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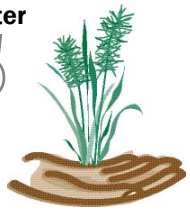

Incorporating Results From the Prioritized "Ecological Hotspots" Model into the Efficient Transportation Decision-Making (ETDM) Process in Florida

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Abstract: In 2000, an expert-based decision-support model to identify and prioritize sites for ecopassages was developed for the Florida Department of Transportation (DOT). The model used a weighting algorithm and several ecological factors (chronic road-kill sites, landscape gradients, focal species hot spots, greenway linkages, presence of listed species, strategic habitat-conservation areas, riparian corridors, rare habitat types, existing conservation lands, and proposed road projects) to prioritize existing road segments for retrofits designed to reduce road-kills and restore important habitat linkages.

In 2003, the Florida DOT began implementing the Efficient Transportation Decision Making (ETDM) process. This process was designed to examine and address potential environmental impacts prior to the planning, design, and construction of new transportation projects. Proposed projects are analyzed using an environmental-screening tool and reviewed by local and state officials and the public.

In 2004-2005, we were engaged by the Florida DOT to update the prioritization-model results for use as a data layer in the environmental-screening process of ETDM. For this purpose the original calculating algorithm was used, with final priorities ranked on a scale of 0 to 1. Many updated coverages were available and cell resolution was improved to increase model precision and accuracy. Updated coverages included roads (including speed limit and annual average daily traffic factors), land cover, road-kills, road projects, and managed conservation lands.

In addition, a new development-threat index based on road density, population density, 2003 existing land use, future land use and municipal boundaries was created. Datasets were combined into six categories for ranking: biological features, landscape features, infrastructure, managed conservation lands, conservation planning, and road-kill. For those road segments prioritized statewide, 72 percent were located in existing protected areas and 27 percent were found in proposed public-conservation lands. Relative weighting and aggregation of data were key determinants to locations of high priority road segments. One hundred seventy-six proposed road projects coincide with prioritized road segments and present significant opportunities for conservation planning.

Introduction

In 2000, an expert-based decision-support model to identify and prioritize sites for ecopassages was developed for the Florida Department of Transportation (DOT). The model used a weighting algorithm and several ecological factors (chronic road-kill sites, landscape gradients, focal species hot spots, greenway linkages, presence of listed species, strategic habitat-conservation areas, riparian corridors, rare habitat types, existing conservation lands, and proposed road projects) to prioritize existing road segments for retrofits designed to reduce road-kills and restore important habitat linkages (Smith 1999).

In 2003, the Florida DOT began implementing the Efficient Transportation Decision Making (ETDM) process. Proposed projects are analyzed using an environmental-screening tool and reviewed by local and state officials and the public. Objectives of the ETDM include:

- Introducing potential environmental and socio-cultural effects much earlier in the planning/project development process
- Studying projects more efficiently
  - Build on agency/citizen input at each stage of review
  - Reduce time and money invested in the project if fatally flawed
  - Discontinue review if environmental impacts are a non-issue
- Expediting permits and project approval

In 2004-2005, we were engaged by the Florida DOT to update the prioritization-model results for use as a data layer in the environmental-screening process of ETDM.

Overview of ETDM

The ETDM process was designed to examine and address potential environmental impacts prior to the development, design, and construction phases of new transportation projects. This process is illustrated in figure 1.

The planning screen involves:

1. Environmental Technical Advisory Team (ETAT) project coordination, review, assessment, and recommendations
2. Community outreach through public meetings and citizen involvement

In the programming screen, ETAT members update the direct-impact assessment and document the "degree of effect," provide scope for technical studies, participate in dispute resolution on significant issues, and establish the FHWA/ FDOT class of action (e.g., EA, EIS). Community outreach is also facilitated by continuing work-program public hearings and making programming summary reports available online.

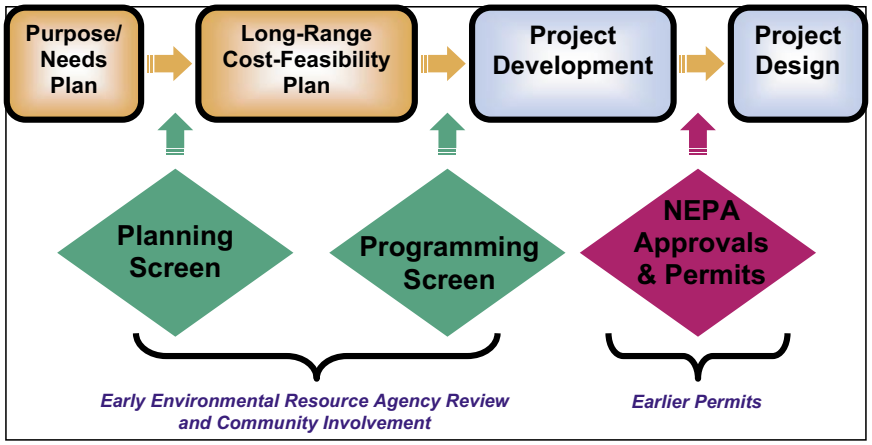

Figure 1. Flow chart of the ETDM process showing environmental-review elements.

