# Change in home range and habitat use of *Canis lupus* x *Canis latrans* hybrid in northern Michigan

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## Abstract

**The gray wolf,** *Canis lupus*, has been extinct from the Lower Peninsula in Michigan since 1935, but in recent years *Canis lupus* x *Canis latrans* hybrids have recolonized the northernmost counties of the peninsula. A female coyote-wolf hybrid radiocollared in 2010 has been tracked periodically and was recently found to have lost a foot. We hypothesized that as a result her home range and average distance traveled during hunting hours would decrease and the habitat types she used would change. The animal was tracked using radiotelemetry for fourteen nights, resulting in a total of 55 data points. Between 2010-2015 and 2016, her home range decreased from 36 $km^2$ to 14 $km^2$ and habitat use shifted to include more agricultural land and less forested habit ($\chi^2$=24.521, df=3, p=0.000). The change in the home range and habitat use of the coyote-wolf hybrid could potentially have a significant impact on its ecosystem, as well as its conservation status. The ecology and impact of the coyote-wolf hybrids should be closely observed in order to clarify their ecosystem role and determine whether conservation measures should be enacted in the future.

## Introduction

*Canis lupus* (gray wolf) was extirpated from the Lower Peninsula in Michigan in 1935 (MDNR 2016). The first gray wolf confirmed in the northern Lower Peninsula since its

extirpation nearly a century earlier was found in 2004, but records of wolf reproduction in Michigan were still limited to the Upper Peninsula (Beyer et al. 2009). However, in 2010, *Canis latrans* x *Canis lupus* hybrids were discovered in the northern Lower Peninsula and marked the first documentation of wolf reproduction in the Lower Peninsula since the species' extirpation (Wheeldon et al. 2012). Currently the status of coyote-wolf hybrids is controversial, with respect to both trophic classification and appropriate conservation legislation.

Apex predator species, which are large species that occupy the highest trophic level and have no natural predators, influence their ecosystems by controlling the herbivore and mesopredator populations through top-down control (Brook et al. 2012). By inhibiting mesopredator and prey species populations, apex predator presence in an ecosystem promotes biodiversity (Wallach et al. 2015). As an apex predator, *Canis lupus* limits population densities of large mammalian herbivores such as cervids (Ripple and Beschta 2012). Since the extirpation of gray wolves, the northern Lower Peninsula in Michigan has lacked a stable population of apex predators. Coyotes are present in the region but are considered mesopredators, which cannot replace apex predators in their absence (Wallach et al. 2015).

Understanding the ecology of coyote-wolf hybrids is key to understanding whether they act as apex predators or mesopredators. Many characteristics, including body size, dietary requirements, and home range offer information about the trophic level occupied by a species within a given ecosystem. Home range acts as the spatial component of the ecological niche of an individual and also provides information about the impact of the individual on its ecosystem (Bowers et al. 1990). Home ranges of gray wolf packs vary widely from approximately 130 to 2500 $km^2$ while coyote home ranges are much smaller at approximately 20-31 $km^2$ in size, although they vary greatly as well (International Wolf Center 2014; Tokar 2001). Due to their

intermediate nature as hybrid animals, coyote-wolf hybrids hold home ranges larger than those of coyotes but smaller than those of wolves (Ellington and Murray 2015).

In 2010, a young female coyote-wolf hybrid was caught by a coyote trapper in Cheboygan County, MI. The animal was fitted with a radiocollar by the Michigan Department of Natural Resources (MDNR) and DNA samples taken from the animal showed the DNA composition to have coyote chromosomal DNA and gray wolf mitochondrial DNA (Wheeldon et al. 2012). Since her collaring in 2010, the MDNR and Mammalogy classes at the University of Michigan Biological Station have periodically studied the animal. Local anecdotal sightings, a photo taken with a camera trap, and a track show that the coyote-wolf hybrid lost a foot in the winter of 2015-2016 (Philip Myers and Nyeema Harris, [University of Michigan, Ann Arbor, MI], personal communication, [August 2016]; Figure 1). We hypothesized that this might cause the home range and average distance traveled during hunting hours to decrease and the habitat types used by the coyote-wolf hybrid to change. Further, the animal is now 6 years old and advancing age may also affect home range size and habitat use.

**Materials and methods**

*Study site*: This study was conducted at and near the University of Michigan Biological Station (UMBS) in Cheboygan County, Michigan (45°33'31.15" N, 84°40'39.35" W). The Station is located in the northernmost county of the Lower Peninsula. The study area included land between Douglas Lake and Burt Lake, which includes a variety of habitats including agricultural land, deciduous forest, coniferous forest, and wetlands.

*Radiotelemetry*: The coyote-wolf hybrid that was the subject of this study was captured as a young animal in 2010 by a coyote trapper and fitted with a radiocollar by biologists from the MDNR. Between 2010 and 2015 MDNR biologists located the animal approximately once a

month from an aircraft during the day. Additionally, in 2012 and 2014, classes at UMBS performed limited, nocturnal, ground-based observations. Tracking during 2016 was accomplished by teams of students who used receivers and directional antennae (Telonics Inc., Mesa, AZ) to triangulate the position of the animal.

The animal was tracked a total of 14 nights between July 2, 2016 and August 2, 2016. Student teams tracked the animal between 23 h and 2 h and between 2 h and 4 h using a network of roads in the area. These times were chosen based on past collected data that showed that the animal consistently moved the furthest from its den site during these hours.

*Data analysis*: The convex hull function of ArcGIS (Esri, Redlands, CA) was used to map and calculate the home range of the coyote-wolf hybrid. Habitat cover was analyzed using Michigan IFMAP/GAP Land Cover Data. A chi-square test was performed to compare the habitats frequented by the animal in 2010-2015 and 2016.

**Results**

*Home range*: We combined data from tracking the coyote-wolf hybrid by the 2012, 2014, and 2016 UMBS Field Mammalogy classes with the MDNR locations made between 2010 and 2016 and estimated the overall home range of the animal to be 36 $km^2$ (Figure 2). Considering the 2016 locations alone (class and MDNR), the home range of the animal was found to have decreased to only 14 $km^2$ (Figure 3).

*Habitat use*: Habitat use by the animal shifted to include more agricultural land and less coniferous forest between 2010-2015 and 2016 (Figures 5-9). The animal was located in lowland coniferous forest for 38% of the observations made prior to 2016, but in 2016 she was found in lowland coniferous forest for only 11% of the observations (Figures 8a, 9a). Inversely, in 2016

the animal was recorded in forage crop land for 24% of the observations, whereas before 2016 the animal was only recorded in forage crop land for 4.7% of the observations (Figures 8a, 9a). A more subtle shift occurred in the percentage of observations for which the animal was recorded in lowland deciduous forest; prior to 2016 the animal was found in this habitat in 6.5% of the observations but by 2016 this had decreased to 1.8% of the observations. (Figures 8a, 9a). When habitat types were pooled into four main types (forest, agriculture, wetland, other open habitat), a significant difference in habitat use was found between 2010-2015 and 2016 ($\chi^2$=24.521, df=3, p=0.000; Table 1 and Figures 8b, 9b).

