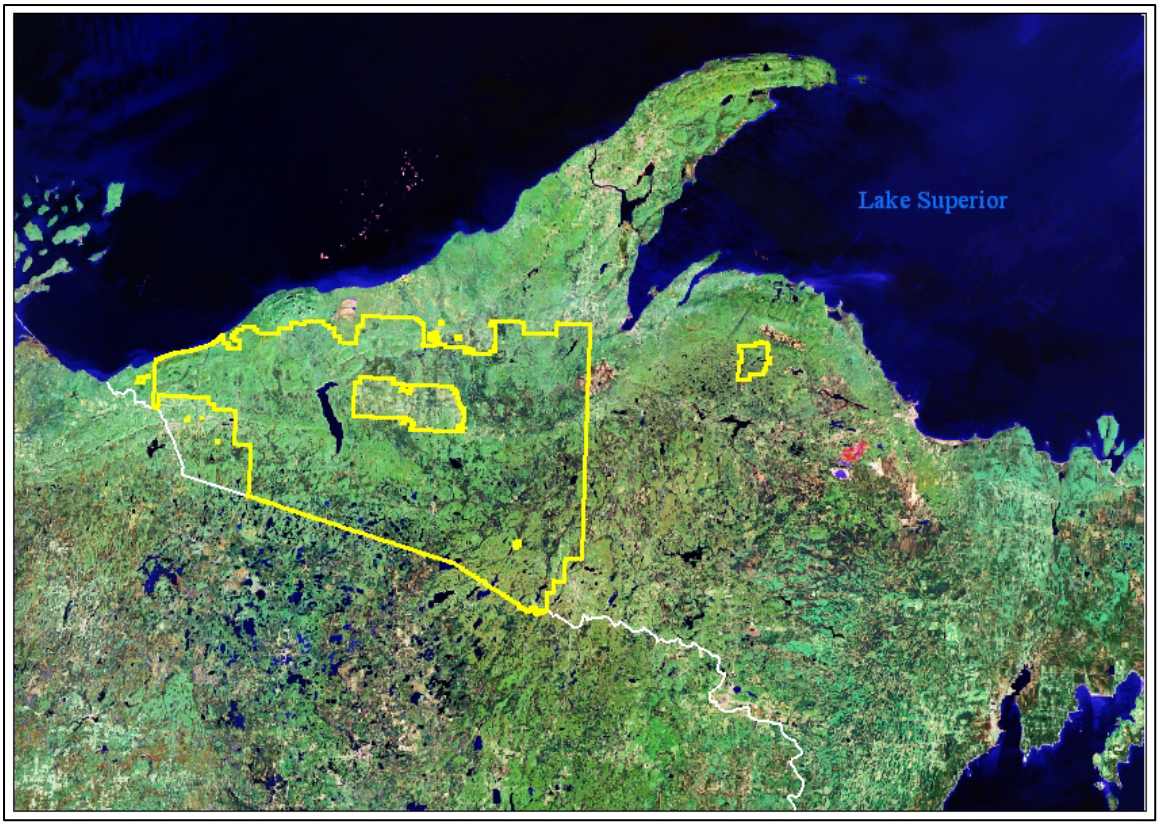
AN ANALYSIS OF ROADS AND ROADLESS AREAS ON THE OTTAWA NATIONAL FOREST, MICHIGAN



Pacific Biodiversity Institute

AN ANALYSIS OF ROADS AND ROADLESS AREAS ON THE OTTAWA NATIONAL FOREST, MICHIGAN

Hans M. Smith IV
Conservation Scientist/GIS Analyst
Pacific Biodiversity Institute
Hans@pacificbio.org

Peter H. Morrison
Executive Director
Pacific Biodiversity Institute
peter@pacificbio.org

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Pacific Biodiversity Institute
P.O. Box 298
Winthrop, Washington 98862
509-996-2490

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The Ottawa National Forest provided most of the data used in this analysis. We made extensive use of 1998 infrared color orthophotos obtained online from the MI Geographic Data Library (MI Department of Information Technology). We also obtained land use-land cover data from the MI Geographic Data Library and used this in our roadless area mapping.

PROJECT FUNDING

This project was funded by Northwoods Wilderness Recovery (Marquette, MI), and Defenders of Wildlife (Washington, DC).

EXECUTIVE SUMMARY

Roads have strong ecological impacts, affecting habitat fragmentation, hydrologic functioning, soil erosion, wildlife movements, and many other issues. In order for natural resource managers to adequately understand and address these issues, reliable information on roads is needed. Conversely, roadless areas provide important habitat for wildlife species that are sensitive to human disturbance. To intelligently manage wildlife resources managers need good information on the location, size and characteristics of roadless areas.

We evaluated the quality of data related to roads, trails, and roadless areas that is maintained by the Ottawa National Forest (ONF). We assessed the data in two ways. First, we examined the internal consistency of their data and information derived from that data as reported in Ottawa National Forest documents. We compared original RARE II roadless areas with roadless data compiled by the ONF for the 2003 Forest Plan Revision Potential Forest Roadless Inventory (ONF, 2005). We also compared two different GIS roads layers mapped by the ONF, one containing data on objective maintenance levels, and the other containing data on "improved" roads.

Second, we compared the Forest Service data to conditions on the ground. We used 1998 color infrared orthophotography for this comparison. We created data layers of roads/trails visible in the orthophotos but undocumented by the ONF's data. We also created a data layer of actual roadless areas, using the best available roads information, and compared this to ONF roadless data.

We found numerous problems with the ONF's roads, trails, and roadless area data. Problems include inconsistent and incomplete mapping of roads and roadless areas, poor spatial and classification accuracy of some roads and trails, and a high proportion of unclassified roads. We document many examples of these problems through maps of Forest Service data overlaid on orthophotos.

We also demonstrate several situations where, by simply reviewing the Forest's GIS data in relation to orthophotography, we were able to provide substantial improvements to their data. Analysis results based on our improvements to the Forest Service data lead to dramatically different conclusions about the miles of road, road density, and acres of roadless areas in the National Forest than those reached without the improvements.

The most recent Forest Service data shows 6,194 miles of road within USFS lands (1,551.62 square miles), with a road density of 3.99 miles per square mile. Using our data improvements we calculated 6,844 miles of roads with a road density of 4.41 miles per square mile – a 10% increase in road miles and density. The Forest Service's RARE II roadless areas and the 2003 Forest Plan Revision Potential Forest Roadless Inventory map 60,520 acres of roadless lands within the Ottawa National Forest (excluding the Cyrus H. McCormick Experimental Forest). Using improved roads data and a clear methodology for consistent mapping of roadless areas, we found 327,482 acres of

roadless lands within roadless areas of 5,000 acres or greater. In addition, we found many smaller roadless areas less than 5,000 acres in size.

The analyses we conducted on the Ottawa National Forest highlight an assortment of mapping and documentation problems concerning roads and roadless areas. Left unaddressed, these problems have the potential to greatly compromise the reliability of transportation system-related analyses and other assessments that the National Forest may make.

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INTRODUCTION

It is widely recognized that roads have strong impacts on forest ecosystems. Roads affect habitat fragmentation, hydrologic functioning, soil erosion, wildlife movements, dispersal of invasive species, mortality of wildlife from vehicle collisions, patterns of insect and disease infestation, and many other issues (Ercelawn 1999). In order for natural resource managers to adequately understand and address these issues, reliable information on roads is needed.

Because of the significance of roads and trails for recreational and commercial activities as well as ecological issues, the Forest Service requires that each National Forest maintain current information on roads and trails. The National Forests have also been directed to evaluate the efficiency of their transportation networks for meeting transportation needs in the Forest while minimizing ecological impacts.

The objective of this project was to evaluate the quality of data related to roads and roadless areas that is maintained by the Ottawa National Forest. The ability of the Forest Service to make good natural resource management decisions depends greatly on having reliable data and analyses on which to base those decisions.

METHODS

Pacific Biodiversity Institute (PBI) assessed the quality of the Ottawa National Forest's (ONF) roads and roadless area data in two ways. First, we examined the internal consistency of their data and information derived from that data as reported in Ottawa National Forest documents. Second, we compared their data to conditions on the ground. We used 1998 color infrared orthophotography for this comparison.

Data Descriptions

We obtained GIS data on roads, trails, and roadless areas from the Ottawa National Forest in the beginning of 2006. We recognize that all these data are continually updated as road and trail status change. This report focuses on systemic problems that we found with the ONF's data rather than a few isolated errors that may have easily been updated between the release of this report and the time that we acquired the data.

Descriptions of the roads, trails, and other primary GIS data used in this assessment are provided below. In addition, a few other GIS layers were incorporated into the roadless area evaluation and these are referenced in the roadless area section of this report.

<u>Roads</u>

USFS Roads – This data layer contains roads classified by jurisdiction and objective maintenance level (OML). OML categories assigned by the Forest Service and used in this report are: (1) basic custodial care (closed), (2) high clearance vehicles, (3) suitable

for passenger cars, (4) moderate degree of user comfort, (5) high degree of user comfort, and (6) decommissioned. In addition, there are some roads with no assigned OML category. Jurisdiction categories include: county – parish – borough, forest service, other federal agency, private, state, state highway, and unknown. There are also roads with no assigned jurisdiction category, though these roads are not necessarily the same as the roads with no OML assignment.