Based on data layers associated with each issue, Florida DOT staff performs the GIS analysis (figure 2) on the project. Twenty-one different elements from three issue types (e.g., environmental, social, economic) are evaluated. Approximately 50 different environmental data layers are included in the analysis. Projects can be buffered by five optional distances (100 ft, 200 ft, 500 ft, 1/4 mile, and 1/2 mile) to address potential impacts to adjacent areas.

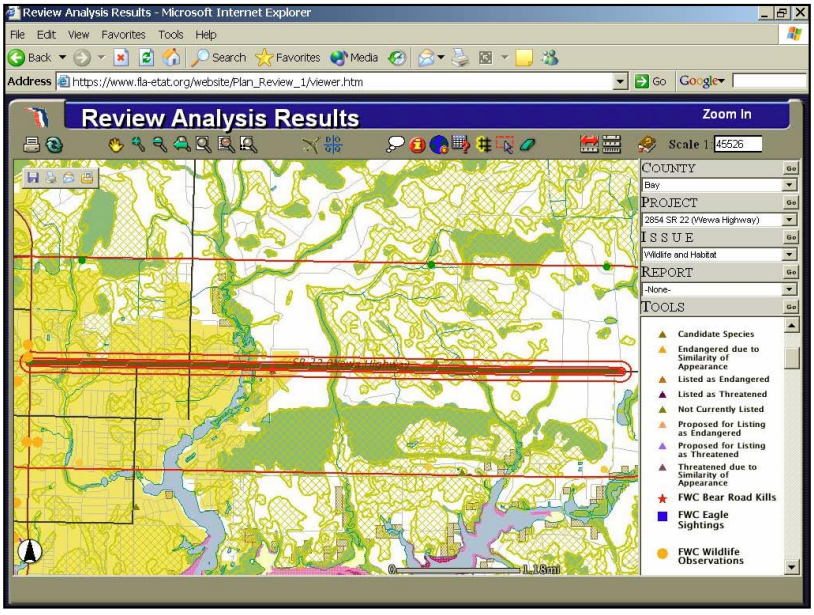

Figure 2. An example of GIS analysis results from the ETDM online environmental-screening tool.

The results of the GIS analysis are made available on the internet to project reviewers. An online Environmental-Screening Tool is used by ETAT members to review the project and evaluate potential impacts (figure 3). This information forms the basis for recommendations to avoid, minimize and/or mitigate potential adverse impacts associated with the project. Recommendations may include additional studies to address identified impacts.