*Hunting range*: The maximum hunting range of the coyote-wolf hybrid was found to be 2.2 $km^2$ (Figure 4). The average hunting range of the animal was calculated to be 0.22 $km^2$, although this calculation included several "ranges" that only consisted of one or two data points and therefore were most likely not representative of legitimate hunting ranges (Figure 4).

**Discussion**

The decrease in the home range size of the coyote-wolf hybrid from 36 $km^2$ to 14 $km^2$ between 2010-2015 and 2016 has undoubtedly affected the ecology of the animal and its impact on its ecosystem (Figures 2, 3). This change may have been caused by the apparent loss of her foot, but there are several alternative explanations as well. For example, this coyote-wolf hybrid is known to be six years old, and her age could be manifesting itself through other health issues that are preventing the animal from traveling larger distances. The average lifespan of a gray wolf in the wild is five to six years, while coyotes have a longer lifespan of six to ten years on average (Tokar 2001; Smith 2002). Another possibility is that an increase in resource abundance, i.e. prey such as deer, has allowed the animal to restrict its activities to a smaller range to fulfill its needs. A third alternate explanation is that the animal has behavior more similar to a coyote

than previously believed. This hypothesis, however, seems unlikely because a multitude of wolf-like characteristics have been observed in this animal; its size, physical appearance, large previous home range, pack behavior, and howling all seem to demonstrate that the animal is more similar ecologically to *Canis lupus* than to *Canis latrans*.

In addition to the decrease in its home range size, habitat type use also markedly transitioned from large majority forest habitat use to slight majority forest habitat use, and use of open land habitats like forage crop land and herbaceous open land increased (Figures 8b, 9b). These changes could indicate that the animal now prefers easier terrain than forests to travel through than she did prior to 2016, likely due to the loss of her foot.

The maximum hunting range and average hunting range calculated for the animal seem fairly small, although minimal data are available for comparisons of hunting ranges of coyotes and wolves. However, the average hunting range may have been biased by "ranges" consisting of only one or two data points that were most likely not accurate representations of the hunting ranges of the coyote-wolf hybrid (Figure 4).

Limitations of this study included large temporal and seasonal variation in data collection; the 2010-2015 data contain many more daytime points and the data points are fairly evenly distributed throughout the year. However, the 2016 data contains very few daytime points and is constrained to only mid-summer. It is very likely that the types of habitat used by the coyote-wolf hybrid depend on the season, and if this is true the 2016 data are biased towards habitat types used more commonly in the summer. Future studies should either account for or control temporal and seasonal variation.

The change in the home range and habitat use of the coyote-wolf hybrid associated with its foot loss and potentially other factors could significantly impact its ecosystem, as well as its

conservation status. Prior to 2016, the home range of the animal was intermediate between that of a wolf and coyote; large for a female coyote but small for a female wolf. This information is concordant with other literature on coyote-wolf hybrids; hybrids often have different space requirements than parental species, and introgressed coyotes hold larger home ranges than non-hybridized coyotes (Ellington and Murray 2015).

In 2016, the home range of the animal was found to have decreased in size to an area even smaller than the average coyote home range and much smaller than the average wolf home range. The ecological impact of this shift in behavior is uncertain, but it is possible that this was correlated with a change in diet for the animal. The shift in habitat use demonstrates a change in areas used for hunting, from coniferous forests to open crop land, and this could affect the species preyed upon by the coyote-wolf hybrid. This change could potentially increase the possibility of conflict with farmers, whose land typically includes the agricultural habitat types that are utilized by the animal more often now than they were prior to 2016.

These changes could signal a broader shift in the behavior of the animal, from more wolf-like to more coyote-like, due to life history events including the loss of its foot and aging. This flexibility in behavior could further confuse the status of coyote-wolf hybrids from a conservation perspective because it complicates their trophic position. An animal that can transition between two trophic positions depending on environmental and individual factors presents an even more uncertain picture.

Information about coyote-wolf hybrids in this geographical area is incomplete, and their potential and current impact on ecosystems and human populations in the northern Lower Peninsula is unclear. In the future, the ecology and impact of the coyote-wolf hybrids in this area should be closely observed to clarify their ecosystem role and determine whether conservation

measures should be enacted. In particular, information regarding the diet of the coyote-wolf hybrids in the northern Lower Peninsula is critical to determining whether they are acting as apex predators. Along with home range, dietary requirements and the actual diet of an animal offer information about the trophic level occupied by the animal in its ecosystem. Like wolves, coyote-wolf hybrids are capable of preying on larger game including deer, moose, and elk, but it is unclear whether the animals in the northern Lower Peninsula are killing those species and if so, how often (Benson and Patterson 2013).

The question of whether coyote-wolf hybrids function as apex predators, mesopredators, or both at different times in their lives has direct implications for their protection by government agencies. If the hybrids act as apex predators and thus promote biodiversity in their ecosystems, an argument could be made for their protection similar to their gray wolf ancestor. However, if the hybrids act as mesopredators like their coyote ancestor, it may be less logical to extend legal protections to those animals. Understanding the ecology of coyote-wolf hybrids and their impact on their ecosystems will be critical to decision-making regarding legal protection for these animals.

**Acknowledgments**

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## Tables and figures

*Figure 1. Coyote-wolf hybrid that was the subject of this study. Courtesy of Nyeema Harris (University of Michigan).*

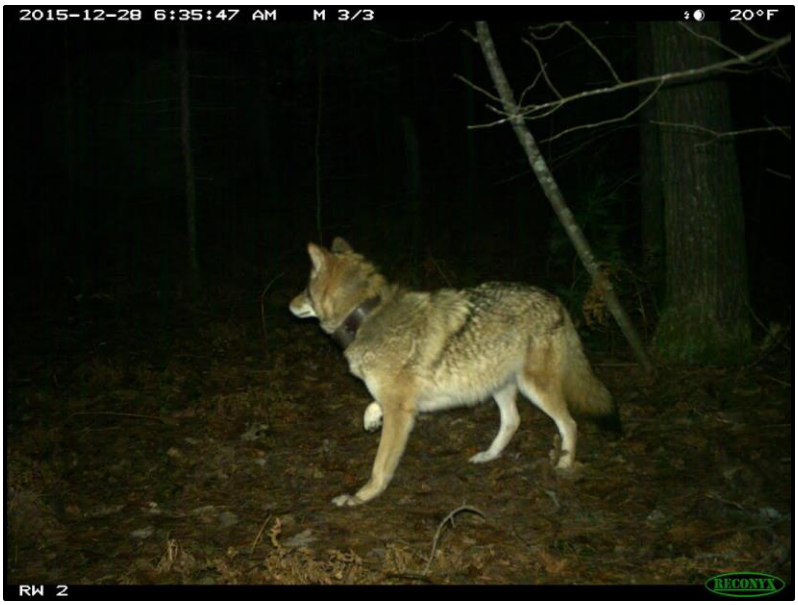


*Figure 2. Total estimated home range using 2010-2016 MDNR and 2012, 2014, 2016 UMBS Field Mammalogy radiotelemetry data points for coyote-wolf hybrid. Red dots are 2016 MDNR & 2016 UMBS Field Mammalogy data points, green dots are 2010-2015 MDNR and 2012, 2014 UMBS Field Mammalogy data points, and the white star is the estimated den site of the animal.* ***2010-2016 home range = 36 km$^2$.***