Improved Roads – This layer was provided by the ONF and contains roads that were assigned a value of "improved" (regardless of OML class) by the ONF for the 2003 draft EIS roadless inventory.

Trails

USFS Snowmobile Trails – This layer was provided by the ONF and contains designated trails usable by snowmobiles.

USFS Trails – This layer was provided by the ONF and contains trails but does specify what type of use is associated with each trail.

Other Transportation Features

USFS Railroads - This layer was provided by the ONF and contains active railroads.

USFS Utility - This layer was provided by the ONF and contains utility line corridors and swaths.

Roadless Areas

MA_86 – This layer was obtained from the ONF and contains the management area emphasis variables for all regions of the Ottawa National Forest. The designated wilderness areas from this layer were used to illustrate the boundaries of the RARE II IRAs (note that the Norwich Plains IRA from RARE II was digitized by hand using hardcopy maps from the 1986 Final EIS for the ONF). These roadless areas were mapped under the 1976 Roadless Area Review and Evaluation II (RARE II) process.

Inventoried Roadless Areas – These are roadless areas as mapped by the Forest Service in conjunction with Appendix B in the 2004 Draft EIS for the ONF Forest Plan Revisions.

Imagery

1998 Color Infrared Orthophotos – Orthophotos were obtained on-line from the Michigan Department of Information Technology website:
http://www.mcgi.state.mi.us/mgdl/

Consistency of Data and Data Reporting

We looked at consistency of the roads and roadless area data from a number of angles. First, we looked at the consistency of mapping and categorizing of features within a given data layer. For example, within the USFS Roads layer we checked whether the assignments of various road categories were consistent or if a wide variety of road types were inappropriately classified. Second, we compared roads as mapped in the USFS Roads layer with those of the Improved Roads layer.

While conducting this review, we found numerous problems with the ONF's roads data. Problems include extremely poor spatial accuracy of some mapped roads and trails and inconsistent categorization and mapping of roads, trails, and roadless areas. As these issues are extremely difficult or time-intensive to assess in a quantitative manner, we documented examples and discuss these issues based on our intensive visual review of the data. Where possible, we conducted quantitative analysis related to these issues for limited areas.

Undocumented Roads and Motorized Trails

We systematically reviewed National Forest lands, mapping roads and motorized trails that are undocumented by the ONF. We measured miles of undocumented roads/trails and analyzed the effects of these omissions on measurements of road density.

We overlaid the USFS Trails, USFS Roads, Improved Roads, USFS Utility, USFS Railroads, and USFS Snowmobile GIS layers on 1998 color infrared orthophotos and on-screen digitized at a 1:10,000 scale roads and motorized trails that were visible on the orthophotos but were not included in any of the ONF GIS layers. The assessment area included all Forest Service owned lands within the Ottawa Congressional boundary, excluding the Cyrus H. McCormick Experimental Forest.

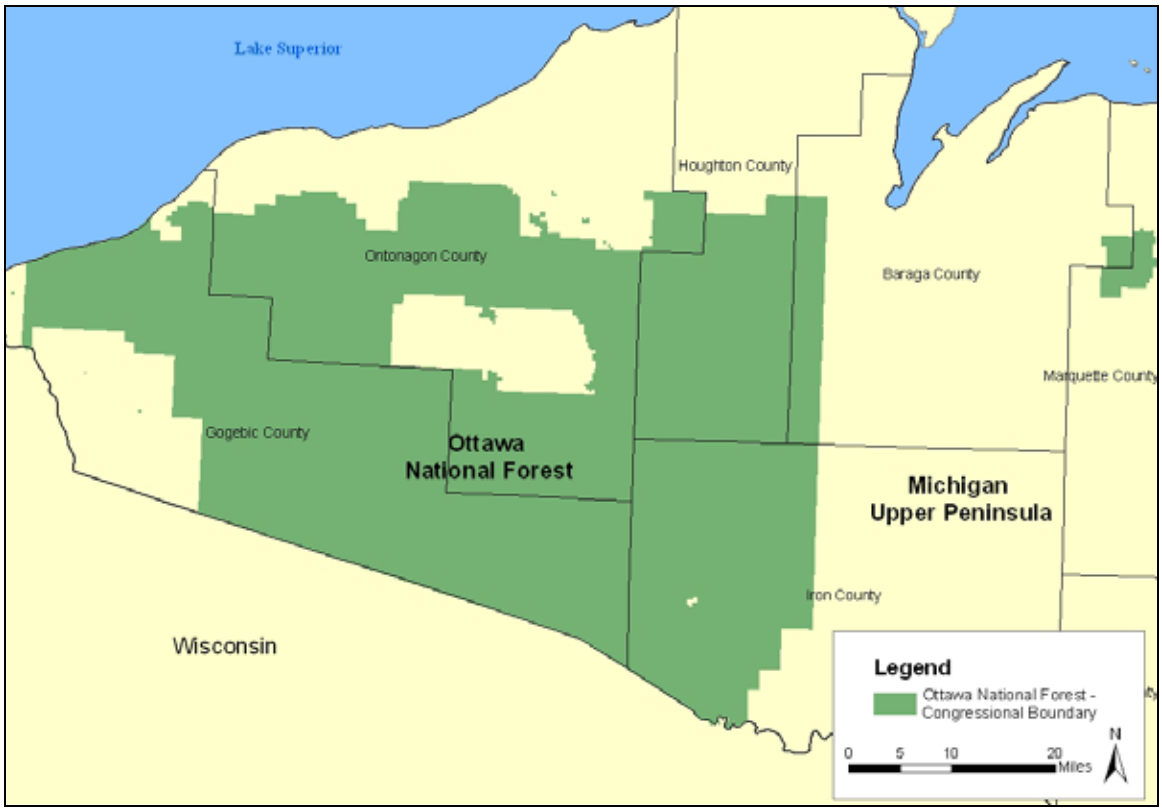

Figure 1. Map of the Ottawa National Forest. The small portion of USFS land in the northeastern portion of the map is the Cyrus H. McCormick Experimental Forest which was not included in this analysis.

We combined the digitized, undocumented roads and motorized trails into a single roads/trails layer. We did this because it is not possible to reliably differentiate on orthophotos between potential well-maintained motorized "trails" and potential "roads". We did not digitize trails that we thought were not usable by motorized vehicles.

We categorized the digitized features according to the following five categories:

Level 1 – Roads that appear to be well maintained and in current use and that correspond to OML levels 3, 4, and 5. Roads are likely to be passable by passenger cars.

Level 2 – Roads/trails that are not overgrown but not as well maintained as Level 1 roads. These roads correspond to OML level 2.

Level 3 – Roads/trails that are somewhat overgrown but may still provide paths for snowmobiles or OHVs. Some of these roads/trails may also be passable by some high clearance vehicles.

Level 4 - A utility corridor or other swath.
Level 5 – Old railroad grade.

Note - Level 1 and 4 features were used in creating a digital layer of roadless lands (see Roadless Areas section below).

We used the following guidelines in digitizing and categorizing undocumented roads/trails:

- We attempted to be conservative. For example, if the appropriate level for a feature was questionable, we typically classified it at the lower level. If it was questionable whether a route should be digitized at all, we generally did not digitize it.

- We did not re-digitize roads or trails from the ONF's GIS data that appeared to represent road or trail features visible on the orthophotos, but were simply mis-mapped. Mis-mapped ONF roads and trails were sometimes as far as 250 meters away from their true location.

- We mostly only digitized routes whose path could be traced back to the main road network. In cases where ONF roads and trails were mis-mapped, we connected our digitizing to the true location of the adjacent roads and trails rather than the mis-mapped data.

- We used local context and adjacent ONF mapped roads to aid in photo interpretation. For example, in areas of high canopy closure roads may appear substantially less prominent than in open areas. We used the classification of nearby ONF roads (e.g. OML 2 or, OML 3 road, etc.) as a guide in photo interpreting and categorizing undocumented features.

Roadless Areas

We used the best available information on roads and other permanent human disturbances to map roadless areas of 1,000 acres or greater in the Ottawa National Forest. Methods used for mapping roadless areas were similar to those developed during Pacific Biodiversity Institute's first inventory of wildlands in Washington State (Morrison et al. 1998). These methods yield an objective assessment of roadless areas as defined by our input parameters (details provided below). We compared our roadless area map with the Forest Service roadless data.

Data Used For Roadless Area Mapping

The data used to create our roadless area layer are described below.

Roads

We combined components of the USFS Roads and Improved Roads data to create a layer on which to base our roadless area analysis. We chose roads with OML levels 3, 4, or 5, and roads with a jurisdiction category of county, state, or state highway from the USFS

Roads data, and combined these with roads labeled as "improved" in the Improved Roads layer. We also added railroads, utility corridors and swaths, undocumented roads (Type 1 roads), and undocumented utility corridors and swaths. We compiled the data into a single "roads" layer.

Land Use

We used the Michigan DNR's 2001 Landsat-based Land Use-Land Cover dataset obtained online at http://www.mcgi.state.mi.us/mgdl/ to identify all permanently developed land use cover types, including gravel pits/mines, farmsteads and other rural developments, urban and industrial areas, roads, improved trails and rail lines.

