	Sands/ loamy sands	Sands	Sands	Sands/loamy sands
Glacial Drift Thickness (feet)	50–350	350–400	400–700	300–600	300–700
Topography	Flat to gently rolling	Generally hilly	Gently to moderately sloping	Gently sloping	Flat to moderately sloping

3.1.3 Hydrology

Michigan falls almost entirely within the Great Lakes Basin: Michigan rivers flow directly into Lakes Michigan, Huron, Erie and Superior (Eagle et al. 2005). A small portion of the far

western Upper Peninsula falls within the Mississippi River Basin. Most rivers in the State have attained a medium to large size at the points where they empty into the Great Lakes (Eagle et al. 2005). Michigan rivers generally have fairly stable flows relative to other rivers across the country, due largely to groundwater contributions and climatic conditions (Poff and Ward 1989, Richards 1990, Wiley et al. 1997). Approximately one-third of river reaches in the Lower Peninsula receives extensive groundwater inputs and another one-third receives moderate groundwater inputs (Seelbach et al. 1997). Groundwater recharge is, in part, facilitated by the coarse-textured soils that are typical of much of the Lower Peninsula (Seelbach et al. 1997, Zorn et al. 1998), including most of the current Michigan range of KBB. These coarse soils encourage water infiltration rather than surface runoff. River basins within the current Michigan KBB range include the Kalamazoo, Muskegon and Manistee Rivers, which have 'superstable' flows, and the Grand River, which has 'stable' flows (Richards 1990). These stable flow conditions are indicators of the large groundwater contributions these rivers receive (Richards 1990, Wehrly et al. 1998).

3.1.4 Water Quality

The major watersheds in occupied KBB habitat in Michigan include the Kalamazoo, Grand, Muskegon, White and Pere Marquette Rivers. Water quality within these watersheds is variable, ranging from good or excellent to highly degraded (Michigan Department of Environmental Quality 2004). Several lakes and rivers do not meet State water-quality standards due to a variety of chemical contaminants, including mercury and polychlorinated biphenyls (Michigan Department of Environmental Quality 2004). Three water bodies within the region are considered Great Lakes Areas of Concern due to poor water or sediment quality caused by toxic chemical contamination. They are: 1) the lower 80 miles of the Kalamazoo River from Morrow Dam to Lake Michigan; 2) Muskegon Lake at the mouth of the Muskegon River before it enters Lake Michigan; and 3) White Lake and a one-quarter-mile-wide zone around the lake at the mouth of the White River before it enters Lake Michigan. Great Lakes Areas of Concern are defined by the United States–Canada Great Lakes Water Quality Agreement (Annex 2 of the 1987 Protocol) as "geographic areas that fail to meet the general or specific objectives of the agreement where such failure has caused or is likely to cause impairment of beneficial use of the area's ability to support aquatic life."

3.1.5 Air Quality

All KBB areas in Michigan meet national air-quality standards for lead, ozone, sulfur dioxide, carbon monoxide, and particulates (U.S. Environmental Protection Agency 2005a) and have pollutant concentrations at levels that are generally considered 'good' (U.S. Environmental Protection Agency 2003a).

3.1.6 Vegetation

Black oak (*Quercus velutina*), white oak (*Quercus alba*), northern pin oak (*Quercus ellipsoidalis*), pignut hickory (*Carya glabra*), white pine (*Pinus strobus*), red pine (*Pinus resinosa*) and jack pine (*Pinus banksiana*) are trees most commonly associated with Michigan savanna (Cohen 2000, 2001, 2004, O'Connor 2006). Understory and shrub layers tend to be

poorly developed and often include American hazelnut (*Corylus americana*), gray dogwood (*Cornus foemina*), serviceberry (*Amelanchier* spp.), huckleberry (*Gaylussacia baccata*), blueberry (*Vaccinium angustifolium*) and sweet fern (*Comptonia peregrina*) (Cohen 2000, 2001, 2004, O'Connor 2006). By contrast, ground layers are generally well developed and composed of a variety of plant species dominated by warm-season grasses and forbs. Grasses most commonly present include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), Pennsylvania sedge (*Carex pensylvanica*), poverty grass (*Danthonia spicata*) and June grass (*Koelaria macrantha*) (Cohen 2000, 2001, 2004, O'Connor 2006). Common forbs include wild lupine (*Lupinus perennis*), hawkweeds (*Hieracium* spp.), puccoons (*Lithospermum* spp.), butterfly-weed (*Asclepias tuberosa*), blazing-stars (*Liatris* spp.), spurges (*Euphorbia* spp.), cinquefoils (*Potentilla* spp.), and coreopsis (*Coreopsis* spp.) (Cohen 2000, 2001, 2004, O'Connor 2006).

KBB larvae feed exclusively on wild lupine, and suitable KBB habitat always includes this plant (Rabe 2001, USFWS 2003a). In Michigan, this perennial occurs as far north as the 46th parallel (Dirig 1994) and can be found throughout the Lower Peninsula and southern areas of the Upper Peninsula. Wild lupine maintains a deep taproot. It begins growing in late April and begins blooming in middle to late May. Seeds begin to mature in late June. The plant gradually senesces as the seeds mature; complete senescence occurs by late July or early August.

Although wild lupine can reproduce by seed, most lupine reproduction occurs through vegetative propagation. Once a plant is established, it typically spreads to form a clump of stems growing from rhizomatous buds provided by the parent plant. The rate of spread is slow, and lupine often comprises a small proportion (<10%) of the ground cover within oak-savanna openings, where it typically grows in clusters (USFWS 2003a).

High-quality KBB sites generally have at least 500 lupine stems (USFWS 2003a) and dense lupine patches of at least 20 plants intermixed with other nectar plants and basking perches (Fettinger 2005). Male KBB generally spend more time in open areas, where lupine tends to be more abundant (Grundel et al. 1998). In partially shaded areas, lupine is less abundant but individual plants may grow larger. KBB larvae prefer to feed on larger lupine plants, and KBB females oviposit and forage more frequently in partially shaded areas (Lane and Andow 2003). One study found that oviposition frequency was highest under 30–60% canopy cover (Grundel et al. 1998).

In addition to lupine, other important KBB habitat factors include availability of nectar plants, open canopy cover, and a diverse vegetative structure (USFWS 2003a, Fettinger 2005). Adult KBB feed on a variety of nectar-producing plants (Table 3). KBB presence is more likely when a large number of nectar plant species are available (Fettinger 2005). KBB adults often perch and bask on grasses and shrubs and other vegetation that is taller than lupine (USFWS 2003a), so some vegetative structural complexity is important; however, suitable habitat usually has a woody canopy cover that is less than 50–60% (Grundel et al. 1998, Fettinger 2005).

KBB habitat patches are generally discrete units clearly separated from each other by unsuitable habitat. Historically, some early-successional openings gradually succeeded into forested conditions as other areas became more open due to fire or other natural disturbance. The result

was a landscape where the location of KBB habitat fluctuated over space and time, but the amount of habitat remained relatively stable, with enough openings and sufficient connectivity to provide for healthy, viable KBB populations. In this dynamic landscape, KBB may have maintained a metapopulation structure within a shifting mosaic of early-successional habitat patches (Givnish et al. 1988, USFWS 2003a).

Many oak savannas have been destroyed through conversion for agriculture, residential and municipal development, and other land uses. Moreover, suppression of wildfire has removed the primary mechanism that historically maintained early-successional oak-savanna habitats (Abrams 1992, O'Connor 2006). These practices have resulted in the loss or degradation of the majority of KBB habitat in Michigan (Cohen 2000, Cohen 2001, Rabe 2001, USFWS 2003a).

Table 3. Nectar plant species reported to be used by KBB (reproduced from USFWS 2003a). Scientific names follow Ownby and Morley (1991), Gleason and Cronquist (1991) or Swink and Wilhelm (1994).

Scientific name	Common name	Location	Reference
----------First brood adult nectar sources----------			
----------Herbaceous species----------			
Achillea millefolium L.	Common yarrow	WI, IN	2,7,14,15
Anenome cylindrical	Gray Thimbleweed	WI,IN	7,15
Arabis lyrata L.	Sand-cress	IN,MN,ON,WI	2,5,7,8,10,9,14, 15
Arenaria serpyllifolia L.	Thyme-leaved sandwort	ON	10
Baptisia bracteata var. *glabrescens* (Larisey) Isely (*leucophaea*)	Prairie wild indigo	WI	2,14
Berteroa incana (L.) DC.	Hoary alyssum	WI	2,7
Centaurea biebersteinii (*maculosa*) DC.	Spotted knapweed	WI	7
Cerastium sp.	Chickweed	WI	7
Chrysanthemum leucanthemum L.	Ox-eye daisy	WI	7
Commandra umbellata (L.) Nutt.	Bastard toadflax	MI	11,13
Coreopsis lanceolata L.	Lance-leafed coreopsis	IN	8,15
Coreopsis tripteris *L*.	Tall coreopsis	IN	15
Erigeron strigosus Muhl.	Daisy fleabane	WI	2
Euphorbia corollata L.	Flowering spurge	WI,IN	9,15
Euphorbia podperae (*esula*) Croizat	Leafy spurge	WI	7,9
Fragaria virginiana	Duchesne Strawberry	NY,WI,IN	3,7,15
Gaylussacia baccata (Wang.) K. Koch	Huckleberry	IN	15
Geranium maculatum L.	Wild geranium	ON	10
Hedyotis (Houstonia) longifolia (Gaetrn.) Hook.	Longleaved houstonia	MN,WI	5,7,9,14
Helianthemum canadense (L.) Michx.	Frostweed	NH,IN	1,15
Hieracium aurantiacum L.	Orange hawkweed	WI	2,7,9,14
Hieracium sp.	Hawkweed	ON,NH,WI	1,2,10
Krigia biflora (Wlt.) Blake	Two-flowered Cynthia	WI	2,14
Liatris Spp.	Blazing star	IN	15
Lithospermum canescens (Michx.) Lehm.	Hoary puccoon	IN	15
Lithospermum caroliniense (Walt.) MacM.	Hairy puccoon	ON,WI,IN	2,10,15

Lupinus perennis L.	Wild lupine	MI,NH,ON,WI, IN	1,2,7,9,10,11,14,15
Medicago lupulina L.	Black medic	WI	2,7
Melilotus officinalis (L.) Pallas	Yellow sweet clover	IN,WI	2,7,8
Pedicularis canadensis L.	Lousewort	WI	2,14
Phlox pilosa L.	Downy phlox	IN	8,15
Potentilla recta L.	Rough-fruited cinquefoil	WI	2
Potentilla simplex Michx.	Common cinquefoil	WI,MI,IN	2,7,13,14,15
Potentilla sp.	Cinquefoil	MI,NY	3,11
Rosa Carolina L.	Carolina rose	IN	15
Rumex acetosella L.	Sheep sorel	WI	2
Senecio pauperculus Michx.	Ragwort	WI	7
Senecio sp.	Ragwort	WI	2,9
Smilacina racemosa (L.) Desf.	False spikenard	WI	2,7
Smilacina stellata (L.) Desf.	Star-flow. fals. sol. seal	WI	2,14
Solidago sciaphila	Steele Cliff goldenrod	WI	7
Tephrosia virginiana (L.) Pers.	Goat's rue	NY	3
Tradescantia ohiensis Raf.	Spiderwort	IN	15
Trifolium hybridum L.	Alsike clover	WI	2,14
Trifolium pratense L.	Red clover	WI	7
Trifolium repens L.	White clover	WI	2
Viccia villosa Roth.	Hairy vetch	WI	2
Viola pedata L.	Bird foot violet	NY,WI	2,3,13
Zizia aurea (L.) Koch	Golden alexanders	WI	2
----------Woody species----------			
Amelanchier sp.	Juneberry	ON	10
Ceanothus herbaceus (ovatus) Raf.	Red root	WI	7
Ceanothus sp.	New jersey tea	WI	2
Physocarpus opulifolius (L.) Maxim.	Common ninebark	WI	7
Prunus sp.	Wild plum	NY	3
Rubus allegheniensis Porter	Blackberry	WI	7
Rubus flagellaris Willd.	Dewberry	IN,MI,WI	7,6,8,13,15
Rubus sp. or spp. (IN)	Bramble	IN,MI,MN,WI	2,5,8,11,9,14,15
Salix humilis Marsh.	Prairie willow	WI	2, 7
Vaccinium sp.	Blueberry	NY,IN	3,15
Vitis riparia Michx.	River grape	MN	5
----------Second brood adult nectar sources----------			
----------Herbaceous species----------			
Achillea millefolium L.	Common yarrow	IN,MI,MN,WI	2,5,7,8,11,14
Amorpha canescens Pursh	Lead plant	WI	2,7,9,14
Apocynum androsaemifolium L.	Spreading dogbane	NH,NY	1,12
Arabis lyrata L.	Sand-cress	IN,WI	2,7,8,14
Asclepias incarnate L.	Swamp milkweed	IN	15
Asclepias syriaca L.	Common milkweed	NH,NY,WI	2,7,12
Asclepias tuberosa L.	Butterfly-weed	IN,MI,MN,NY, ON,WI	2,3,4,5,6,7,8,10,11, 13,15
Asclepias verticillata L.	Whorled milkweed	MI,WI,IN	2,7,8,11,9,13,15
Aster sp.	Aster	WI	2,13
Aureolaria pedicularia (L.) Raf.	Fern-leave false foxglove	WI	2
Aureolaria sp.	False foxglove	WI	2,13
Berteroa incana (L.) DC.	Hoary alyssum	NY,WI	2,4
Campanula rotundifolia L.	Harebell	MN,WI	1,2,9,14
Centaurea biebersteinii (maculosa) DC.	Spotted knapweed	MI,NY,WI	2,3,4,7,11,13,14

Chrysanthemum leucanthemum L.	Ox-eye daisy	WI	7
Coreopsis lanceolata L.	Lance-leaved coreopsis	MI	11
Coreopsis palmata Nutt.	Stiff tickseed	WI	7,9,14
Coreopsis sp.	Coreopsis	WI	2
Dianthus armeria L.	Deptford pink	MI	11
Erigeron annuus (L.) Pers.	Daisy fleabane	MI,MN	5,11
Erigeron canadensis		WI	9
Erigeron strigosus Muhl.	Daisy fleabane	WI,IN	2,7, 9,15
Erigeron sp.	Fleabane	IN,WI,MI	2,8,13,14
Euphorbia corollata L.	Flowering spurge	IN,MI,MN,WI	1,2,5,6,7,8,11,13, 14, 15
Euphorbia podperae (esula) Croizat	Leafy spurge	WI	2,7
Euthamia graminifolia (*Solidago graminifolia*) (L.) Nutt	Grass-leaved goldenrod	NH,WI	2,12,14
Froelichia floridana (Nutt.) Moq.	Cottonweed	WI	7
Galium sp.	Bedstraw	WI	2,14
Gnaphalium obtusifolium L.	Sweet everlasting	MN,WI	1,2,5,9,14
Hackelia deflexa (Wahlenb.) Opiz	Stickseed	MN	5
Hedyotis (Houstonia) longifolia (Gaetrn.) Hook.	Longleaved houstonia	WI	2,14
Helianthemum canadense (L.) Michx.	Frostweed	WI	9
Helianthus divaricatus L.*	Woodland sunflower	IN,MI	8,11,15
Helianthus occidentalis Riddell	Western sunflower	MN,WI,IN	2,5,7,9,14,15
Helianthus sp.	Sunflower	NH,NY,MI,WI	2,11,12,14
Hieracium aurantiacum L.	Orange hawkweed	WI	2,7,9,14
Hieracium pilosella L.	Mouse ear hawkweed	MI	11
Hieracium sp.	Hawkweed	MI	11
Hypericum perforatum L.	Common St.John's wort	MI	11
Krigia biflora (Walt.) Blake	Two-flowered Cynthia	WI	2,14
Lespedesa capitata Michx.	Bush clover	WI	2,14
Liatris aspera Michx.	Rough blazing star	MI,WI	2,6,7,11,9,14
Liatris cylindracea Michx.	Dwarf blazing-star	ON,WI	2,7,9,12,14
Liatris sPP.	Blazing-star	IN	15
Lilium philadelphicum L.	Wood lily	NH	1
Linaria canadensis (L.) Dum.-Cours.	Old-field toad flax	WI	2
Linaria vulgaris Hill	Butter-and-eggs	WI	2
Lithospermum caroliniense (Walt.)MacM	Hairy puccoon	WI	2
Lobelia spicata Lam.	Pale-spike lobelia	WI	7
Lotis corniculatus L.	Birdsfoot trefoil	MI,WI	2,11,14
Lupinus perennis L.	Wild lupine	NY,WI	2,12,14
Lycopus americanus Muhl.	Water-horehound	IN	15
Lysimachia sp.	Loosestrife	WI	2,14
Lythrum alatum Pursh.	Winged loosestrife	IN	15
Medicago lupulina L.	Black medic	WI	2,7,9
Medicago sativa L.	Alfalfa	WI	2
Melilotus alba Medic.	White sweet clover	IN,MN,WI	2,5,7,8,9,14,15
Melilotus officinalis (L.) Pallas	Yellow sweet clover	MN,WI	2,5,7
Monarda fistulosa L.	Wild bergamot	IN	8,9,14,15
Monarda punctata L.	Horsemint	IN,MI,MN,NY, ON, WI	2,3,4,5,6,7, 8, 9, 10,11,14,15
Oenothera sp.	Evening primrose	WI	2,13
Petalostemon candidum (Willd.) Michx.	White prairie clover	WI	2,7,9

Petalostemon purpureum (Vent.) Rydb.	Purple prairie clover	WI	2,7
Phlox pilosa L.	Downy phlox	IN	15
Polygala polygama Walt.	Racemed milkwort	MI	11
Polygonum sp.	Knotweed	WI	2,14
Potentilla recta L.	Rough-fruited cinquefoil	IN	15
Potentilla simplex Michx.	Common cinquefoil	WI	2,14
Pycanthemum virginianum L.	Mountain-mint	IN	15
Rosa Carolina L.	Carolina rose	IN	15
Rosa sp.	Wild rose	WI	2,14
Rudbeckia hirta (serotina) L.	Black-eyed susan	MI,MN,ON,WI, IN	2,5,7,9,10,11,14,15
Saponaria officinalis L.	Soapwort	NY,IN	3,15
Scutellaria epilobiifolia	Marsh skullcap	IN	15
Smilacina stellata (L.) Desf.	Star-flow. fals. sol. seal	WI	2,14
Solidago ptarmicoides (Nees) Boivin (*Aster ptarmicoides*)	Upland white aster	WI	2,9
Solidago speciosa Nutt.	Showy goldenrod	WI,IN	13,15
Solidago sp.	Goldenrod	IN,NH,WI	1,2,8,14
Spiraea tomentosa L.	Meadowsweet	WI	14
Talinum rugospermum Holz.	Fameflower	WI	2
Tephrosia virginiana (L.) Pers.	Goat's rue	IN	8,14,15
Tradescantia ohiensis Raf.	Spiderwort	IN	15
Tradescantia virginiana L.*	Virginia spiderwort	MI	11
Trifolium arvense L.	Rabbit-foot clover	WI	2,14
Trifolium hybridum L.	Alsike clover	WI	2,14
Trifolium pratense L.	Red clover	WI	2,7,14
Trifoliium repens L.	White clover	WI	2,7,14
Vicia villosa Roth.	Hairy vetch	WI	2,14
----------Woody species----------			
Ceanothus americanus L.	New Jersey tea	IN,NH,NY,ON,WI	1,2,3,4,8,10,14, 15
Ceanothus herbaceus (ovatus) Raf.	Red root	ON	10
Rhus copallinia	Winged sumac	IN	14

References: 1= Bidwell, in Helmbolt and Amaral 1994, 2 = Bleser 1992, 3 = Dirig 1976, 4 = Fried 1987, 5 = Lane, pers. comm. 1994, 6 = Lawrence 1994, 7 = Leach 1993, 8 = Martin 1994, 9 = Maxwell and Givnish 1994, 10 = Packer 1987, 11 = Papp 1993, 12 = Schweitzer, pers. comm. 1994, 13 **=** Sferra et al. 1993, 14 = Swengel and Swengel 1993, 15 = Grundel and Pavlovic 2000.

3.1.7 Wildlife

Oak savanna is a species-rich environment. More than 30 species of butterflies and skippers alone are known to occupy savannas in Michigan. This insect diversity attracts insect predators including birds, dragonflies and bats which, in turn, attract second-level predators including hawks and owls. Although the wildlife remains diverse, habitat loss and degradation has had detrimental impacts on many savanna species. Taken together, prairie and savanna comprise the habitat type that supports the greatest number of rare and declining species in Michigan (Eagle et al. 2005).

Michigan's Wildlife Action Plan (Eagle et al. 2005) identified 75 Species of Greatest Conservation Need (SGCN) that are associated with savannas in the Lower Peninsula, where KBB in Michigan currently occurs (Table 4). Species of Greatest Conservation Need include wildlife species classified as federally or State endangered, species identified by Michigan

Natural Features Inventory (2002) as 'special concern species,' and other species in need of conservation due to declining populations or other characteristics that make them vulnerable (Eagle et al. 2005).

Thirty-two insect species associated with savannas in the Lower Peninsula have been identified as SGCN (Table 4). Many other insect species commonly occur in Michigan savannas. Some of them include many mound-building ant species (e.g., ants in the Forminicinae family), many butterflies and moths, such as coral hairstreak (*Harkenclenus titus*), Edward's hairstreak (*Satyrium edwardsii*), sleepy duskywing (*Erynnis brizo)* and hummingbird clearwing moth (*Hemaris thysbe*), a variety of tiger beetles (e.g., *Cicindela formosa*), grasshoppers (e.g., *Schistocerca emarginata*), and cicada killers (e.g., *Sphecius speciosus*) (J. Kleitch, Michigan DNR, personal communication).

Table 4. Species of Greatest Conservation Need associated with savannas in the Lower Peninsula of Michigan (adapted from Eagle et al. 2005).