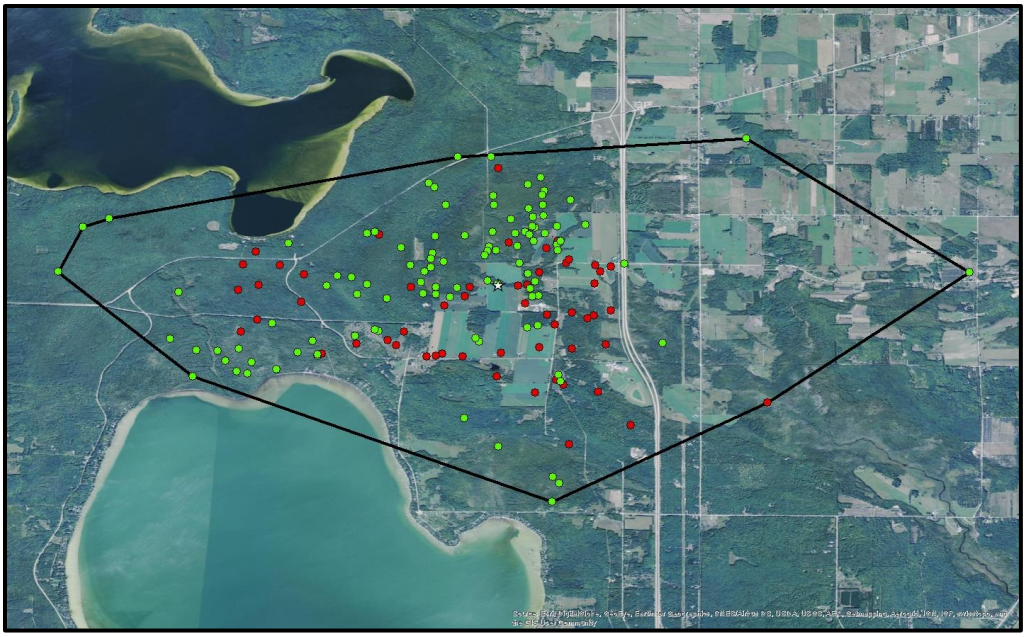

*Figure 3. Total estimated home range using 2016 MDNR and 2016 UMBS Field Mammalogy radiotelemetry data points for the coyote-wolf hybrid. The white star is the estimated den site of the animal.* ***2016 home range = 14 km$^2$.***

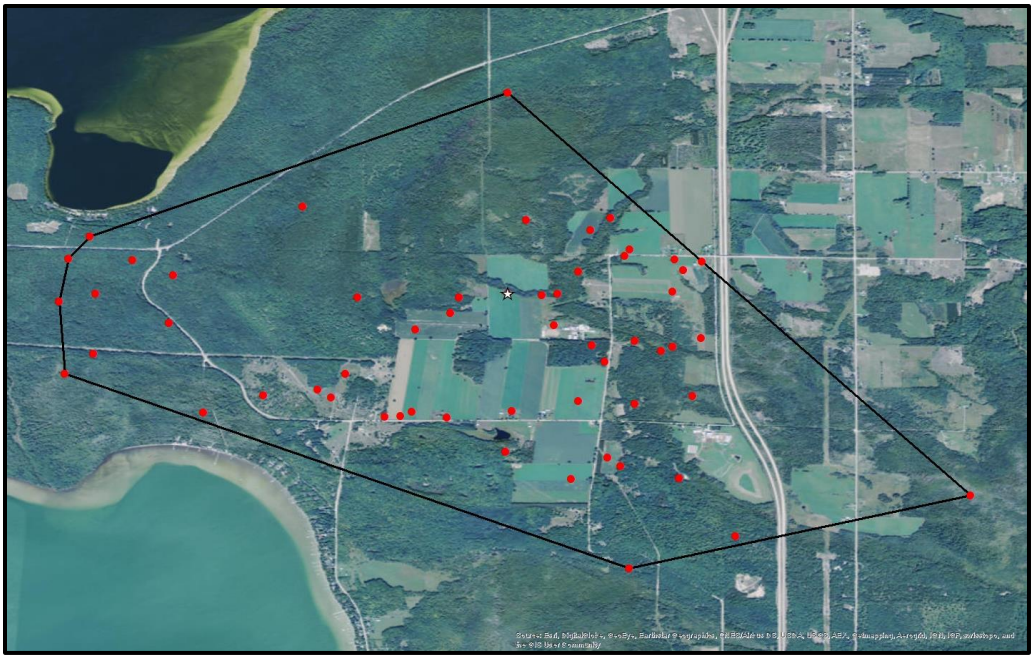

*Figure 4. Area traversed by the coyote-wolf hybrid per day; each polygon represents the area traversed by the animal on a different day. The white star is the estimated den site of the animal.* ***Average hunting range = 0.22 km$^2$; maximum hunting range = 2.20 km$^2$.***

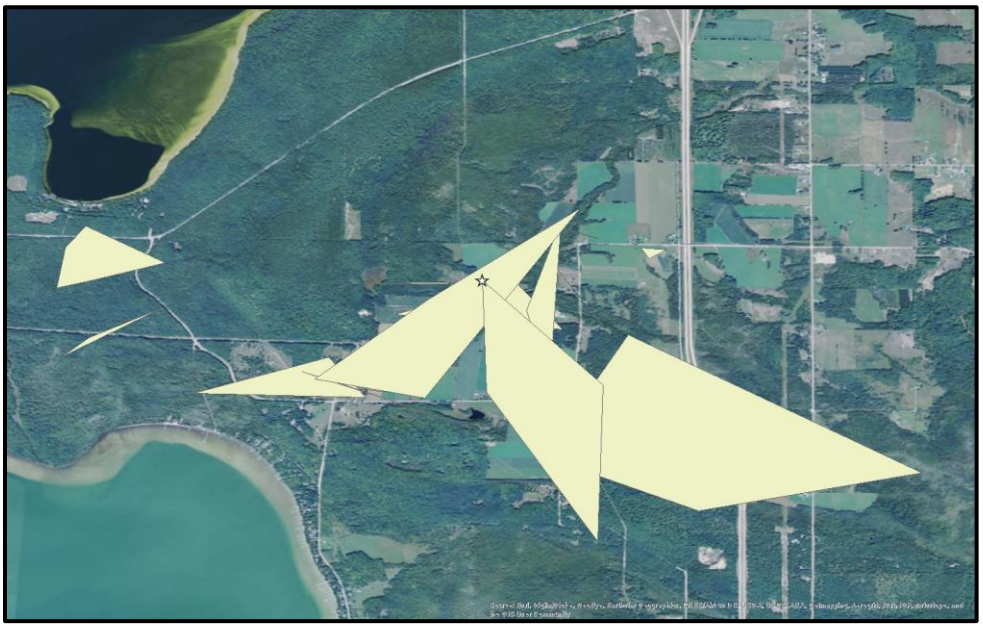

*Figure 5. Coyote-wolf hybrid habitat use map. Red dots are 2016 MDNR and 2016 UMBS Field Mammalogy radiotelemetry data points, green dots are 2010-2015 MDNR and 2012, 2014 UMBS Field Mammalogy radiotelemetry data points, and the white star is the estimated den site of the animal.*