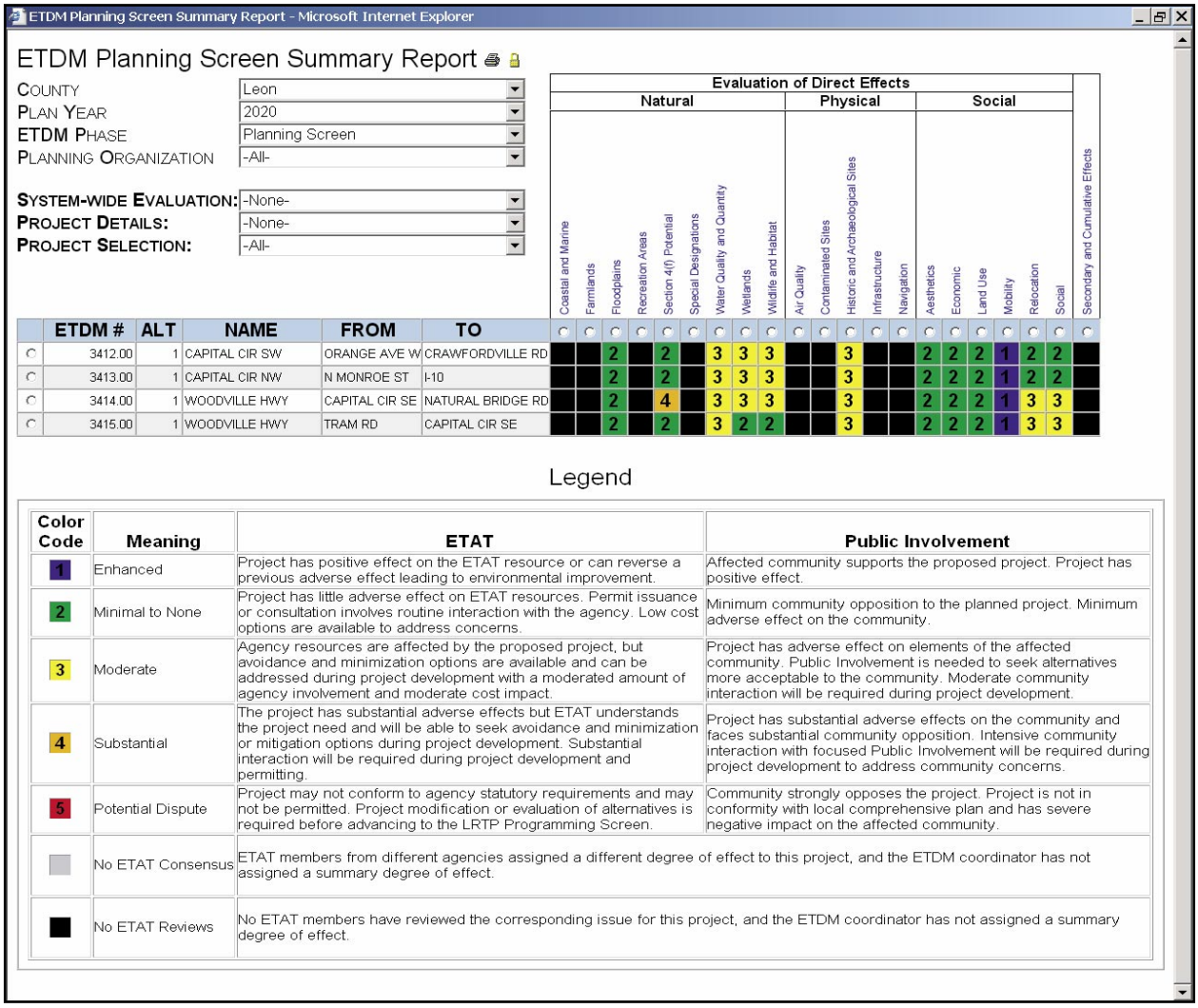

Figure 3. An example of the planning-screen summary from the ETDM online envirThe public has access to several types of online information:

1. Agency reviews of project effects
2. Agency reviews of project purpose and need
3. Environmental-review summary reports
4. GIS analysis results
5. Transportation-plan overview
6. Use of the ETDM Mapper (figure 4)