Land Ownership and Protection Status

We used ownership and the 1986 Management Areas GIS data obtained from the ONF to identify Forest Service owned lands and protected areas.

Roadless Area Mapping Methods

We defined roadless areas as any area greater than 20 meters from a road that was at least 1,000 acres in size with a minimum width of 400 meters. The calculation of minimum size was made after all developed and permanently disturbed areas (e.g. urban, agriculture, mines, etc.) were removed.

We used a grid cell size of 10 meters for all analyses. Due to the approximation of linear road features by square cells, the actual setback distance from the road will vary somewhat. While a smaller base grid cell size would result in more accurate delineation of roadless areas, the level of accuracy obtained from 10-meter cells was sufficient for the scale of this project.

We conducted the roadless area analysis on lands owned and managed by the Ottawa National Forest. All other ownerships were excluded.

To delineate the roadless areas, we first calculated those areas greater than 20 meters from any road using a line-distance function. Next, we excluded any permanently developed or disturbed areas as well as major water bodies (lakes over 250 acres according to USFS waterbodies data). Then we excluded any non-Forest Service owned lands. Any areas falling below the 1,000-acre minimum size were then eliminated.

To detect points of a roadless area below 400 meters in width, we used an algorithm to "shrink" and "expand" the roadless areas. This process effectively "pinched off" any narrow necks between larger areas or appendages to a roadless area. After this process, areas falling below 1,000 acres were again eliminated.

The final roadless area grid was converted to a polygon layer. We coded the roadless areas into three size classes - those between 1,000 and 2,500 acres, those between 2,500 and 5,000 acres, and those over 5,000 acres. This is the final roadless area layer used for mapping and comparison with Forest Service data.

RESULTS

We found significant inaccuracies with the Ottawa National Forest's GIS roads, trails and roadless area data. The following sections describe and provide examples of problems regarding each of the topics listed below:

1) Inconsistent road maps
2) Non-attributed roads
3) Spatial accuracy of road and trail maps
4) Undocumented roads/trails
5) Duplicate or even triplicate arcs representing a single section of road
6) Incomplete roadless area maps.

Inconsistent Road Maps

In this section, we assess the quality and consistency of the ONF's road layers *in relation to each other* and the ability of the Forest Service, based on these data sets, to provide fundamental information on total mileage, location, and density of roads in the National Forest. In later sections we assess in much greater detail the quality and consistency of these data when compared to *actual conditions on the ground,* as interpreted by overlaying the data with 1998 orthophotography.

The Forest Service provided PBI with 2 primary GIS data layers related to roads: 1) USFS Roads, which contains OML and jurisdiction classifications for roads in the National Forest, and 2) Improved Roads, which contains information on which roads are "improved" roads.

We found that both of these layers contain numerous errors and are incomplete when compared to each other and conditions on the ground. More importantly, due to spatial inconsistencies in the data, the layers cannot be easily combined to provide a single complete data set from which reliable calculations of total road mileage and road density can be made.

Some of the problems we found with the USFS Roads layer are: 1) the spatial accuracy of some roads is very poor, 2) it does not include many existing, well-maintained roads, 3) it has many roads lacking attribute information, some of which appear so old or so inaccurately mapped that there is no evidence of a corresponding road on recent orthophotography, 4) many non-attributed roads appear to be well-maintained, and at least as prominent as many of the roads with OML ratings 2 - 5, 5) some "real" road features (roads evident in the 1998 orthophotos) have multiple arcs representing them (541 miles worth of duplication), and in some cases the OML classification and/or jurisdiction between these arcs is different, and 6) some of the roads classified with OML ratings do not correspond to any road visible on recent orthophotography.

The USFS Roads layer covers all ownerships within the Ottawa NF boundary (Forest Service, private, state, county, etc). As may be expected, the accuracy of this layer in depicting the distribution and conditions of roads is poorer on non-Forest Service lands.

The Improved Roads layer also contains many of the spatial problems listed above. Although similar to the USFS Roads layer in terms of depicting road distributions, the Improved Roads layer does not contain attributes describing OML classes for each road segment. The Improved Roads layer does however provide jurisdictional information similar to the USFS Roads data, although the jurisdictional classifications between the two layers do not always tend to agree (we did not attempt to determine which layer was more correct in this regards). The most important information in the Improved Roads layer concerns the labeling of "improved" roads that correspond to roads in the USFS Roads layer that have an OML class less than 3 or have no OML class at all. Roads labeled as "improved" in this layer meet the Regional Office's definition of an improved road (USDA Forest Service 1997b). In August 1997 the Regional Office provided two definitions of an "improved road":

> 1. An improved road is any constructed or existing feature or facility created on the land for the purpose of travel by passenger vehicles (four wheeled, 2 wheel drive) which are legally allowed to operate on forest roads or public roads and highways, and vehicles are greater than 50 inches in width. Said facility will have an area for vehicles to travel on and will incorporate some manner for the disposal of surface runoff.
>
> 2. An improved road has a definable, constructed cross-section, is properly drained, may or may not be surfaced, and is useable by most vehicle types. Some roads may be useable by high clearance vehicles. It is also stable for the predominant traffic during the normal use season. All roads assigned an objective maintenance level (OML) of 3, 4 or 5 in the Forest Development Transportation Plan are improved roads maintained for travel by standard passenger cars. OML 1 (roads closed to vehicle use for one year or longer) and OML 2 (roads maintained for high clearance vehicles such as pick-ups, 4x4's, etc.) are 'improved roads' if they meet the above description.

Besides being used to represent additional roads that should qualify as "improved" in the USFS Roads layer, the Improved Roads GIS data has too many errors and inconsistencies to be considered a useful stand-alone road map.

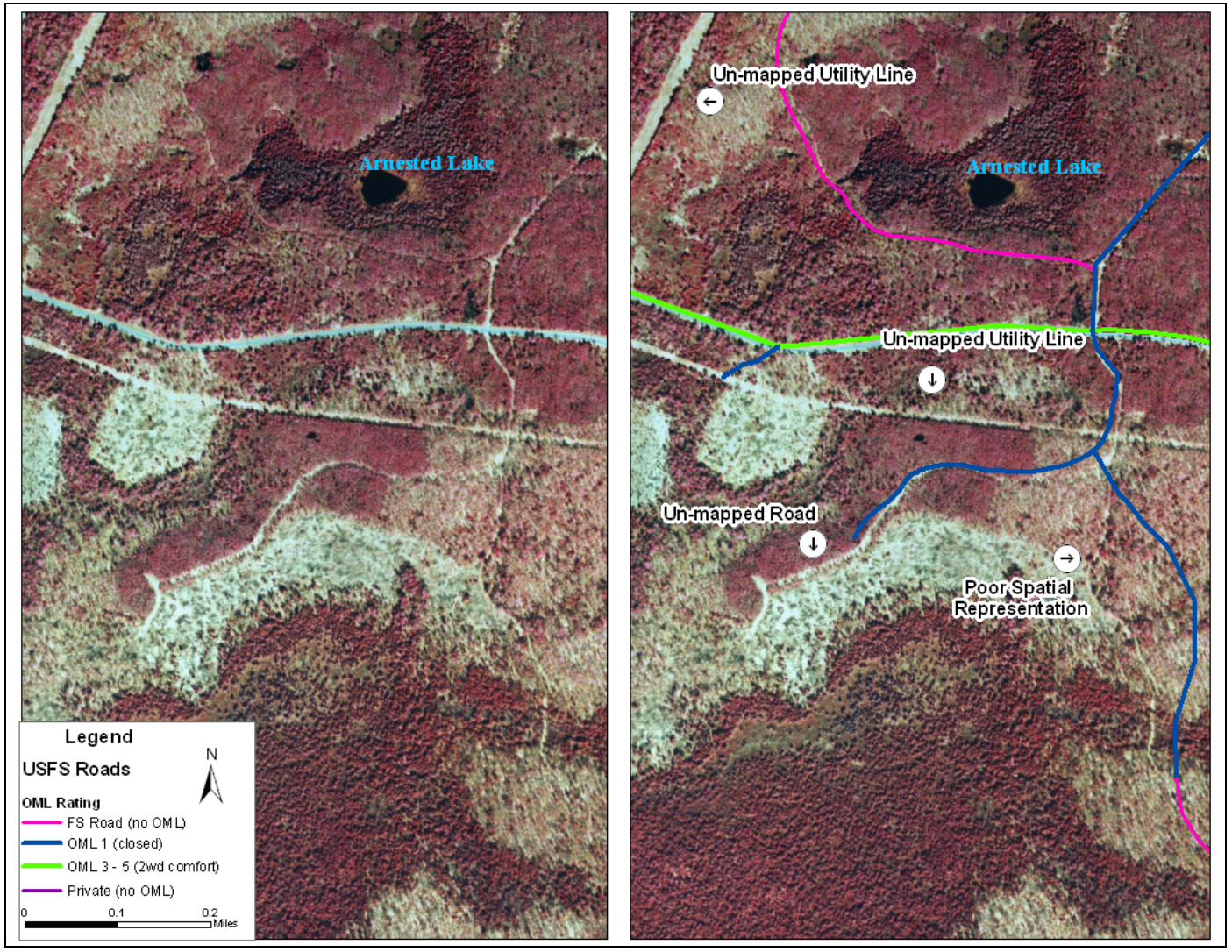

Figure 2. Paired maps showing an area where the USFS Roads layer exhibits poor spatial accuracy, and where a section of road clearly existing in the orthophoto is missing in the USFS roads data. The Improved Roads layer also fails to map the described road. Also, the USFS Utility layer failed to map these readily apparent utility line corridors.