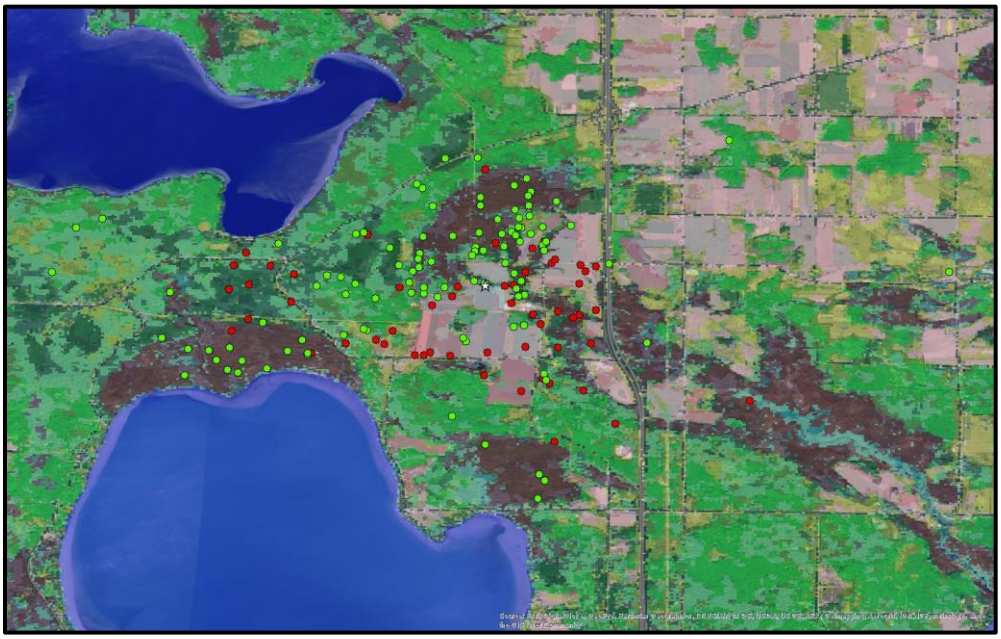

*Figure 6. Land cover key utilized in ArcGIS to create Figure 4. Courtesy of the Michigan GAP Analysis.*


*Figure 7. Pooled habitat types key for Figures 8b and 9b.*

Pooled habitat types

**Forest:** aspen types, lowland conif., lowland decid, lowland mixed, mixed upland conif, mixed upland decid, northern hardwoods, oak types, pine types, upland mixed conifer, other upland conifer
**Wetland:** emergent wetland, shrub wetland
**Agricultural:** forage crops, herbaceous open land, high intensity urban, roads, row crops
**Other open areas:** sand/soil, shrub and low density trees

*Figure 8a. Percentage of habitat use in 2010-2015.*

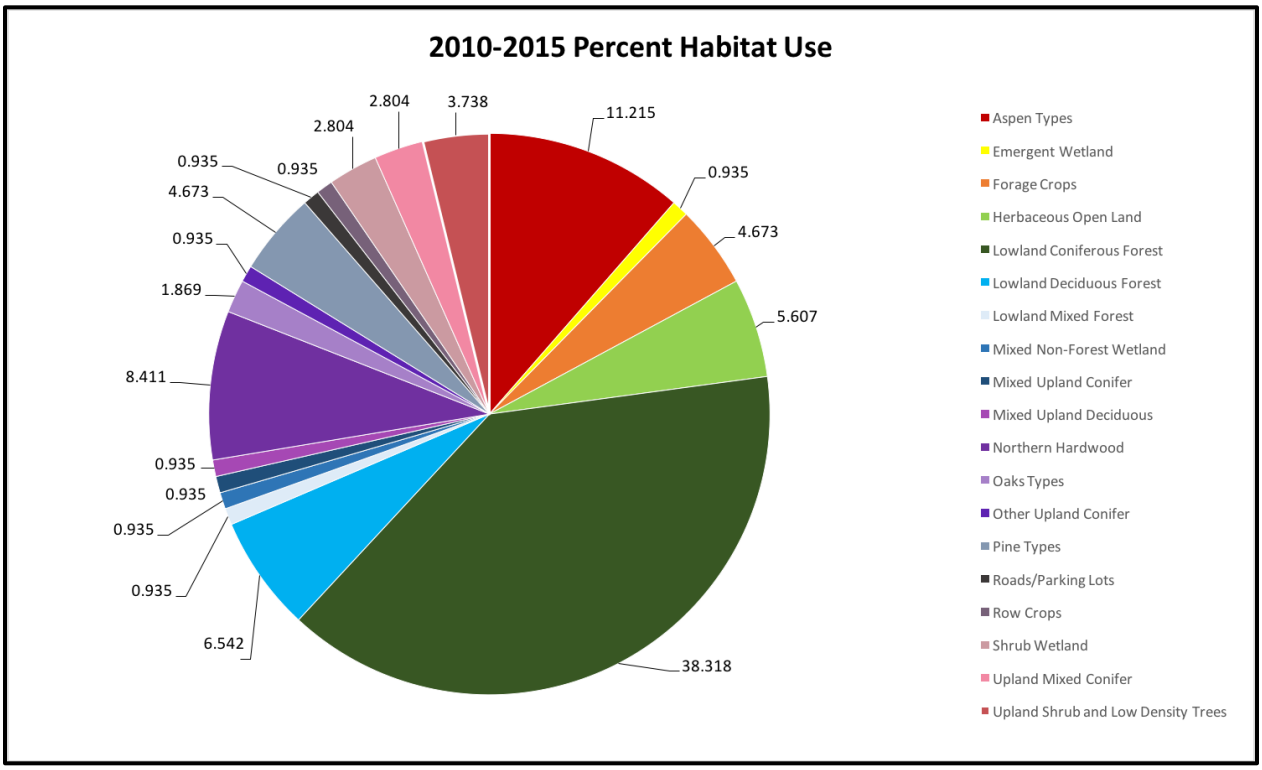


*Figure 8b. Percentage of habitat use in 2010-2015, with pooled habitat types (see Figure 7).*