Taxon group	Common name	Scientific name
Insects	Barrens locust	*Orphulella pelidna*
	A spur-throat grasshopper	*Melanoplus eurycercus*
	Blue-legged locust	*Melanoplus flavidus*
	Secretive locust	*Appalachia arcana*
	Davis's shield-bearer	*Atlanticus davisi*
	Hebard's green-legged locust	*Melanoplus viridipes*
	Atlantic-coast locust	*Psinidia fenestralis*
	Conehead grasshopper	*Neoconocephalus retusus*
	Great Plains spittlebug	*Lepyronia gibbosa*
	A spittlebug	*Philaenarcys killa*
	Red-legged spittlebug	*Prosapia ignipectus*
	A leafhopper	*Flexamia reflexus*
	Wild indigo duskywing	*Erynnis baptisiae*
	Persius duskywing	*Erynnis persius persius*
	Grizzled skipper	*Pyrgus wyandot*
	Ottoe skipper	*Hesperia ottoe*
	Dusted skipper	*Atrytonopsis hianna*
	Pipevine swallowtail	*Battus philenor*
	Northern hairstreak	*Fixsenia favonius ontario*
	Karner blue butterfly	*Lycaeides melissa samuelis*
	Henry's elfin	*Callophrys henrici*
	Frosted elfin	*Callophrys irus*
	Gorgone checkerspot	*Chlosyne gorgone carlota*
	Tawny crescent	*Phyciodes batesii*
	Barrens buckmoth	*Hemileuca maia*
	Sprague's pygarctia	*Pygarctia spraguei*

	Boreal fan moth	*Brachionych borealis*
	Doll's merlolonche	*Merolonche dolli*
	Three-staff underwing	*Catocala amestris*
	Quiet underwing	*Catocala dulciola*
	Blazing star borer	*Papaipema beeriana*
	Phlox moth	*Schinia Indiana*
Birds	Sharp-tailed grouse	*Tympanuchus phasianellus*
	Northern bobwhite	*Colinus virginianus*
	Cooper's hawk	*Accipiter cooperii*
	Northern goshawk	*Accipiter gentilis*
	Merlin	*Falco columbarius*
	Yellow-billed cuckoo	*Coccyzus americanus*
	Short-eared owl	*Asio flammeus*
	Common nighthawk	*Chordeiles minor*
	Red-headed woodpecker	*Melanerpes erythrocephalus*
	Northern flicker	*Colaptes auratus*
	Least flycatcher	*Empidonax minimus*
	Eastern kingbird	*Tyrannus tyrannus*
	Migrant loggerhead shrike	*Lanius ludovicianus Migrans*
	Northern shrike	*Lanius excubitor*
	Purple martin	*Progne subis*
	Sedge wren	*Cistothorus platensis*
	Northern mockingbird	*Mimus polyglottos*
	Brown thrasher	*Toxostoma rufum*
	Prairie warbler	*Dendroica discolor*
	Eastern towhee	*Pipilo erythrophthalmus*
	Field sparrow	*Spizella pusilla*
	Vesper sparrow	*Pooecetes gramineus*
	Dickcissel	*Spiza americana*
	Bobolink	*Dolichonyx oryzivorus*
	Western meadowlark	*Sturnella neglecta*
Mammals	Least shrew	*Cryptotis parva*
	Prairie vole	*Microtus ochrogaster*
	Woodland vole	*Microtus pinetorum*
	Southern bog lemming	*Synaptomys cooperi*
	Deer mouse	*Peromyscus maniculatus gracilis*
Amphibians	Smallmouth salamander	*Ambystoma texanum*
	Tiger salamander	*Ambystoma tigrinum*
	Fowler's toad	*Bufo fowleri*
	Northern leopard frog	*Rana pipiens*

Reptiles	Blue racer	*Coluber constrictor foxii*
	Black rat snake	*Elaphe obsolete obsolete*
	Eastern hognose snake	*Heterodon platirhinos*
	Smooth green snake	*Liochlorophis vernalis*
	Six-lined racerunner	*Apidoscelis sexlineatus*
	Eastern massasauga	*Sistrurus catenatus catenatus*
	Spotted turtle	*Clemmys guttata*
	Blanding's turtle	*Emydoidea blandingii*
	Eastern box turtle	*Terrapene carolina carolina*

Twenty-five bird SGCN are associated with Michigan savannas in the Lower Peninsula (Table 4). Some of the other birds that commonly occupy Michigan savannas include: Lincoln's sparrow (*Melospiza lincolnii*), indigo bunting (*Passerina cyanea*), eastern bluebird (*Sialia sialis*), chipping sparrow (*Spizella passerina*), field sparrow (*Spizella pusilla*), blue-winged warbler (*Vermivora pinus*), Nashville warbler (*Vermivora ruficapilla*), sharp-shinned hawk (*Accipter striatus*), upland sandpiper (*Bartamia longicauda*), ruffed grouse, red-tailed hawk (*Buteo jamaicensis*), American goldfinch (*Carduelis tristis*), killdeer (*Charadrius vociferus*), lark sparrow (*Chondestes grammacus*), American kestrel (*Falco sparverius*), Baltimore oriole (*Icterus galbula*), wild turkey, eastern screech owl (*Otus asio*) and mourning dove (*Zenaida macroura*) (Cohen 2000, 2001, 2004).

Five mammal species associated with savannas in the Lower Peninsula have been identified as SGCN (Table 4). Some other mammals frequently associated with this habitat include coyote (*Canis latrans*), meadow vole (*Microtus pennsylvanicus*), white-tailed deer, fox squirrel (*Sciurus niger*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), badger (*Taxidea taxus*), red fox (*Vulpes vulpes*) and jumping meadow mouse (*Zapus hudsonia*) (Cohen 2000, 2001, 2004).

Thirteen amphibian and reptile SGCN are associated with savannas in the Lower Peninsula (Table 4). Some of the other, more-common species associated with this habitat include American toad (*Bufo americanus*), common garter snake (*Thamnophis sirtalis*) and milk snake (*Lampropeltis triangulum*) (Cohen 2000, 20001, 2004).

3.1.8 Existing Land Use

3.1.8.1 Statewide

Land ownership

Approximately 20% of Michigan's 36.4 million acres are managed by Federal, State or local governments. More than seven million acres are in State and Federal ownership.

The Michigan DNR manages 4.5 million acres as State Forests, State Wildlife Areas, and State Parks and Recreation Areas. These areas provide wildlife habitat, opportunities for outdoor

recreation such as hunting, wildlife viewing and boating, and resources for timber and mineral extraction. An additional 375,000 acres are managed by the Michigan Department of Transportation and Department of Military and Veterans Affairs. The State government also holds title to approximately 25 million acres of Great Lakes bottomlands.

The Federal government manages 3.1 million acres in Michigan for a variety of purposes, including provision of wildlife habitat, protection of rare natural features, provision of recreational opportunities, and resource extraction. This land includes 2.85 million acres of National Forest managed by the U.S. Department of Agriculture Forest Service, 730,000 acres within two National Lakeshores and one National Park managed by the National Park Service, and 115,000 acres within three Federal Refuges managed by the USFWS.

Local governments manage approximately 114,000 acres in Michigan, primarily for recreational purposes.

Approximately, 80% (29 million acres) of land in Michigan is privately owned. Planning and use decisions affecting this land occur at local levels; State law grants authority to local governments to determine the extent, rate and types of development that will occur in individual municipalities and counties. Compared to other States, local land-use planning in Michigan is especially fragmented. Whereas most States have between 300 and 500 local government units possessing authority to engage in planning, Michigan has more than 1,800 of these units (Public Sector Consultants 2002). Local governments typically do not coordinate at regional levels: as of 2002, only 25 of 83 counties had adopted countywide zoning ordinances (Public Sector Consultants 2002). Consequently, local planning for private land in Michigan tends to produce a patchwork of disparate development and land-use schemes across the landscape.

Occupied KBB habitat in Michigan is almost equally divided between public (51%) and private (49%) land (Table 1). Of public land, Federal land encompasses 57% of all known occupied habitat. The remaining 43% of occupied KBB habitat on public land occurs within a mix of State, county and local ownerships. Non-public land encompassing occupied KBB habitat include ownerships by non-governmental organizations, utility companies, railroad companies, and other private entities. The majority of non-public land with occupied KBB habitat consists of many small, privately owned parcels.

Patterns of land use

On average, Michigan has approximately 175 people per square mile, but this population is disproportionately distributed: residents of the 14 Upper Peninsula counties represent 3% of the total State population, whereas the three southeastern Detroit-metro counties (Oakland, Macomb and Wayne) account for 40% of the total State population (U.S. Census Bureau 2005). Other significant population centers in southern Michigan include: Kent County (6%), Genesee County (4.4%) and Washtenaw County (3.4%).

The 2000 United States census estimated Michigan's human population to be just under 10 million people. This figure represented an increase of 6.9% since 1990, but was less than the national average of 13.1% (U.S. Census Bureau 2005). The impact of development on the

landscape has been disproportionate to population growth. 'Built' (developed) land area in Michigan increased 25% from 1980 to 1995, a rate that is eight times the estimated population growth rate (3%) during the same period (Public Sector Consultants 2001). This increase was accompanied by a decline in average population density in developed areas, from 3.8 persons per acre in the early 1980s to 2.8 persons per acre in the late 1990s (Norris and Soulé 2003). This shift has accelerated the rate of land conversion, because low-density housing developments in the suburbs require more area for each individual household. Between 1990 and 2000, significant emigration was experienced by several Michigan cities (with percent population change): Detroit (-7.5%); Flint (-12%); Saginaw (-11.6%) (Michigan Land Use Leadership Council 2003). During the same period, outlying areas experienced unprecedented development.

In 1978, 6% of Michigan's land area was defined as urban (Smyth 1995). By 2002, the acreage of developed land increased by more than 30% (Public Sector Consultants 2002). If present development trends continue, between 1.5 and 2 million additional acres of un-built land could be urbanized by 2020 and the acreage of developed land could increase by 178% by the year 2040 (Public Sector Consultants 2001).

Patterns of land use have also affected the amount of farmland in the State. From the early 1800s through the middle of the 20th century, Michigan acreage in agricultural production steadily and rapidly increased. Following this expansion, this acreage began to decline due to conversion to urban and suburban areas and abandonment of farmland, which was often allowed to succeed to forested land. In 1978, 29% of Michigan acreage was agricultural land (Smyth 1995); between 1982 and 1997, farmland acreage decreased by almost 1.5 million acres, or 13.3% (Norris and Soulé 2003); between 1997 and 2002, Michigan lost an additional 3% of its farmland (U.S. Department of Agriculture 2002). If current trends continue, Michigan will lose 25% of its fruit-producing land and 1.9 million acres of other farmland in the next 40 years (Public Sector Consultants 2002).

3.1.8.2 Oak Savannas

Historic land use of oak savannas following European settlement focused around logging, which first became a common practice in those habitats in the 1800s (Dickman and Leefers 2003). Although few trees occurred in the savannas themselves, these openings served as log landings and supported a trail infrastructure over which forest products could be removed. In the 1900s, these openings were appealing to farmers who were the first to intensively use the land. Vestiges of both of these historic land uses remain apparent. Where soil fertility permits, farming has generally continued.

Savannas are fire-dependent communities, and wildfires once shaped and maintained them (O'Connor 2006). However, the occurrence of wildfire precluded other land uses like residential and business development. Beginning in the 1920s, wildfire control activities reduced the impact of fire on the Michigan landscape (Abrams 1992). Wildfire is now largely eliminated as a shaping force on natural communities. Although not a land use in the classical sense, this process was a mandatory precursor to most current land uses.

Forestry practices have also changed the character of these savannas. These practices include planting of pine and hardwood plantations, fertilizing established plantations, harvesting trees, and chemically treating or scarifying soils.

Development of residences and businesses, together with its associated road and utility infrastructure, has also reduced and fragmented savanna. Expansion of urban and suburban areas is and will continue to be a major factor in reducing natural communities, including savannas (Skole et al. 2002). Indeed, the counties of Allegan, Kent, Muskegon and Ottawa, situated between the urban centers of Grand Rapids, Holland and Muskegon, are among the most rapidly growing populations in the State (Skole et al. 2002).

Outdoor recreational activities such as hunting, fishing, hiking and bird watching are important to the regional economy and the quality of life of local residents. Other recreational activities like off-road vehicle use and horseback riding are also important, but have reduced the function of savannas in some cases.

Due to the combined impacts of all of these land uses, high-quality savannas have been reduced to less than 1% of their pre-European settlement extent (Comer et al. 1995, Cohen 2004). The potential for restoration exists in only a small fraction of the degraded savannas. Thus, the outlook for savannas in Michigan is one of a limited number of treed openings bounded within a matrix of forest and land converted to other human uses.

3.2 Species of Concern in the Plan Area

3.2.1 Wildlife Species of Concern

3.2.1.1 Federally Listed and Candidate Species

Federally threatened or endangered species that could potentially occur in or near KBB habitat currently include KBB, Kirtland's warbler (*Dendroica kirtlandii*), and Indiana bat (*Myotis sodalis*). The only candidate species that could occur in or near occupied KBB habitat is the eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*).

Karner blue butterfly

KBB is classified as endangered under Federal law and as threatened under Michigan law. It has a historic range from Maine to Minnesota, south to Iowa and Pennsylvania, and north to southern Ontario, Canada (USFWS 2003a). Within Michigan, KBB is currently known to occur on approximately 3,900 acres within 10 counties in the western Lower Peninsula (Fettinger 2005; Figure 1). KBB was also found in Monroe County in southeastern Michigan as recently as 1986, but is now believed to be extirpated from that portion of the State.

KBB is bivoltine, meaning two broods are produced annually. First-brood larvae hatch from eggs in mid to late April and feed exclusively on wild lupine for 3–4 weeks. During this time, they pass through four instars. First-brood pupation occurs in May and early June, typically on leaf litter, stems or twigs. Pupation may last 7–11 days (Dirig 1976). First-brood adults first

emerge in late May. Emergence may continue for weeks, but individual KBB live an average of 5 days (USFWS 2003a).

After emergence, adult KBB feed on a variety of nectar plants (Table 3). Male KBB generally spend more time in open areas, where they forage, mate and patrol their territories (Grundel et al. 1998). Female KBB spend similar amounts of time in open and partially shaded areas. Grundel et al. (1998) found that oviposition occurred most frequently under 30–60% canopy cover. Lupine stem density is often lower in partially shaded areas, but the larger size of individual plants in these areas is preferred by feeding larvae (Grundel et al. 1998). First-brood females typically lay their eggs on lupine leaves, petioles or stems, but they may also lay eggs on other plants in proximity to lupine (USFWS 2003a).

Second-brood eggs hatch in June and July, and larvae feed on lupine until pupation. Late instars of second-brood larvae are often tended by ants, resulting in higher larval survival rates (Lane 1999). Adult emergence begins in mid July and may continue until late August. Second-brood females lay eggs on materials close to the ground, typically on grasses, sedges, lupine and leaf litter (Lane 1999). These eggs do not hatch until the following spring, and closeness to the ground offers protection during winter conditions (Bernays and Chapman 1994). The first brood is typically smaller than the second brood, in part due to high mortality rates of overwintering eggs (USFWS 2003a).

KBB are not particularly strong fliers. Their movements have been characterized as a series of frequent, low, short flights of 5 meters or less (USFWS 2003a). KBB within-patch movements are usually less than 300 m and within a 2.5-hectare (6.2-acre) area; however, individuals may range over as much as 32 hectares (79 acres), and a subset of individuals (typically less than 10%) disperse from their natal habitat patch (USFWS 2003a).

KBB dispersal corridors include nectar plants, grasses for roost sites, exposure to the sun for much of the day, and a woody vegetation border. KBB dispersal is higher when the dispersal landscape is open and when more nectar sources are available in the intervening habitat (USFWS 2003a). The presence of lupine in a dispersal corridor may join two otherwise separate habitat patches. Greater numbers of butterflies disperse from larger subpopulations and from habitat units that are declining in quality (USFWS 2003a).

Dispersal between habitat patches greater than 2.3 km apart is probably rare, but one female was documented to move at least 6.6 km (4.1 mi; USFWS 2003a). In Michigan, KBB are more likely to occupy high-quality habitat when it occurs within 1,000 m of another occupied patch (Fettinger 2005). Given current knowledge of dispersal potential, lupine patches within 200 m of each other can reasonably be considered to be occupied by the same subpopulation (and are thus within the same habitat patch). Separation distances less than 2.0 km are generally expected to allow occasional inter-patch dispersal.

Kirtland's warbler

The currently known breeding range of the Kirtland's warbler, a Federal and State endangered species, occurs entirely within Michigan, Wisconsin and Ontario. The current range of the

Kirtland's warbler breeding area in Michigan includes Alcona, Clare, Crawford, Grand Traverse, Iosco, Kalkaska, Montmorency, Ogemaw, Oscoda, Otsego, Presque Isle and Roscommon Counties in the Lower Peninsula and Baraga, Chippewa, Delta, Luce, Marquette and Schoolcraft Counties in the Upper Peninsula (Michigan DNR 2005a, 2006b).

The Kirtland's warbler nests in large, dense stands of jack pine growing on poor, well-drained sandy soils (USFWS 1985). Availability of suitable nesting habitat is further restricted by the availability of ground vegetation under overhanging branches. Trees in nesting areas are typically 5–20 years old (Olson 2002**)**. As trees grow larger, the overlapping branches reduce sunlight to lower branches, causing them to die. As lower branches and ground cover are lost, the area becomes unsuitable for Kirtland's warbler nesting. Once this occurs, warblers do not use the site again until disturbance removes the old trees and allows younger trees to grow.

The practice of fire suppression that began early in the 20th century reduced or removed the primary natural process that historically maintained jack-pine habitats in conditions suitable for Kirtland's warbler nesting. The loss of nesting habitat due to succession and nest parasitism caused by brown-headed cowbirds (*Molothrus ater*) are the primary threats to the species (USFWS 1985). In response to management that addresses these threats, the Kirtland's warbler population has increased steadily since the mid 1980s.

Currently, the ranges of KBB and Kirtland's warbler do not overlap. Management practices for each species generally preclude the presence of the other: the habitats currently supporting nesting Kirtland's warbler do not contain documented occurrences of the lupine required by KBB; no occupied KBB habitat contains the density of jack pine required for Kirtland's warbler nesting. Thus, occasional occurrence of a migrating Kirtland's warbler in occupied KBB habitat is possible but extended residence is unlikely.

Indiana bat

The Federal and State endangered Indiana bat has a Midwest distribution that extends south to Kentucky, Missouri and Oklahoma (USFWS 1999). Michigan represents the northern periphery of the species range. In Michigan, Indiana bat has been known to occur at scattered locations throughout much of the southern Lower Peninsula and in the northwest Lower Peninsula within and around the Manistee National Forest (Kurta and Rice 2002).

Indiana bats roost under exfoliating bark or in crevices of tree snags or live trees (Kurta et al. 1996, Kurta and Rice 2002, Kurta et al. 2002), usually within lowland or riparian forests (Humphrey et al. 1977, Kurta and Rice 2002, Kurta et al. 2002) but also within savannas or upland woodlands near edges or openings (Clark et al. 1987, Gardner et al. 1991, Brack 2006). Most maternity colonies are found in trees with diameters larger than 9 inches (22 cm) (Menzel et al. 2001, Kurta et al. 2002, Kurta 2004). Sunlight seems to be an important component in snag selection in Michigan; snags with heavy canopy cover tend to be avoided, except during exceptionally warm weather (Kurta et al. 1996, 2002). A variety of tree species are used for roost and maternity sites. Ash trees (*Fraxinus* spp.) are the primary roost trees in Michigan (Kurta et al. 1993, Kurta et al. 1996), but maples (*Acer* spp.) and elms (*Ulmus* spp.) are also frequently used (Kurta and Rice 2002). Indiana bats generally change roost trees every few

days, so they require areas where multiple suitable roost trees are available (Kurta et al. 1996, 2002, Foster and Kurta 1999). Specific natural communities in Michigan where Indiana bat may be found include floodplain forests, southern swamps, oak barrens and oak–pine barrens.

When dispersing, Indiana bats generally follow linear forested features like river corridors or fence rows (Murray and Kurta 2004, Winhold et al. 2005). At night, they feed on insects over streams, rivers, ponds and other small wetlands or in forest openings or along forest edges (USFWS 1999, Murray and Kurta 2002).

Except for one hibernation site at Tippy Dam in Manistee County, known hibernacula occur south of Michigan in karst areas of the east-central United States. Indiana bats emerge from hibernation and arrive in Michigan as early as mid April (Viele 1994, Viele et al. 2002, Kurta and Rice 2002). Females form maternity colonies in May and young are born in late June or early July (Kurta and Rice 2002). Males may disperse widely or remain near their hibernacula and generally roost individually or in small groups (Kurta 2004). Indiana bats are highly philopatric, returning to the same breeding area in subsequent years (Kurta and Murray 2002, Winhold et al. 2005). Indiana bats that presumably migrate to hibernacula south of the State have been known to remain in southern Michigan until as late as October 11 (Kurta and Rice 2002). The summer range and migration characteristics of the Indiana bats that hibernate in Tippy Dam are unknown.

Eastern massasauga rattlesnake

The eastern massasauga rattlesnake, a Federal candidate species, occurs from southeastern Minnesota, eastern Iowa and northeastern Missouri east to southern Ontario, western New York and northwestern Pennsylvania (Harding 1997). The eastern massasauga has declined dramatically throughout its range. Michigan remains as a last stronghold for this species (Szymanski 1998). Historically, eastern massasaugas in Michigan were found throughout the Lower Peninsula and on Bois Blanc Island, Mackinac County (Szymanski 1998, Lee and Legge 2000). The species still maintains this general distribution, but threats such as persecution, habitat loss and habitat fragmentation have caused extirpation of individual populations and significant declines in others (Szymanski 1998, Michigan DNR 2005b).

Massasaugas are usually associated with wetlands, including both wooded communities like swamps and riverine corridors, and herbaceous communities including marsh borders and wet prairies (Szymanski 1998, Lee and Legge 2000). In summer, they also move into immediately adjacent upland herbaceous communities including grasslands, shrubby old fields, and pasture and hay fields (Szymanski 1998, Lee and Legge 2000). Young are born in August and early September (Harding 1997, Lee and Legge 2000). Massasaugas usually retreat to wetlands in late September or October, overwinter in crayfish and mammal burrows from late October to April, and return to upland habitats in June (Szymanski 1998, Lee and Legge 2000).

Opportunities for massasaugas to use KBB habitat occur where suitable wetlands are adjacent to oak savannas. Therefore, during summer, massasaugas could occasionally occur in KBB habitats identified for treatment or disturbance. Additional information can be found in Harding (1997) and Lee and Legge (2000).

3.2.1.2 Michigan State-listed Wildlife Species

At least 17 wildlife species classified as threatened or endangered under the Michigan Endangered Species Protection Law (Public Act 451 of 1994, Part 365) could occur in or near occupied KBB habitat (Table 5). Other Species of Greatest Conservation Need associated with savanna in the Lower Peninsula of Michigan are listed in Table 4. The following text provides information on those State-listed wildlife species (arranged alphabetically by scientific name) that are not also classified as Federal threatened, endangered or candidate species.

Table 5. Wildlife species classified as threatened or endangered under Michigan law that potentially occur in or near occupied KBB habitat.

Common name	Scientific name	Status
Dusted skipper	*Atrytonopsis hianna*	State threatened
Three-staff underwing	*Catocala amestris*	State endangered
Spotted turtle	*Clemmys guttata*	State threatened
Least shrew	*Cryptotis parva*	State threatened
Prairie warbler	*Dendroica discolor*	State endangered
Kirtland's warbler	*Dendroica kirtlandii*	Federal endangered; State endangered
Persius dusky wing	*Erynnis persius persius*	State threatened
Bald eagle	*Haliaeetus leucocephalus*	State threatened
Ottoe skipper	*Hesperia ottoe*	State threatened
Frosted elfin	*Incisalia irus*	State threatened
Migrant loggerhead shrike	*Lanius ludovicianus migrans*	State endangered
Great Plains spittlebug	*Lepyronia gibbosa*	State threatened
Karner blue butterfly	*Lycaeides melissa samuelis*	Federal endangered; State threatened
Prairie vole	*Microtus ochrogaster*	State endangered
Indiana bat	*Myotis sodalis*	Federal endangered; State endangered
Phlox moth	*Schinia indiana*	State endangered
Regal fritillary	*Speyeria idalia*	State endangered

Dusted skipper (Atrytonopsis hianna)

The State-threatened dusted skipper has been known to occur as a locally uncommon species at scattered locations in the northern and west-central Lower Peninsula and in Monroe County. The entire range of the species encompasses much of eastern and central North America. This skipper occurs in oak savannas and dry sand prairies where larvae feed on little bluestem (Wilsman 1994). Adults nectar on strawberry (*Fragaria* spp.), raspberry (*Rubus* spp.) and clover (*Trifolium* spp.) from late May to early or mid June. Dusted skipper appears to be secure across its range, but it is considered to be vulnerable, imperiled or critically imperiled in most States within its range (NatureServe 2006). Additional information can be found in Nielsen (1999).