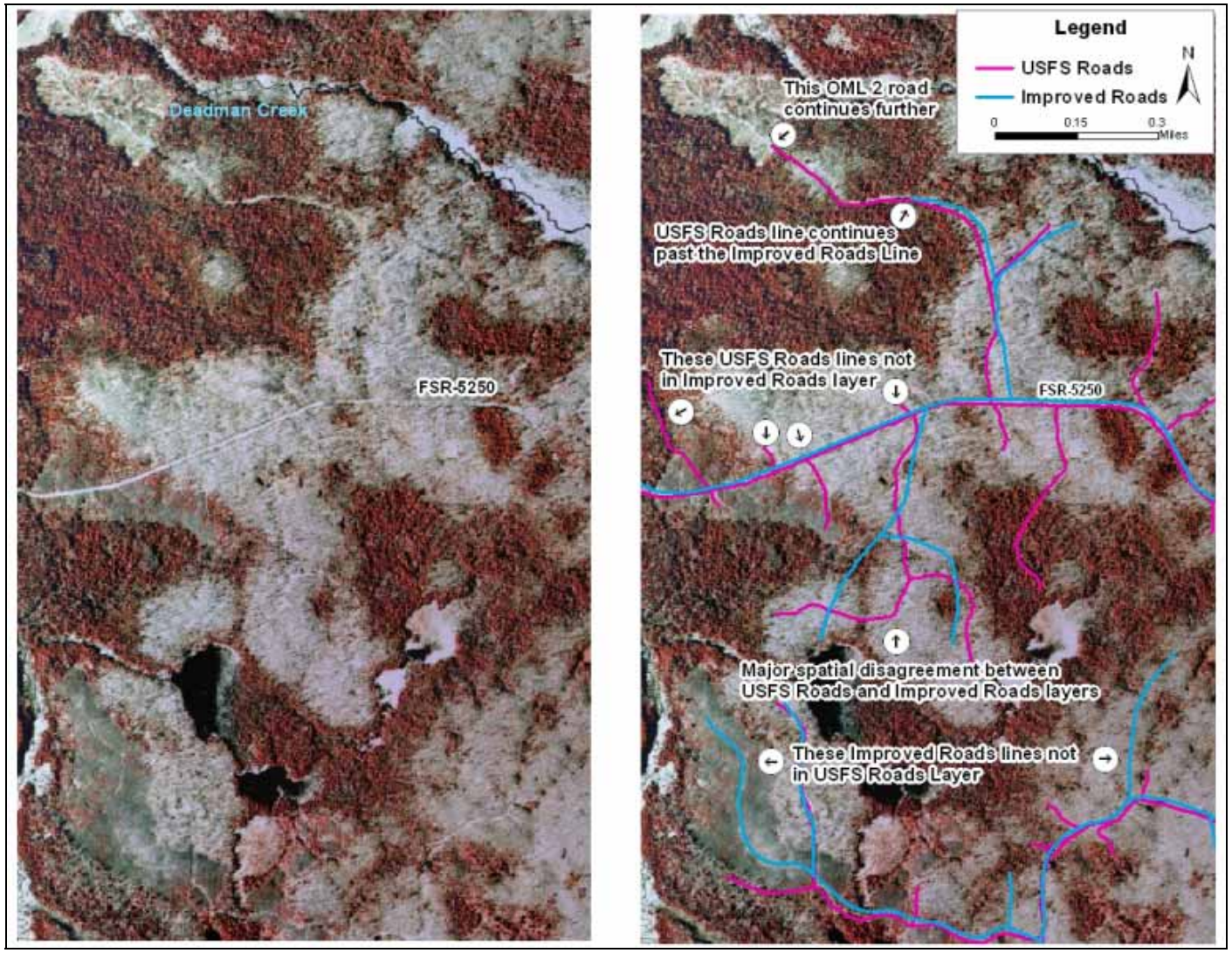

Figure 3. Paired maps showing some of the more dramatic discrepancies between the USFS Roads layer and the Improved Roads layer. Unfortunately, the spatial disagreement between the two layers prohibits them from being easily merged together to create a better roads representation layer because many roads would end up being represented at least twice.

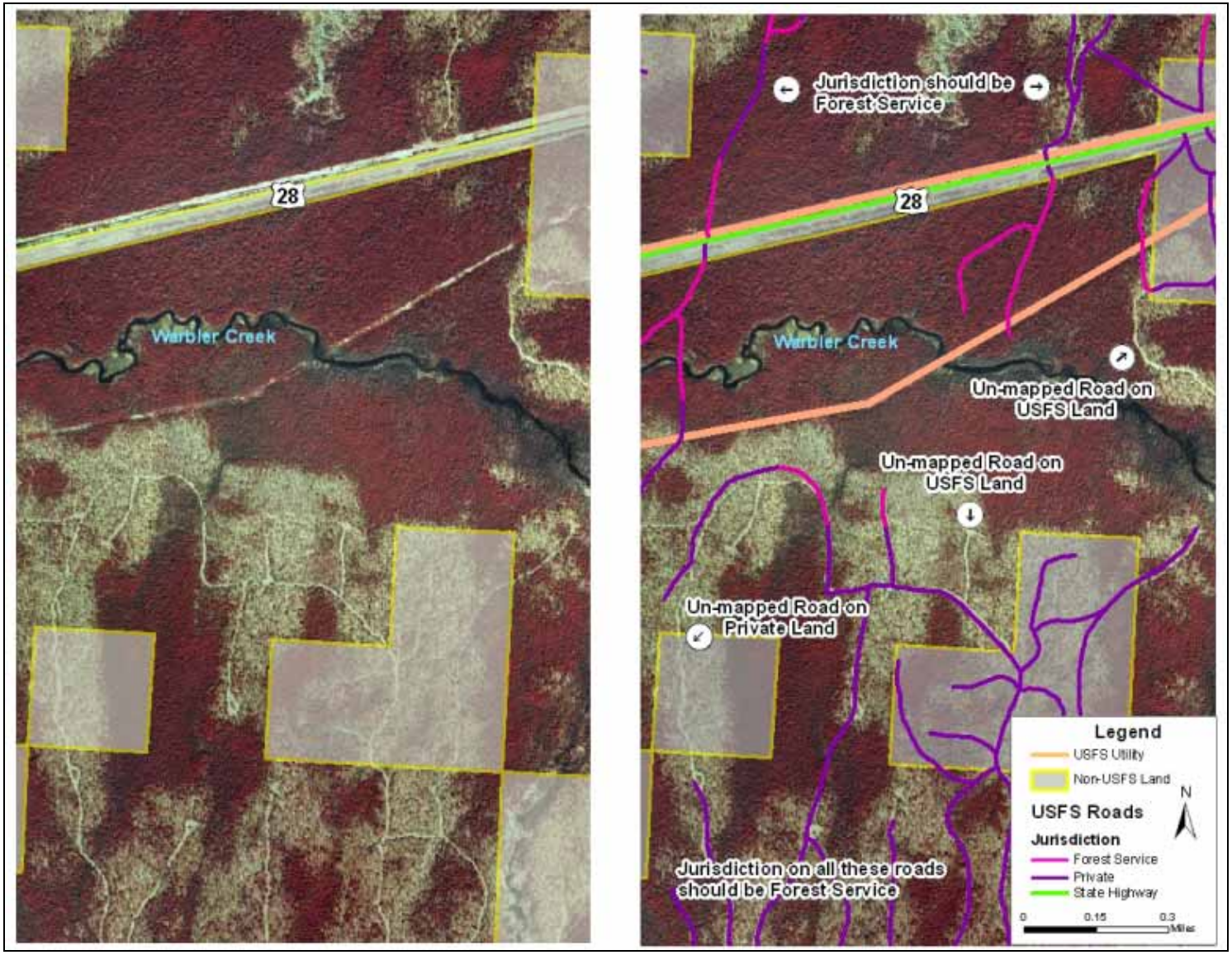

Figure 4. Paired maps illustrating roads misclassified by jurisdiction in the USFS Roads layer. These misclassified roads have no OML classification.

Because of the problems discussed above, the Forest Service has two incomplete, and differently flawed road layers that cannot be easily combined without duplicating or eliminating valid road mileage. Because the mapped location of a road is sometimes different in the USFS Roads layer than the Improved Roads layer it is not possible to automatically identify which roads are missing from one layer or the other by simply overlaying them. In addition, it is not possible to cross-reference these by their road number since many of the roads are not classified. Some automated methods can be used to preliminarily identify missing data from one or the other layer but to do a good, reliable job requires a significant amount of examination and manual categorization of roads. Even if the National Forest did combine these data to create a new layer with the "best" information from both layers, we found significant problems with non-attributed and undocumented roads that would still prevent a combined layer from accurately portraying the road system. These problems are discussed in detail in the following sections.