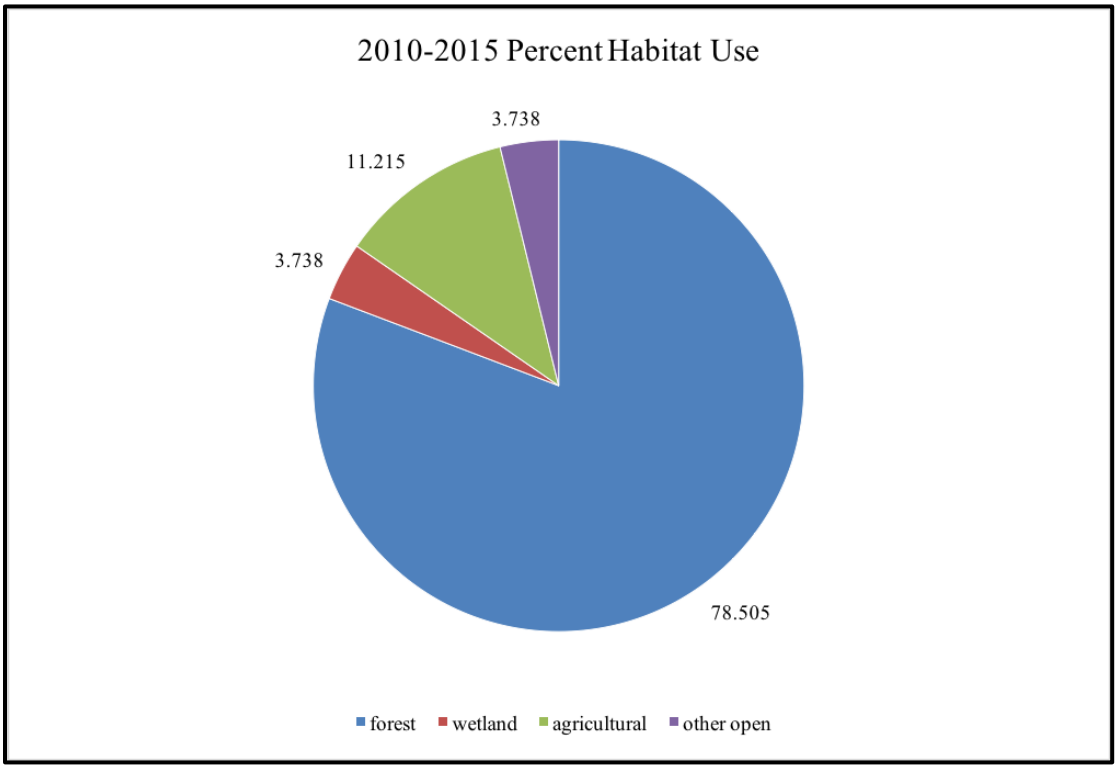

*Figure 9a. Percentage of habitat use in 2016.*

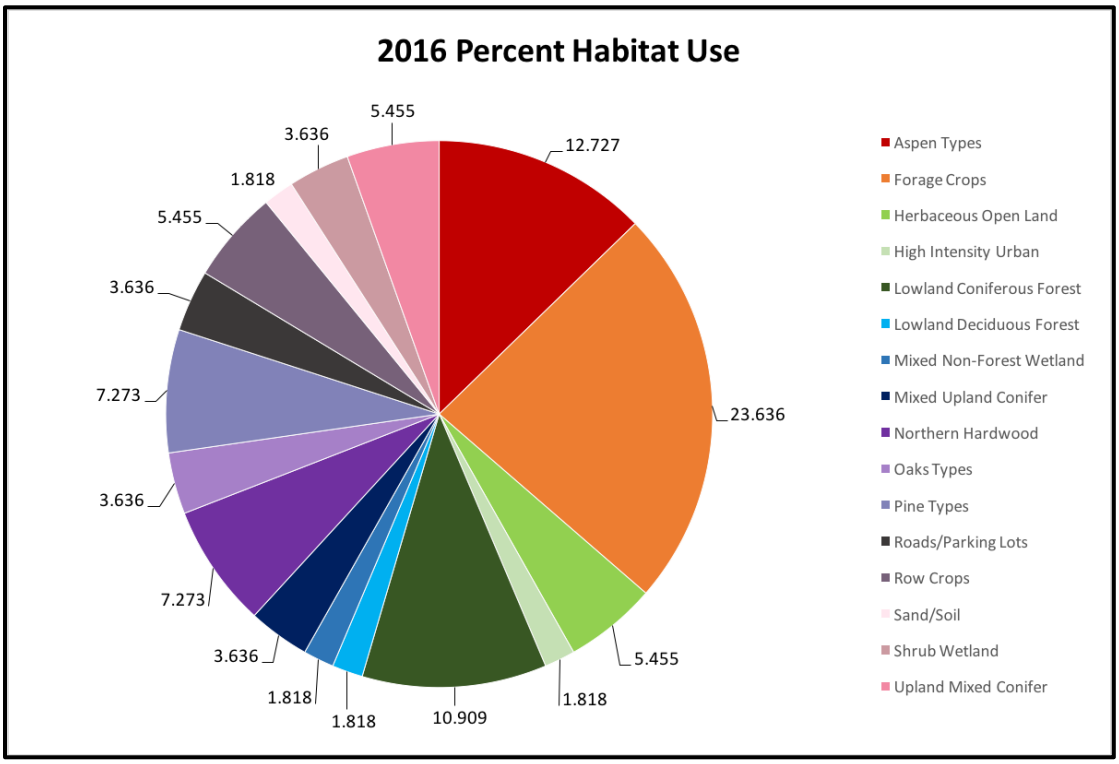


*Figure 9b. Percentage of habitat use in 2016 with pooled habitat types (see Figure 7).*