Three-staff underwing (Catocala amestris)

In Michigan, the State-endangered three-staff underwing is known to be extant in only one location in Barry County. Although this species is not known to occur within the range of KBB, few surveys for this species have been conducted, and it may be more widespread than currently believed. It occurs in dry to mesic sand prairies and other prairies with loamy soils where leadplant (*Amorpha canescens*) is abundant, including in rights-of-way (Wilsman 1994). Leadplant is the only known larval host plant in Michigan. Larvae feed from late May through June and adults are most often found from late July to early August. Range-wide, this species appears to be in little or no danger of extinction (NatureServe 2006). Additional information can be found in Wilsman (1994).

Spotted turtle (Clemmys guttata)

The State-threatened spotted turtle is known from much of Michigan's Lower Peninsula, particularly the southern half of the State. It generally occurs in clear, shallow water with mud or muck bottoms; it is commonly found in aquatic and emergent vegetation associated with shallow ponds, wet meadows, tamarack swamps, bogs, fens, marsh channels, sphagnum seepages, and slow streams. Spotted turtles often wander on land, particularly in search of nesting areas. June is the primary month for females to seek sunny open areas with sandy or loamy soil. They have also been known to nest in grassy sites in the tops of grass or sedge hummocks. Hatchlings emerge in August or September. Spotted turtles reach maturity at 8–10 years. They typically hibernate in shallow water from mid October to late March. Protection of upland nesting habitat adjacent to identified and active core wetland habitats is required for the continued survival of this species. Spotted turtles occur throughout much of eastern North America. They are secure across much of their range (NatureServe 2006). Additional information can be found in Harding (2000).

Least shrew (Cryptotis parva)

The State-threatened least shrew is considered rare in Michigan and has been known to occur at scattered locations in the southern Lower Peninsula. It occurs in a variety of grassland areas including old fields, fence rows, wet meadows, orchards and forest edges (Evers 1994). Feral house cats may pose a threat to this species. Populations are difficult to survey; more surveys are

needed to determine existing occurrences of this species. Additional information can be found in Evers (1994).

Prairie warbler (Dendroica discolor)

The State-endangered prairie warbler has been known to nest at scattered locations throughout the Lower Peninsula, as well as a few locations in the Upper Peninsula. It prefers scrub–shrub habitats, including old fields, young jack pine stands, oak clearcuts, and powerline rights-of-way (Cooper 2000). This species has gradually declined after peaking in abundance in the 1950s and 1960s. The primary threats to the prairie warbler include habitat loss, nest parasitism from brown-headed cowbirds, and nest predation. Beneficial management includes prescribed fire, clearcutting, and intermediate succession of old fields. Additional information can be found in Cooper (2000).

Persius dusky wing (Erynnis persius persius)

The State-threatened Persius dusky wing has been reported in southern Michigan, as far north as Lake County. This uncommon skipper occurs locally in oak savannas. The larval food source is wild lupine. The single-brooded adults live from May through early June and nectar on a variety of plant species. Larvae probably mature by mid July, at which time they enter diapause. Following lupine senescence, larvae overwinter below ground. Individuals are sensitive to fire, but populations are most threatened by loss of oak savanna due to fire suppression and development. Persius dusky wing are secure throughout much of northwestern North America, but the eastern subspecies is highly imperiled throughout northeastern North America and is believed to be extirpated from several States (NatureServe 2006). Additional information can be found in Nielsen (1999).

Bald eagle

The State threatened bald eagle breeds throughout most of Michigan, with breeding activity increasing from south to north (Michigan Natural Features Inventory 2007, USFWS 2006). Bald eagle nesting locations are patchily distributed within the Michigan KBB range (Michigan DNR 2006a, Michigan Natural Features Inventory 2006, USFWS 2006). Bald eagles typically nest in forested areas (>10% forest cover) with at least a few large trees that are located near water and away from significant human activity (USFWS 1983, Bowerman et al. 2005, Michigan DNR 2006a). Adults often return to historic nest sites (USFWS 1983) and initiate nesting in mid February to mid March (Michigan DNR 2006a). Nesting activity continues until late summer (generally August) when chicks fledge (Michigan DNR 2006a). Bald eagle populations declined greatly across their range after World War II due primarily to the widespread use of DDT and other organochlorine insecticides, which resulted in egg-shell thinning and high rates of reproductive failure (USFWS 1983). Following the ban on the use of such chemicals in the early 1970s, bald eagle numbers in Michigan began to increase in the early 1980s (Michigan DNR 2006a). Since then, Michigan's eagle population has continued to increase and expand across its historic range (Eagle et al. 2005, Michigan DNR 2006a, USFWS 2006).

Ottoe skipper (Hesperia ottoe)

The State-threatened Ottoe skipper ranges from southern Manitoba through the continental Midwest to northern Texas. It has been reported in southwestern Michigan, as far north as Newaygo County. This skipper is localized in its occurrence, and is almost always found close to larval food plants including little bluestem and fall witchgrass (*Leptoloma cognatum*). In Michigan, this skipper occurs in dry sand prairies and oak savannas, often in association with wild lupine. The single-brooded adults are active from late June through mid August. Eggs hatch and develop to fourth instar larvae before late summer or fall hibernation in buried shelters. Additional information can be found in Nielsen (1999) and Cuthrell (2001). Ottoe skipper is vulnerable to extinction throughout its range and is considered to be imperiled or critically imperiled in most States within its range (NatureServe 2006).

Frosted elfin (Incisalia irus)

The State-threatened frosted elfin has been reported in southern Michigan, as far north as Mason and Iosco counties. The range of the species encompasses much of eastern North America. The single-brooded adults nectar on blueberry (*Vaccinium* spp.) from late April to early June. This elfin occurs in oak savannas where larvae feed on wild lupine flowers. Larvae develop through all subadult life stages and pupate at the base of lupine plants where they overwinter at or below ground level. Frosted elfin is vulnerable to extinction throughout its range and is considered to be imperiled or critically imperiled in most States within its range (NatureServe 2006). Additional information can be found in Nielsen (1999).

Migrant loggerhead shrike (Lanius ludovicianus migrans)

The State-endangered migrant loggerhead shrike has been documented from numerous locations in the Lower Peninsula, mostly in counties bordering the Great Lakes. It can be found in a variety of habitats, including pastures, old fields, rights-of-way, and other grassy areas with perches from which to search for food. They feed on insects, small mammals, small birds, reptiles and amphibians. They nest in a variety of vegetation, but seem to prefer short trees and shrubs that offer a tangle of protective branches or thorns. Loggerhead shrikes arrive in Michigan in early spring and depart in August or September. Shrike numbers declined through the 1960s and 1970s in Michigan, possibly in response to the use of pesticides. Range-wide, migrant loggerhead shrikes have a spotty distribution, have experienced steep declines, and may be vulnerable to extinction (NatureServe 2006).

Great Plains spittlebug (Lepyronia gibbosa)

The Great Plains spittlebug is a State-threatened species in Michigan. It is known from numerous locations in eight counties in western and southwestern Michigan, where it is often locally abundant (Dunn et al. 2002). The Great Plains spittlebug occurs in mesic portions of sand-prairie and oak-savanna communities (Wilsman 1994, Dunn et al. 2002). It appears to use a variety of host plants as nymphs, but may be limited to big bluestem and little bluestem as adults. This single-brooded insect appears as an adult as early as June and persists throughout the summer, probably laying eggs in the late summer or early fall. It appears to be sensitive to

fire in all life stages; however, fire is important for the maintenance of its habitat. This species is also found in Indiana and Ontario where it is believed to be highly imperiled (NatureServe 2006). Additional information can be found in Hanna (1970) and Hamilton (1982).

Prairie vole (Microtus ochrogaster)

The State-endangered prairie vole is known to occur only in the southwestern corner of Michigan, where it is extremely rare. It occurs in a variety of upland grasslands including old fields, hayfields, fence rows, rights-of-way and oak savannas (Evers 1994). Habitat loss and feral cats may pose threats to this species. The prairie vole has probably always been rare in the State. Additional information can be found in Evers (1994).

Phlox moth (Schinia indiana)

In Michigan, the State-endangered phlox moth is known from only three locations in Newaygo and Montcalm Counties. It occurs in oak savannas and dry prairie areas. As juveniles, this moth feeds on the flowers and developing seed pods of downy phlox (*Phlox pilosa*); adults spend most of their time on these plants (Wilsman 1994). Phlox moth appears to have a flight period determined by the length of the flowering period of the phlox. Adults have been recorded from late May through early July. Pupae spend August through April at or below the soil surface, where they are less susceptible to mortality from fire. Phlox moth occurs across much of central North America, but is believed to be very rare throughout much of its range and it may be imperiled range-wide. Additional surveys are necessary to determine its distribution and abundance in Michigan. Additional information can be found in Swengel and Swengel (1999).

Regal fritillary (Speyeria idalia)

The State-endangered regal fritillary was known to occur historically throughout much of southern Michigan and in Newaygo and Montcalm Counties. It occurs in prairies, savannas and old field grasslands, and may occasionally be found in KBB habitat (Wilsman 1994). Adults begin emerging in late June and live through most of the summer. Larvae feed on a variety of violets (*Viola* spp.) and adults feed on a variety of species, but usually seek tall plants such as milkweed (*Asclepias* spp.). Males wander widely but both sexes actively avoid trees (Wilsman 1994). Vegetative succession due to fire suppression has probably been a significant contributor to the decline of this species. Regal fritillary has not been observed in Michigan since 1980 and may be extirpated from the State. It has experienced a recent range-wide contraction of approximately 30%; this large-scale decline may be ongoing (NatureServe 2006). It is probably extirpated from approximately 15 States within its historic range. Additional information can be found in Nielsen (1999).

3.2.2 Plant Species of Concern

3.2.2.1 Federally Listed and Candidate Species

Pitcher's thistle (*Cirsium pitcheri*) is classified as federally and State threatened, and is the only federally listed plant species in Michigan that could be reasonably expected to occur in or near

KBB habitat. It is endemic to the Great Lakes region. Its entire range occurs along or in close proximity to the shorelines of Lakes Michigan, Huron and Superior (USFWS 2002). Pitcher's thistle occurs on open sand dunes and occasionally on partially open dunes or lag gravel areas associated with dunes (Higman and Penskar 1999).

Pitcher's thistle is monocarpic (once-flowering) with a rosette that matures to flowering in 5–8 years, after which the plant dies (Higman and Penskar 1999, USFWS 2002). Seeds germinate in May or June. The taproot of this thistle, which can reach 2 m in length, enhances the plant's ability to survive the often-desiccating conditions of its dune habitat (Higman and Penskar 1999). Pitcher's thistle blooms from approximately late June to early September (Higman and Penskar 1999).

Pitcher's thistle occurs within a dynamic dune ecosystem and therefore occurrences and densities of the species vary considerably over space and time (USFWS 2002). Pitcher's thistle colonizes open, windblown areas of dunes and gradually declines as vegetative succession occurs (USFWS 2002). Established individuals can persist within a patch with moderate vegetation densities, but new seedlings will not establish without significant areas of open sand (McEachern 1992).

The long-lived nature of Pitcher's thistle combined with its dependence upon a rare and dynamic dunal ecosystem make it highly susceptible to shoreline alteration (USFWS 2002). Development of shoreline habitat is probably the most serious threat to this species, but other activities such as off-road vehicle traffic and heavy foot traffic can result in extirpation (Higman and Penskar 1999, USFWS 2002).

Pitcher's thistle is not known to occur in occupied KBB habitat in Michigan, but the two species do overlap at the Indiana Dunes National Lakeshore (Indiana Dunes National Lakeshore 2000). The potential for overlap in Michigan may exist in some rare circumstances.

3.2.2.2 Michigan State-listed Plant Species

At least 16 plant species classified as threatened or endangered under the Michigan Endangered Species Protection Law (Public Act 451 of 1994, Part 365) could occur in or near occupied KBB habitat (Table 6). The following text provides information on those State-listed plant species (arranged alphabetically by scientific name) that are not also classified as Federal threatened, endangered or candidate species.

Table 6. Plant species classified as threatened or endangered under Michigan law that potentially occur in or near occupied KBB habitat.

Common name	Scientific name	Status
Rock-jasmine	*Androsace occidentalis*	State endangered
Beach three-awned grass	*Aristida tuberculosa*	State threatened
Silky aster	*Aster sericeus*	State threatened
Canadian milk-vetch	*Astragalus canadensis*	State threatened

Side-oats gramma	*Bouteloua curtipendula*	State threatened
Pitcher's thistle	*Cirsium pitcheri*	Federal threatened; State threatened
Rattlesnake master	*Eryngium yuccifolium*	State threatened
White gentian	*Gentiana flavida*	State endangered
Downy gentian	*Gentiana puberulenta*	State endangered
Prairie smoke	*Geum triflorum*	State threatened
Wild potato-vine	*Ipomoea pandurata*	State threatened
Virginia flax	*Linum virginianum*	State threatened
Leiberg's panic-grass	*Panicum leibergii*	State threatened
Smooth beard-tongue	*Penstemon calycosus*	State threatened
Missouri goldenrod	*Solidago missouriensis*	State threatened
Blue curls	*Trichostema dichotomum*	State threatened

Rock-jasmine (Androsace occidentalis)

The State-endangered rock-jasmine is known from a single location in the southwestern Lower Peninsula. This species is most likely to be found in dry sand prairies and oak savannas in sandy soils in Michigan (Michigan Natural Features Inventory 2006). This species may persist in the State in habitat remnants in southern portions of the Lower Peninsula, where it may be easily overlooked. More information on rock-jasmine can be found in Michigan Natural Features Inventory (2006).

Beach three-awned grass (Aristida tuberculosa)

The State-threatened beach three-awned grass is known from two locations in the southwestern Lower Peninsula. It can be found in dry sand prairies or oak savannas in sandy soils (Michigan Natural Features Inventory 2006). This species may have been historically rare in Michigan, but loss and degradation of habitat may have resulted in a decline in occurrences in the State. Fire is probably required to maintain habitat for this species. More information on beach three-awned grass can be found in Michigan Natural Features Inventory (2006).

Western silvery aster (Aster sericeus)

The State-threatened silvery aster is known from dry sand prairie (Michigan Natural Features Inventory 2006). Loss and degradation of habitat is the primary threat to this species. Protection of existing prairie remnants and restoration of prairie and savanna areas through prescribed fire

and brush removal are necessary for conservation of this species. More information on western silvery aster can be found in Michigan Natural Features Inventory (2006).

Canadian milk-vetch (Astragalus canadensis)

The State-threatened Canadian milk-vetch has been known to occur in scattered locations throughout the southern Lower Peninsula and in Delta County in the Upper Peninsula. It occurs in oak-savanna and alvar grassland areas, usually in moist soil conditions (Michigan Natural Features Inventory 2006). Many historic records for this species in the State exist, but the present status is poorly understood. More information on Canadian milk-vetch can be found in Michigan Natural Features Inventory (2006).

Side-oats gramma (Bouteloua curtipendula)

The State-threatened side-oats gramma has been known to occur in the southeastern Lower Peninsula and in Kalamazoo and Kent counties in southwestern Michigan. It occurs in oak savannas and hillside prairies in Michigan and has been found in alvar elsewhere (Michigan Natural Features Inventory 2006). Primary threats to this species are habitat loss and habitat degradation due to woody succession and proliferation of invasive species. Brush removal and prescribed fire are needed to restore habitat for this species. More information on side-oats gramma can be found in Michigan Natural Features Inventory (2006).

Rattlesnake master (Eryngium yuccifolium)

The State-threatened rattlesnake master has been known to occur in the southwestern Lower Peninsula. It occurs in prairie fens, dry sand prairies, mesic prairies, and wet-mesic prairies (Michigan Natural Features Inventory 2006). Threats to this species include habitat loss and degradation through vegetative succession. Prescribed fire and other techniques to maintain openings are needed for the conservation of this species. More information on rattlesnake master can be found in Michigan Natural Features Inventory (2006).

White gentian (Gentiana flavida)

The State-endangered white gentian has been known to occur in scattered locations across the southern Lower Peninsula. It occurs in dry or moist prairies and oak savannas (Michigan Natural Features Inventory 2006). Threats to this species include habitat loss and degradation of habitat through vegetative succession. Prescribed fire and other techniques to maintain openings are needed for the conservation of this species. More information on white gentian can be found in Michigan Natural Features Inventory (2006).

Downy gentian (Gentiana puberulenta)

The State-endangered downy gentian has been known to occur in the southeastern Lower Peninsula and in Kent and Allegan counties in southwestern Michigan. It occurs in oak savannas, often along coastal plain marshes (Michigan Natural Features Inventory 2006). Alteration of natural disturbance regimes leading to habitat loss is the primary threat to this

species. Prescribed fire and brush removal are needed to restore habitat for this species. More information on downy gentian can be found in Michigan Natural Features Inventory (2006).

Prairie smoke (Geum triflorum)

The State-threatened prairie smoke has been known to occur in the west-central Lower Peninsula and in Chippewa County in the Upper Peninsula. It occurs in dry sand prairies and oak savannas (Choberka et al. 2000). It flowers in mid May and bears fruit from late May to mid June. Threats to this species include off-road-vehicle traffic, invasive species, habitat loss and vegetative succession. More information on prairie smoke can be found in Choberka et al. (2000).

Wild potato-vine (Ipomoea pandurata)

The State-threatened wild potato-vine is known only from a few scattered locations in the southern Lower Peninsula, including Kent County. It is generally found in oak savannas and rights-of-way (Michigan Natural Features Inventory 2006). This sprawling ground-vine has been known to grow to 6 feet long and blooms in late summer. The status of this species in the State is generally unknown; more surveys are needed to determine current distribution. More information on wild potato-vine can be found in Michigan Natural Features Inventory (2006).

Virginia flax (Linum virginianum)

The State-threatened Virginia flax is known from scattered locations in the southern Lower Peninsula, including Kent County. It can be found in oak savannas and other woodland openings (Michigan Natural Features Inventory 2006). This perennial plant flowers from mid to late summer. Large-scale vegetative succession to a woody canopy is probably the major threat to this species. More information on Virginia flax can be found in Michigan Natural Features Inventory (2006).

Leiberg's panic-grass (Panicum leibergii)

The State-threatened Leiberg's panic-grass is known from scattered locations in the southern Lower Peninsula, including Ionia County. It is found in dry to wet prairie remnants, including dry sand prairies, hillside prairies, oak openings and rights-of-way (Penskar and Crispin 2004). It flowers in June and fruiting usually occurs in July but occasionally persists into August or September. Prescribed fire is needed to mimic the natural disturbance regime that historically provided habitat for this species. More information on Leiberg's panic-grass can be found in Penskar and Crispin (2004).

Smooth beard tongue (Penstemon calycosus)

The State-threatened smooth beard tongue is known from three counties in Michigan: Menominee County in the western Upper Peninsula, St. Clair County in southeastern Michigan, and Kent County in southwestern Michigan. Throughout its range, it occurs in prairies, meadows, rocky slopes, and sparsely vegetated woodlands (Penskar 2004). More information is

needed on the distribution of this species in the State. This species would likely benefit from prescribed fires in the prairie communities where it is found. More information on smooth beard-tongue can be found in Penskar (2004).

Missouri goldenrod (Solidago missouriensis)

The State-threatened Missouri goldenrod occurs in dry sand prairies (Michigan Natural Features Inventory 2006). This drought-tolerant perennial plant flowers in summer or early fall. More surveys are needed in Michigan to determine its status and distribution in the State. This species would likely benefit from prescribed fires in the prairie communities where it is found. More information on Missouri goldenrod can be found in Michigan Natural Features Inventory (2006).

Blue curls (Trichostema dichotomum)

The State-threatened blue curls or bastard pennyroyal is known to occur in oak savannas in the southern Lower Peninsula (Michigan Natural Features Inventory 2006). It flowers in late summer or fall. The open, early-successional habitat it requires was historically maintained by natural disturbance, especially fire. Prescribed fires would probably benefit this species. More information on blue curls can be found in Michigan Natural Features Inventory (2006).

4. PROJECT DESCRIPTION/ACTIVITIES COVERED BY PERMIT

4.1 Project Description

Authorized by a 20-year ITP, a coalition of management partners will cooperate to implement this HCP. Management partners could include State, county and local government agencies, non-governmental organizations, utility and transportation right-of-way managers, private land developers, and other private landowners. Landowners and land managers will not be required to participate in implementation of the HCP. Rather, participation will be offered as a reasonable and practical option for those agencies, organizations and individuals that seek authority for incidental take of KBB. Activities under this HCP will not be conducted on any particular parcel of land without the participation and explicit permission of the landowner. Activities that will be conducted under this HCP fall into three general categories: 1) habitat management; 2) utility and transportation right-of-way maintenance; and 3) development.

4.2 Activities Covered by Permit

4.2.1 Habitat Management

Habitat management will involve simulation of natural processes to maintain the conditions required by KBB and other species associated with the Oak Savanna Ecosystem. Natural processes historically included fire, windthrow, wild herbivore grazing, and insect and disease outbreaks (Nuzzo 1986, Grundel et al. 1998, Ritchie et al. 1998, Fuhlendorf and Engle 2001). Management techniques that will be used to mimic these processes include:

- prescribed burning,
- mowing/hydroaxing,
- manual vegetation removal,
- chemical vegetation removal,
- soil scarification,
- seeding and planting, and
- livestock grazing.

Disturbance levels associated with use of these techniques will occur within the natural range of variability. The techniques could be used separately or in combination, and are expected to have short-term (<2 growing seasons) adverse impacts but long-term benefits to KBB, other species of concern, and the Oak Savanna Ecosystem.

4.2.1.1 Prescribed Burning

Prescribed burning will be used to suppress undesirable plant species, enhance the diversity and abundance of desirable plant species, reduce soil nitrogen and organic matter, raise soil pH, expose mineral soils, and reduce woody plant cover and thus increase incident sunlight at ground level (Wright and Bailey 1982, Tester 1989, Haney and Apfelbaum 1990, Lane 1994, Payne and Bryant 1994, Neary et al. 2005). Soil-disturbance measures required as a part of this activity will conform to specifications described under the subsequent heading for soil scarification.

Prescribed burning may be conducted throughout the Michigan range of KBB, but it will not be used when it could pose a threat to human safety, property, or the safe and reliable use of utility infrastructure. Public-safety, property and infrastructure concerns will be addressed through existing requirements to secure permits from the appropriate State or local agencies prior to burning. Additionally, prescribed burning will conform to National Wildfire Coordinating Group (NWCG) Standards, and burns will be conducted by Certified Burn Managers pursuant to Michigan law (Public Act 451 of 1994, Part 515). This law deals comprehensively with codified prerequisites, certifications and processes for prescribed burning, and is compatible NWCG Standards.

As required by Michigan law, prescribed burning will be conducted under a system of redundant containment and control measures, wherein appropriate firebreaks, ignition strategies, and suppression equipment (e.g., fire plows, pump trucks, bulldozers) will be used by trained personnel to safely and effectively conduct burns. In addition, modeling of expected fire intensity will be used to assist in optimizing application of containment measures. Finally, local fire departments will be informed of all prescribed fire plans and burn dates in case there is need to mobilize them. These measures will help ensure prescribed fires remain under control, and will thus ensure a high degree of safety and prevent the burning of more occupied KBB habitat than intended.

4.2.1.2 Mowing/Hydroaxing

Mowing and hydroaxing will be used to mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie

et al. 1998, Fuhlendorf and Engle 2001). It will suppress herbaceous and woody plants and increase incident sunlight at ground level. Tools used in this activity will include rotary mowers (e.g., mowers, brushogs, hydroaxes) powered and propelled by rubber-tired or tracked vehicles (e.g., tractors, skidders, dozers, all-terrain vehicles).