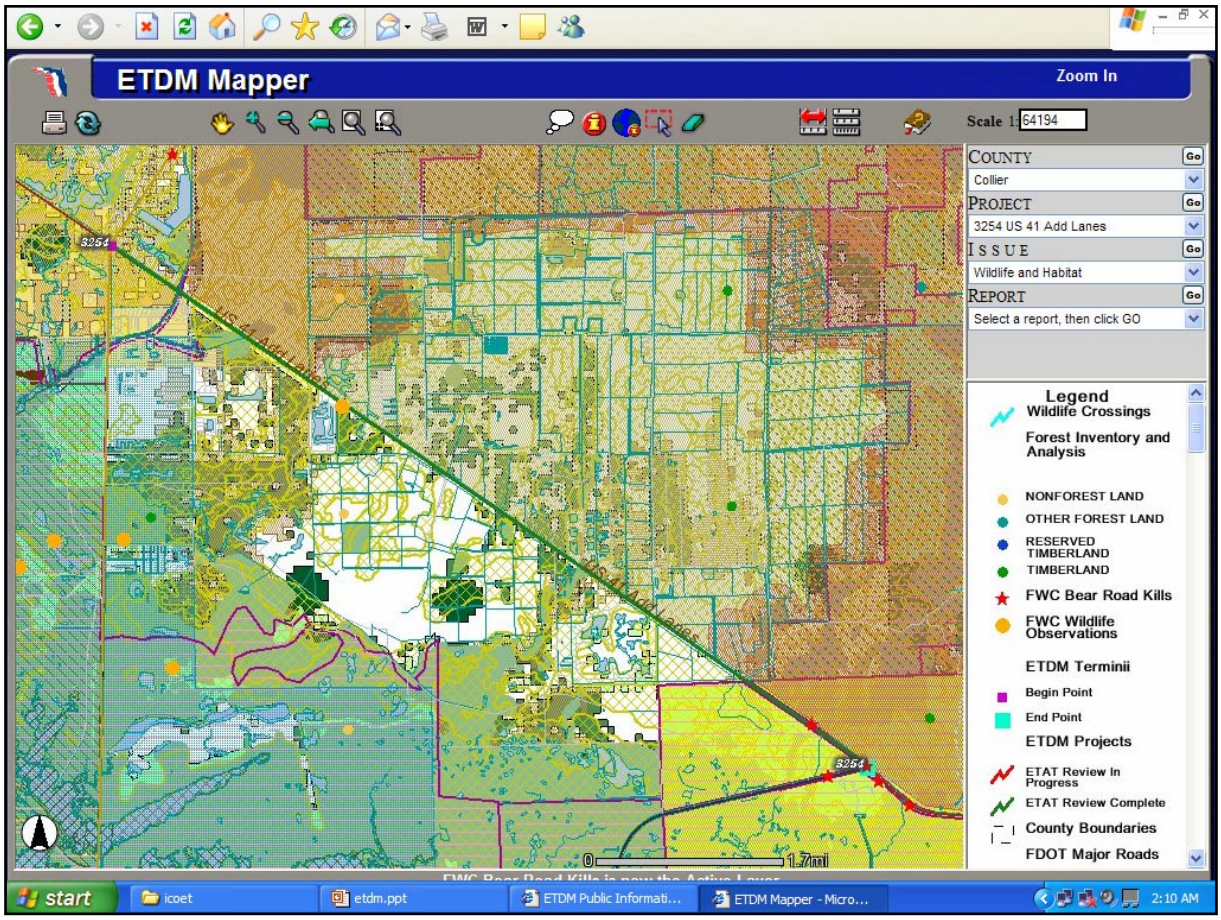

Figure 4. The ETDM mapper. It can be used by the public to see resources potentially impacted by proposed transportation projects.

The "Ecological Hotspots" Prioritization Model

First created in 2000, the model was designed for use by transportation/conservation planners. It integrates state conservation initiatives such as the Florida Greenways (Hoctor et al. 2000) and Florida Forever (the state conservation land-acquisition program) initiatives with transportation planning programs. A McHargian overlay process was employed (McHarg 1971). It combines multiple sets of resources into one data layer to highlight cumulative effects (locations with multiple impacts or "hotspots").

Criteria and rankings were based on responses to a survey conducted at the 1996 International Conference on Wildlife Ecology and Transportation in Orlando, Florida (Smith et al. 1996). Eleven criteria were identified and ranked as follows:

1. Chronic road-kill sites
2. Known migration/movement routes
3. Focal species hot spots
4. Landscape linkages (designated greenways)
5. Presence of listed species
6. Strategic habitat-conservation areas
7. Riparian corridors (with potential for retrofitting existing structures)
8. Core conservation areas
9. Presence of ephemeral breeding sites
10. Public ownership (or in public land-acquisition program)
11. Proposed road-improvement project

Spatial data layers corresponding to these criteria were normalized on a scale of 1 to 16 and grouped into six categories to balance weightings and to account for redundancy of information:

Category	Layers/Elements	Weight
Landscape Features	8	6
Biological Features	2	7
Chronic Road-kill Sites	1	9
Conservation Planning	5	5
Public Ownership	1	3
Infrastructure	1	1

The original calculation algorithm (Smith 2003) was used (figure 5). Final priorities were presented on a scale of 0 to 1 (zero the lowest priority and one the highest priority).

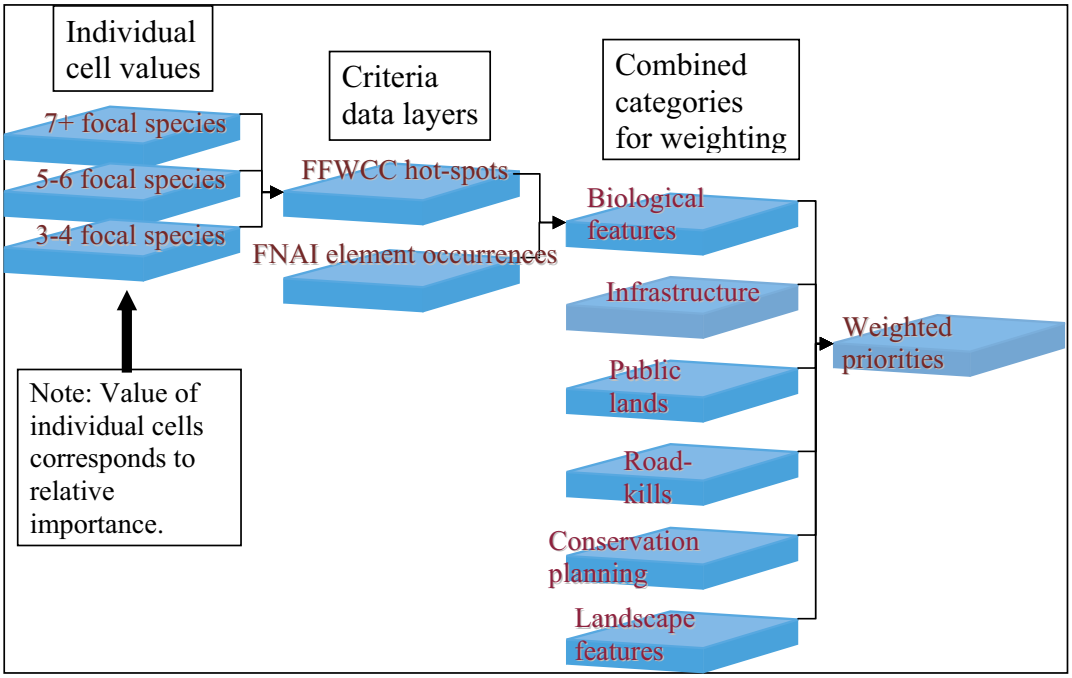

Figure 5. An example showing the function of the analysis algorithm. Each combined category is multiplied by its assigned weighting and then added together to generate a final priorities layer.