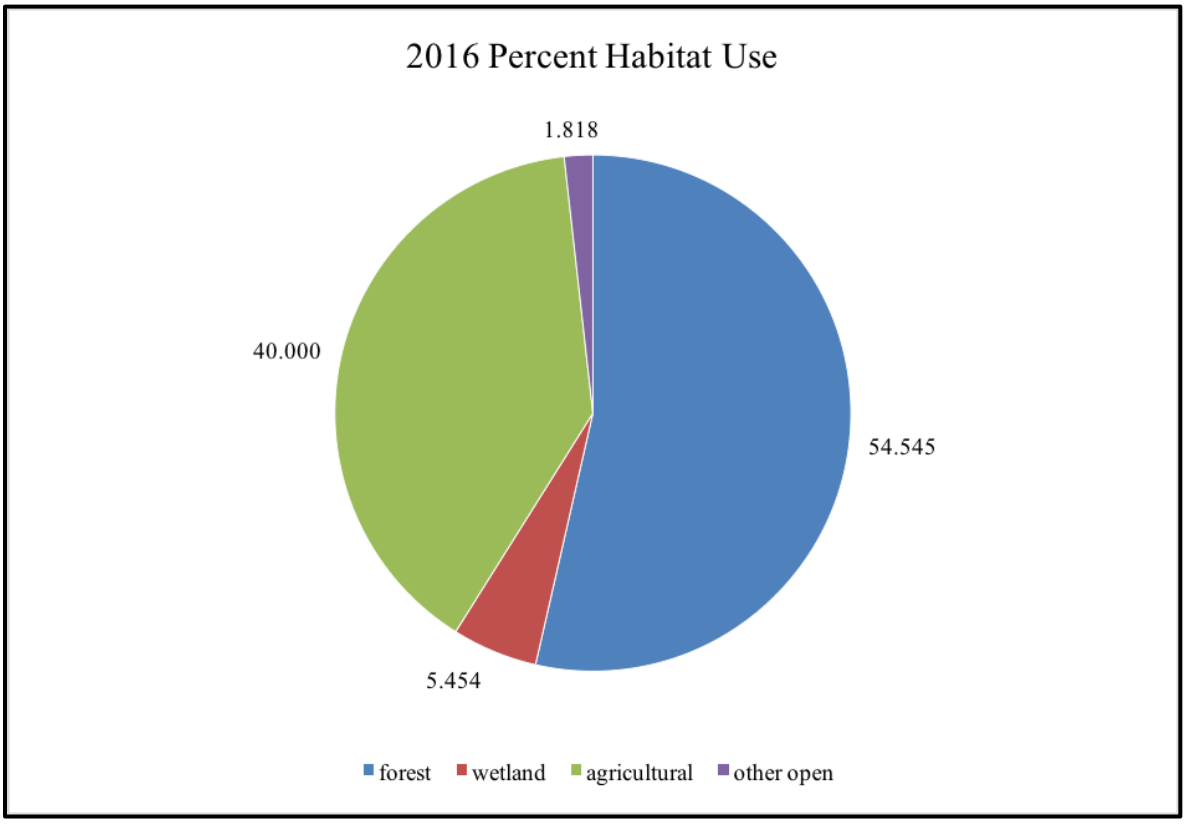

*Table 1. Chi-square tabulation for habitat type ($\chi^2$=24.521, df=3, p=0.000).*

| Chi-square tabulation | | | Year class | | |
|---|---|---|---|---|---|
| | | | 2010-2015 | 2016 | Total |
| **Habitat type** | **Forest** | *Count* | 83 | 30 | **113** |
| | | *Expected Count* | 74.6 | 38.4 | **113.0** |
| | **Agriculture** | *Count* | 8 | 21 | **29** |
| | | *Expected Count* | 19.2 | 9.8 | **29.0** |
| | **Other open habitat** | *Count* | 9 | 1 | **10** |
| | | *Expected Count* | 6.6 | 3.4 | **10.0** |
| | **Wetland** | *Count* | 7 | 3 | **10** |
| | | *Expected Count* | 6.6 | 3.4 | **10.0** |
| **Total** | | ***Count*** | **107** | **55** | **162** |
| | | ***Expected Count*** | **107.0** | **55.0** | **162.0** |

## Appendix

*Appendix 1. 2010-2015 MDNR and 2012, 2014, 2016 UMBS Field Mammalogy radiotelemetry data points for the coyote-wolf hybrid.*

| Date | Average Time | Latitude | Longitude | Habitat Use |
|---|---|---|---|---|
| 6/27/16 0:00 | 15:20 | 45.54879 | -84.62489 | Lowland Coniferous Forest |
| 7/2/16 0:00 | 13:47 | 45.56046 | -84.65583 | Northern Hardwood |
| 7/3/16 0:00 | 4:09 | 45.54465 | -84.62322 | Lowland Deciduous Forest |
| 7/5/16 0:00 | 1:16 | 45.55288 | -84.6512 | Northern Hardwood |
| 7/5/16 0:00 | 2:14 | 45.5529 | -84.64273 | Aspen Types |
| 7/5/16 0:00 | 0:31 | 45.55315 | -84.63452 | Shrub Wetland |
| 7/6/16 0:00 | 5:58 | 45.543325 | -84.64669444 | Row Crops |
| 7/6/16 0:00 | 11:27 | 45.5447 | -84.65908 | Aspen Types |

| | | | | |
|---|---|---|---|---|
| 7/7/16 0:00 | 0:57 | 45.542925 | -84.64893889 | High Intensity Urban |
| 7/7/16 0:00 | 0:31 | 45.54646667 | -84.65221667 | Herbaceous Open Land |
| 7/7/16 0:00 | 1:13 | 45.54327 | -84.66408 | Lowland Coniferous Forest |
| 7/10/16 0:00 | 3:08 | 45.54297 | -84.64762 | Row Crops |
| 7/10/16 0:00 | 3:40 | 45.5452 | -84.65457 | Oaks Types |
| 7/10/16 0:00 | 1:28 | 45.54 | -84.63888 | Aspen Types |
| 7/11/16 0:00 | 11:51 | 45.5475 | -84.63056 | Roads/Parking Lots |
| 7/12/16 0:00 | 4:13 | 45.5502 | -84.6464 | Forage Crops |
| 7/12/16 0:00 | 2:39 | 45.5489 | -84.63167 | Shrub Wetland |
| 7/12/16 0:00 | 1:12 | 45.55305556 | -84.63583333 | Sand/Soil |
| 7/14/16 0:00 | 0:27 | 45.54926 | -84.62809 | Lowland Coniferous Forest |
| 7/14/16 0:00 | 0:43 | 45.55504444 | -84.63279444 | Lowland Coniferous Forest |
| 7/19/16 0:00 | 0:32 | 45.550542 | -84.634783 | Forage Crops |
| 7/19/16 0:00 | 1:03 | 45.5442 | -84.63275 | Forage Crops |
| 7/19/16 0:00 | 1:57 | 45.558503 | -84.631733 | Forage Crops |
| 7/21/16 0:00 | 23:23 | 45.537783 | -84.624339 | Aspen Types |
| 7/22/16 0:00 | 1:49 | 45.537739 | -84.633364 | Row Crops |
| 7/22/16 0:00 | 1:11 | 45.532975 | -84.619678 | Northern Hardwood |
| 7/22/16 0:00 | 0:14 | 45.538828 | -84.629275 | Oaks Types |
| 7/22/16 0:00 | 22:23 | 45.548433 | -84.625836 | Lowland Coniferous Forest |
| 7/22/16 0:00 | 1:39 | 45.536325 | -84.6 | Mixed Non-Forest Wetland |
| 7/25/16 0:00 | 22:42 | 45.555839 | -84.622464 | Forage Crops |
| 7/25/16 0:00 | 23:18 | 45.555119 | -84.624011 | Forage Crops |
| 7/25/16 0:00 | 23:45 | 45.556025 | -84.624714 | Forage Crops |
| 7/26/16 0:00 | 0:06 | 45.553358 | -84.624872 | Forage Crops |
| 7/28/16 0:00 | 22:32 | 45.55635 | -84.628917 | Roads/Parking Lots |