4.2.1.3 Manual Vegetation Removal

Manual vegetation removal will be used to mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). This activity will remove or suppress individual herbaceous or woody plants and increase incident sunlight at ground level. It will be conducted through plant cutting, plant pulling, or application of heat to individual plants (e.g., propane-torch removal). Tools used in this activity will include various forms of hand-operated and power-assisted hand-directed implements (e.g., axes, saws, weed whips, spades, loppers) and various forms of hand-held torches and gas-fueled torches mounted on all-terrain vehicles (ATVs). The torches will be used to direct heat to individual plants when the immediately surrounding environment is too wet to burn. On-site fire-suppression capabilities (e.g., hand pumps, ATV-mounted sprayers, extinguishers) will provide for contingency response in case of fire persistence.

4.2.1.4 Chemical Vegetation Removal

Chemical vegetation removal will be used to mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). It will involve application of chemicals to remove or suppress individual herbaceous or woody plants and to increase incident sunlight at ground level. Tools used in this activity will include various forms of hand-held, ATV-mounted, and machine-driven applicator tools. Herbicides will be applied by certified applicators in compliance with label directions.

4.2.1.5 Soil Scarification

Soil scarification will mimic certain effects of fire by exposing mineral soils, reducing organic material, and providing sunlit seed beds to promote germination and growth of lupine and nectar plants (Tester 1989, Payne and Bryant 1994, Neary et al. 2005). Tools used in this activity will include hand-operated and power-driven implements (e.g., blades, rakes, thatchers, discs, harrows). This activity will be used when lupine or nectar plant densities are insufficient to meet KBB habitat-management objectives. This technique will often be followed by seeding or planting.

4.2.1.6 Livestock Grazing

Livestock grazing may be used to mimic effects of wild herbivore grazing and browsing (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). This activity would be used in short rotation to suppress herbaceous and woody plants, expose

mineral soils, and increase incident sunlight at the soil surface through the clipping of above-ground parts and limited trampling.

4.2.1.7 Seeding and Planting

This activity will involve planting of seed, vegetative parts, and plugs of lupine and KBB nectar plants, often following prescribed burning, mowing/hydroaxing, manual and chemical vegetation removal, and soil scarification. Equipment used in this activity will include seeders, drills, planters and spades. Only native species will be seeded or planted. When feasible, seeds will be collected locally. When seed or plants are purchased from commercial sources, efforts will be made to obtain and use local genotypes.

4.2.1.8 Treatment Combinations

A combination of activities, often applied in sequence, may be used to maintain occupied KBB habitat by increasing lupine coverage, increasing plant diversity, reducing woody cover, and reducing occurrence of invasive species. These combinations would involve application of two or more of the listed habitat-management techniques.

4.2.2 Utility and Transportation Right-of-Way Maintenance

Utility and transportation right-of way maintenance will involve activities that maintain vegetation and infrastructure in conditions appropriate for the intended purpose of rights-of-way. Vegetation-manipulation techniques available to right-of-way managers include:

- prescribed burning,
- mowing/hydroaxing,
- manual vegetation removal,
- chemical vegetation removal,
- soil scarification,
- seeding and planting, and
- livestock grazing.

These activities are described under the Habitat Management heading (4.2.1). Although these activities will be conducted for the primary purpose of maintaining rights-of-way, they will be implemented in ways to maintain habitat for KBB. They are expected to have short-term (<2 growing seasons) adverse impacts but long-term benefits to KBB.
A second category of right-of-way maintenance activity includes those activities that could result in habitat disturbance not expected to provide long-term benefits to KBB. This type of habitat disturbance is associated with infrastructure replacement and repair, and includes:

- heavy-equipment operation/traffic and
- soil excavation.

4.2.2.1 Heavy-equipment Operation/Traffic

This activity may involve the operation of vehicles and use of heavy machinery in occupied KBB habitat for the purpose of repairing or replacing physical structures such as pipelines, towers, transmission lines, electrical conductors, signs, fencing, railroad rails and ties, roadways and culverts.

4.2.2.2 Soil Excavation

Soil excavation involves the removal or disruption of the soil profile. It may be conducted for the purposes of repairing or replacing structures such as pipelines, towers, signs, railroad rails and ties, roadways and culverts.

4.2.3 Development

Development activities could include:

- commercial, residential and public-facility construction;
- agriculture, horticulture and intensive forestry; and
- road and utility development.

Commercial, residential and public-facility construction could involve construction of buildings, parking lots, recreational complexes, and other artificial structures, as well as all land modifications necessary to support those infrastructures. Activities could involve: removal of native plant communities; disturbance of the soil profile; partial or complete covering of occupied KBB habitat with structures and hardened surfaces (e.g., buildings, pavement); introduction of foreign soils, plants and chemicals for landscaping purposes (e.g., lawns, ornamentals, fertilizers, pesticides); and fragmentation and isolation of remaining habitat patches. In addition, these activities could be accompanied by an increase in human activity.

Agriculture, horticulture and intensive forestry could involve land conversion for crop and livestock production, plant cultivation, and timber harvest and regeneration. Activities could involve: removal of native plant communities; disturbance of the soil profile; introduction of foreign soils, plants and chemicals (e.g., crops, cultivated plants, fertilizers, pesticides); introduction of livestock; planting and seeding of trees; creation of access routes; and changes in connectivity among habitat patches.

Road and utility development could involve construction of new rights-of-way for transportation and utility purposes. Rights-of-way could include roadways, railways, and pipeline and power-line corridors. Activities could involve: removal of native plant communities; disturbance of the soil profile; partial or complete covering of occupied KBB habitat with structures and hardened surfaces (e.g., poles and towers, rails and ties, pavement); and changes in connectivity among habitat patches.

5. MEASURES TO MINIMIZE AND MITIGATE ADVERSE IMPACTS

5.1 Measures to Minimize Adverse Impacts

5.1.1 Habitat Management

Habitat management is expected to yield long-term benefits to KBB, other species of concern, and the Oak Savanna Ecosystem. However, some short-term (<2 growing seasons) adverse biological impacts associated with habitat management will be necessary to achieve those long-term benefits. To avoid or minimize adverse impacts, habitat-management techniques will be conducted according to the following conditions.

5.1.1.1 General

Habitat-management techniques will usually be applied to no more than one-third of any particular occupied KBB habitat patch within a calendar year. Treatment will be conducted first on the most degraded third of a patch. This approach will reduce take of KBB and other species of concern, and it will facilitate re-colonization of recently treated portions. The entirety of a patch or metapopulation complex will not be treated until the initially treated portion benefits from two growing seasons and monitoring confirms densities of KBB, lupine and flowering nectar plants that exceed pre-treatment levels.

Treatment of more than one-third of any particular occupied KBB habitat patch within a calendar year may be conducted under any of the following conditions:

- treatment of a larger area is necessary to prevent the spread of invasive species and disease outbreaks that threaten the viability of a KBB population.
- a large viable KBB metapopulation is identified, expanding the focus for treatment from the level of individual habitat patches to the level of the metapopulation complex as a whole. In this case, treatment within a calendar year will be limited to one-third of the area of the metapopulation complex.
- an occupied habitat patch is less than 1 hectare. A patch this size may be treated in its entirety within a single calendar year if a suitably connected source population exists within 1 kilometer.
- take of KBB would not occur on more than one-third of the patch (e.g., when mowing over snow cover, spot-spraying for invasive species).
- experimental management techniques require testing.

In these instances, project-specific approval from the Michigan DNR and the USFWS will be required prior to implementation.
With rare exception, management that could result in take will not occur when adult KBB are present, typically between May 15 and August 15. Management that could result in take may be conducted during this period only if it is necessary to achieve KBB habitat-management objectives or to test experimental management techniques, or when new information indicates take would not exceed that which would occur during other periods. Take activities that would

occur between May 15 and August 15 will require specific authorization from the Michigan DNR and the USFWS.

Surveys will be used to determine the presence and distribution of KBB within proposed treatment areas. Whenever pre-treatment surveys are not conducted, presence of KBB throughout the treatment area will be assumed. Pre-treatment habitat assessments will also be used to identify the most degraded habitat portions on which to focus treatment.

To the extent possible, foot and vehicle traffic will avoid occupied KBB habitat and other lupine patches outside treatment areas.

All employees and contractors working in occupied habitat will be trained on KBB life history and habitat requirements, and instructed on the measures required to minimize or avoid take of the species.

5.1.1.2 Prescribed Burning

Prescribed burning may be conducted throughout the Michigan range of KBB, but it will not be used when it could pose a threat to human safety, property, or the safe and reliable use of utility infrastructure. Public-safety, property and infrastructure concerns will be addressed through existing requirements to secure permits from the appropriate State or local agencies prior to burning. Additionally, prescribed burning will conform to NWCG Standards, and burns will be conducted by Certified Burn Managers pursuant to Michigan law (Public Act 451 of 1994, Part 515). This law deals comprehensively with codified prerequisites, certifications and processes for prescribed burning, and is compatible NWCG Standards.

As required by Michigan law, prescribed burning will be conducted under a system of redundant containment and control measures, wherein appropriate firebreaks, ignition strategies, and suppression equipment (e.g., fire plows, pump trucks, bulldozers) will be used by trained personnel to safely and effectively conduct burns. In addition, modeling of expected fire intensity will be used to assist in optimizing application of containment measures. Finally, local fire departments will be informed of all prescribed fire plans and burn dates in case there is need to mobilize them. These measures will help ensure prescribed fires remain under control, and will thus ensure a high degree of safety and prevent the burning of more occupied KBB habitat than intended.

5.1.1.3 Mowing/Hydroaxing

Take of KBB due to mowing or hydroaxing can be entirely avoided when at least 4 inches of snow cover the ground or when cutting equipment would directly avoid lupine. These activities will be scheduled to occur under these conditions whenever possible. When mowing over snow is not possible, mowing and hydroaxing will be restricted to periods when adult KBB are not present. To avoid or minimize impacts to lupine and KBB eggs and larvae, equipment will be operated to achieve a cutting height of at least 6 inches above the ground.

Where aggressive vegetation (e.g., bracken fern: *Pteridium aquilinum*) threatens to shade out lupine throughout the lupine growing season, mowing may be conducted during periods when adult KBB are present, on as much as one-third of the area each year, provided Michigan DNR and USFWS approval has been received.

5.1.1.4 Manual Vegetation Removal

Compared to mowing and hydroaxing, this activity is more selective with regard to the plants that are removed. It will be conducted through plant cutting, plant pulling, or application of heat to individual plants (e.g., propane-torch removal). The torches will be used to direct heat to individual plants when the immediately surrounding environment is too wet to burn. On-site fire-suppression capabilities (e.g., hand pumps, ATV-mounted sprayers, extinguishers) will provide for contingency response in case of fire persistence and will help prevent the unintentional ignition of lupine and KBB nectar plants.

5.1.1.5 Chemical Vegetation Removal

Broadcast application (spray or wick) will involve application of herbicide to a target area, and will be conducted according to the general guidelines outlined under 5.1.1.1. Spot spraying will involve selective application of herbicide to the target plants while avoiding drift into areas occupied by lupine. Because lupine impacts and KBB take will be avoided with this technique, spot spraying may be conducted throughout an occupied site when it will be most effective for achieving KBB habitat-management objectives. Herbicides will be applied by certified applicators in compliance with label directions.

5.1.1.6 Soil Scarification

Soil scarification will be conducted according to the general guidelines outlined under 5.1.1.1.

5.1.1.7 Livestock Grazing

Livestock grazing may be conducted through the release of grazing animals on up to one-third of occupied KBB habitat patches that are greater than 1 acre. To minimize damage to lupine and KBB eggs and larvae, grazing would be conducted on short rotation; livestock would be removed before vegetation is reduced to a height of 6 inches.

5.1.1.8 Seeding and Planting

Only native species will be seeded or planted. When feasible, seeds will be collected locally. When seed or plants are purchased from commercial sources, efforts will be made to obtain and use local genotypes. Seeding and planting will typically occur in areas not yet re-colonized by KBB following treatment. Therefore, these activities will cause no take or other adverse impacts to KBB.

5.1.1.9 Treatment Combinations

Treatment combinations will comply with the restrictions set forth for the individual habitat-management techniques. This practice will often result in a more protracted treatment period for selected habitat-patch portions while remaining patch portions are retained in an untreated condition.

5.1.2 Utility and Transportation Right-of-Way Maintenance

Utility and transportation right-of way maintenance will involve activities that maintain vegetation and infrastructure in conditions appropriate for the intended purpose of rights-of-way. Vegetation-manipulation techniques available to right-of-way managers include:

- prescribed burning,
- mowing/hydroaxing,
- manual vegetation removal,
- chemical vegetation removal,
- soil scarification,
- seeding and planting, and
- livestock grazing.

Although these activities will be conducted for the primary purpose of maintaining rights-of-way, they will be implemented in ways to maintain habitat for KBB. To achieve both purposes while minimizing take of KBB, vegetative manipulation will, to the extent possible, be conducted according to the conditions outlined under 5.1.1 (Habitat Management). Conducted in this manner, these activities are expected to have short-term (<2 growing seasons) adverse impacts but long-term benefits to KBB, other species of concern, and the Oak Savanna Ecosystem. Vegetation manipulation not consistent with the conditions outlined above may have long-term adverse impacts to KBB and therefore may occur only if mitigation is conducted according to the requirements outlined in 5.2.

A second category of right-of-way maintenance activity will include activities that could result in habitat disturbance not expected to provide long-term benefits to KBB. This type of habitat disturbance is associated with infrastructure replacement and repair, and includes:

- heavy-equipment operation/traffic and
- soil excavation.

To avoid or minimize incidental take of KBB, these techniques will be conducted according to the following conditions.

5.1.2.1 General

With rare exception, activities in occupied KBB habitat that could result in take will not occur when adult KBB are present, typically between May 15 and August 15.

Surveys will be used to determine the presence and distribution of lupine and KBB within rights-of-way prior to disturbance. Whenever pre-treatment surveys are not conducted, presence of KBB throughout the right-of-way will be assumed.

Prior to any ground-disturbing activities, areas that contain lupine immediately adjacent to treatment areas will be flagged or otherwise marked; workers will not stockpile materials, park vehicles, or otherwise cause adverse impacts in those areas.

All employees and contractors working in project sites will be trained on KBB life history and habitat requirements, and instructed on the measures required to avoid or minimize take of the species.

Maintenance activities may deviate from the preceding conditions in emergency situations demanding immediate repair of malfunctioning or dangerous infrastructure. In such situations, measures will be taken to minimize take of KBB, and long-term adverse impacts will be subsequently mitigated according to requirements of 5.2 (Mitigation).

5.1.2.2 Heavy-equipment Operation/Traffic

To the extent possible, truck and heavy-equipment traffic will be limited to existing disturbed areas, such as access roads that run within a right-of-way. When traffic must leave existing routes to conduct maintenance activities, steps will be taken to avoid lupine areas and to minimize the extent of new disturbance. During replacement and repair of infrastructure, existing structures will be dismantled in place or otherwise repaired in ways to avoid impacts to lupine to the extent possible.

Posts driven into the ground (e.g., sign posts) without excavation represent minimal habitat disturbance and will not be expected to result in take of KBB. Therefore, posts may be driven in occupied KBB habitat during any time of the year if the associated equipment operation and human trampling is not expected to adversely affect lupine or KBB.

If disturbance of lupine areas in occupied KBB habitat can not be avoided by heavy-equipment traffic or operation, mitigation will be conducted according to the requirements outlined in 5.2 (Mitigation).

5.1.2.3 Soil Excavation

When soil excavation will occur in lupine areas, efforts will be made to minimize the footprint of the area disturbed. To the extent possible, displaced soils will be deposited away from lupine areas and within the smallest possible side-cast areas needed for temporary storage. Following repair or replacement of structures, excavated areas will be backfilled using the original soil that was deposited in temporary storage areas. Additional mitigation will also be required according to the requirements outlined in 5.2 (Mitigation).

5.1.3 Development

Development activities could include:

- commercial, residential and public-facility construction;
- agriculture, horticulture and intensive forestry; and
- road and utility development.

The primary objectives of these three types of development generally do not include maintenance of KBB habitat. Some development activities could have long-term impacts that convert at least portions of occupied KBB habitat patches into conditions incompatible with sustaining KBB. However, some types of development, such as creation of utility rights-of-way, can have positive impacts on KBB by creating corridors that link existing occupied habitats or by expanding existing habitat patches. Adverse impacts of development activities will be minimized and mitigated (see 5.2) in ways to ensure no long-term net reduction in KBB population sizes, area of occupied KBB habitat, or connectivity of occupied KBB habitat patches. To avoid or minimize incidental take of KBB, any development activities will be conducted according to the following conditions.

Any development in occupied KBB habitat will be planned to avoid or minimize adverse impacts to KBB to the extent possible. For example, project footprints will be minimized or configured to retain lupine areas wherever possible. Where it will help reduce overall adverse impacts to KBB, development will not occur between May 15 and August 15. Development in occupied KBB habitat will not proceed until project planning demonstrates that adverse impacts will be adequately avoided or minimized and mitigated according the requirements outlined in 5.2 (Mitigation).

Surveys will be used to determine the presence and distribution of lupine and KBB prior to project planning and implementation. Whenever pre-development surveys are not conducted, presence of KBB throughout the area to be developed will be assumed.

Prior to any ground-disturbing activities, adjacent lupine areas that will not be developed will be flagged or otherwise marked; workers will not stockpile materials, park vehicles, or otherwise cause adverse impacts in those areas.

All employees and contractors working in project sites will be trained on KBB life history and habitat requirements, and instructed on the measures required to avoid or minimize take of the species.

No invasive plant species will be introduced into developed areas.

The specific acreage of occupied KBB habitat that could be impacted by development will be limited by developer interest, zoning, and opportunity and funding for adequate mitigation. Mitigation will be required to ensure activities conducted under this HCP do not cause a long-term net reduction in KBB population sizes, area of occupied KBB habitat, or connectivity of occupied KBB habitat patches. Given an expected time lag between initiation of mitigation and

actual replacement of lost occupied KBB habitat, development that would cause occupied KBB habitat on non-Federal land to be reduced by more than 1% at any given time will not be permitted. Given the currently known KBB distribution and this restriction, the amount of occupied KBB habitat that might be developed in any given year ranges from 0 acres to 27 acres.

5.2 Measures to Mitigate Unavoidable Adverse Impacts

Mitigation will be required when activities within occupied KBB habitat will have adverse impacts, either short-term or long-term, that are not expected to ultimately enhance KBB habitat or otherwise provide a net benefit to KBB. Thus, habitat management performed specifically to enhance KBB habitat according to the prescribed conditions generally will not require mitigation. Similarly, activities conducted primarily for other purposes (e.g., right-of-way vegetation manipulation) but implemented in ways to maintain habitat for KBB (see 5.1.2) will not require mitigation. Mitigation will most often be required where activities, such as development, lead to permanent conversion of occupied KBB habitat.

Mitigation for any particular project will be sufficient to ensure no long-term net reduction in KBB population sizes, area of occupied KBB habitat, or connectivity of occupied KBB habitat patches. The type and amount of mitigation required for individual projects will depend upon a combination of several factors, including:

- area of occupied habitat to be disturbed or converted;
- density of KBB in the disturbed habitat;
- quality of the habitat disturbed (e.g., lupine density);
- degree to which disturbance would reduce patch connectivity
- nature of the disturbance;
- expectation for recovery of the disturbed habitat and resident KBB subpopulation;
- role of the affected KBB subpopulation within a larger metapopulation; and
- expectation for KBB habitat enhancement and subpopulation establishment within a proposed mitigation area.

In some cases where impacts will be minimal and habitat is expected to recover within the same growing season, required mitigation could entail nothing more than monitoring to document that no discernible impacts to KBB occurred. In other cases, required mitigation could include habitat restoration (repair or re-establishment of an oak savanna opening with lupine) on-site as well as creation of suitable KBB habitat in other areas. Long-term or permanent destruction (conversion) of occupied KBB habitat will typically require creation of suitable KBB habitat elsewhere.

When possible, mitigation will include restoration of the entire disturbed area as well as creation of additional suitable KBB habitat equal in size to 25–50% of the disturbed area. Restoration and creation of a total area greater than that which is disturbed will help ensure no net loss of KBB habitat; if all restoration is successful, it could yield a net increase in KBB habitat. The required area of suitable KBB habitat creation will vary inversely with the proportion of the disturbed occupied habitat to be restored. That is, as less of the disturbed area can be restored, more habitat creation will be required. A mitigation land-exchange ratio of up to 3:1 (3 acres of

habitat created for every 1 acre of occupied KBB habitat disturbed and not restored) will be the upper limit for mitigation. If an area three times the size of an occupied patch is not expected to provide sufficient habitat to compensate for the loss of the occupied patch, the project will not qualify under this HCP. This circumstance could occur when a project would result in the complete loss of a large core KBB population within a metapopulation or when created habitat would not adequately replace the function of lost patches.

When possible, suitable habitat will be created in areas adjacent to disturbed occupied patches, provided:

- ecological conditions are suitable;
- immediate threats to KBB and the habitat are not present; and
- a neighboring source KBB population (within 1 km) is expected to colonize the created habitat.

This practice will maximize the chance of natural colonization, help ensure long-term population viability, and maintain metapopulation structure. If habitat creation is not possible in areas adjacent to disturbed occupied patches, new patches will be created in other, disjunct areas where:

- ecological conditions are suitable;
- immediate threats to KBB and the habitat are not present;
- a neighboring source KBB population (within 1 km) is expected to colonize the created habitat;
- habitat creation would maintain or improve patch connectivity; and
- habitat creation would replace the metapopulation function of the lost patch.

Sites with created habitat will be protected (e.g., through conservation easement or donation to a land trust) and not used for purposes inconsistent with persistence of KBB. Purchase and protection of occupied KBB habitat may be considered as mitigation if it is accompanied by additional habitat expansion or if habitat management necessary to maintain existing populations is assured.

Except in emergency situations (see 5.1.2.1), surveys to determine baseline habitat conditions and KBB population densities will precede all activities that require mitigation, and all mitigation areas will be monitored to determine habitat and population impacts and restoration success (see 7. Monitoring and Reporting).

The need for mitigation may be met in advance of specific projects by applying a concept similar to that of a Safe Harbor Agreement. To do so, a baseline of existing occupied KBB habitat would be established. If the amount of habitat increased more than 25% above baseline, then treatment/disturbance of occupied KBB habitat could occur without need for further mitigation, provided the amount of occupied habitat remains at least 25% above baseline and habitat patch function is not compromised. Retaining a total area greater than baseline level would help ensure no net loss of KBB habitat as well as offset any indirect impacts associated with disturbance of adjacent areas.

5.3. Adaptive Management

Adaptive management allows for changes in approaches or techniques based on new information. It evaluates the outcomes of implemented actions so that relative success can be documented and subsequent actions can be adapted for greater effectiveness. A successful adaptive management approach requires a clear statement of management goals and objectives so that a series of monitoring benchmarks can be developed accordingly (Noon 2003). Objectives should address the conservation target, the geographic area, the desired action, a measurable state or degree of change desired, and a time frame (Elzinga et al. 2001).

To assess habitat management conducted under this HCP, habitat and/or KBB population goals and objectives will be developed for each treatment. Pre-treatment habitat conditions and KBB densities, as well as ecological assessments of site potential, may be used to develop these goals and objectives. Benchmarks toward obtaining objectives will then be identified. When applicable to the treatment, these benchmarks will reflect expectations of annual changes as habitat stabilizes or improves. KBB habitat and population goals will be set at levels that meet or exceed pre-treatment lupine or KBB densities. Higher densities may be used as additional benchmarks toward an anticipated or preferred outcome. If benchmarks are not met as anticipated (or other unexpected effects occur), a prompt review of the management application will be initiated. The review will include assessments of the technique and site conditions. Those applications that consistently achieve objectives will be continued or considered for expanded application.