Non-Attributed Roads in the USFS Roads Layer

Some of the greatest problems with the ONF's data are related to the massive network of non-attributed roads in the USFS Roads layer. According to the ONF's GIS data, 46% (2868 miles) of the total road mileage in the National Forest has no OML classification (Table 1).

Table 1. Miles of road by OML type on the Ottawa National Forest. Mileages were calculated without removing duplicate arcs, resulting in a total 541 miles greater than actual road mileage..

Type	Miles	% of total mileage
Unclassified	2,868	43%
1	2,504	37%
2	678	10%
3	231	3%
4	322	5%
5	71	1%
Decommissioned	62	1%
TOTAL	6,735	100%

We examined the non-attributed roads in relation to 1998 orthophotography and found categorization of these roads to be confusing. When viewed as an overlay on the orthophotography, it is clear that non-OML classified roads represent a wide variety of road types and conditions, from completely overgrown or non-existent to being very similar to roads with OML attributes. Figure 5 shows two extremes of roads that are both lacking OML classification.

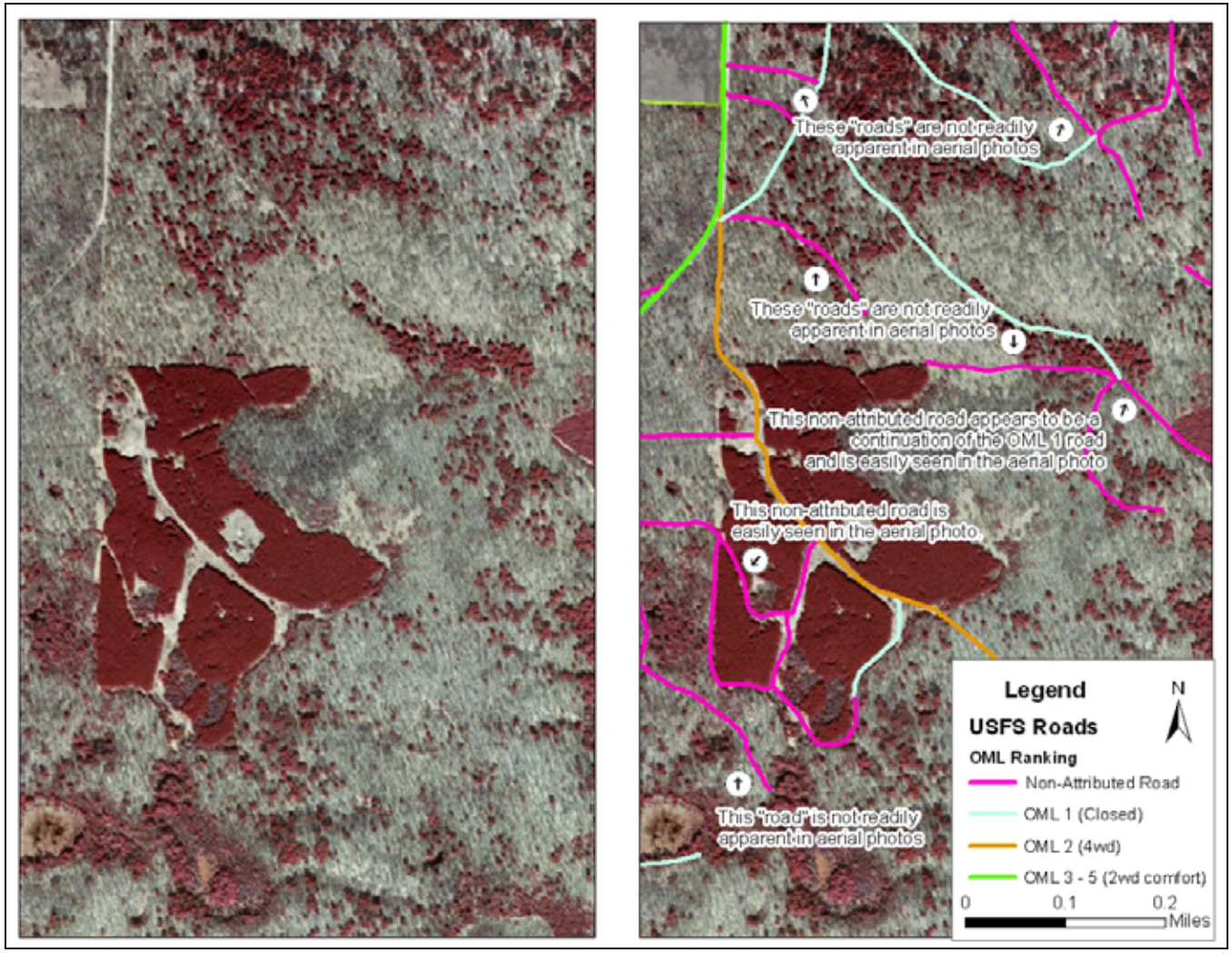

Figure 5. Paired maps showing examples of the variation between non-attributed road types in the USFS Roads layer. On the orthophoto, many non-attributed roads are not apparent or look overgrown, while some are easily seen and look to be similar to roads containing OML attributes.

Spatial Accuracy of Roads and Trails data

We found the spatial accuracy of the roads and trails data to be highly variable and in some places, extremely poor. We did not conduct a quantitative assessment of spatial accuracy, which would be a large and complex task. We did however, record locations of particularly inaccurate road and trail locations in our GIS as we were evaluating other aspects of the ONF's road and trail data. We found many examples of poorly mapped roads and trails, some as much as ¼ kilometer from their true location (Figure 6). Because of the high level of spatial inaccuracy of the Forest Service road mapping, it is difficult to discern in some places whether a road which appears in aerial photography represents a mismapped road or an undocumented road that has never been mapped.

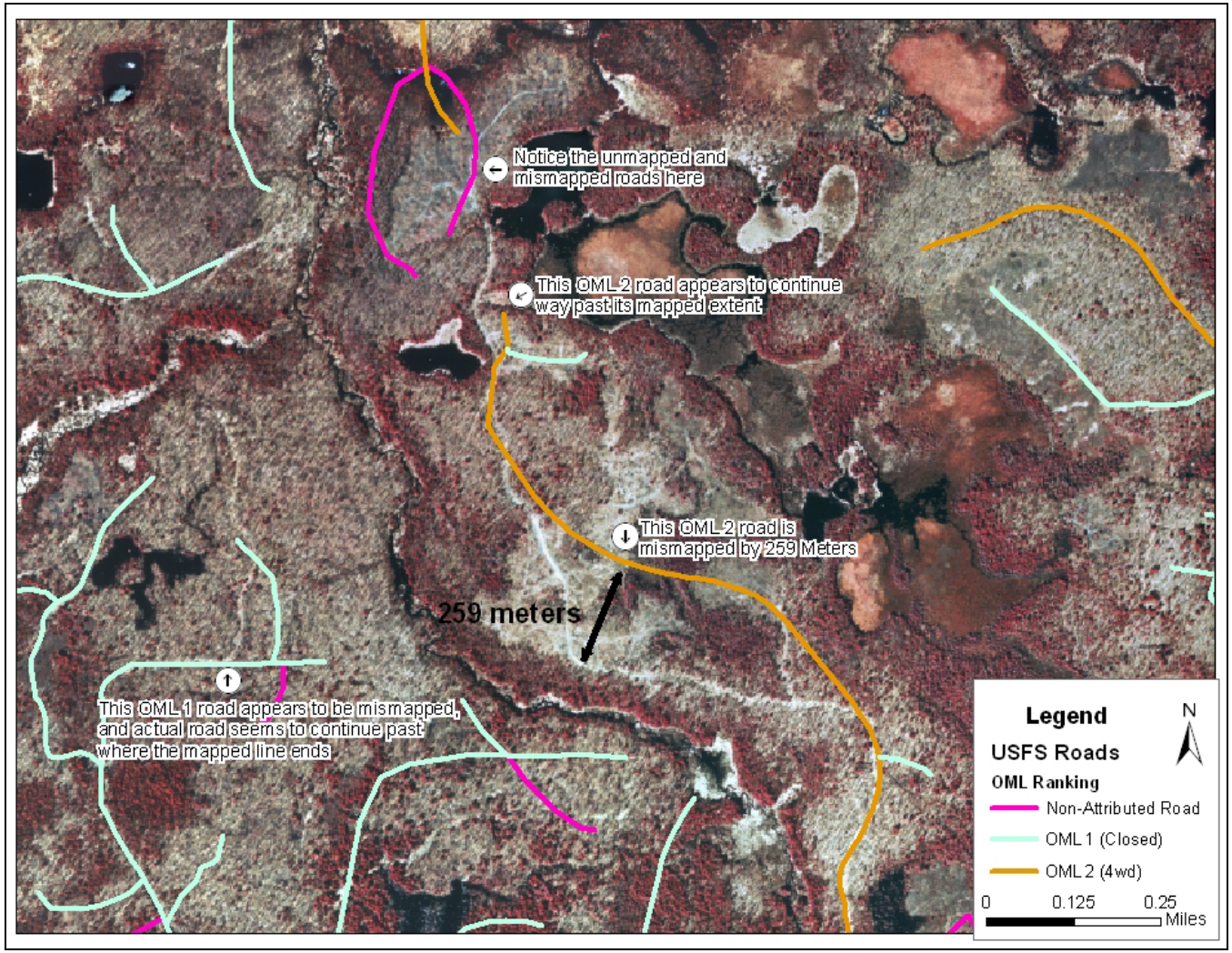

Figure 6. Map showing inaccurately mapped roads.