| | | | | |
|---|---|---|---|---|
| 7/29/16 0:00 | 0:33 | 45.55685 | -84.6285 | Forage Crops |
| 7/29/16 0:00 | 0:06 | 45.559336 | -84.637128 | Aspen Types |
| 7/30/16 0:00 | 22:48 | 45.55073 | -84.66697 | Herbaceous Open Land |
| 7/30/16 0:00 | 23:54 | 45.54817 | -84.67331 | Mixed Upland Conifer |
| 7/30/16 0:00 | 23:08 | 45.54649 | -84.67567 | Lowland Coniferous Forest |
| 7/31/16 0:00 | 0:56 | 45.55601 | -84.67003 | Aspen Types |
| 7/31/16 0:00 | 2:16 | 45.55793 | -84.67357 | Aspen Types |
| 7/31/16 0:00 | 1:25 | 45.5532 | -84.67314 | Pine Types |
| 7/31/16 0:00 | 1:51 | 45.55251 | -84.67613 | Pine Types |
| 7/31/16 0:00 | 2:46 | 45.55611 | -84.67536 | Pine Types |
| 7/31/16 0:00 | 0:32 | 45.55472 | -84.66658 | Mixed Upland Conifer |
| 8/1/16 0:00 | 22:52 | 45.54287 | -84.64378 | Forage Crops |
| 8/1/16 0:00 | 23:19 | 45.55154 | -84.64347 | Forage Crops |
| 8/1/16 0:00 | 23:52 | 45.54451 | -84.65341 | Forage Crops |
| 8/1/16 0:00 | 0:33 | 45.559489 | -84.630083 | Upland Mixed Conifer |
| 8/2/16 0:00 | 0:48 | 45.54338 | -84.63832 | Forage Crops |
| 8/2/16 0:00 | 1:26 | 45.53028 | -84.62854 | Northern Hardwood |
| 8/2/16 0:00 | 3:03 | 45.53952 | -84.63031 | Pine Types |
| 8/2/16 0:00 | 3:31 | 45.54401 | -84.62807 | Upland Mixed Conifer |
| 10/21/10 0:00 | 18:20 | 45.55201 | -84.64945 | Aspen Types |
| 10/28/10 0:00 | 12:20 | 45.56673 | -84.63203 | Lowland Coniferous Forest |
| 11/2/10 0:00 | 12:20 | 45.56673 | -84.63203 | Lowland Coniferous Forest |
| 11/10/10 0:00 | 11:35 | 45.56149 | -84.63342 | Herbaceous Open Land |
| 11/17/10 0:00 | 13:30 | 45.5616 | -84.6338 | Herbaceous Open Land |
| 12/3/10 0:00 | 10:00 | 45.55859 | -84.65262 | Upland Shrub and Low Density Trees |
| 12/16/10 0:00 | 10:30 | 45.54226 | -84.67789 | Lowland Coniferous Forest |

| | | | | |
|---|---|---|---|---|
| 12/22/10 0:00 | 12:58 | 45.54407 | -84.67598 | Lowland Coniferous Forest |
| 12/29/10 0:00 | 10:43 | 45.54516 | -84.66542 | Lowland Coniferous Forest |
| 1/7/11 0:00 | 9:00 | 45.5534 | -84.63876 | Mixed Non-Forest Wetland |
| 1/12/11 0:00 | 11:00 | 45.56869 | -84.63262 | Lowland Deciduous Forest |
| 2/3/11 0:00 | 14:45 | 45.54356 | -84.6675 | Lowland Coniferous Forest |
| 2/16/11 0:00 | 14:00 | 45.54046 | -84.67474 | Shrub Wetland |
| 2/25/11 0:00 | 14:00 | 45.54107 | -84.67054 | Lowland Coniferous Forest |
| 3/2/11 0:00 | 13:00 | 45.55578 | -84.64834 | Lowland Coniferous Forest |
| 3/8/11 0:00 | 13:30 | 45.55282 | -84.64465 | Aspen Types |
| 3/31/11 0:00 | 13:45 | 45.56028 | -84.64344 | Lowland Coniferous Forest |
| 4/7/11 0:00 | 14:45 | 45.56087 | -84.63482 | Lowland Coniferous Forest |
| 4/21/11 0:00 | 17:15 | 45.56294 | -84.63373 | Herbaceous Open Land |
| 4/29/11 0:00 | 13:45 | 45.56155 | -84.69843 | Northern Hardwood |
| 5/4/11 0:00 | 17:00 | 45.56725 | -84.64787 | Northern Hardwood |
| 5/12/11 0:00 | 13:00 | 45.5628 | -84.69461 | Aspen Types |
| 5/20/11 0:00 | 10:17 | 45.55923 | -84.66882 | Aspen Types |
| 5/25/11 0:00 | 15:50 | 45.55603 | -84.6513 | Pine Types |
| 5/31/11 0:00 | 13:00 | 45.55434 | -84.65975 | Aspen Types |
| 6/10/11 0:00 | 13:45 | 45.55185 | -84.65901 | Herbaceous Open Land |
| 6/15/11 0:00 | 15:10 | 45.55871 | -84.64005 | Lowland Coniferous Forest |
| 6/27/11 0:00 | 19:45 | 45.54382 | -84.68207 | Shrub Wetland |
| 7/13/11 0:00 | 13:00 | 45.5421 | -84.67413 | Lowland Coniferous Forest |
| 7/26/11 0:00 | 16:50 | 45.5647 | -84.63229 | Lowland Coniferous Forest |
| 8/10/11 0:00 | 16:00 | 45.56538 | -84.62825 | Lowland Coniferous Forest |
| 8/23/11 0:00 | 8:10 | 45.55171 | -84.63287 | Lowland Coniferous Forest |
| 9/6/11 0:00 | 15:30 | 45.55948 | -84.63355 | Lowland Coniferous Forest |