The majority of habitat-management techniques that will be implemented under this HCP have already proven to be effective in the restoration and maintenance of oak-savanna habitats. KBB populations have also benefited from these management techniques (Rabe 2001). However, some questions regarding the resiliency of KBB populations following application of individual techniques have not yet been answered. Therefore, management prescriptions outlined under this HCP are conservatively designed to limit risk to KBB populations (e.g., take will typically occur on no more than one-third of an occupied habitat patch within a single calendar year) rather than maximize habitat-management efficiency or flexibility. The adaptive-management approach will provide additional validation for the use of proven management techniques and will provide for assessment of additional, relatively unproven management practices.

A management technique will be considered ‘proven’ when the USFWS concludes it consistently results in improved habitat and maintenance of KBB populations under a variety of conditions. A proven technique may include a treatment that repeatedly results in higher-quality habitat that is quickly re-colonized such that KBB densities fully recover within 2 years. If approval is granted by the USFWS, pre- and post-treatment monitoring requirements for proven techniques may be reduced to qualitative assessments. Qualitative assessments could be as simple as a walk through an occupied patch during KBB flight to count the number of KBB encountered per unit effort and to characterize lupine coverage. This type of assessment would be conducted to ensure that wild lupine and KBB are abundant following treatment. Quantitative surveys would resume if any evidence suggests a proven technique is not achieving objectives.

Relatively unproven management techniques (e.g., burning more than one-third of a habitat patch in a single calendar year) may be experimentally initiated on a limited scale following USFWS approval of a detailed treatment plan. This plan would include a detailed description of the management prescription, why it is desired, the anticipated outcomes (including goals, objectives and benchmarks), a description of the monitoring design to be used to evaluate the application, and the schedule for reporting results. If benchmarks are not met as anticipated (or other unexpected effects occur), the experimental management would be suspended, and a prompt review of the management application would be initiated. This review would involve assessments of the technique and site conditions. If an experimental treatment repeatedly and consistently results in higher-quality habitat that is quickly re-colonized such that KBB densities fully recover within 2 years, this HCP may be amended to include the newly proven technique.

Like habitat management, right-of-way maintenance has proven to be effective at maintaining habitat for KBB. Many of the techniques used for this activity will be conducted according to the same conditions required for habitat management (see 5.1). Those techniques will be tested and revised based on the same adaptive-management principles outlined above.

Goals and objectives will be developed to assess the effectiveness of mitigation efforts related to development and right-of-way maintenance that does not follow the guidelines for habitat management. The level of take of KBB and habitat will be used to determine mitigation goals, objectives and associated benchmarks. The minimum objectives for mitigation will be to ensure no net reduction in KBB population sizes, no net loss of occupied habitat area, and no net loss in connectivity among occupied KBB habitat patches due to activities conducted under this HCP (see 5.2). Similar to the approach for habitat management, benchmarks will be used to determine the success of mitigation efforts. When benchmarks are not met as anticipated (or other unexpected effects occur), a prompt review of the mitigation planning and implementation will be initiated. This review will include assessments of the techniques and site conditions.

6. POTENTIAL BIOLOGICAL IMPACTS/TAKE ASSESSMENT

6.1 Direct and Indirect Impacts

6.1.1 Habitat Management

Based on currently known KBB distribution, habitat management under this HCP could occur on approximately 2,700 acres of occupied KBB habitat.

6.1.1.1 Direct Impacts

Many detrimental changes have occurred within the Oak Savanna Ecosystem since European settlement (Abrams 1992). Fire suppression resulted in succession of many open oak savannas to closed-canopy forests. In many cases, this transition occurred within the span of a few decades (e.g., Curtis 1959). Oak savannas that have succeeded to closed-canopy forest often have a diminished graminoid component as a result of reduced light availability at ground level and the accumulation of thick litter layers (Abella et al. 2001). The overstory is often simplified

due to selective timber harvest (Minc and Albert 1990). Native floristic diversity is often reduced as a result of fire suppression, sustained livestock grazing, woody encroachment, and the establishment of invasive species such as spotted knapweed (*Centaurea maculosa*)(Cohen 2000, 2001, 2004). These changes in structure and vegetation were accompanied by declines of many wildlife species that are associated with oak savanna (Eagle et al. 2005, O'Connor 2006).

Habitat management will help prevent or reverse many of these detrimental impacts by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem. Thus, habitat management will be used to restore the natural community structure and ecological function of oak savannas.

Fire was the primary mechanism that historically maintained oak savannas in early-successional conditions and provided suitable habitat for many savanna-dependent species (Abrams 1992, O'Connor 2006). Prescribed burning will be used to mimic the effects of fire that occurred under a natural disturbance regime. Prescribed burning will reduce canopy cover and the density of woody stems (Pauly 1997). It will increase light availability at ground level and increase nutrient availability, which will help maintain high levels of graminoid and forb diversity (Tester 1989). It will also reduce litter layers and help prevent the establishment and spread of invasive herbaceous and woody species (Chapman et al. 1995).

Oak savannas often burn patchily, especially when burns are conducted in the spring. This patchiness will provide natural refugia for fire-sensitive species (Chapman et al. 1995). Moreover, only one-third of an occupied KBB habitat patch will be burned within a single calendar year. With this approach, ample refugia will be available to allow re-colonization of burned areas by fire-sensitive species.

Mowing and hydroaxing, manual vegetation removal, chemical vegetation removal, livestock grazing, and soil scarification will be used to mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). These activities will suppress herbaceous and woody plants and increase incident sunlight at ground level. Some of these activities will expose mineral soils, reduce organic material, provide sunlit seed beds, and thus promote germination and growth of lupine and nectar plants (Tester 1989, Payne and Bryant 1994, Neary et al. 2005). All of these activities will simulate processes that occurred historically under a natural disturbance regime, and will help counter some of the detrimental impacts that have occurred since European settlement.

Individuals of some oak-savanna species could be sensitive to the effects of mowing and hydroaxing, manual vegetation removal, chemical vegetation removal, livestock grazing, and soil scarification. Accordingly, these activities will generally be conducted during times of the year when adverse impacts could be avoided or minimized. When impacts could not be avoided with timing, only a portion (generally one-third) of an occupied KBB habitat patch will be treated within a single calendar year. This approach will provide refugia from treatment effects and will allow re-colonization of treated areas by oak-savanna species.

The local and regional diversity of plant and wildlife species is not expected to change as a result of the proposed habitat management. Rather, existing diversity will be maintained by preventing losses associated with the degradation of oak savannas. By contrast, if management was not conducted, species diversity would be expected to decline locally or regionally because loss and fragmentation of early-successional habitat patches could result in the extirpation of several species (Eagle et al. 2005).

Oak savannas are not particularly productive environments due to their harsh physical features (e.g., low nutrients, droughty soils); however, many wildlife species frequently use these areas for foraging due to the structural complexity and the presence of specific (e.g., host plants) or high-quality (e.g., acorns) food sources. Management will help maintain productivity at levels normal for a functioning savanna. Without the management of oak-savanna habitat outlined in this HCP, food sources for some species could be lost and productivity could subsequently decline.

6.1.1.2 Indirect Impacts

Climate

Habitat management will have no measurable impact on regional climate. Some management activities will alter microclimate in ways that simulate conditions under a natural disturbance regime.

Elevated levels of carbon dioxide are contributing to global climate change (Vitousek 1994, Karl and Trenberth 2003), and prescribed burning will introduce additional carbon dioxide into the atmosphere. Given the currently known distribution of KBB on non-Federal land in Michigan and the management conditions outlined under 5.1.1, no more than 900 acres of occupied KBB habitat could be burned in any single year. The acreage that would actually be burned in any year would probably be much lower. Thus, the amount of carbon dioxide introduced by prescribed burning will be negligible compared to that introduced by vehicle and industrial emissions and by the tens of thousands of acres of wildfires that annually occur elsewhere in the United States (Vitousek 1994, Karl and Trenberth 2003).

Similarly, vehicles used during management activities (e.g., mowers, ATVs) will introduce carbon dioxide and other greenhouse gases into the atmosphere. However, a small number of vehicles (<10) will be used at the same time, and they will be operated for only a few days per year in any given habitat patch. Therefore, the emissions from these vehicles will be negligible compared to emissions from other local sources.

Habitat management will create the range of microclimate conditions that occurred historically in oaks savannas under a natural disturbance regime. The presence of a range of thermal environments is beneficial to KBB and other insects (Lane and Andow 2003, Grundel and Pavlovic in press), and canopy cover will be managed in a pattern that provides both open and shaded areas. In areas where openings are created, average incident sunlight and temperatures at ground level will increase and average relative humidity will decrease. These changes will occur at the microhabitat level, and will not affect climate conditions at a broader scale. Moreover,

localized changes will be of short duration: in the absence of perpetual management, ecological succession will increase canopy cover and shading through time.

Topography and soils

Habitat management will not alter natural topography. Thus, the flat expanses and moderately rolling relief of KBB habitat will remain unchanged. However, habitat management may have minor, temporary and localized impacts on soil features.

Within managed habitat patches, prescribed burning will reduce soil nitrogen and organic matter, raise pH, and expose mineral soils (Tester 1989, Payne and Bryant 1994). These changes occurred historically under a natural disturbance regime, and they will counter the detrimental impacts of fire-suppression practices that have occurred since the 1920s (Abrams 1992).

Soil compaction due to management-vehicle traffic (e.g., ATVs) will be negligible because: 1) sandy soils are resistant to compaction; 2) only a small number of vehicles will be used during management activities; and 3) management vehicles will be operated for only a few days per year in any given habitat patch.

If used, livestock grazing will expose mineral soils and increase soil nutrients. These impacts will be similar to those that occurred prior to European settlement, when wild herbivores sometimes congregated in oak savannas and helped inhibit succession (Ritchie et al. 1998, Fuhlendorf and Engle 2001). Soil compaction would be expected to be negligible because sandy soils are resistant to compaction and livestock would be introduced at low densities and on short rotation schedules. All impacts associated with livestock grazing will be of short duration and low intensity because livestock will be removed from any single habitat patch before vegetation is reduced to a height of 6 inches.

Soil scarification will disturb the upper soil profile, expose mineral soils and reduce organic material. Scarified areas will provide seed beds to promote germination and growth of lupine and nectar plants (Tester 1989, Payne and Bryant 1994, Neary et al. 2005). These impacts will be similar to those that occurred historically as a result of wildfires and wild herbivore activity.

Hydrology

With rare exception, habitat management will be conducted in upland habitats, and no measurable impacts to hydrology are expected. Due to sandy, well-drained soils and minimal slopes, water infiltration rates will remain high regardless of whether vegetation and other organic matter are removed. Where tree density and canopy cover are reduced, less water will be lost through evapotranspiration, but the difference is not expected to be significant. Therefore, groundwater inputs to lotic systems are not expected to change as a result of management in occupied KBB habitat patches. Hydrological impacts due to soil compaction associated with management-vehicle traffic (e.g., ATVs) and livestock grazing will be negligible because sandy soils are resistant to compaction and traffic and livestock impacts will be of short duration and low intensity. Given the topographic and soil features of occupied KBB habitats, erosion is not expected to increase as a result of habitat management.

Water quality

Habitat management is not expected to have measurable impacts on water quality. Oak savanna occurs in upland areas with sandy, well-drained soils and minimal slopes. Even though some habitat-management activities will remove organic matter, runoff will still be negligible. No contaminants will be introduced to local water bodies. All herbicide application will conform to label specifications; accordingly, no herbicide will be applied closer than the required setback distance from any water body. Moreover, negligible runoff and high infiltration rate of the sandy soils will provide high retention rates, allowing for onsite chemical breakdown. Given the upland locations and negligible runoff of managed habitats, livestock will not contaminate water sources.

Air quality

Effects on air quality due to habitat management are expected to be minor, temporary and localized. Most management activities will have no impact on air quality. Vehicle emissions associated with management (e.g., mowers, ATVs) will be negligible compared to emissions from other local sources. Moreover, most vehicle operation will occur from September to May, when air-pollutant (e.g., ozone) levels pose less of a health risk. Prescribed burning will comply with Michigan's smoke management plan (Public Act 451 of 1994, Part 515), which confines emissions within parameters established by National Ambient Air Quality Standards (U.S. Environmental Protection Agency 2005b) and addresses local smoke-management concerns. Additionally, prescribed burning will be conducted in ways that will not cause a reduction in U.S. Environmental Protection Agency Air Quality Index (U.S. Environmental Protection Agency 2003b) levels for local areas.

6.1.2 Utility and Transportation Right-of-Way Maintenance

Based on currently known KBB distribution, utility and transportation right-of-way maintenance under this HCP could occur on approximately 800 acres of occupied KBB habitat.

6.1.2.1 Direct Impacts

Activities that involve vegetation manipulation will be conducted for the primary purpose of maintaining rights-of-way, but will be implemented in ways that simulate or replace the natural processes that historically maintained the Oak Savanna Ecosystem. Vegetation manipulation will generally be conducted according to the conditions outlined under 5.1.1. Thus, the biological impacts of vegetation manipulation within rights-of-way will generally be the same as those outlined under 6.1.1.1.

Additional activities conducted for right-of-way maintenance will include infrastructure repair and replacement, and may involve heavy equipment traffic/operation and soil excavation. These activities may result in take of individual plants and animals. However, given their localized nature, short duration, and associated requirements to minimize adverse effects (see 5.1), the direct impacts of these activities are expected to be smaller in scope than those of vegetation

manipulation. These activities are expected to have negligible impacts on biological structure, function, diversity and productivity.

6.1.2.2 Indirect Impacts

Vegetation manipulation will generally be conducted according to the conditions outlined under 5.1.1. Thus, the indirect impacts of vegetation manipulation within rights-of-way will be the same as those outlined under 6.1.1.2.

Additional activities conducted for right-of-way maintenance include infrastructure repair and replacement, and may involve heavy-equipment traffic/operation and soil excavation. The indirect impacts of these activities are provided under the following headings.

Climate

Increased levels of greenhouse gases are contributing to global climate change (Vitousek 1994, Karl and Trenberth 2003), and heavy equipment used during maintenance activities (e.g., trucks, backhoes) will introduce greenhouse gases into the atmosphere. However, a small number of vehicles will be used at the same time, and they will be operated for only a few days per year in any given habitat patch. Therefore, the emissions from heavy equipment will be negligible compared to emissions from other local sources. Therefore, heavy-equipment operation/traffic will have no measurable impact on regional climate. Soil excavation will not have impacts on regional climate.

Repair and replacement of existing structures within rights-of-way is not expected to alter shading patterns or the range of thermal environments. Therefore, these activities are not expected to change microclimate conditions.

Topography and soils

Infrastructure repair and replacement will not alter the natural topography of KBB habitat. Thus, the flat expanses and moderately rolling relief of KBB habitat will remain unchanged. However, infrastructure repair and replacement may have minor, temporary and localized impacts on soil features.

Soil compaction due to heavy-equipment traffic/operation will be negligible for four reasons: 1) sandy soils are resistant to compaction; 2) to the extent possible, truck and heavy-equipment traffic will be limited to existing disturbed areas, such as access roads that run within a right-of-way; 3) only a small number of vehicles will be used during maintenance activities; and 4) heavy equipment will be operated for only a few days per year in any given habitat patch.

Soil excavation will disrupt the soil profile in localized areas of occupied KBB habitat patches. Compared to soil scarification, soil excavation will generally occur on a smaller area of an occupied patch, but the depth of soil disturbance may be greater. To the extent possible, displaced soils will be deposited away from lupine areas and within the smallest possible side-cast areas needed for temporary storage. Following repair or replacement of structures,

excavated areas will be backfilled using the original soil that was deposited in temporary storage areas. Thus, the composition of soils in occupied KBB habitat patches is not expected to change as a result of soil excavation.

Hydrology

No measurable impacts to hydrology as a result of infrastructure repair and replacement are expected. Hydrological impacts due to soil compaction associated with heavy-equipment operation/traffic will be negligible because sandy soils are resistant to compaction and operation/traffic will be of short duration and low intensity. Due to sandy, well-drained soils, minimal slopes, and relatively small areas of impact, erosion is not expected to increase as a result of soil excavation.

Water quality

Infrastructure repair and replacement is not expected to have measurable impacts on water quality. Right-of-way managers implement safety protocols to prevent spills or leaks (e.g., of petroleum products) associated with heavy equipment and pipelines, and no such accidents are expected. However, in the event a spill or a leak does occur, the upland locations, well-drained soils, and minimal slopes of occupied KBB habitats will minimize runoff and help prevent contamination of local water bodies.

Air quality

No measurable impacts to air quality as a result of infrastructure repair and replacement are expected. Emissions associated with heavy-equipment operation/traffic will be negligible compared to emissions from other local sources. Moreover, most equipment operation will occur from September to May, when air-pollutant (e.g., ozone) levels pose less of a health risk.

6.1.3 Development

6.1.3.1 Direct Impacts

Development activities may include: commercial, residential and public-facility construction; agriculture, horticulture and intensive forestry; and road and utility development.

Generally, as development occurs, some oak-savanna habitats are lost, species diversity declines locally and regionally, and productivity for some species may decline. However, some types of development, such as creation of utility rights-of-way, may have positive biological impacts by creating corridors that link existing occupied KBB habitats or by expanding existing habitat patches.

The specific acreage of occupied KBB habitat that will be impacted by development under this HCP will be limited by developer interest, zoning, and opportunity and funding for adequate mitigation. Mitigation will be required to ensure activities conducted under this HCP do not cause a long-term net reduction in KBB population sizes, area of occupied KBB habitat, or

connectivity of occupied KBB habitat patches. Given an expected time lag between initiation of mitigation and actual replacement of lost occupied KBB habitat, development that would cause occupied KBB habitat on non-Federal land to be reduced by more than 1% at any given time will not be permitted. Given the currently known KBB distribution and this restriction, the amount of occupied KBB habitat that might be developed under this HCP in any given year ranges from 0 acres to 27 acres.

The specific biological impacts of 0–27 additional acres of developed land per year will depend on the types of development that will occur. However, the impacts will be small in comparison to those already being caused by development elsewhere within the Michigan KBB range.

Without this HCP, development within the Michigan KBB range would be expected to continue, either legally, following other authorization processes, or illegally with regard to the ESA. Even though development conducted under this HCP could have localized direct impacts to biological features, the type and scale of those impacts will not differ regionally from those that would have otherwise occurred. Under this HCP, however, adverse impacts to KBB and occupied KBB habitat will be offset by required mitigation measures. Oak savanna that is restored or created as part of mitigation will not be eligible for future development. Thus, adverse impacts of development in one area will be balanced with the habitat protection offered in another (i.e., habitat that could have otherwise been developed legally will be protected).

6.1.3.2 Indirect Impacts

Given the currently known KBB distribution and mitigation requirements, the amount of occupied KBB habitat that might be developed in any given year ranges from 0 acres to 27 acres. The specific indirect impacts of 0–27 additional acres of developed land per year will depend on the types of development that will occur. However, the impacts will be small in comparison to those already being caused by development elsewhere within the Michigan KBB range.

Climate

Elevated levels of greenhouse gases are contributing to global climate change (Vitousek 1994, Karl and Trenberth 2003), and increased traffic and industrial emissions associated with some types of development (e.g., commercial, residential and public-facility construction) would introduce more of these gases into the atmosphere. Other types of development (e.g., agriculture, horticulture and intensive forestry) would not necessarily increase greenhouse gas emissions, and may even help remove some greenhouse gases from the atmosphere.

The climate impacts of a maximum of 27 additional acres of developed land per year are difficult to predict, in part because the impacts will depend on the type of development. In any case, those impacts will be negligible compared to the climate impacts of ongoing development within the region and across the United States (Vitousek 1994, Karl and Trenberth 2003). Moreover, given that the rate of development within the Michigan KBB range would not be expected to be different in the absence of this HCP, any regional climate impacts would not differ from those that would have otherwise occurred.

Topography and soils

Development could affect topographic and soil features in several ways, including: disruption of the soil profile due to grading, excavation or agriculture; soil compaction due to construction of infrastructure and traffic; alteration of soil chemistry due to hardened-surface runoff, agriculture and horticulture; increased erosion due to increased soil exposure and alteration of flow patterns; and modification of organic-matter levels and nutrient availability. The nature and scope of these impacts will depend on the site-specific details of individual development projects.

Hydrology

With its sandy, well-drained soils and upland locations, oak-savanna habitats are less susceptible than other habitat types to changes in hydrology due to development. The primary sources of impacts associated with development could be: 1) the creation of hardened surfaces that are impervious to precipitation or otherwise alter infiltration rates or flow patterns; and 2) irrigation for agricultural or horticultural purposes. These sources could affect surface runoff, groundwater flow, and groundwater recharge. The nature and scope of these impacts will depend on the site-specific details of individual development projects.

Water quality

Water quality could be adversely affected by several factors related to development, including hardened-surface runoff, erosion, entrainment of contaminants, and industrial, agricultural and municipal pollution. The nature and scope of impacts will depend on the site-specific details of individual development projects.

Air quality

Some types of development (e.g., commercial, residential and public-facility construction) could increase vehicle and industrial emissions and thus introduce additional pollutants into the atmosphere. Other types of development (e.g., agriculture, horticulture and intensive forestry) would not necessarily lead to an increase in atmospheric pollutants. The nature and scope of impacts will depend on the site-specific details of individual development projects.

6.2 Anticipated Take: Wildlife Species

6.2.1 Karner Blue Butterfly

6.2.1.1 Habitat Management

Some habitat management prescriptions will result in the mortality of individual KBB. For instance, a prescribed burn through an occupied area would destroy KBB juveniles or eggs. However, even within a burn unit, mortality may not be complete, because burn intensity tends to be uneven across a patch, and some juveniles or eggs at or near ground level may survive. Take of immature forms of insects (especially eggs) is difficult to quantify; therefore, take will be indirectly quantified as acres of occupied KBB habitat that could be impacted.

Based on known occurrences, habitat management could occur on approximately 2,700 acres of occupied KBB habitat. Habitat-management techniques that could result in take will not be applied to more than one-third of any particular occupied habitat patch within a calendar year, except under the exceptions identified in 5.1. Given these restrictions and based on the current amount of known occupied KBB habitat, take could occur on no more than 900 acres in any single calendar year. In practice, treating as many as 900 acres in a single calendar is unlikely for several reasons (e.g., weather conditions and logistical constraints that prevent treatment, lack of complete landowner participation in the HCP, limited financial and staffing resources). If the amount of known occupied KBB habitat on non-Federal land increases due to other recovery efforts, take under the ITP could occur on a larger number of acres (i.e., during a single calendar year, habitat management that could result in take could be conducted on one-third of each additional occupied KBB habitat on non-Federal land that is discovered or established).

6.2.1.2 Utility and Transportation Right-of-Way Maintenance

Based on known occurrences, right-of-way maintenance could occur in approximately 800 acres of occupied KBB habitat (This area is included in the acreage identified for potential habitat management in 4.2.1.1; that is, total acreage under this HCP currently does not exceed 2,700 acres). Given the treatment restrictions and based on the current amount of known occupied habitat in rights-of-way, take due to this activity could occur on no more than approximately 270 acres during any single calendar year. However, all right-of-way acreage will eventually receive some vegetation management. If the amount of known occupied habitat in rights-of-way increases due to other recovery efforts, right-of-way maintenance involving take under the ITP could occur on a larger number of acres.

6.2.1.3 Development

Given the mitigation requirements and the currently known KBB distribution, the amount of occupied KBB habitat that might be developed under specific authority of the ITP in any given year ranges from 0 acres to 27 acres. The extent of KBB take on any developed acres would depend on the types of development that would occur there.