Many updated and new coverages were available and cell resolution was improved (from 100 m to 30 m) to improve model precision and accuracy. Updated or new coverages included:

Category	Data Layer
Infrastructure	Road projects (2004-2009) Speed limit
Chronic Road-Kill Sites	Florida black bear (2004) Florida panther (2004)
Public Ownership	Managed conservation lands (2005)
Conservation Planning	Strategic habitat-conservation areas (FWC 2000) Proposed conservation lands (Florida Forever 2005) FNAI priority habitat areas (2003) Greenway final rankings (2004) Integrated wildlife habitat-ranking system (FWC 2001)
Biological Features	FWC focal species hotspots (2000) FNAI element occurrences (2000)
Landscape Features	FWC land cover (2003) FNAI priority wetlands (2003) Intermittent wetlands in natural context Physiographic features Severe slopes

Note Abbreviations: Florida Natural Areas Inventory (FNAI), Fish and Wildlife Conservation Commission (FWC).
References: Cox and Kautz 2000, Endries and Gilbert 2001.

Results of the prioritization process can be applied to different scales (e.g., statewide, state/federal roads template, public roads template). The scale most applicable for use in ETDM is a statewide data layer. Priorities for the entire state are shown in figure 6. The darkest areas shown in figure 6 are the highest priorities and generally correspond to existing conservation lands. Category weighting and aggregation (natural breaks) of data were key elements in the prioritization process. Model priorities indicate significant focus toward nationally and regionally significant conservation areas and riparian corridors. Listed species road-kills (e.g., Florida panther and black bear), element occurrences, and focal species hotspots strongly influenced results due to the high weighting assigned to these criteria.

For state/federal road segments ranked 0.514-1 (figure 7), 72 percent were located in existing protected areas and 27 percent were found in proposed public-conservation lands. One hundred seventy-six road projects from the Florida DOT 5-year work plan coincide with prioritized road segments and present significant opportunities for conservation planning.

