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FLORIDA'S COMMUNITIES AT RISK

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1. INTRODUCTION

In 1998, devastating wildfires ravaged Florida, approximately 2,300 wildfires burned nearly 500,000 acres. Hundreds of homes were lost or destroyed, thousands evacuated, and the economic impact of lost timber resources was estimated at 300 million dollars. The Governor responded by establishing a task force to formulate recommendations on ways Florida could reduce its wildfire risk. This group focused on key areas of emergency preparedness, response, wildfire recovery, prevention and mitigation (Wildfire Response and Mitigation Review Committee, 1998).

The committee developed 90 key recommendations that would assist in lessening the social, economic, and ecological effect from wildfire in the state. Recognizing that Florida's unique environment is both prone and ecologically tied to frequent and periodic burning, yet simultaneously experiencing a rapid population growth rate; addressing wildland urban interface issues was seen as paramount. The following Committee's recommendations are examples from the Report that directly focus on land use planning and fire ecology:

- promote compact urban growth through the comprehensive planning process to prevent and mitigate the potential adverse impacts of wildfires on urbanizing areas
- identify fire management areas or fire-prone habitats and provide a disclosure mechanism for current landowners and new buyers

Florida's environment may be unique but the complexity of the wildland urban interface (WUI) issue extends across the entire country. The National Fire Plan, which is comprised of a series of reports, directives, and implementation strategies, sets forth broad action items whereby Federal, State, local, and tribal fire management entities cooperate in dealing with the WUI problem. The report 'A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy – Implementation Plan' (2002) identifies several goals and guiding principles that provide a working framework in which all administrative levels of fire management can successfully reduce wildfire risk to the public.

In 2001, following the development of the National Fire Plan, community at risk lists were generated in the Federal Register (2001). These lists were created in an attempt at determining the impact of federally managed lands on adjacent urban, rural, or suburban centers. No standard definition was applied across the country therefore, the communities could not be ranked or prioritized. Furthermore, it was recognized that much of the land that is being impacted by severe and catastrophic wildfire are those that are private, state, or tribally owned. For Florida, 231 communities were listed in the Federal Register. In order to more systematically address this issue the National Association of State Foresters (NASF) has been tasked with developing a definition of communities at risk and a method for prioritizing such communities. Once formulated, this information will form the foundation to "identify priority fuel reduction and ecosystem restoration projects" (NASF, 2002).

The Florida Fire Risk Assessment System, completed in December 2002, by Space Imaging for the Florida Division of Forestry (FLDOF), is an information system which assists fire managers in prioritizing mitigation projects throughout the state and also functions as a planning tool for local fuel reduction efforts. It provides canned map and report products that illustrate risk areas and allows spatial analysis capabilities. GIS inputs of wildland fire susceptibility, population density, and values at risk, are weighted and combined to develop estimates of "levels of concern." Outputs from the FRAS system were utilized in this study to assess fire ignition probability. This paper outlines an approach that the FLDOF is testing to define and

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prioritize communities across the State. It utilizes spatial analysis to assign communities in the state a ranking of high, medium, or low wildfire risk.

2. METHODS

The methodology employed in this analysis is straightforward, allowing ease of replication and updating with more current information. Geographic information systems (GIS) were used to spatially relate data output that reflects the probability of fire occurring with known locations of communities, thereby providing an indication of the fire probability of an area. Communities were then ranked into high, medium, or low categories. This process will be further described below.

A key index in the FRAS model is the Wildland Fire Susceptibility Index (WFSI). The WFSI indicates areas apt to be impacted by wildfire. It is represented as a value between 0 and 1 and is shown as a percentage. The WFSI integrates the probability of an acre igniting and the expected final size based on the rate of spread in four weather percentile categories into a single measure of fire susceptibility. It is made up of several spatial and non-spatial data layers namely: fuels (Anderson Standard 13); topographic characteristics: slope, aspect, and elevation; historical fire occurrence locations; canopy closure; weather percentile; and spread vs. fire size relationships, all processed together at a 30 meter resolution.

The fire behavior program, FlamMap, developed by the Fire Sciences Lab and Systems for Environmental Management (SEM), both of Missoula, Montana, is used to calculate fire spread rates, flame length, crown fire activity and other characteristics for each cell by percentile weather category. Although several other variables were utilized to develop the final "levels of concern" for FRAS, the WFSI illustrates environmental conditions on a landscape level with potential fire behavior included.

The spatial distribution of the WFSI relative to known cities, communities, urban areas, towns, subdivision etc., provides a means to assess the relative risk these areas are to wildfire. A database of community locations was compiled from several sources: the U.S. Geological Survey's, 'places' database, a vendor based dataset of known places, and the U.S. Census Bureau's urban areas data. Data acquired were in both polygon and point formats at varying scales. All GIS layers were reviewed for applicability and supplemented with additional communities of concern by FLDOF field managers. Staff had discretion to define in their area of jurisdiction what they considered to be a 'community at risk'. Ultimately, a fairly broad definition of community was applied in this analysis; from the largest metropolitan areas of the State to small single-family subdivisions.