6.2.2 Other Federally Listed and Candidate Species

6.2.2.1 Listed Species

Projects conducted under authority of the ITP will not take or otherwise adversely affect federally listed species other than KBB. Prior to implementation of any project, the potential presence of federally listed species will be evaluated based on review of the Biotics data base (Michigan Natural Features Inventory 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. Occupied KBB habitat does not typically overlap with that of other federally listed species in Michigan; thus, the potential for impacts to those species will be small. In the rare event any federally listed species occurs or is likely to occur in or near a project area while it is listed, the project could proceed only if it would not adversely affect the species. Adverse effects might be avoided by

reconfiguring activity areas, adjusting timing of activities, or modifying the nature of activities. Projects that can not avoid adverse effects will not be authorized.

6.2.2.2 Candidate Species

Certain habitat-management and right-of way maintenance activities conducted under authority of the ITP may result in injury or mortality to a small number of eastern massasauga rattlesnakes. For example, individuals could be killed or injured during prescribed burning, mowing, or by heavy-equipment traffic. However, only a small subset of occupied KBB habitat is likely to be occupied by massasaugas, and the conditions required to avoid or minimize take of KBB will also generally minimize adverse impacts to massasaugas. In fact, management activities conducted from late fall to early spring are expected to avoid impacts entirely because massasaugas hibernate in lowland areas during that time. Consequently, habitat management and right-of-way maintenance conducted under the ITP will not jeopardize the continued existence of the species. Indeed, activities that maintain KBB habitat will usually improve conditions for massasaugas as well.

Development has occurred and is currently occurring within the overlapping range of KBB and the eastern massasauga rattlesnake, such that the landscape is becoming increasingly fragmented. Under this HCP, regional rates of development and fragmentation are not expected to differ from those that would have otherwise occurred. Development in occupied KBB habitat could be specifically authorized by the ITP; however, required mitigation would remove the option of developing in newly restored or created oak savanna in other areas. Probability of massasauga presence would not be expected to be different between areas that would be developed and areas that would be protected by mitigation measures. Thus, the threat posed by development in one area could be offset by the habitat protection offered in another (i.e., massasauga habitat that would have otherwise been developed legally would be protected). This protection could be important for the viability of the eastern massasauga in Michigan, given that neither Federal nor State law protects the species against development impacts. In addition, mitigation requirements will help ensure no net increase in fragmentation of occupied KBB habitat and thus, no reduction in habitat connectivity for the eastern massasauga rattlesnake where it occurs with KBB.

6.2.3 Michigan State-Listed Wildlife

At least 17 wildlife species classified as threatened or endangered under Michigan law could occur in or near occupied KBB habitat (Table 5). Prior to implementation of any project under this HCP, the potential presence of these species will be evaluated based on review of the Biotics data base (Michigan Natural Features Inventory 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. If a State-listed species is determined to be present in a project area, proposed activities potentially resulting in take could proceed only if authorized under the provisions of the Michigan Endangered Species Protection Law (Public Act 451 of 1994, Part 365).

Many of the State-listed species that co-occur with KBB are also dependent upon early-successional conditions and therefore require the same management techniques to mimic natural disturbance. Thus, where other State-listed species are present, management may still occur,

following consideration of any special requirements for individual species. Habitat-management activities performed to maintain occupied KBB habitat will generally improve conditions for these savanna-associated species.

Some habitat-management techniques could result in take of some State-listed species. For example, some individuals of State-listed species could be killed or injured during prescribed burning, mowing, or by heavy-equipment traffic. However, the habitat degradation (e.g., woody succession, invasive species encroachment) caused by lack of management would be more harmful than any take caused by management. Many of the conditions required to avoid or minimize take of KBB will also generally minimize adverse effects to other early-successional species.

Given treatment restrictions and based on the current amount of known occupied KBB habitat, actions under this HCP that could result in take of a State-listed species could occur on no more than 900 acres in any single calendar year. Only a small subset of occupied KBB habitat is likely to be occupied by any particular State-listed plant species.

6.3 Anticipated Impacts: Plants

6.3.1 Federally Listed Plants

Pitcher's thistle is the only federally listed plant species in Michigan that could be reasonably expected to occur in or near KBB habitat. Prior to implementation of any project, the potential presence of this species will be evaluated based on review of the Biotics data base (Michigan Natural Features Inventory 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. KBB habitat is not currently known to overlap with Pitcher's thistle habitat in Michigan; thus, the potential for impacts to this species is small. In the rare event this species occurs or is likely to occur in or near a project area while it is listed, the project could proceed only if it would not adversely affect the species. Adverse effects might be avoided by reconfiguring action areas, adjusting timing of activities, or modifying the nature of the action. Projects that can not avoid adverse effects will not be authorized under the ITP.

6.3.2 Michigan State-Listed Plants

At least 16 plant species classified as threatened or endangered under Michigan law could occur in or near occupied KBB habitat (Table 5). Prior to implementation of any project under this HCP, the potential presence of these species will be evaluated based on review of the Biotics data base (Michigan Natural Features Inventory 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. If a State-listed species is determined to be present in a project area, proposed activities potentially resulting in take could proceed only if authorized under the provisions of the Michigan Endangered Species Protection Law (Public Act 451 of 1994, Part 365).

Habitat management conducted under this HCP will result in long-term benefits to State-listed savanna plants, even though some take of these species may occur. Savanna plant species tend

to be highly resilient to disturbance, and activities like prescribed burning or mowing may not kill individual plants. Often, take will occur only as damage to plant material rather than outright mortality. Moreover, conditions required to avoid or minimize take of KBB will also minimize take of these species. Thus, the benefits to State-listed, savanna-dependent plants will vastly outweigh the risks associated with any take that might occur due to habitat management (M. Penskar, Michigan Natural Features Inventory, personal communication). If species-specific conflicts associated with habitat treatments do arise, the needs of State-listed plants will be addressed in local management plans.

Given treatment restrictions and based on the current amount of known occupied KBB habitat, actions under this HCP that could result in take of a State-listed species could occur on no more than 900 acres in any single calendar year. Only a small subset of occupied KBB habitat is likely to be occupied by any particular State-listed plant species.

6.4 Cumulative Impacts

6.4.1 Historic Cumulative Impacts

The Oak Savanna Ecosystem likely reached its greatest extent in North America during the warm, dry hypsithermal period, peaking between 4,000 and 6,000 years ago (Cohen 2004). Although little is known from this period, it is reasonable to conclude that oak savanna was both extensive and more contiguous compared with its current occurrence and character. Frequent fires, wind, wild herbivores, and insect and disease outbreaks shaped and maintained the early-successional character of this ecosystem (Nuzzo 1986, Grundel et al. 1998, Ritchie et al. 1998, Fuhlendorf and Engle 2001).

During the centuries that followed the hypsithermal period until the advent of Europeans on the continent around 1500 A.D., the climate gradually became cooler and more humid. Again, little is known from this period, but it is reasonable to conclude that oak savanna progressively declined, possibly by an order of magnitude, and became less contiguous as a result of these climatic changes. With the decline of oak savanna, KBB would have been subjected to habitat that was less extensive and more fragmented.

During this period, Native Americans strongly influenced the frequency of fires in savanna habitats (Cohen 2004, O'Connor 2006). Native Americans set fires deliberately for a variety of purposes, and they sometimes set fires accidentally (Cohen 2004, O'Connor 2006). These activities created early-successional habitats that would have been used by many savanna-associated species.

European settlement of the continent in the 1500s resulted in the introduction of human-borne diseases. These diseases spread quickly across the continent and had a profound effect on Native Americans, reducing their numbers continent-wide to a fraction of what they were prior to European settlement (Denevan 1992a). As a result, the substantial influence of Native Americans (e.g., prescribed fire) on maintenance of early-successional areas such as oak savannas sharply diminished (Denevan 1992b, Dickman and Leefers 2003).

With European settlement of Michigan in the mid 1800s, many savannas were logged and then converted to agriculture (Dickman and Leefers 2003). Some of this acreage was eventually abandoned because it was not able to support continued farming, and subsequently reverted back to degraded savanna. Many of these areas have now succeeded to forest, and in many of the savannas that remain, soil disturbance and introduction of exotic plant species have marginalized habitat suitability for many savanna-associated species.

Oak savannas in Michigan were subjected to another impact beginning in the 1920s as broad-scale control of wildfires began (Abrams 1992). This practice sharply reduced the scope and frequency of fire on the landscape, further marginalizing a force that historically maintained the early-successional conditions characteristic of oak savannas. Fire suppression resulted in succession of many open oak savannas to closed-canopy forests. In many cases, this transition occurred within the span of a few decades (e.g., Curtis 1959). Oak savannas that have succeeded to closed-canopy forest often have a diminished graminoid component as a result of reduced light availability at ground level and the accumulation of thick litter layers (Abella et al. 2001). The overstory is often simplified due to selective timber harvest (Minc and Albert 1990). Native floristic diversity is often reduced as a result of fire suppression, sustained livestock grazing, woody encroachment, and the establishment of invasive species such as spotted knapweed (Cohen 2000, 2001, 2004). These changes in structure and vegetation were accompanied by declines of many wildlife species that are associated with oak savanna (Eagle et al. 2005, O'Connor 2006).

The period from the 1920s to the present in Michigan can be characterized by gradually declining acreage in agriculture and forestry, increasing land-use conversion to residential, commercial and industrial uses, and increasing fragmentation. These changes have caused additional decreases in high-quality savanna and increased degradation and isolation of savanna remnants. As a result, high-quality oak savanna has been reduced to less than 1% of its pre-European settlement extent (Comer et al. 1995, Cohen 2004).

Taken together, these historic cumulative impacts have had a substantial effect on both the Oak Savanna Ecosystem and its associated plant and animal species. They have also resulted in cumulative degradation in water quality, altered hydrologic patterns, changes in many soil features, and some localized degradation in air quality. The scale and degree of these impacts vary locally and regionally.

6.4.2 Contemporary Cumulative Impacts

Habitat management under this HCP will be conducted primarily to counter historic and ongoing cumulative impacts that threaten the persistence of oak-savanna habitats, KBB and other oak-savanna species. These ongoing, cumulative impacts include habitat loss and fragmentation due to land conversion (e.g., agriculture, forestry, industrial, commercial and residential development, right-of-way development), vegetative succession following removal of fire from the landscape, and the proliferation of invasive species. These cumulative impacts have contributed to regional loss and degradation of oak-savanna communities and declines in a large number of plant and animal species that depend upon them. Also impacted as a result of these ongoing, cumulative impacts are the ecological contributions of oak savannas. These impacts

include a decline in species diversity and productivity. The decline in oak-savanna habitats and subsequent loss of associated species in Michigan contribute to regional declines that are occurring throughout the Midwest (Leach and Ross 1995, USFWS 2003a).

Habitat management under this HCP will have no known cumulative impacts because it will generally counter the ongoing impacts described above, have impacts that will be temporary, cause levels of disturbance within the natural range of variability for oak savannas, and follow guidelines developed to minimize adverse effects to KBB and other species of concern. Because habitat management will occur in upland oak-savanna sites, mimic natural disturbance regimes, and have only temporary impacts that will be within the natural range of variability, there should be negligible cumulative impacts on climate, topography and soils, hydrology, water quality and air quality.

Similar to habitat management, utility and transportation right-of-way maintenance under this HCP will also tend to counter the ongoing, cumulative impacts of vegetative succession and invasive species proliferation. For most right-of way maintenance activities, impacts will be temporary, within the natural range of variability, and carefully contained by following guidelines developed to minimize adverse effects to KBB and other species of concern. Therefore, they are not expected to contribute to adverse cumulative impacts on oak savannas and related biological components, including KBB and other species of concern. When guidelines outlined in 5.1.2 are not followed during vegetation manipulation, or when heavy-equipment operation/traffic or soil excavation occurs in occupied KBB habitat, impacts will be minimal and temporary, or mitigation would be required to counter the impacts. Therefore, these activities are expected to provide negligible or no overall contribution to adverse cumulative impacts on oak savannas, KBB and other related biological components. Similarly, there should be negligible cumulative impacts on climate, topography and soils, hydrology, water quality and air quality.

Development activities specifically conducted under this HCP could result in the destruction of some occupied KBB habitats; therefore, they could impact existing oak savannas and related biological components, including KBB and other species of concern. Development could also have some impacts on climate, topographic and soil features, hydrology, water quality and air quality. However, those impacts would not be expected to differ from those already occurring within the KBB range. Moreover, mitigation will be required for all development that results in long-term adverse impacts to KBB or occupied KBB habitat. If the mitigation proposed would not, at minimum, replace the area and function of the occupied KBB habitat that would be lost, the proposed development would not be allowed under this HCP. Impacts to other species of concern also will be considered in the mitigation process. Moreover, because mitigation areas will not be developed, overall development rates within the region are not expected to differ from current rates due to activities conducted under this HCP. Therefore, net cumulative impacts of development specifically authorized by the ITP on oak savannas, KBB, other biological features, climate, topography and soils, hydrology, water quality and air quality are expected to be negligible.

This HCP offers opportunities for collaboration among owners of occupied KBB habitat. It is expected to result in improved coordination in efforts to conserve KBB populations and will

allow for better tracking of KBB populations. It will also maximize exposure to conservation issues related to KBB, because all non-Federal occupied KBB habitat and the widest diversity of partners are eligible for participation. This exposure is expected to provide more protection for KBB, more information on KBB distribution, and more opportunities for pro-active management.

7. MONITORING AND REPORTING

Monitoring will be conducted to help evaluate KBB distribution and to assess effects of HCP activities on KBB populations and habitat. Monitoring associated with specific projects will be funded by the management partners that conducted the treatments/disturbances. It will be conducted by qualified personnel, either on management-partner staff or contracted through other organizations. Monitoring will be conducted at a subset (approximately one-third) of treated sites following habitat management and right-of-way vegetation manipulation; each of the treatment types used will be adequately represented within the subset of sites monitored. Monitoring will be conducted in all restored and created habitats associated with mitigation for development and right-of-way management.

The objectives of monitoring will be to:

- quantify habitat conditions before and after treatment/disturbance;
- assess KBB numbers before and after treatment/disturbance;
- evaluate techniques for their success in enhancing KBB habitat;
- evaluate techniques for compatibility with KBB persistence;
- assess success of mitigation efforts; and
- track KBB take at the statewide level.

Monitoring will include two components: habitat monitoring and population monitoring. Data for both components will be collected prior to treatment/disturbance and during years 1, 2 and 5 following treatment/disturbance (Pre-treatment/disturbance monitoring may not be required in rare circumstances; in these cases, presence of KBB throughout the area to be affected would be assumed.). Habitat monitoring will be conducted at least twice between May and August during these years; population monitoring will be conducted approximately weekly throughout the second KBB flight (July–August) during these years. Habitat monitoring will quantify the area and estimated density of lupine and nectar plants. Population monitoring will document presence/absence and relative abundance (if present) of KBB.

With USFWS approval, the quantitative monitoring required above could be replaced by qualitative assessments following designation of particular management techniques as ‘proven’ (A management technique may be considered ‘proven’ when the USFWS concludes it consistently results in improved habitat and maintenance of KBB populations under a variety of conditions.). These qualitative assessments could be as simple as walks through occupied patches during the peak of the second KBB flight to count the number of KBB encountered per unit effort and to characterize lupine coverage. These assessments would be conducted to ensure

that wild lupine and KBB are abundant following treatment. Quantitative monitoring would resume if anything suggested a proven technique was not achieving objectives.

Determination of the relationship between KBB abundance and habitat quality in occupied sites could reduce the required intensity of population surveys (Appendix B summarizes an initial effort to assess whether KBB density can be predicted through characterization of habitat quality). However, survey intensity may be reduced only after the method has been rigorously tested and approval from the USFWS has been received.

A report of activities and monitoring results will be submitted to the USFWS by January 31 each year the ITP is in effect. At a minimum, the report will include:

- a summary of annual activities resulting in take of KBB, including acres treated/disturbed.
- a summary of habitat monitoring conducted at treated/disturbed sites.
- a summary of presence/absence and relative abundance surveys conducted at treated/disturbed sites.
- an analysis of the effect of management techniques on habitat quality at a subset of treated sites. The analysis will include comparison of pre- and post-treatment/disturbance conditions.
- an analysis of the effect of management techniques on KBB populations at a subset of treated sites. The analysis will include comparison of pre- and post-treatment/disturbance population estimates.
- a description of known and assumed take. Known take is take of KBB individuals that is directly observed; assumed take will be reported indirectly as area of occupied habitat treated/disturbed.

8. FUNDING

8.1 Funding for HCP Administration

Administration of this HCP will be directed through the Michigan DNR Wildlife Division. Within this Division, the Natural Heritage Unit will be responsible for overseeing this effort. This unit coordinates efforts related to endangered and threatened species and nongame programs. Administrative costs will be associated with activities such as planning of monitoring, evaluation of habitat treatments, reporting, auditing of Partnering Agreements, oversight of minimization and mitigation measures, and modification of the HCP prompted by new information obtained through research and adaptive management. Annual program costs are expected to vary.

Administrative costs will be covered with funding provided to the Natural Heritage Unit in the Wildlife Division budget. The Wildlife Division has supported efforts related to threatened and endangered species since the mid 1950s. A formal endangered species program was initiated in the mid 1970s with the passage of State endangered species regulations. Efforts under this program have been funded by revenue sources such as Federal grants and revenue-matching

projects, State income-tax check-offs, public donations, vehicle registration plates, and State restricted funds. Supported by this mix of funding sources, the Michigan DNR has expended efforts on behalf of the KBB continuously for many years. The Michigan DNR will continue to provide funding necessary to perform the administrative tasks of this HCP.

8.2 Funding for HCP Implementation

Management will be conducted on State game and wildlife areas to maintain KBB habitat and help ensure the long-term persistence of extant populations. These areas have a long history of oak-savanna management. Management activities have been funded by several sources, including Federal matching funds and State restricted funds. Funding used to enhance game-species populations during the past several decades has also benefited KBB by maintaining oak-savanna habitat. More recently, projects funded through the Federal State Wildlife Grant program, the Federal Endangered Species program, and the State Nongame Fish and Wildlife Trust Fund have been conducted specifically to benefit KBB. Continued management of oak savannas will be funded by a combination of these sources.

Partnering Agreements will be developed with management partners, both public and private. Management partners will provide funding for any management, maintenance, mitigation or monitoring that they conduct under this HCP. Partnering Agreements will include assurances of adequate funding.

When mitigation measures are required to offset detrimental impacts of a project, they will be implemented prior to initiation of the project whenever possible. When project and mitigation measures are initiated concurrently, the involved management partners will be required to provide assurances that mitigation and monitoring actions will be completed. Assurances may include posting of bonds or letters of credit, establishment of endowments or trust funds, or other guarantees that financially commit the management partner to completion of these activities.

9. ALTERNATIVES

Several alternatives to this HCP were identified following a review of other, existing HCPs (e.g., Wisconsin Department of Natural Resources 2000), after consultation with scientific and management experts, and following focused public involvement (Appendix C). These alternatives were then evaluated for their functionality in achieving HCP objectives within an acceptable timeframe. Three alternatives are discussed here.

9.1 Alternative 1: No Action

Under this alternative, an ITP would not be issued. Activities resulting in legal KBB take would include: 1) KBB habitat management authorized by existing 10(a)(1)(A) permits issued to the Michigan DNR and the Michigan Chapter of The Nature Conservancy, 2) habitat management conducted under the Landowner Incentive Program; and 3) any development or right-of-way maintenance authorized separately under existing Federal, State and local regulations.

This HCP could address conservation needs of KBB on approximately 2,700 acres of occupied KBB habitat. By contrast, the no-action alternative would be limited, at least initially, to approximately 900 acres of occupied KBB habitat. Some habitat management would continue on public land and some, limited private land, but this management could be conducted on only one-third of known, non-Federal occupied KBB habitats.

Given the limited geographic scope of this alternative, the accumulation of negative impacts due to land-use patterns, interruption of natural process, and introduction of invasive species would generally continue under current trends. For example, oak savanna would continue to degrade at or near current rates due to ongoing, cumulative impacts, including habitat loss and fragmentation due to land conversion, vegetation succession following removal of fire from the landscape, and the proliferation of invasive species.

Under this alternative, utility and transportation right-of-way maintenance would likely continue in some occupied KBB habitats, but it would not be coordinated with statewide KBB conservation efforts. Instead, individual, project-specific HCPs would be required. Proposed mitigation within these project-specific HCPs may not be well-coordinated with other KBB conservation efforts.

Similarly, development that could involve take of KBB would not be coordinated with KBB conservation efforts and would require individual, project-specific HCPs. Without a process to coordinate development with statewide efforts to conserve KBB, there would be fewer opportunities for acquisition of KBB distribution information and pro-active KBB habitat management and protection.

9.2 Alternative 2: Reduced-scope HCP

A reduced-scope HCP would differ from this HCP in the:

- scope of affected land;
- number and diversity of management partners; and
- types of activities conducted.

Under this alternative, as for this HCP, a coalition of management partners would cooperate to implement a KBB HCP authorized through a 20-year ITP. Whereas this HCP will focus conservation efforts on all non-Federal land with occupied KBB habitat in Michigan, a reduced-scope HCP would involve only a subset of those habitats. That subset would be limited to occupied KBB habitat owned and managed by State agencies, local governments and conservation-oriented non-governmental organizations (approximately 900 acres). A reduced-scope HCP would not address occupied KBB habitat on land owned by private transportation and utility companies, private-land developers, and other private landowners. Accordingly, the coalition of management partners would be smaller than that under this HCP, reflecting the smaller scope of affected land.

Given the limited geographic scope of this alternative, the accumulation of negative impacts due to land-use patterns, interruption of natural process, and introduction of invasive species would

generally continue under current trends. For example, oak savanna would continue to degrade at or near current rates due to ongoing, cumulative impacts, including habitat loss and fragmentation due to land conversion, vegetation succession following removal of fire from the landscape, and the proliferation of invasive species. Some habitat management would continue on KBB-occupied public land and some, limited private land. However, this management could be conducted on only slightly more than one-third of existing, non-Federal KBB-occupied land.

Development and private utility and transportation right-of-way maintenance would not be authorized specifically by a reduced-scope HCP. Private right-of-way maintenance would likely continue in some occupied KBB habitats, but it would not be coordinated with statewide KBB conservation efforts. Instead, individual, project-specific HCPs would be required. Proposed mitigation within these project-specific HCPs may not be well-coordinated with other KBB conservation efforts.

Similarly, development that could involve take of KBB would not be coordinated with KBB conservation efforts and would require individual, project-specific HCPs. Without a process to coordinate development with statewide efforts to conserve KBB, there would be fewer opportunities for acquisition of KBB distribution information and pro-active KBB habitat management and protection.

9.3 Alternative 3: Provision of Refuges

Under this alternative, attempts would be made to conserve KBB and other species of concern through establishment of permanent refuges. Although this approach would offer assurances that land would be set aside for conservation of these species, it would not necessarily maintain it in a successional state that meets their respective habitat needs. The use of refuges to conserve these species would also concentrate them within focused sites and thereby increase risks associated with local disturbances and catastrophic events (Saunders et al. 1991). Moreover, KBB may have occurred historically in metapopulations that existed on the landscape as dispersed subpopulations (Givnish et al. 1988, USFWS 2003a); these subpopulations would have occurred in a shifting mosaic consisting of discrete but transient habitat sites connected by dispersal corridors that facilitated habitat-site re-colonization following local extirpations. With this metapopulation structure, subpopulations would have shifted over the landscape as disturbance and succession either created or eliminated patches of suitable habitat. Therefore, an approach that permanently restricts populations to discrete, isolated areas does not consider the ecological processes that may be required by KBB and other species of concern. However, when used in conjunction with other management approaches, refuges do have value and are recognized as a part of a viable strategy in this HCP.