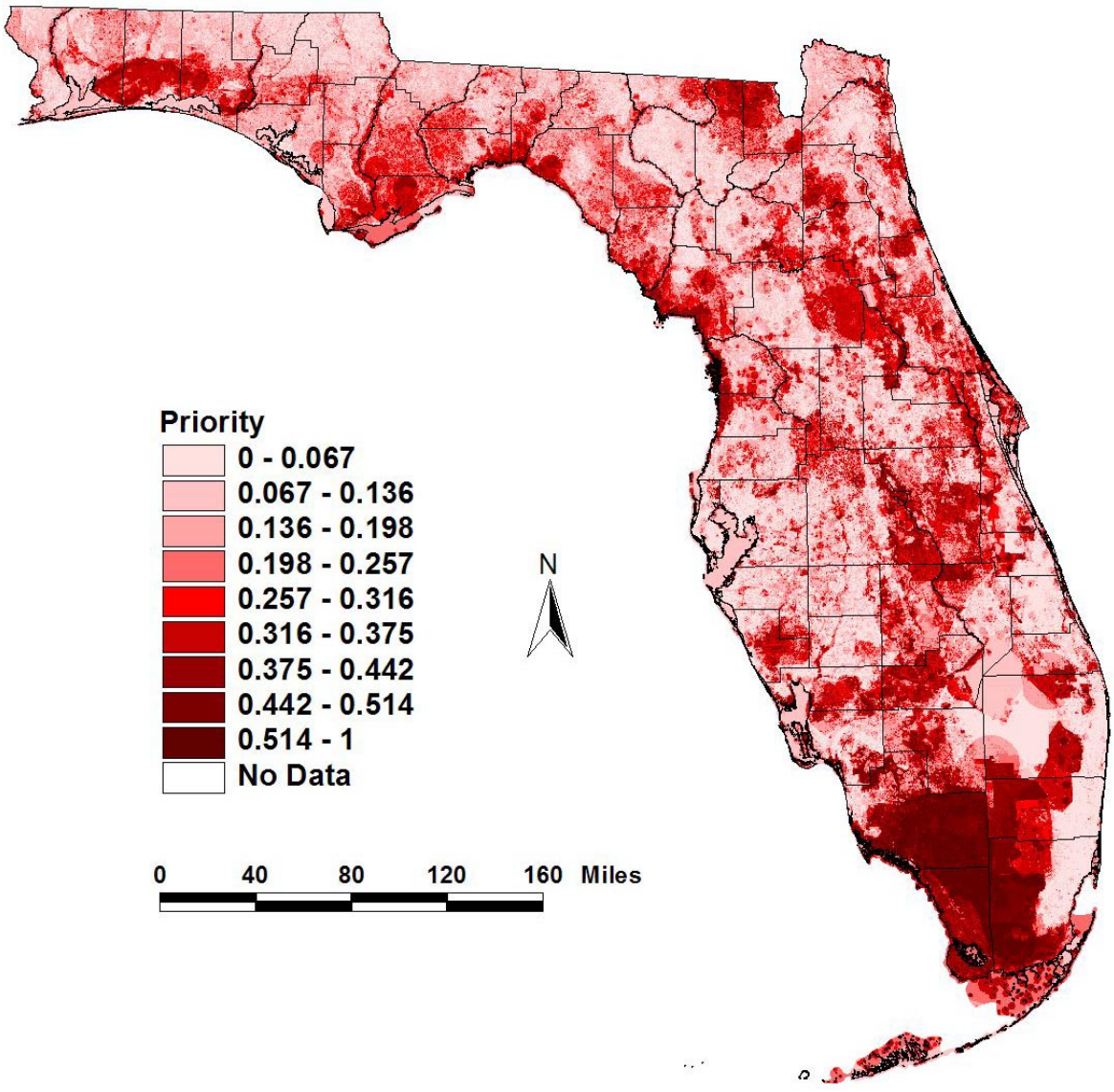

Figure 6. Ecological hotspots–statewide priorities.

In addition to the updated ecological hotspots priorities, a new development-threat index (scale of potential/existing development) based on annual average daily traffic level, road density (km/km2), population density (U.S. Census block groups), 2003 existing land use, MPO urban planning areas, and city/town boundaries was created (figure 8). Water bodies and large wetlands were considered to have no data in this analysis. Noteworthy from figure 8, the areas of greatest threat from development (darkest shades) are located on the fringe of major cities and along major transportation corridors (e.g., interstates, toll roads, and other major federal highways).