A three-mile buffer was generated around these identified communities and a weighted average of the WFS values for each cell within the buffered area was calculated. The three-mile buffer was chosen based on fire behavior under normal weather conditions the distance a fire would spread during a standard fire response cycle of two burn periods. In densely populated areas such as the Tampa Bay area and the Miami-Dade metropolitan area of south Florida where urban sprawl tends to dominate, several communities were analyzed together. Both point and polygon type feature classes were analyzed with industry standard GIS software and then compiled for the final of ranking of high, medium, and low across the state. Although most areas of the state are potentially vulnerable to wildfire impacts this ranking provides a way in which to prioritize fuel reduction and mitigation measures; by targeting specific areas needing treatment.

The average for the point and polygon GIS data layers were combined and summarized; 2381 "community" locations were ultimately evaluated. The results were mapped statewide for verification purposes and to identify spatial patterning.

3. RESULTS

The range of the calculated average WFSI for all communities studied was 0% to 90.35%, with the mean being 14.7%, and the standard deviation 16.09%. Several methods were investigated for categorizing the communities based on the average WFSI within the three mile buffer: natural breaks (method 1) and quantile method (method 2). The natural breaks method finds groups and patterns inherent in the data set. It attempts to form classes so that the differences between the observations within the same class are minimized and the differences between classes are maximized. Jenks optimization algorithm was used within the GIS software. By using the natural breaks method for statistically grouping the communities into three classes the vast majority of the communities ranked in the low and medium group. See Figure 1 for distribution.

Figure 1: Distribution of Ranking

Rank	Break Points (%) Method 1	Break Points (%) Method 2
HIGH	38.22 - 90.35 %	14.95 – 90.35 %
MEDIUM	14.64 - 38.21 %	5.05 – 14.94 %
LOW	0 - 14.63 %	0 – 5.04 %

Sorting and summarizing the communities by the four Florida Division of Forestry administrative regions was conducted in order to better evaluate the spatial distribution of the high, medium, and low communities. See figure 2 for the breakdown of number of communities per region in each class.

Figure 2: Breakdown of Ranking per FL Division Region Using the natural breaks Method

	R-1 North FL	R-2 Northeast FL	R-3 Central Florida	R-4 South Florida	Total
High	--	--	89	150	**239**
Medium	3	51	321	177	**552**
Low	545	579	246	220	**1590**
	548	**630**	**567**	**547**	**2381**

Another applicable approach of classifying data is to equally distribute the communities using the quantile statistical function. In the quantile classification method, data are rank-ordered and an equal number of the enumeration units placed in each class. It is best suited for data that is linearly distributed. See figure 3 for the FLDOF regional ranking of communities using this method.

Figure 3: Breakdown of Ranking per FL Division Region Using Equal Distribution

	R-1 North FL	R-2 Northeast FL	R-3 Central Florida	R-4 South Florida	Total
High	3	65	402	322	**792**
Medium	110	328	200	155	**793**
Low	435	237	54	70	**796**
Total	**548**	**630**	**656**	**547**	**2381**

When using the natural breaks method a noticeable number of communities ranked high in Polk County, Lee County, along east coast of Florida, and around the eastern fringes of Lake Okeechobee. It is interesting to note that there were no high ranked communities in the Panhandle or Northeast regions. Communities that ranked in the medium grouping were distributed across the State; however the low ranked communities were concentrated in the north and Panhandle areas of the State. While using the equal distribution method, although there are a couple high ranked communities in the north, it is clear that south and central Florida have the majority of high and medium ranked communities.

The greatest population of the state is congregated in central and south Florida, so it is not surprising that the greatest number of high and medium ranked communities falls within these regions. There is a visual correlation between the location of these more "at risk" communities, from a probability standpoint, and known wildfire causes in the State. The greatest number of fires is human caused (70-80%), followed by lightning. Many of the cities that ranked high fall along major transportation corridors such as Interstate 4, and Interstate 75.

A problem with the analysis, which somewhat skews the high ranked communities to fall in the south and along coastal areas, is that because the 0 values, which represent "non-burnable" (water or urban), are removed the actual number of cells that are within the buffer that are ultimately calculated may be very few, especially in congested areas. For example, around Miami-Dade only 6% of the buffered area is calculated after the 0 values are removed.

4. SUMMARY

In summary a methodology for ranking the communities at risk in Florida was explored using GIS analysis capabilities. Two methods of categorizing the communities were investigated: natural breaks (Jenks) and equal distribution (quantile). The methodology presented here is meant to be a starting point for additional refinement to the model. This spatial analysis expands and compliments the efforts of the Florida Fire Risk Assessment System by providing fire managers an additional planning and education tool. It provides a means of prioritizing fuel mitigation strategies and sets the framework for localized studies. A way to increase the accuracy of the communities and their locations would be to conduct additional verification of the GIS data layers. By updating the core spatial data layers that describes the location of human land use and settlement patterns; this analysis further defines "community" in the context of fire protection. Enhancing the spatial integrity of the analysis may aide in identifying the unique characteristics, as well as defining the wildland urban interface in this State; information that may allow fire managers to be better equipped at facing the numerous challenges associated with ensuring that the citizens of Florida are safe but also minimizes the negative ecological and economic impact from wildfire. Further exploration may be useful in order to better define what precisely, is a "community" - in the context of wildfire risk and the wildland urban interface.

5. REFERENCES

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