10. PLAN IMPLEMENTATION, CHANGED AND UNFORESEEN CIRCUMSTANCES

10.1 Plan Implementation

The Michigan DNR, as holder of the ITP, will implement this HCP at the administrative level. The Natural Heritage Unit within the DNR Wildlife Division will be responsible for overseeing this effort. Administrative activities will include planning of monitoring, evaluation of habitat treatments, reporting, auditing of Partnering Agreements, oversight of minimization and mitigation measures, and modification of the HCP prompted by new information obtained through research and adaptive management. Wildlife Division field staff will be responsible for administering operational implementation of this HCP on State lands. Operational activities will include pre-treatment surveys, site assessments, habitat management, and habitat and population monitoring. Annual Wildlife Division work plans will help partition tasks necessary to achieve multi-year operational objectives.

Partnering Agreements will be developed between the Michigan DNR and management partners, both public and private, to facilitate operational implementation of this HCP on non-State land. These agreements will translate strategic objectives into operational objectives for habitat on specific parcels. The Michigan DNR will annually review the implementation of Partnering Agreements and will monitor adherence to Partnering Agreement conditions.

10.2 Changed Circumstances

The Habitat Conservation Plan Assurances ("No Surprises") Rule (50 CFR Part 17.32(b)(5); 63 Federal Register 8859—February 23, 1998) provides regulatory assurances that, generally, no additional land-use restrictions with respect to species covered by an ITP will be required of a permit holder, even if changed or unforeseen circumstances arise after the permit is issued, provided the HCP is being properly implemented. "Changed circumstances" refers to "changes in circumstances affecting a species or geographic area covered by an HCP that can reasonably be anticipated by HCP developers and the USFWS and that can be planned for (e.g., the listing of a new species or a fire or other natural catastrophic event in areas prone to such events)" (50 CFR Part 17.3).

Changed circumstances relevant to this HCP might include events like species listing or delisting or the completion of research that suggests ways to improve management techniques. These changed circumstances would be addressed through the adaptive management process outlined in this HCP. If a modified approach would benefit KBB, other species of concern, or associated habitats due to changed circumstances, the USFWS and the Michigan DNR may agree to modify the HCP based on current conditions or new information (50 CFR Part 17.22(b)(5)).

10.3 Unforeseen Circumstances

"Unforeseen circumstances" refers to "changes in circumstances affecting a species or geographic area covered by an HCP that could not reasonably have been anticipated by plan developers and the USFWS at the time of HCP negotiation and development, and that result in a

substantial, adverse change in the status of the covered species" (50 CFR Part 17.3). Unforeseen circumstances relevant to this HCP might include the introduction of harmful diseases or additional exotic species that could have significant detrimental effects on KBB or other species of concern. Should the USFWS determine, based on considerations outlined in 50 CFR Part 17.22(b)(5)(iii)(c), that unforeseen circumstances have arisen during the permit term, the USFWS and the Michigan DNR will consider potential measures to address the changed conditions.

10.4 Other Measures as Required by the Director

An HCP Implementing Agreement between the Michigan DNR and the USFWS is required prior to issuance of an ITP. This agreement is included in Appendix D.

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APPENDIX A: GLOSSARY OF TERMS AND ACRONYMS

Adaptive management: a formal, structured approach for continually improving management practices and policies by learning from the outcomes of operational programs

Anthropogenic: derived from human activities

Barrens: a sparsely forested area (savanna) on poor, infertile, usually sandy soils with trees that tend to be resistant to fire and are often stunted; dominant herbaceous vegetation is often composed of plants specialized to these soil conditions and to relatively open conditions; fire is often a key component in shaping barren vegetation, but open conditions are, in part, maintained by soil conditions

CFR: (United States) Code of Federal Regulations, as in 50CFR17.11, meaning Title 50 of the Code of Federal Regulations, Part 17, Section 11

Canopy: the coverage of branches and foliage, intercepting sunlight, formed by the crowns of trees or shrubs

Connectivity: the degree to which patches of habitat are linked to allow for between-site movement by individuals, either within or between populations

Conservation easement: a legally binding agreement between a landowner and a government agency or non-profit organization that allows a landowner to permanently protect the environmental value of his or her land while continuing to own it; protection usually includes, but is not limited to, limitations on development

Diapause: a biological condition of inactivity and suspended development, usually to avoid or increase resistance to environmental extremes

Disturbance: a relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment; disturbance can include natural events such as wildfire or anthropogenic activities such as prescribed burning or mowing that interrupt natural plant succession and allow for early successional species to persist or colonize an area

Early-successional: a habitat state (usually vegetational) that is either created by a disturbance event or is maintained by frequent disturbance events; used to refer to herbaceous or shrubby vegetation that requires disturbance or quickly colonizes following a major disturbance event such as a wildfire

Emergence: when an adult insects comes out of a cocoon or pupa following metamorphosis

Endemic: confined to a certain region or to a specific community; having a comparatively restricted distribution

Extirpation: the elimination of a species from a particular area; with KBB, this term is most often applied to subpopulations

Fragmentation: the breaking up of large and continuous ecosystems, communities and habitats into smaller areas as a result of land-use changes or creation of migration barriers (e.g., roads); especially as it relates to the ability of an organism to move among patches of habitat

Granivorous: characterized by consumption of seed or grains by animals

Habitat patch: a contiguous or well-connected area of suitable habitat or restorable habitat that is separated from other suitable habitat by an appropriate separation distance (>200 meters)

Herbivorous: characterized by consumption of live plant materials by animals

Hibernaculum: the place where an animal hibernates or overwinters

Hypsithermal period: the post-glacial period 9,000 to 2,500 years before present during which global climate was warmer and dryer than today

Incidental take: take of a federally-listed species which occurs incidental to, and is not the purpose of, otherwise legal activities; allowed under section 10(a)(1)(B) of the Federal Endangered Species Act of 1973, as amended (87 Stat 884, 16 U.S.C. § 1531 et seq.; ESA), provided that an HCP has been developed and approved by the U.S. Fish and Wildlife Service with assurance that actions will not jeopardize the continued existence of the species

Instar: a larval development stage, between molts; KBB has four instars

Landscape: an area composed of adjacent and interacting ecosystems that are related because of proximity, geology, land forms, soils, climate, biota, and human influence

Larvae: the wingless juvenile stage of an insect before undergoing metamorphosis; the caterpillar stage for butterflies and moths

Long-term habitat impact: the results of an action or combination of actions that impacts habitat such that it fails to recover to a pre-treatment condition and fails to support pre-treatment KBB numbers within two growing seasons

Metapopulation: set of local populations within some larger area, where local populations are able to occasionally exchange individuals or (re)colonize sites where suitable habitat exists; each local population is generally referred to as a subpopulation

Nectar plants: plants sought out by a species for feeding on nectar, in this case the Karner blue butterfly

Nectivorous: characterized by consumption of plant nectar by animals

Occupancy: occupied by a selected organism

Occupied site: (Occupied patch) an area of suitable habitat where a certain species currently occurs; a habitat patch where a KBB subpopulation currently occurs

Patch: an area of suitable habitat or restorable habitat that is separated from other suitable habitat by an appropriate separation distance (>200 meters)

Pupae: the inactive stage of metamorphosis of many insects, following the larval stage and preceding the adult form

Recovery action: activity undertaken with the intent of recovering a population of an endangered or threatened species, under provisions of Section 4 of the Endangered Species Act of 1973, as amended (87 Stat 884, 16 U.S.C. § 1531 et seq.; ESA)

Recovery Unit: a major physiographic, vegetational, and climatic region within the range of the KBB, as described in the Federal recovery plan

Reintroduction: moving individuals (in this case, KBB eggs, larvae, pupae or adults) from one or more existing locations to help create a new population (or subpopulation) in a separate geographic area

Senescence: a plant stage from maturity to dormancy or death

Short-term habitat impact: the results of an action or combination of actions that impact habitat such that it recovers to pre-treatment conditions and supports pre-treatment KBB numbers within two growing seasons

Subpopulation: (Local population) a set of individuals that live in the same habitat patch and therefore interbreed; most naturally applied to populations living in such small patches that they are susceptible to eventual extirpation due to habitat degradation, catastrophic events, or demographic variability and therefore require connectivity with other local populations (as in a metapopulation)

Succession: the natural process, following a disturbance, in which one community of plants and animals gradually replaces another, in response to changing environmental conditions; generally results in changes in organic structure and energy flow

Take: as defined in the Endangered Species Act of 1973, as amended (87 Stat 884, 16 U.S.C. § 1531 et seq.; ESA), "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" a federally-listed threatened or endangered species, "or to attempt to engage in any such conduct"

Vegetative propagation: A form of asexual reproduction in multicellular plants, in which new plants develop from the roots, stems, or leaves of the parent plant

APPENDIX B: SURVEY OF KARNER BLUE BUTTERFLIES AT ALLEGAN STATE GAME AREA, 2004

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Introduction

The Karner blue butterfly *(Lycaeides melissa samuelis)* is a federally endangered butterfly that occurs in habitats supported within oak savanna in Michigan. The U.S. Fish and Wildlife Service (USFWS) has commissioned a Karner Blue Butterfly Recovery Plan (USFWS 2003) which identifies an approach for recovering this butterfly that focuses on perpetuation of metapopulations in historic areas of occurrence of the butterfly. The plan outlines the need to maintain habitat within historic areas to perpetuate these metapopulations.

To meet objectives of the Recovery Plan, there is a need to recognize and quantify habitat for this butterfly. Similarly, there is a need to estimate butterfly numbers within selected habitats to help in habitat characterization. Finally, survey protocols need to be evaluated for their application to local habitat patches (or habitat sites) and butterfly populations.

Estimates of total butterfly numbers for the full duration of a flight period within a habitat patch have been attempted in a number of ways, including mark-release-recapture sampling, transect sampling with expansion to the area of the habitat patch, and total counts on the flight peak date and multiplying by a previously established factor. All of these methods involve direct measurement of butterfly populations.

An objective of the pilot effort described in this report was to begin to establish a basis for indirectly estimating butterfly population levels through assessment of the quantity and robustness of the associated habitat. Direct measurement of the butterfly is seen as an intermediate step in establishing this indirect population measurement and as a means to periodically validate the indirect population quantification.

The pilot effort was conducted specifically to evaluate the effectiveness of using an expansion of Pollard-Yates transects in estimating butterfly populations at selected sites. This effort also explored the effectiveness of using visually characterized habitat as a predictor of butterfly density. Finally, this effort combined the information on butterfly densities by habitat patch with information on visually characterized habitat throughout metapopulation areas to suggest a means for estimating butterfly numbers within entire metapopulation areas.

Study Area

Allegan State Game Area, a state-owned property in southwest Michigan managed by the Department of Natural Resources, was chosen as the study site for this pilot effort. This Game Area hosts two of the eight areas of historic butterfly occurrence in Michigan where the

Recovery Plan recommends that metapopulations be perpetuated. Both butterflies and habitat on this Game Area have been well studied, and the availability of this information contributed to selection of this Game Area for this effort.

Each of the two metapopulation areas managed for the butterfly on the Game Area is roughly 10 square miles and occurs south of the Kalamazoo River and east of Swan Creek (Pine Plains Management Unit) and south of the Kalamazoo River and west of Swan Creek (Sand Plains Management Unit). The habitat, and thus the butterfly, occurs in multiple discrete habitat patches or habitat sites scattered within each of the metapopulation areas. The Pine Plains Management Unit is managed to support a metapopulation that has the structural form of a core–satellite metapopulation; the Sand Plains Management Unit is managed to support a metapopulation that has the structural form of a patchy metapopulation (USFWS 2003).

Methods

This pilot effort was focused in five selected habitat patches in the Pine Plains Management Unit and four selected habitat patches in the Sand Plains Management Unit. Within each Management Unit, habitat patches were selected that had both low and high wild lupine *(Lupins perennis)* coverage based upon visual characterization. Although lupine coverage was not further quantified for this effort, lupine coverage on this Game Area has been previously reported in another study involving these habitat patches to range from 0.2% to 14.6% (Lawrence 1994). Acreage for each habitat patch was determined, and the Game Area database was queried to establish that each selected habitat patch was known to be occupied by Karner blue butterflies.

Pollard-Yates transects (Pollard and Yates 1993) were run periodically (every 3 to 8 days) within each of the nine selected habitat patches throughout the second flight period of the butterfly (29 June to 5 August, 2004). Transects were run only when temperatures were above 70 degrees Fahrenheit, there was no precipitation, and wind speeds were less than 10 miles per hour. Meandering routes for transects were plotted within each of the habitat patches to cover the entire patch, including areas of lupine occurrence, and to avoid double counting of butterflies. These routes were reused when transects were subsequently rerun. The distance covered and the number of butterflies seen was recorded. All transects were run by the author, thereby ensuring greater consistency of sampling application.

Several species of butterflies and skippers were encountered during these transects. The perpendicular distance from the transect line to each butterfly identified as a Karner blue butterfly was recorded. Records were not made of butterflies that could not be positively identified, and no effort was made to depart from the transect line to pursue butterflies for purposes of better identification. This resulted in no records for butterflies that were greater than 4 meters from the transect line.

Transects that resulted in no butterflies seen were recorded as presence/absence surveys and were not included in total transects run. These zero counts occurred only at the beginning or end of the flight period and were taken as evidence of flight end points for individual habitat patches.

A daily population index was developed each time a transect was completed by taking the number of butterflies seen on an individual transect and reflecting this number against the distance traveled on that transect. This index was recorded as butterflies per 100 meters of transect.

The perpendicular distance from the transect line to each individual Karner blue butterfly identified (n=396) was entered into a histogram, and modeling was used to derive an Effective Strip Width (ESW) within which the total number of butterflies present could be estimated. This method follows that in regular use by other researchers and is recommended for the butterfly (King 2000, Buckland and others 1993, Brown and Boyce 1998, Thomas 1983). The ESW is that perpendicular distance on either side of the transect line out to which the number of butterflies seen within that distance equals the number of butterflies seen beyond that distance. The ESW determined for this study was 1.5 meters on each side of the transect line. This result agrees closely with that determined by King (2000: ESW=1.47 meters) in Wisconsin.

Given an effective counting width of 3 meters (one ESW of 1.5 meters on each side of the transect line), the distance traveled on each transect was multiplied by 3 meters to generate a measure of survey-area coverage for each transect. The number of butterflies observed on each transect was then reflected against this area of coverage to generate a butterfly density estimate for each day a transect was run within an individual habitat patch. That density estimate was recorded as butterflies per 100 square meters. Butterfly density was combined with individual habitat patch area to generate a butterfly population estimate for the entire habitat patch for that day.

All daily habitat patch population estimates were plotted against the days of second-flight duration to generate a curve intersecting the x-axis at the date of the beginning and the end of the flight. The area under the curve was calculated and equated to the number of butterfly-days occurring within a given habitat patch. Noting that butterflies live an average of 5 days (USFWS 2003), the number of butterfly-days was divided by 5 to derive an estimate of the aggregate number of butterflies supported within a given habitat patch during the second flight. This number was further divided by the area of the habitat patch to arrive at a second-flight aggregate density for each patch, recorded as individuals per 100 square meters. This approach to population estimation is an expansion of methods summarized by Southwood (1978) and Krebbs (1989).

Results

A total of 45 Pollard-Yates transects were completed within the nine selected habitat patches where Karner blue butterflies were seen (Table 1). In the Pine Plains Unit, the aggregate number of butterflies in the five selected habitat patches ranged from approximately 200 to approximately 2,000 individual butterflies for a total in the 5 habitat patches of 4,827 individual butterflies during the second flight (Table 1). Aggregate butterfly density in these five habitat patches ranged from roughly 2 butterflies per 100 square meters to nearly 16 butterflies per 100 square meters. The three habitat patches that were judged prior to surveying to have high lupine coverage were found to have an aggregate butterfly density area-weighted average of 9.26 butterflies per 100 square meters. By comparison, the two habitat patches that were judged prior

to surveying to have low lupine coverage were found to have an aggregate butterfly density area-weighted average of 3.29 butterflies per 100 square meters.

In the Sand Plains Unit, the aggregate number of butterflies in the four selected habitat patches ranged from approximately 100 to approximately 3,000 individual butterflies for a total in the four habitat patches of 5,445 individual butterflies during the second flight (Table 1). Aggregate butterfly density in these four habitat patches ranged from roughly 0.5 butterflies per 100 square meters to nearly 16 butterflies per 100 square meters. The single habitat patch that was judged prior to surveying to have high lupine occurrence was found to have an aggregate butterfly density of 15.93 butterflies per 100 square meters. By comparison, the three habitat patches that were judged prior to surveying to have low lupine occurrence were found to have an aggregate butterfly density area-weighted average of 1.96 butterflies per 100 square meters.

The nine habitat patches selected for this pilot effort are subsets of much larger numbers of habitat patches within each of the two metapopulation areas on the Game Area. Some of these patches are known to be occupied by butterflies whereas occurrence information is lacking for other habitat patches. Area and lupine coverage were documented for an additional 10 known occupied habitat patches (Table 2). These additional 10 patches were combined with the original nine patches within metapopulation areas and then grouped by lupine coverage (high or low).

The acreage in these lupine coverage groupings was combined with the expected aggregate butterfly density within each grouping to provide totals that could be summed as estimates of butterflies within each of the two metapopulation areas. By this process, the second-flight estimates were 10,100 butterflies in the Pine Plains Unit and 18,369 butterflies in the Sand Plains Unit. These estimates are generated from only the subset of habitat patches where information is available to support this process. Thus, from that consideration, they must be viewed as minimum estimates of metapopulation sizes.

Discussion

Management approaches for invertebrates have been typically developed and modified based on population responses measured directly through surveys. Although this approach is intuitive, it is also intensive, costly, and potentially harmful to the populations selected as indicators. Maintenance of habitat is often advocated as pivotal to conservation of these target species. Thus, cueing management directly to habitat needs and indirectly to population response may be more efficient and timely. This effort begins to develop that linkage.

In part, this pilot study represents an effort to quantify butterfly numbers at Allegan State Game Area. Previous to this study, a survey using mark-release-recapture methods performed in 1989 resulted in an estimate of 2,000 to 3,000 butterflies on the Game Area (Lawrence 1994). However, this survey was focused entirely in the Sand Plains Unit because the occurrence of butterflies in the Pine Plains Unit was not known at that time. Additional butterfly subpopulations in the Sand Plains Unit were also subsequently discovered as a result of surveying additional habitat patches. Because these patches existed at least as early as 1989, this estimate of butterflies in the Sand Plains Unit is conservative.

Subsequent to Federal listing in 1992 (USFWS 1992), additional effort was expended in surveying for the Karner blue butterfly throughout its range in Michigan. At the time of listing, the butterfly was known from six counties; during subsequent survey efforts, it was observed in 11 counties (Wilsman 1994). Similarly, additional survey effort at Allegan State Game Area resulted in discovery of several additional subpopulations and a relatively complete understanding of butterfly distribution on the Game Area.

In 1998, another effort was made to quantify butterfly numbers on Allegan State Game Area. In that effort, the Michigan Natural Features Inventory conducted total counts of all butterflies in known occupied habitat patches in both Management Units during 13–15 July approximating the peak of the second flight (M. Rabe, personal comm.). A total of 2,332 individual butterflies were counted; a majority occurred in habitat patches in the Sand Plains Management Unit. Expanding this total by a factor of 3 (Schweitzer 1994, USFWS 2003) provides a conservative estimate of approximately 7,000 butterflies for the two Management Units combined during the second flight in 1998.

Transect sampling was selected for this pilot effort because the method can be effectively applied in the field with limited resources, and it is a method accepted by other practitioners. However, expansion of transect results to population estimates covering a protracted flight period has been problematic. The method of using transect results to support population estimates for a single day and the use of such transect results repeated for selected dates throughout the flight period as points to define a curve that characterizes butterfly abundance throughout the flight is applied here. This method allows greater flexibility in selecting sample dates, can be customized to the attributes of the organism being studied, and is useful in characterizing population attributes in addition to population size.

The Recovery Plan recommends conservation of this butterfly through management of metapopulations (USFWS 2003). Under the plan, a minimum viable metapopulation includes at least 3,000 butterflies occurring in interacting subpopulations. A large viable metapopulation includes at least 6,000 butterflies occurring in interacting subpopulations distributed over at least 640 acres of habitat. The results of this pilot effort suggest that 6,000 butterflies can be supported on considerably less than 640 acres of habitat.

Isolation of individual metapopulations may allow evolution of unique attributes. The isolation necessary to accommodate this evolution is typically a function of physical distance and barriers. The distance between the approximate centers of the two metapopulations at the Game Area is approximately 6 miles (10 kilometers). The distance between the closest subpopulations of these respective metapopulations is approximately 4 miles (6.5 kilometers).

Swan Creek, separating these metapopulations, is assumed to be a functional barrier. Although the creek itself is not large, it exists within a riverine corridor whose bottom ranges from 3 to 10 meters (10 to 30 feet) below escarpment tops on either side of the corridor and is more than 1 kilometer wide in many places. Thus, the corridor occurs as a wide, deep trench on the landscape that is fully forested with lowland hardwoods. This combination of distance and a stream corridor acting as a physical barrier is assumed to have functionally precluded butterfly migration between metapopulations, thereby facilitating independence.

Given this presumed independence, a review of the data was conducted to identify unique attributes. Subpopulation numbers (n=4) in the Sand Plains Management Unit seem to have peaked a couple days earlier than subpopulation numbers (n=5) in the Pine Plains Management Unit. However, small sample sizes precluded the opportunity to consider statistical significance (Table 1). Additionally, the second flight appeared to be more protracted and butterfly appearance was more widely distributed through the flight in the Sand Plains Management Unit than in the Pine Plains Management Unit. Again, however, small sample sizes may have precluded detection of a statistically significant difference (Kolmogorov-Smirnov Test).

This pilot effort was effective in highlighting the robustness of a process for assessing butterfly populations and in estimating the need for resources in expanding this effort in 2005. The effort also offered a data set with which to better understand the attributes of populations. Preliminary results from the limited set of habitat patches on which this effort was focused suggest that the habitat patches, in their aggregate, are sufficiently robust to support desired populations. Although management will be needed to maintain them in a condition that supports the butterfly, management for corridors to allow butterfly interaction between subpopulations should receive priority to attain similar robustness.

Acknowledgments

I thank Maria Albright, Wildlife Technician at Allegan State Game Area, for her efforts in retrieving and compiling data from the Game Area database. The study design was improved through comments offered by Jennifer Fettinger. The manuscript benefited greatly from review by Matthew Herbert and Todd Hogrefe. This study is a contribution of Federal Aid in Wildlife Restoration, Michigan Planning Grant, E-3-HCP.

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Table 1. Karner blue butterfly survey results for Allegan State Game Area, 2004.

Habitat Patch	Area (Acreage)	Aggregate Butterfly Estimate For Patch	Population Peak (Date)	Aggregate Butterfly Density (Indiv/100 sq meters)	Lupine Cover
Pine Plains Management Unit					
North Opening	0.4	197	89 (7/12)	12.18	High
Middle Opening	2.9	1858	1238 (7/12)	15.84	High
South Opening	5.5	1241	476 (7/12)	5.58	High
42nd NE Opening	5.2	509	413 (7/12)	2.47	Low
Monroe Opening	6.4	1022	627 (7/15)	3.94	Low
Sand Plains Management Unit					
Circle Opening	1.6	1031	500 (7/12)	15.93	High
Annex Opening	7.9	834	304 (7/7)	2.61	Low
49th NE Opening	41.7	3444	1502 (7/12)	2.04	Low
Natural Area E	6.1	136	54 (7/7)	0.55	Low

Table 2. Known occupied Karner blue butterfly habitat at Allegan State Game Area.