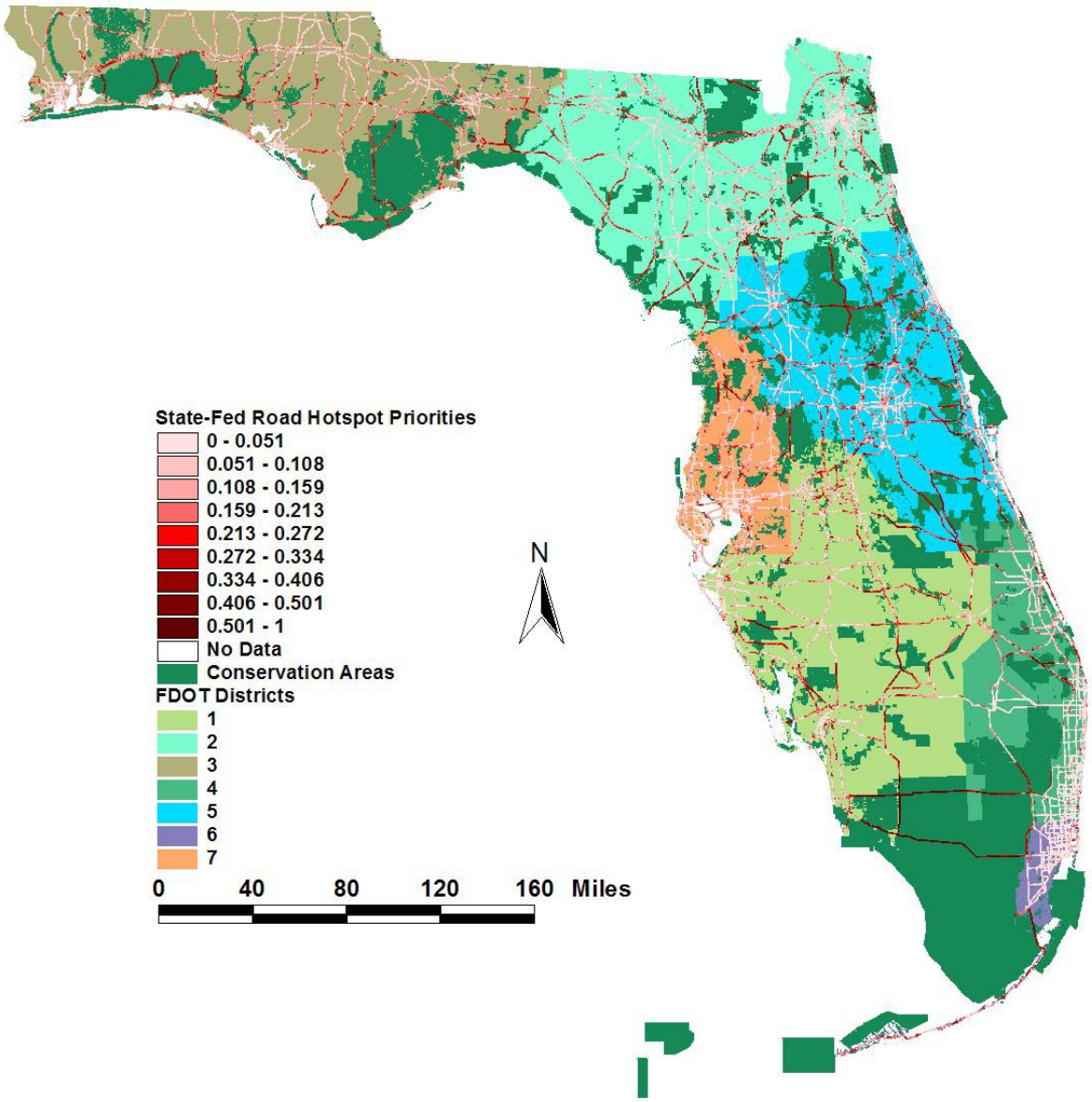

Figure 7. Ecological hotspots–state and federal roads.

Conclusion

ETDM currently provides many environmental data elements that can be examined independently by ETAT members to evaluate potential impacts of individual projects. The prioritized "ecological hotspots" data layer provides ETAT members an alternative method for displaying potential cumulative impacts (in a prioritized format) for any given location. It represents a systematic approach to data synthesis–identifying specific locations (at a 30-m scale) with the greatest potential adverse impacts.

The development-threat index may be most appropriate for use in determining urgency in land-acquisition projects. The prioritized "ecological hotspots" data layer can be used alongside other environmental and cultural resource comparison criteria in ETDM to generate summary reports that official reviewers use to detail the potential project's "degree of effect" and to provide options for adverse impact avoidance and minimization.