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| 9/14/11 0:00 | 13:30 | 45.5606 | -84.63624 | Lowland Deciduous Forest |
| 10/5/11 0:00 | 10:30 | 45.56025 | -84.64774 | Emergent Wetland |
| 10/21/11 0:00 | 14:30 | 45.54369 | -84.67907 | Lowland Coniferous Forest |
| 10/28/11 0:00 | 8:00 | 45.54766 | -84.67117 | Pine Types |
| 11/14/11 0:00 | 8:20 | 45.55482 | -84.63441 | Lowland Coniferous Forest |
| 11/22/11 0:00 | 10:30 | 45.55778 | -84.64821 | Lowland Coniferous Forest |
| 12/2/11 0:00 | 8:30 | 45.52557 | -84.6308 | Lowland Coniferous Forest |
| 1/4/12 0:00 | 10:15 | 45.522 | -84.63099 | Lowland Coniferous Forest |
| 2/8/12 0:00 | 9:04 | 45.56084 | -84.63953 | Lowland Coniferous Forest |
| 3/16/12 0:00 | 15:00 | 45.55379 | -84.64024 | Other Upland Conifer |
| 5/29/12 0:00 | 13:20 | 45.557 | -84.64841 | Lowland Coniferous Forest |
| 6/27/12 0:00 | 14:50 | 45.54481 | -84.61507 | Lowland Mixed Forest |
| 7/23/12 0:00 | 0:00 | 45.546617 | -84.655933 | Northern Hardwood |
| 7/25/12 0:00 | 22:00 | 45.5402 | -84.630067 | Pine Types |
| 7/26/12 0:00 | 21:00 | 45.55655 | -84.6465 | Upland Mixed Conifer |
| 7/27/12 0:00 | 5:00 | 45.539283 | -84.629717 | Aspen Types |
| 7/28/12 0:00 | 5:00 | 45.547067 | -84.63455 | Forage Crops |
| 7/28/12 0:00 | 5:00 | 45.5473317 | -84.633017 | Forage Crops |
| 7/28/12 0:00 | 6:00 | 45.55635 | -84.635683 | Upland Mixed Conifer |
| 7/28/12 0:00 | 21:00 | 45.5537 | -84.6334 | Lowland Coniferous Forest |
| 7/30/12 0:00 | 1:00 | 45.55505 | -84.5709 | Herbaceous Open Land |
| 7/30/12 0:00 | 5:00 | 45.560783 | -84.6564 | Aspen Types |
| 7/31/12 0:00 | 6:00 | 45.560433 | -84.63425 | Lowland Coniferous Forest |
| 7/31/12 0:00 | 21:00 | 45.552633 | -84.634057 | Shrub Wetland |
| 8/2/12 0:00 | 14:30 | 45.53405 | -84.64354 | Northern Hardwood |
| 8/31/12 0:00 | 14:00 | 45.5459 | -84.6593 | Lowland Deciduous Forest |

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| 10/12/12 0:00 | 8:50 | 45.55508 | -84.70195 | Aspen Types |
| 11/13/12 0:00 | 13:00 | 45.55143 | -84.6456 | Forage Crops |
| 12/11/12 0:00 | 13:30 | 45.55191 | -84.64765 | Herbaceous Open Land |
| 1/23/13 0:00 | 8:50 | 45.56791 | -84.64868 | Northern Hardwood |
| 2/25/13 0:00 | 15:10 | 45.55452 | -84.66177 | Aspen Types |
| 4/17/13 0:00 | 8:45 | 45.54677 | -84.65644 | Oaks Types |
| 5/20/13 0:00 | 13:30 | 45.55307 | -84.66332 | Aspen Types |
| 6/19/13 0:00 | 15:40 | 45.56321 | -84.63219 | Upland Shrub and Low Density Trees |
| 7/25/13 0:00 | 8:15 | 45.54547 | -84.6859 | Pine Types |
| 8/28/13 0:00 | 16:00 | 45.55216 | -84.68463 | Lowland Coniferous Forest |
| 10/25/13 0:00 | 14:05 | 45.54081 | -84.67629 | Lowland Coniferous Forest |
| 12/5/13 0:00 | 14:00 | 45.52466 | -84.62992 | Lowland Coniferous Forest |
| 2/28/14 0:00 | 13:30 | 45.55287 | -84.64765 | Lowland Deciduous Forest |
| 4/22/14 0:00 | 15:25 | 45.55125 | -84.65472 | Northern Hardwood |
| 6/20/14 0:00 | 8:00 | 45.56058 | -84.65749 | Oaks Types |
| 7/25/14 0:00 | 16:00 | 45.545509 | -84.641914 | Upland Shrub and Low Density Trees |
| 7/25/14 0:00 | 23:00 | 45.571663 | -84.639748 | Northern Hardwood |
| 7/25/14 0:00 | 13:45 | 45.565992 | -84.639373 | Lowland Coniferous Forest |
| 7/25/14 0:00 | 14:00 | 45.5647 | -84.63933 | Lowland Coniferous Forest |
| 7/25/14 0:00 | 14:30 | 45.558124 | -84.640179 | Mixed Non-Forest Wetland |
| 7/26/14 0:00 | 22:38 | 45.567646 | -84.634383 | Lowland Coniferous Forest |
| 7/26/14 0:00 | 23:56 | 45.551563 | -84.633755 | Lowland Coniferous Forest |
| 7/26/14 0:00 | 16:13 | 45.558155 | -84.638975 | Mixed Non-Forest Wetland |
| 7/27/14 0:00 | 16:00 | 45.561655 | -84.630248 | Row Crops |
| 7/27/14 0:00 | 10:56 | 45.571661 | -84.64448 | Mixed Upland Conifer |

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| 7/27/14 0:00 | 1:45 | 45.540035 | -84.682606 | Lowland Deciduous Forest |
| 7/27/14 0:00 | 2:00 | 45.540036 | -84.6826048 | Lowland Deciduous Forest |
| 7/27/14 0:00 | 8:20 | 45.564182 | -84.634279 | Lowland Deciduous Forest |
| 7/28/14 0:00 | 16:25:00 | 45.556263 | -84.620597 | Roads/Parking Lots |
| 7/28/14 0:00 | 22:43 | 45.564664 | -84.646269 | Northern Hardwood |
| 7/28/14 0:00 | 23:33 | 45.574283 | -84.603044 | Northern Hardwood |
| 7/28/14 0:00 | 22:50 | 45.55751 | -84.640606 | Aspen Types |
| 7/28/14 0:00 | 17:05:00 | 45.558955 | -84.630252 | Lowland Coniferous Forest |
| 7/28/14 0:00 | 17:20:00 | 45.559491 | -84.629772 | Lowland Coniferous Forest |
| 7/29/14 0:00 | 6:01 | 45.561811 | -84.626173 | Forage Crops |
| 7/29/14 0:00 | 6:20 | 45.560611 | -84.632001 | Upland Shrub and Low Density Trees |
| 7/29/14 0:00 | 5:45 | 45.558749 | -84.635947 | Pine Types |
| 7/29/14 0:00 | 5:54 | 45.566155 | -84.632345 | Lowland Coniferous Forest |
| 7/29/14 0:00 | 6:13 | 45.558208 | -84.63011 | Lowland Coniferous Forest |
| 7/29/14 0:00 | 16:12 | 45.543199 | -84.664627 | Lowland Coniferous Forest |
| 7/29/14 0:00 | 16:17 | 45.543049 | -84.664627 | Lowland Coniferous Forest |
| 7/29/14 0:00 | 16:26 | 45.543199 | -84.664627 | Lowland Coniferous Forest |
| 11/26/14 0:00 | 11:00 | 45.55512 | -84.64929 | Mixed Upland Deciduous |
| 1/26/15 0:00 | 8:20 | 45.55357 | -84.64977 | Aspen Types |
| 4/17/15 0:00 | 8:10 | 45.55334 | -84.65759 | Upland Mixed Conifer |
| 7/24/15 0:00 | 9:20 | 45.56271 | -84.63685 | Lowland Coniferous Forest |
| 9/17/15 0:00 | 10:00 | 45.54499 | -84.64145 | Forage Crops |
| 11/20/15 0:00 | 9:00 | 45.52996 | -84.63869 | Lowland Coniferous Forest |