Undocumented Roads and Trails

By examining the 1998 orthophotos we found 325 miles of roads/trails (PBI Level 1 and 2) on National Forest land that are likely usable by passenger vehicles, high clearance vehicles and/or OHVs but are not documented in the USFS Roads or Improved Roads data (Table 2). This is a conservative estimate and does not include an additional 325 miles of undocumented roads/trails (PBI Level 3), which appeared somewhat overgrown but potentially usable as snowmobile and/or OHV routes. Many of these PBI Level 3 features may also be usable by high clearance vehicles. Examples of PBI digitized roads or trails are in Figure 8.

We combined the above types of undocumented roads with the USFS Roads layer (minus the mileage of duplicate arcs) to calculate our best estimate of actual road mileage and density in the Ottawa National Forest. We compared this to road mileage and density calculated from the USFS Roads layer alone.

We found that the total road mileage for National Forest lands increased by 10%, from 6,194 miles to 6,844 miles, when undocumented roads were considered. Road density increased from 3.99 miles per square mile to 4.41 miles per square mile for the same area (Table 3).

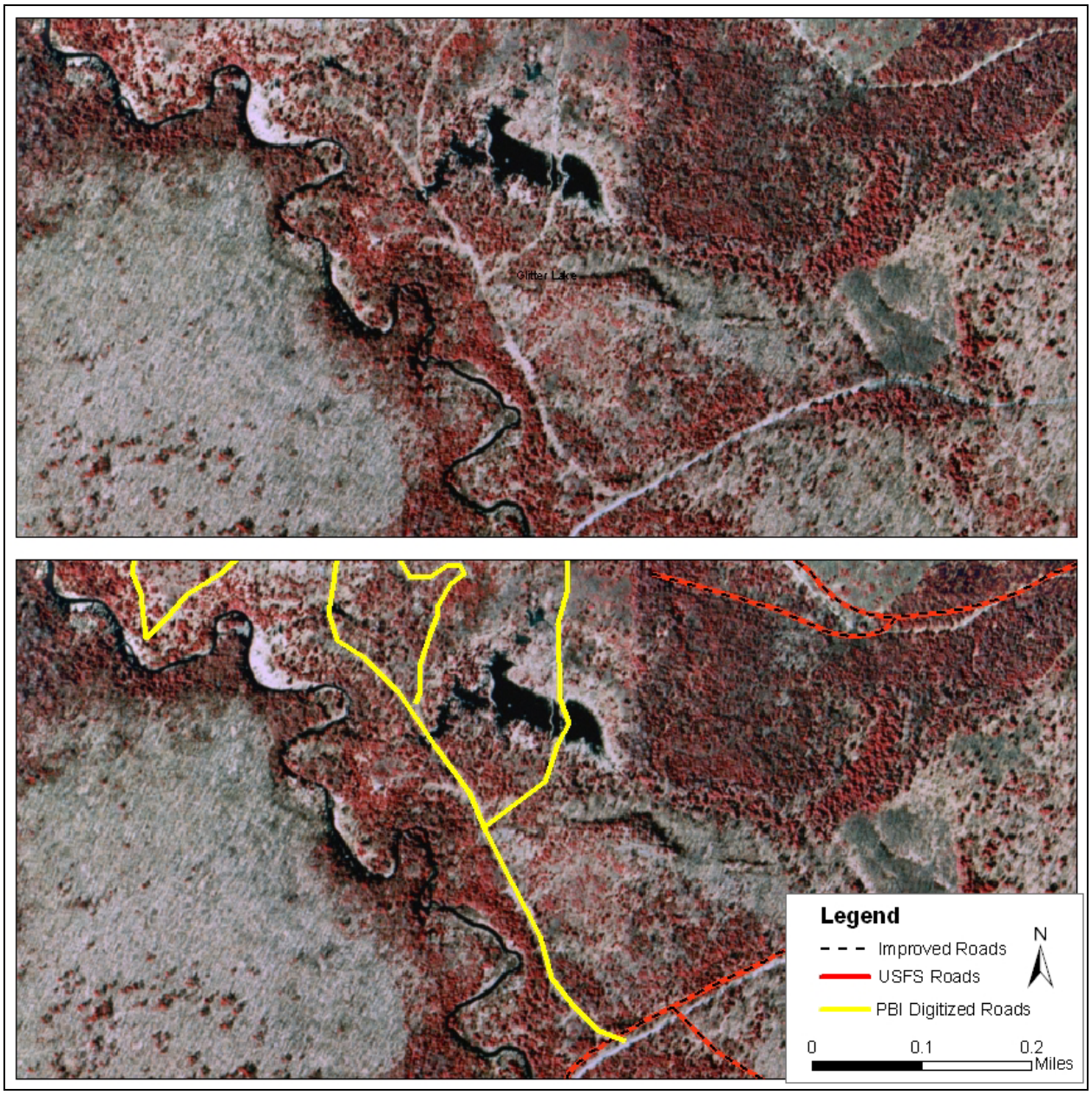

Figure 7. Paired maps showing roads undocumented by the Forest Service in both the USFS Roads data and Improved Roads data.

Table 2. Miles of road on Forest Service ownership that are visible on 1998 orthophotos but not included in the USFS Roads GIS layer.

Road Type	Miles of Road
Roads/Trails undocumented in both USFS Roads and Improved Roads GIS layers that were photo interpreted and digitized by PBI	
PBI Level 1 roads/trails - passable by passenger vehicles	4
PBI Level 2 roads/trails - passable by high-clearance vehicles and/or OHVs	321
Total PBI Levels 1 & 2	**325**
PBI Level 3 roads/trails – overgrown, but probably passable by snowmobiles and/or OHVs, and possibly high-clearance vehicles	325
Total PBI Levels 1, 2, & 3	**650**

Table 3. Differences in road mileage and density when calculated for roads documented in the USFS Roads layer versus actual roads (USFS Roads plus undocumented roads).

Road Type	Miles of Road	Road Density (miles/square mile)
USFS Roads	6,194	3.99
All actual roads and trail features not included in USFS layer (PBI Level 1 – 3 roads mileage from Table 3)	650	0.42
Total Roads	6,844	4.41

Evaluation of Roadless Area Maps

Considering all the wilderness and roadless areas mapped by the ONF between RARE II and the 2003 roadless inventory, the Forest Service has identified 4 roadless areas totaling around 60,520 acres (excluding the Cyrus H. McCormick Experimental Forest).

In dramatic contrast to the roadless area mapping conducted by the Forest Service, Pacific Biodiversity Institute found 36 roadless areas over 5000 acres in size totaling 327,483 in the Ottawa National Forest (Figure 10). We also found 134 roadless areas between 1000 and 5000 acres in size totaling 371,658 acres in the Ottawa National Forest. The differences between our roadless inventory and those conducted in the past by the Forest Service are listed in Table 4 and illustrated in Figures 8 through 11.

Table 4. Comparison of Forest Service roadless area inventories with that of Pacific Biodiversity Institute.

Roadless Description	Area (acres)
Forest Service RARE II roadless	44,447
Forest Service IRA 2003 roadless	16,072
Actual roadless areas 1000 to 2500 acres in size as mapped by PBI	98,448
Actual roadless areas 2500 to 5000 acres in size as mapped by PBI	273,210
Actual roadless areas greater than 5000 acres in size as mapped by PBI	327,483
Actual roadless areas of all sizes mapped by PBI	699,141