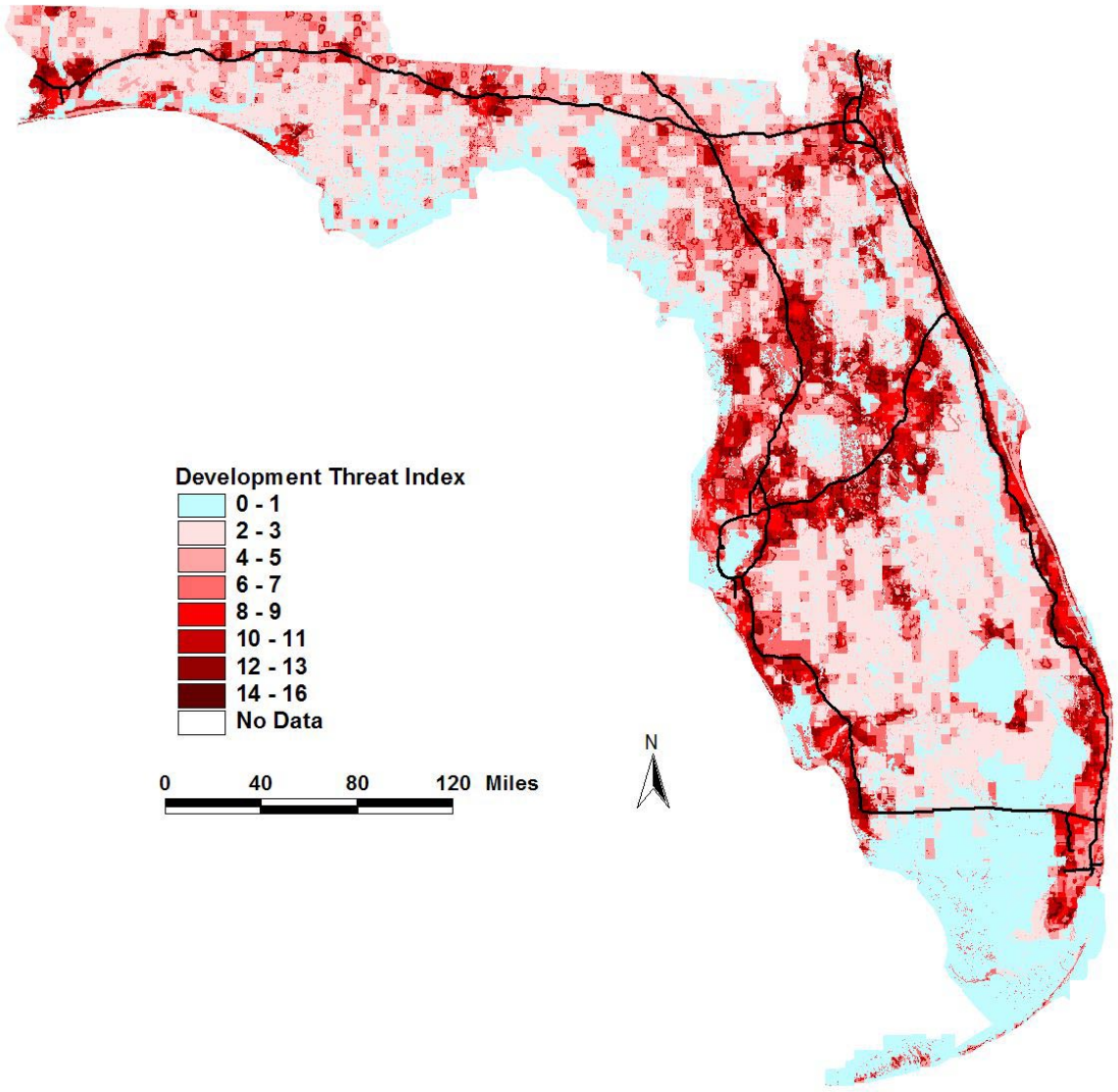

Figure 8. Scale of existing/potential development. It is composed of AADT levels, road density, population density, and existing land use, city/town limits, and MPO planning areas, and 1- and 2-km urban-area buffers.

Biographical Sketch: Daniel J. Smith has a Ph.D. in wildlife ecology and conservation from the University of Florida (2003). He has conducted research on the ecological effects of roads for the past 10 years. Specific research interests include the effects of habitat fragmentation and land management practices on native biodiversity and the change in landscape form and function. He is currently a research associate in the program for conservation biology in the Department of Biology at the University of Central Florida.

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Appendix. Model Criteria and Grid Values.

Category	Criteria	Base Value
Landscape	**Gradients**	
Features	Topography	
	> 75 m	16
	60-74 m	13
	40-59 m	10
	20-39 m	6
	< 20 m	3
	Slope	
	15.4-19.2 degrees	16
	11.5-15.3 degrees	13
	7.7-11.4 degrees	10
	3.9-7.6 degrees	6
	0-3.8 degrees	3
	Physiography (isolated upland features)	
	Ridges	16
	Hills	13
	Inclines	10
	Slopes	6
	Bar	3
	Ecotone (natural lands)	16
	Riparian	
	Streams/lakes/springs in rare habitats	16
	Streams/lakes/springs in native communities	14
	Canals in rare/native communities	12
	Streams/lakes/springs in disturbed natural areas	9
	Canals in disturbed natural areas	7
	All in substantially converted lands	5
	All in urban areas	2
	Intermittent Wetlands (context)	
	Rare habitats	16
	Native communities	13
	Disturbed natural areas	10
	Substantially converted lands	6
	Urban areas	3
	Priority Wetlands (context)	
	Rare habitats	16
	Native communities	13
	Disturbed natural areas	10
	Substantially converted lands	6
	Urban areas	3

Appendix. (Continued).

Category	Criteria	Base Value
Landscape	**GFC Habitat/Land Cover**	
Features	Rare/Important Habitats	16
(cont.)	Native Communities	13
	Disturbed Natural Areas	10
	Substantially converted Lands	6
	Human-dominated Areas	3
Biological	**GFC Focal Species Hotspots**	
Features	10-12 species in wetlands	16
	7-9 species in uplands	12
	4-6 species in uplands/wetlands	8
	1-3 species in uplands/wetlands	4
	FNAI Element Occurrence (listed species locations)	
	Endangered	16
	Threatened	12
	Species of Special Concern/Bird Rookery	8
	Other Rare Species	4
Road-kill	**Road-kill**	
	Endangered Species (panther, key deer)	16
	Threatened Species (black bear)	13
	Parks (t & e), Other Focal Species (river otter, beaver)	10
	Parks—high traffic	7
	Parks—low traffic	4
Planning	**Strategic Habitat-Conservation Areas (FWC)**	
	Seven	16
	Six	14
	Five	12
	Four	9
	Three	7
	Two	5
	One	2
	Proposed Conservation Lands (Florida Forever)	
	Three	16
	Two	11
	One	5

Appendix. (Continued).

Category	Criteria	Base Value
Planning	**FNAI Priority Habitat Areas**	
(cont.)	Six	16
	Five	13
	Four	10
	Three	7
	Two	4
	One	2
	Greenway Final Rankings (linkages)	
	One	16
	Two	14
	Three	12
	Four	10
	Five	8
	Six	6
	Seven	4
	Eight	2
	Integrated Wildlife Habitat-Ranking System	
	Nine	16
	Eight	14
	Seven	12
	Six	10
	Five	8
	Four	6
	Three	4
	Two	2
	One	1
Public	**Public Lands (FLMNA 2005)**	
	Public or private trust preserves/national parks	16
	Restricted access public-conservation lands	11
	Multi-use conservation areas	5
Infrastructure	**Road Projects**	
	Proposed, Bridge Replacements	16
	Existing	8
	Speed Limit (non-urban)	
	70 mph	16
	55-65 mph	12
	35-50 mph	8
	15-30 mph	4