Habitat Patch	Area (Acreage)	Lupine Coverage
Pine Plains Management Unit		
North Opening	0.4	High
Middle Opening	2.9	High
South Opening	5.5	High
42nd Northeast Opening	5.2	Low
Monroe Opening	6.4	Low
Power Line Opening	11.3	Low
Monroe West Opening	4.2	Low
40th Pipe Opening	15.3	Low
40th South Opening	1.4	Low
Staging Southeast Opening	7.3	Low
Sand Plains Management Unit		
Circle Opening	1.6	High
Pipeline 1 Opening	15.5	High
Horsemans 2 Opening	1.8	High
126th Southeast Opening	6.6	Low
Annex Opening	7.9	Low
49th Northeast Opening	41.7	Low
Natural Area East	6.1	Low
Horsemans 3 Opening	9.2	Low
46th Northeast Opening	6.5	Low

APPENDIX C: COMMUNITY INVOLVEMENT PROCESS

The community involvement process has focused on continuous public involvement throughout the development of this HCP. The process involved both outreach elements and input elements.

Outreach elements were designed to further stakeholder understanding of Karner blue butterfly and the HCP-development process. The John Ball Zoo took the lead in directing and coordinating outreach efforts. Outreach elements included a brochure, lupine finder card, website (KarnerBlue.org), numerous presentations, and field trips.

Input elements provided opportunities for the public to provide input on the HCP-development process. Input elements included statewide press releases, comment opportunities embedded within the website, advisory-group participation, project contact information, comment opportunities at public meetings, and opportunities for stakeholder review of the draft HCP.

In February and March 2004, the DNR opened a 60-day public comment period and hosted public meetings. The purpose of these input venues was to help identify and prioritize alternatives for HCP development.

The community involvement process also incorporated input and insights from a scientific advisory group (Karner Blue Butterfly Working Group) and a land-management advisory group (Management Partners Workgroup). The Karner Blue Butterfly Working Group has met annually since the late 1980s and advises on scientific matters related to KBB biology and management. Inclusion in this group has remained open to anyone with an interest in KBB. Originally assembled on the recommendation of the U.S. Fish and Wildlife Service, this Michigan-based group has provided input which has been incorporated into the Karner Blue Butterfly Recovery Plan and more recently into the HCP.

The Management Partners Workgroup was assembled in 2003 as an advisory body to provide input on development of the HCP. Membership in this group has been by invitation from the DNR, but attendance by other experts has added valued perspective to many discussion topics. This workgroup met quarterly and provided input during development of the HCP. The quarterly meetings provided an opportunity to update the group on research findings, expose the group to habitat conditions and management needs through field trips, and share information on other KBB initiatives with the group.

Under this HCP, management partners are stakeholders that share in the responsibilities for implementing this HCP. Management partners could include State, county and local government agencies, non-governmental organizations, utility and transportation right-of-way managers, private land developers, and other private landowners. Landowners and land managers will not be required to participate in implementation of this HCP. Rather, participation is offered as a reasonable and practical option for those agencies, organizations and individuals that seek authority for incidental take of KBB. The following list shows some of the stakeholders who have demonstrated a continuing interest in participating in this HCP. Stakeholders who have land-management authority on occupied Karner blue butterfly habitat are marked with an asterisk.

- Allegan County
- Binder Park Zoo
- Brooks Township, Newaygo County*
- Consumers Energy*
- Detroit Zoo
- El Paso Pipeline Company*
- Grand Rapids Community College
- Grand Valley State University
- Huron-Manistee National Forest
- Indiana Dunes National Lakeshore
- John Ball Zoo
- Land Conservancy of West Michigan*
- Michigan Electric Transmission Company*
- Michigan Department of Military and Veterans Affairs
- Michigan Department of Natural Resources*
- Michigan Department of Transportation*
- Michigan Natural Features Inventory
- Michigan Nature Association*
- Michigan State University
- Muskegon County
- Southwest Michigan Land Conservancy*
- The Nature Conservancy*
- Toledo Zoo
- U.S. Fish and Wildlife Service
- West Michigan Butterfly Association

APPENDIX D: IMPLEMENTING AGREEMENT

IMPLEMENTING AGREEMENT

by and between

U.S. FISH AND WILDLIFE SERVICE

and

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

for

MANAGEMENT, MAINTENANCE AND DEVELOPMENT ACTIVITIES

within

OCCUPIED KARNER BLUE BUTTERFLY HABITAT IN MICHIGAN

_____ 200_

This Implementing Agreement (Agreement), made and entered into as of the ___ day of _____, 200_, by and between the the United States Fish and Wildlife Service (USFWS) and the Michigan Department of Natural Resources (DNR), hereinafter collectively called the "Parties," defines the Parties' roles and responsibilities and provides a common understanding of action that will be undertaken to minimize and mitigate the adverse effects on the Karner Blue Butterfly (*Lycaeides melissa samuelis*; KBB) and its habitats of the Management, Maintenance and Development Activities outlined in the Michigan Statewide Karner Blue Butterfly Habitat Conservation Plan (HCP).

1. RECITALS

The parties have entered into this agreement in consideration of the following facts:

WHEREAS, the federally endangered KBB is currently known to occur across 11 counties in Michigan on public and private lands;

WHEREAS, the USFWS has primary jurisdiction over the conservation, protection, restoration, enhancement and management of federally listed fish, wildlife, plants and their habitats, as necessary for biologically sustainable populations of those species to the extent set forth in the Federal Endangered Species Act of 1973, as amended (87 Stat 884, 16 U.S.C. § 1531 et seq.; ESA);

WHEREAS, the persistence of KBB at most locations is dependent on disturbance (e.g., fire) to maintain early successional habitat, and the natural forms of these disturbances have largely been suppressed;

WHEREAS, the DNR is responsible for the conservation, protection, and management of Michigan's wildlife resources, including implementation of the Michigan Endangered Species Protection Law (Public Act 451 of 1994, Part 365);

WHEREAS, the DNR desires a process to allow management, to the extent possible, of Occupied KBB Habitat for the benefit of KBB;

WHEREAS, the DNR desires a process to allow for some conversion of Occupied KBB Habitat to other land uses provided that mitigation efforts are sufficient to ensure that KBB populations and habitat will not decrease;

WHEREAS, the area covered by the HCP is comprised of all Occupied KBB Habitat (including areas that become occupied in the future) within the entire State of Michigan;

WHEREAS, the DNR has developed a series of measures, described in the HCP, to avoid, minimize or mitigate, to the maximum extent practicable, the effects of take of KBB incidental to Management, Maintenance or Development Activities; and,

THEREFORE, the Parties hereto do hereby understand and agree as follows:

2. DEFINITIONS

The following terms as used in this agreement will have the meanings set forth below:

2.1 **"Development Activities"** means all activities of any type or nature conducted by the DNR and its Management Partners that will permanently impact Occupied KBB Habitat to the detriment of KBB, as described in detail in Section 3 of the HCP. The Parties acknowledge and agree that these impacts must be fully minimized and mitigated as described under the HCP.

2.2 **"Maintenance Activities"** means all activities conducted by the DNR and its Management Partners to maintain vegetation and infrastructure in conditions appropriate for specific land uses (e.g., utility right-of-way), but implemented in ways that will maintain habitat for KBB, as described in detail in Section 3 of the HCP. The Parties acknowledge and agree that certain Maintenance Activities may result in impacts within the activity area which may be fully avoided or minimized and mitigated under the HCP.

2.3 **"Management Activities"** means all activities of any type or nature conducted by the DNR and its Management Partners to maintain Occupied KBB Habitat, as described in detail in Section 3 of the HCP. The Parties acknowledge and agree that certain Management Activities may result in impacts within the activity area which may be fully avoided or minimized under the HCP.

2.4 **"Management Partner"** means an agency, individual or organization sharing in the benefits and responsibilities outlined in the HCP, this Implementing Agreement and the Permit.

2.5 **"Occupied KBB Habitat"** means areas that currently support KBB.

2.6 **"Partnering Agreement"** means a legally binding document between the DNR and a Management Partner that prescribes the manner of sharing in the benefits and responsibilities of an incidental take permit as outlined in the HCP, this Implementing Agreement and the Permit.

2.7 **"Permit"** means an incidental take permit issues by the USFWS to the DNR and Management Partners pursuant to Section 10(a)(1)(B) of the Endangered Species Act (ESA).

2.8 **"Permit Area"** means any Occupied KBB Habitat where the DNR or other Management Partner has the authority and ability to conduct Management, Maintenance or Development Activities consistent with and approved under the terms of the HCP.

2.9 **"Take"** means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct.

2.10 **"Unforeseen Circumstances"** means circumstances affecting KBB within the area covered by the HCP that could not reasonably have been anticipated by the Parties at the time the HCP was prepared and that have resulted in a substantial and adverse change in the status of KBB.

3. HABITAT CONSERVATION PLAN

Pursuant to the provisions of Section 10(a)(1)(B) of the ESA, the DNR has prepared an HCP and submitted it to the USFWS with a request that the USFWS issue a Permit to allow the DNR and Management Partners to incidentally take KBB within the State of Michigan as described in the HCP. The HCP proposes guidelines to avoid, minimize and mitigate for take of KBB to prevent adverse impacts on KBB populations and their habitats and to allow for active management for the benefit of KBB populations and their habitats.

4. INCORPORATION OF HCP

The HCP and each of its provisions are intended to be, and by this reference are, incorporated herein. In the event of any direct contradiction between the terms of this Agreement and the HCP, the terms of this Agreement shall control. In all other cases, the terms of this Agreement and the terms of the HCP shall be interpreted to be supplementary to each other.

5. LEGAL REQUIREMENTS

To fulfill the requirements that will allow the USFWS to issue the Permit, the HCP sets forth measures that are intended to ensure that any take occurring within the Permit Area will be incidental; that the impacts of the take will, to the maximum extent practicable, be minimized and mitigated; that procedures to deal with unforeseen circumstances will be provided; that adequate funding for avoidance, minimization, and mitigation measures will be provided; and that the take will not appreciably reduce the likelihood of the survival and recovery of KBB in the wild. It also includes measures that have been suggested by the USFWS as being necessary or appropriate for purposes of the HCP.

6. COOPERATIVE EFFORT

In order that each of the legal requirements as set forth in Paragraph 5.0 hereof are fulfilled, each of the Parties to this Agreement must perform certain specific tasks as more particularly set forth in the HCP. The HCP thus describes a cooperative program by Federal and State agencies and private interest to avoid, minimize and mitigate the effects of Management, Maintenance and Development Activities on KBB.

7. TERMS USED

Terms defined and used in the HCP and the ESA shall have the same meaning when used in this Agreement, except as specifically noted.

8. PURPOSES

The Purposes of This Agreement are:

8.1 To ensure implementation, to the extent practicable, of each of the terms of the HCP;

8.2 To describe remedies and recourse should any Party fail to perform its obligations, responsibilities, and tasks as set forth in this Agreement; and,

8.3 As stated in paragraph ____ hereof, to provide assurances to the DNR and Management Partners participating in the HCP that as long as the terms of the HCP, the Permit, and issues pursuant to the HCP and this Agreement are fully and faithfully performed, no additional mitigation will be required except as provided for in this Agreement or required by law.

9. TERM

This Agreement shall become effective on the date the USFWS issues the Permit and shall remain in full force and effect for a period of 20 years or until termination of the Permit, whichever occurs sooner. Notwithstanding the stated term as herein set forth, the Parties agree and recognize that when KBB have been incidentally taken and their habitat modified by Development Activities pursuant to the HCP, the take and habitat modification will be permanent. It is therefore the intention of the Parties that the provisions of the HCP and of this Agreement regarding the establishment and protection of habitat for KBB as part of required mitigation shall likewise, to the extent permitted by law, be permanent and extend beyond the terms of this Agreement.

10. FUNDING

10.1 The DNR will provide such funds as may be necessary, to the extent practicable, to carry out the general administration of the HCP.

10.2 The DNR and Management Partners shall be responsible for funding the necessary avoidance, minimization and mitigation measures as required under Section 5.2 and 5.3 of the HCP.

10.3 The DNR and Management Partners shall be responsible for monitoring and reporting as required under Section 5.4 of the HCP.

10.4 When mitigation measures are required to offset detrimental impacts of a project, they will be implemented before initiation of the project whenever possible. When project and mitigation measures are initiated concurrently, the involved Management Partners will be required to develop guarantees that mitigation and

monitoring actions will be completed. Guarantees may include posting of bonds or letters of credit, establishment of endowments or trust funds, or other assurances which financially commit the management partner to completion of these activities.

10.5 The DNR and all Management Partners have, and will expend, such funds as may be necessary and are practicable to fulfill their obligations under the HCP. The DNR will promptly notify the USFWS of any material change in the DNR or Management Partner financial ability to fulfill its obligations.

11. RESPONSIBILITIES OF THE PARTIES

11.1 Responsibilities of the DNR and Management Partners

11.1.1 The HCP will be properly functioning if the terms of the Agreement have been or are being fully implemented.

11.1.2 The DNR will be responsible for the general administration of the HCP, including annual and other reporting, as required under the HCP, and joint (with Management Partners) preparation and execution of Partnering Agreements. Annual reports will include descriptions of all activities and an analysis of whether the terms of the HCP were met for the reporting period. Partnering Agreements will be subject to review by the USFWS during preparation.

11.1.3 The DNR and Management Partners shall avoid or minimize impacts to KBB during Management, Maintenance and Development Activities and will conduct monitoring and adaptive management procedures, as specified within Section 5 of the HCP and consistent with requirements under the Permit.

11.1.4 The DNR and Management Partners shall complete mitigation for Maintenance or Development Activities as specified within the Partnering Agreements and Sections 5.2 and 5.3 of the HCP.

11.2 Responsibilities of the USFWS

11.2.1 The USFWS will cooperate and provide, to the extent funding is available, guidance to the DNR and Management Partners, and review of Partnering Agreements, site plans, and other consultation as detailed in the HCP.

11.2.2 Nothing in this Agreement shall require the USFWS to act in a manner contrary to the requirements of the Anti-Deficiency Act.

11.2.3 After issuance of the Permit, the USFWS will monitor the implementation thereof, including each of the terms of this Agreement and the HCP to ensure compliance with the Permit, the HCP and this Agreement.

12. REMEDIES AND ENFORCEMENT

12.1 Remedies in General

Except as set forth below, each Party shall have all remedies otherwise available to enforce the terms of this Agreement, the Permit, and the HCP, and to seek remedies for any breach hereof, subject to the following:

12.1.1 No money damages

No Party shall be liable in damages to any other Party or other person for any breach of this Agreement, any performance or failure to perform a mandatory or discretionary obligation imposed by this Agreement or any other cause of actions arising from this Agreement. Notwithstanding the foregoing:

12.1.1.1 Retain liability

All Parties shall retain whatever liability they would possess for their present and future acts or failure to act without existence of this Agreement.

12.1.1.2 Land owner liability

All Parties shall retain whatever liability they possess as an owner of interests in land.

12.1.1.3 Responsibilities of the United States

Nothing contained in this Agreement is intended to limit the authority of the United States government to seek civil or criminal penalties or otherwise fulfill its enforcement responsibilities under the ESA.

12.1.2 Injunctive and temporary relief

The Parties acknowledge that KBB are unique and that their loss as species would result in irreparable damage to the environment and that therefore injunctive and temporary relief may be appropriate to ensure compliance with the terms of this Agreement.

12.2 The Permit

12.2.1 Permit suspension or revocation

12.2.1.1 Defaults

Any material breach or violation of this Agreement, the HCP, or the Permit shall be deemed a default under this Agreement.

12.2.1.2 Notice and opportunity to cure

On occurrence of a default by either Party, the non-defaulting Party may notify the defaulting Party in writing, describing the details of the default. The defaulting Party shall have 60 days to respond to or refute the allegation, to cure the default, or to commence to cure a default which cannot reasonably be cured within a 60-day time period, provided such cure is diligently pursued.

12.2.1.3 Ordinary remedies

After notice of and time to cure a default as provided above, the non-defaulting Parties shall have the right to revoke, terminate, or suspend the Permit or any other authorization to Take KBB issued pursuant to this agreement and the HCP, in conformance with the provisions of applicable law. Suspension, revocation, or termination of the Permit by the USFWS shall occur in conformance with the provisions of 50 CFR 13.27-13.29.

12.2.1.4 Additional remedies of the USFWS

A. Except as otherwise provided, the USFWS shall have the right to suspend, revoke, or terminate the Permit or any other authorization to Take KBB issued pursuant to this Agreement and the HCP. Suspension, revocation, or termination of the Permit by the USFWS shall occur in conformance with the provisions of 50 CFR 13.27-13.29.

B. Prior to taking action to suspend, revoke, or terminate the Permit, the USFWS shall meet and confer with the DNR to attempt to avoid this action.

C. The USFWS shall not initiate an action to revoke any Permit on grounds which would constitute grounds for suspension, without first pursuing action to suspend the permit in accordance with 50 CFR 13.27. Any action by the USFWS to

suspend the Permit shall be limited so as to address the specific action or inaction underlying the suspension, in order to minimize any impacts on the DNR. Any Take authorizations suspended or revoked shall be reinstated immediately upon cure of the default that led to the suspension or revocation.

12.3 Limitations and Extent of Enforceability

12.3.1 No surprises policy

Subject to the availability of appropriated funds as provided in Paragraph 14.6 hereof, and except as otherwise required by law, no further mitigation for the effects of activities conducted under conditions of the HCP may be required from the DNR or Management Partners who have otherwise abided by the terms of the HCP, except in the event of unforeseen circumstances, provided that any such additional mitigation may not require additional land-use restrictions or financial compensation from the DNR or Management Partners without their written consent.

12.3.2 Private property rights and legal authorities unaffected

Except as otherwise specifically provided herein, nothing in this Agreement shall be deemed to restrict the rights of the DNR or Management Partners to the use or development of those lands, or interest in lands, constituting the Permit Area; provided that nothing in this Agreement shall absolve the DNR or Management Partners from such other limitations as may apply to such lands, or interest in lands, under other laws of the United States and the State of Michigan.

13. AMENDMENTS

13.1 Generally

Amendments to the HCP may be proposed by either Party. The Party proposing the amendment shall provide to the other Party a statement of the reasons for the amendment and an analysis of the effect of the amendment on KBB and Take authorizations.

13.2 Minor Amendments

Minor amendments to the HCP shall not require amendment of this Agreement or the Permit. The Parties will make every effort to review a proposed minor amendment, and approve or deny the proposed amendment within 90 days of receipt of a proposal, except where longer timelines are imposed by requirements of law. Minor amendments shall require the approval of both the USFWS and DNR.

If the USFWS determines within 90 days of receipt of a proposed minor amendment that the amendment should be treated as a standard amendment, the amendment will be addressed as described in paragraph 13.3, below.

13.3 Standard Amendments

A standard amendment is any proposed amendment that is not a minor amendment. Standard amendments to the HCP shall also require an amendment to this Agreement and the Permit. Following receipt of the proposed standard amendment, the USFWS shall publish notice of the proposed amendment to the Permit in the Federal Register as required under ESA. The USFWS shall use its best efforts to process the proposed amendment within 120 days of publication, except where longer periods are required by law.

14. MISCELLANEOUS PROVISIONS

14.1 No Partnership

Except as expressly set forth herein, neither this Agreement nor the HCP shall make or be deemed to make any Party to this Agreement the agent for, or the partner of any other Party.

14.2 Successors and Assigns

This Agreement and each of its covenants and conditions shall be binding on and shall inure to the benefit of the Parties hereto and their respective successors and assigns.

14.3 Notice

Unless otherwise specifically provided herein, all notices, demands, and other communications given under the HCP and the Permit shall be in writing, shall be properly addressed to the Party to receive such notice at the address or addresses for such Party listed below, or to such other address or person as any Party may designate to the others for such purpose in the manner set forth in this subsection and shall be given or sent (1) Certified United States Mail, postage and fees prepaid, return receipt requested; (2) Federal Express, DHL, or United Parcel Service, charges prepaid or charged to sender's account; (3) personal delivery; or (4) facsimile, along with initiation on the same day of delivery by another means described in this subsection. Each such notice shall be deemed given when received by the addressee unless delivery of a properly sent notice is not made because: (1) acceptance of delivery is refused by addressee, (2) the addressee has moved without providing proper notice of such move, or (3) the addressee is not open for business on the date of attempted delivery (unless such delivery is attempted on a Saturday, Sunday, or national holiday), in any of which events such

notice shall be deemed given on the date of such attempted delivery. The addresses of the Parties for notices are as follows:

If to DNR:

Department of Natural Resources
Wildlife Division
P.O. Box 30028
Lansing, Michigan 48909
Attention: Chief

If to USFWS:

U.S. Fish and Wildlife Service
Region 3 Office
Fort Snelling, Minnesota
Attention: Regional Director

14.4 Entire Agreement

This Agreement, together with the HCP and the Permit, constitutes the entire Agreement between the Parties. It supersedes any and all other Agreements, either oral or in writing among the Parties with respect to the subject matter hereof and contains all of the covenants and Agreements among them with respect to said matters, and each Party acknowledges that no representation, inducement, promise or Agreement, oral or otherwise, has been made by any other Party or anyone acting on behalf of any other Party that is not embodied herein.

14.5 Elected Officials Not to Benefit

No member of or delegate to the Michigan legislature or the United States Congress shall be entitled to any share or part of this Agreement, or any benefit that may arise from it.

14.6 Availability of Funds

Implementation of this Agreement and the HCP by the USFWS is subject to the requirements of the Anti-Deficiency Act and the availability of appropriated funds. Nothing in this Agreement will be construed by the Parties to require the obligation, appropriation, or expenditure of any money from the U.S. Treasury. The Parties acknowledge that the USFWS will not be required under this Agreement to expend any Federal agency's appropriated funds unless and until an authorized official of that agency affirmatively acts to commit such funds.

14.7 Duplicate Originals

This Agreement shall be executed in any number of duplicate originals. A complete original of this Agreement shall be maintained in the official records of each Party.

14.8 Third-party Beneficiaries

Without limiting the applicability of the rights granted to the public pursuant to the provisions of 16 USC 1540(g), this Agreement shall not create any right or interest in the public, or any member thereof, as a third-party beneficiary hereof, nor shall it authorize anyone not a party to this Agreement to maintain a suit for personal injuries or property damages pursuant to the provisions of this Agreement. The duties, obligations, and responsibilities of the Parties to this Agreement with respect to third parties shall remain as imposed under existing Federal or State law.

14.9 Relationship to the ESA and Other Authorities

The terms of this Agreement shall be governed by and construed in accordance with the ESA and other applicable laws. In particular, nothing in this Agreement is intended to limit the authority of the USFWS to seek penalties or otherwise fulfill its responsibilities under the ESA. Moreover, nothing in this Agreement is intended to limit or diminish the legal obligations and responsibilities of the USFWS as an agency of the Federal government.

14.10 References to Regulations

Any reference in this Agreement, the HCP, or the Permit to any regulation or rule of the USFWS shall be deemed to be a reference to such regulation or rule in existence at the time an action is taken.

14.11 Applicable Laws

All activities undertaken pursuant to this Agreement, the HCP, or the Permit must be in compliance with all applicable State and Federal laws and regulations.

14.12 Changes in the Environmental Laws

It is acknowledged and agreed by the Parties that the DNR and Management Partners are agreeing to perform substantial avoidance, minimization, mitigation measures in this Agreement. If a change in or addition to the Environmental Laws takes place, the USFWS shall give due consideration to the measures required of the DNR and Management Partners under the HCP in applying the new laws and regulations.

IN WITNESS WHEREOF, THE PARTIES HERETO have executed this Implementing Agreement to be in effect as of the date last signed below.

By:_____ Date:_____
Director
Department of Natural Resources
Lansing, MI

By:_____ Date:_____
Regional Director
US Fish and Wildlife Service
Region 3 Office
Fort Snelling, MN