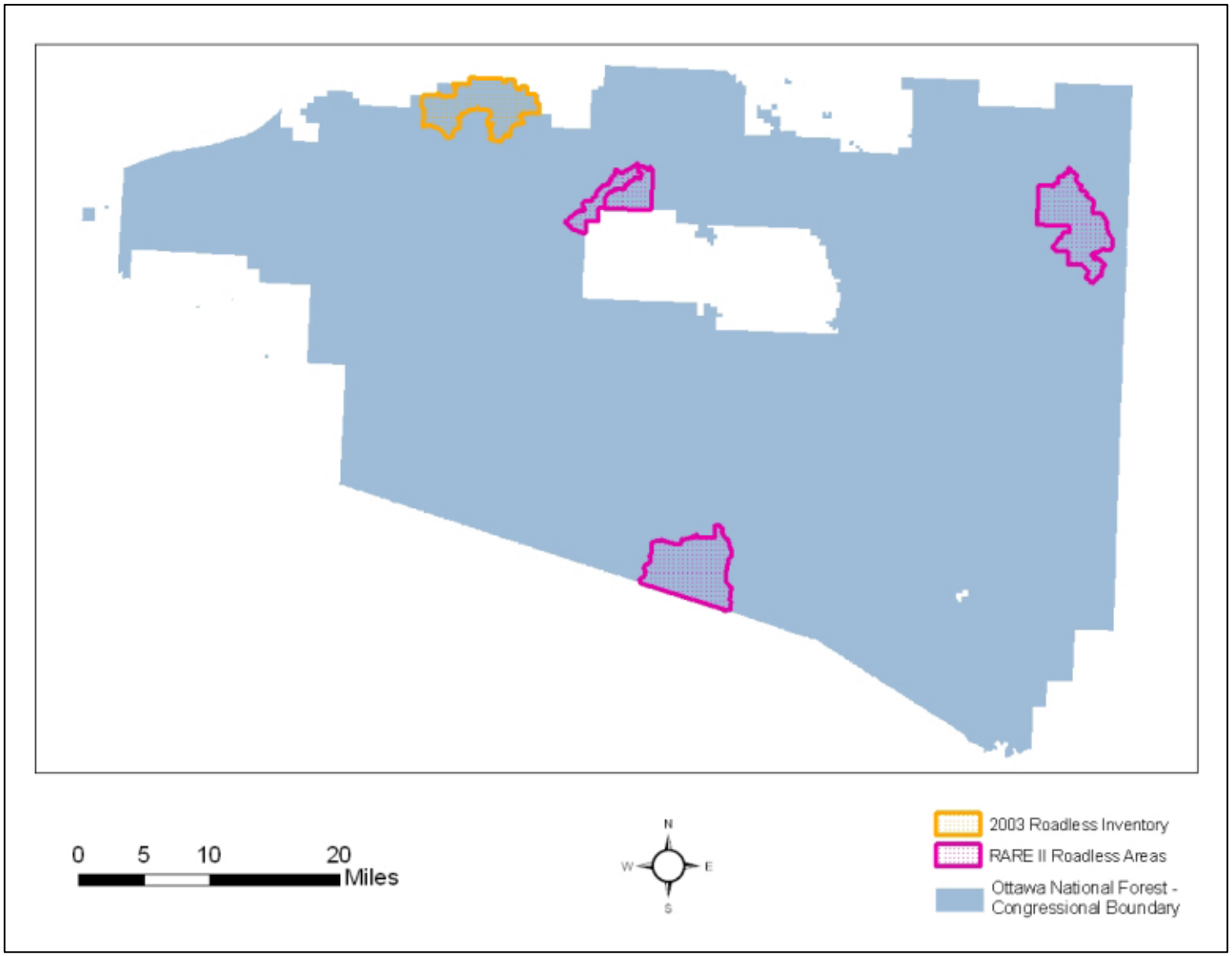

Figure 8. Map showing the RARE II roadless areas and Inventoried Roadless Areas delineated in the 2003 Forest Plan Revision Potential Forest Roadless Inventory.

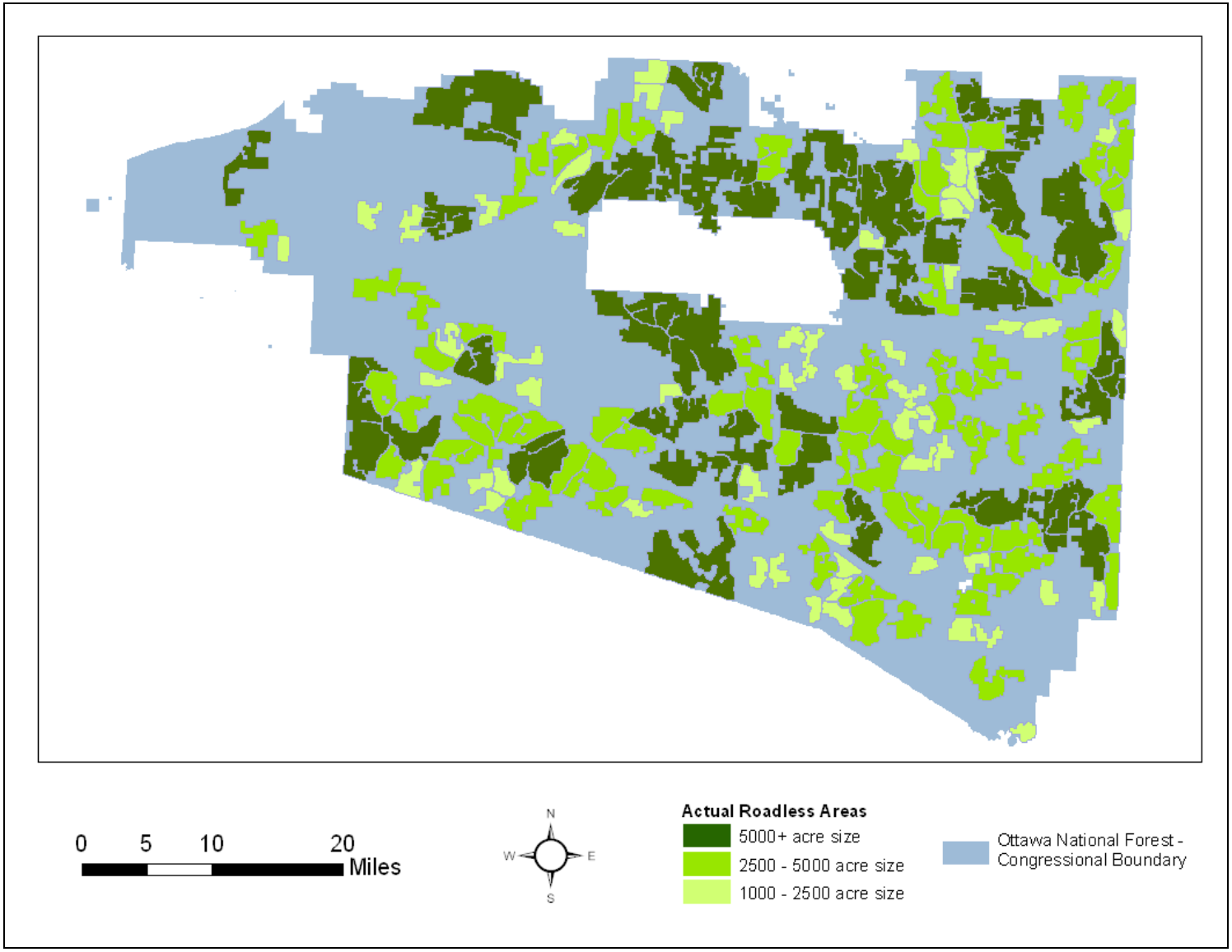

Figure 9. Actual roadless areas delineated by Pacific Biodiversity Institute using the most current information on roads and development.

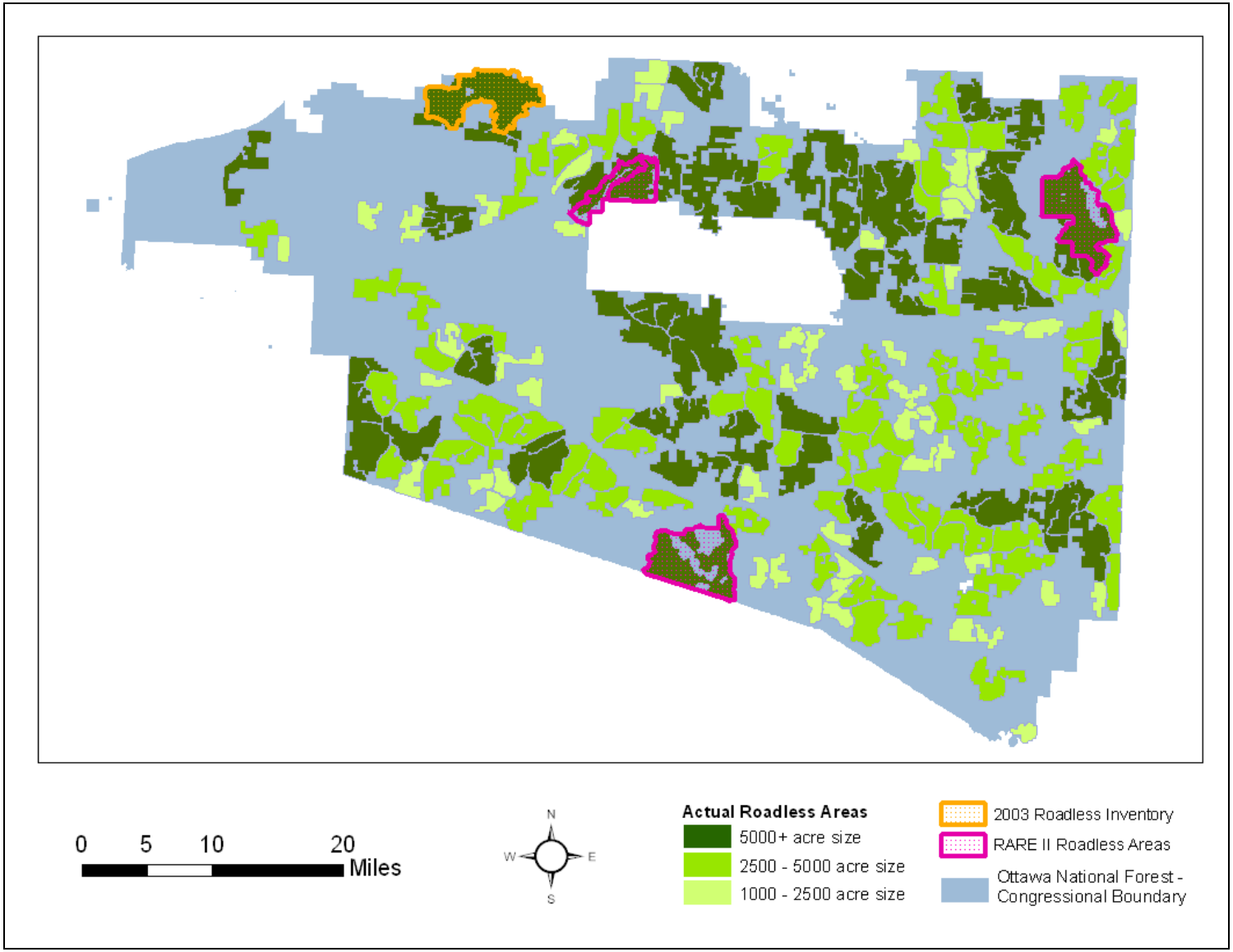

Figure 10. Map comparing the actual roadless areas delineated by Pacific Biodiversity Institute with Inventoried Roadless Areas delineated in the 2003 Forest Plan Revision Potential Forest Roadless Inventory and in RARE II.

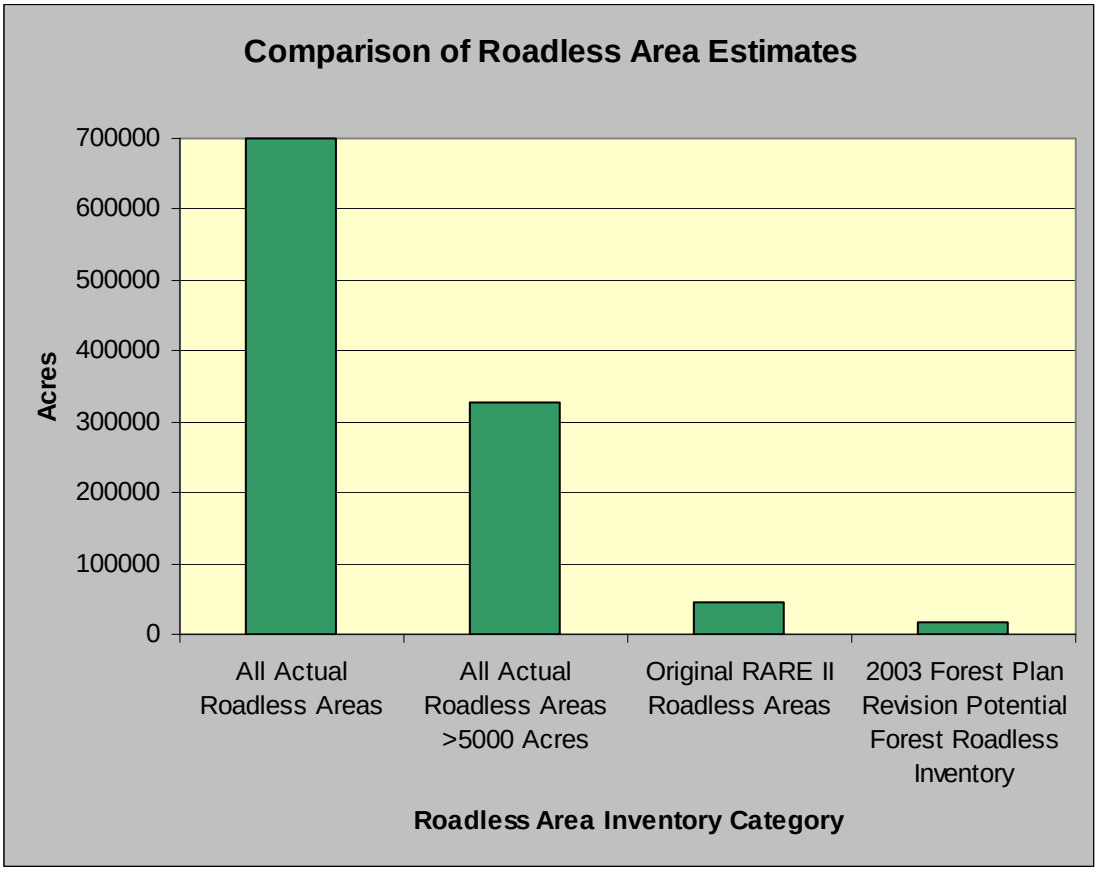

Figure 11. Comparison of actual roadless areas mapped by PBI in the Ottawa National Forest in 3 size classes with the original Forest Service RARE II roadless areas and the Inventoried Roadless Areas delineated in the 2003 Forest Plan Revision Potential Forest Roadless Inventory.

DISCUSSION

Our staff has evaluated the quality of both road and roadless area maps and related GIS data in all National Forests of the United States. From the analysis we conducted for this report, we feel the road data and the data on roadless areas managed by the Ottawa National Forest contain sufficient amounts of inaccurate information to warrant concern for the effects of these inaccuracies on transportation-related analyses and other assessments that the National Forest may make. Many National Forests across the country have developed highly accurate data on the location and classification of their transportation network and it is advisable that the Ottawa National Forest undertakes improvement in this regard.

One of the greatest challenges we found in working with the Forest Service's roads and roadless data is the high level of inconsistency within and between its GIS data layers. Despite intensive and extensive review of the data in relation to current landscape conditions (as visible in the 1998 orthophotos), we were unable to find patterns or understand the logic as to why some roads and roadless areas were included or excluded from their data layers. For example, many areas that are actually roadless were not included in their roadless area layers while other roaded and logged areas (such as areas within the Ehlco proposed IRA) were mapped as roadless. The ONF cites road density as the justification for eliminating 46 of 47 roadless area polygons (all polygons except the Ehlco proposed IRA) from their 2003 Forest Plan Revision Potential Forest Roadless Inventory, including the RARE II mapped Norwich Plains IRA. However, slight boundary modifications on the part of the ONF analysis team (which arbitrarily mapped possible roadless area boundaries to begin with) could have easily amended the road density calculations to be less than .5 miles of improved road per 1000 acres, the density limit being used by the ONF assessment team as the cutoff parameter. 7 of the 47 polygons had only 0.6 miles of improved roads per 1000 acres, and at least 47% of the polygons had less than 1 mile of improved road per 1000 acres. The 2003 inventory mapped 398,603 acres of roadless area within those 47 polygons, and it is clear from our own roadless area analysis that many of these polygons should not have been eliminated as possessing roadless area potential due to the road density calculations.

Typically, roads and trails are some of the easiest landscape features to map. Roads tend to be prominent features on aerial photography and their location can easily be checked using digital orthophotos and other image data. Roads can also be easily mapped on the ground using GPS technology. The Ottawa National Forest has access to high quality, recent orthophotography that covers much of its area. While it cannot be used to classify or map roads at the level of detail needed by the Forest Service for management purposes, particularly in areas of high canopy cover, it can be used to easily improve spatial accuracy of roads and trails and identify some existing roads and trails that are missing from current data sets. In this report, we demonstrated several situations where, by simply reviewing the Forest's GIS data in relation to orthophotography, we were able to provide substantial improvements to their data.

The Forest Service data shows 6,194 miles of road with a road density of 3.99 miles per square mile. Using our data improvements we calculated 6,844 miles of roads with a road density of 4.41 miles per square mile – a 10% increase in road miles and density. Increases in road mileage are significant because they can have substantial and disproportionate influence on many measures of landscape fragmentation, such as patch size and core areas (Hawbaker and Radeloff 2004). Road density and fragmentation measurements are important for the management of some sensitive species in the Forest, including lynx and wolves (Mladenoff et al. 1995, Mech et al. 1988).

The Forest Service's RARE II roadless areas and Inventoried Roadless Areas under the 2003 Forest Plan Revision Potential Forest Roadless Inventory map 60,520 acres of roadless lands in the ONF (excluding the Cyrus H. McCormick Experimental Forest). Using Improved Roads data and a clear methodology for consistent mapping of roadless areas, we found 327,483 acres of roadless lands within roadless areas of 5,000 acres or greater. In addition, we found many smaller roadless areas less than 5,000 acres in size.

It is clear from this analysis that despite heavy roading in some areas, significant unprotected roadless lands remain within the Ottawa National Forest. Many roadless areas are smaller than 5000 acres in size and are partially penetrated by roads. The wildlands that once existed in the Ottawa National Forest are now highly fragmented, but some relatively large, and many small roadless patches remain throughout much of the forest. Given its inaccurate data on roadless areas, the Forest Service is unable to portray and consider the ecological value of these true roadless areas in its management decisions.

The many problems we found with the Ottawa National Forest's roads, trails, and roadless area data have the potential to greatly compromise the reliability of transportation-related analyses and other assessments that the National Forest may make, based on the data. Special consideration should be given to the fact that, according to the Ottawa National Forest, these data and analyses derived from them were used to inform the recent process of revising the Forest's Land Management Plan, which will guide Forest management for many years to come.

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