FIRE FUEL MAPPING FOR TEN NORTHEAST REGION NATIONAL PARKS

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INTRODUCTION

The primary objective of this research was to develop fire fuel model maps for ten National Parks in the Northeast Region: Acadia National Park (ACAD), Appomattox Courthouse National Historical Park (APCO), Booker T. Washington National Monument (BOWA), Colonial National Historical Park (COLO), Fire Island National Seashore (FIIS), Fredericksburg and Spotsylvania National Military Park (FRSP), George Washington Birthplace National Monument (GEWA), Petersburg National Battlefield (PETE), Richmond National Battlefield Park (RICH), Thomas Stone National Historic Site (THST). In an attempt to minimize the amount of fieldwork required to construct these maps, we developed a procedure to predict fuel loads and subsequently fuel model from existing vegetation databases.

In preliminary research recently conducted for the NPS (Devine, Millinor, and Smith 2003), we found a one-to-one correspondence between formation level vegetation classes and National Fire Fuel Laboratory (NFFL) fuel models (Anderson 1982) based on field data collected at BOWA and GEWA. In those two parks, we found that each vegetation formation corresponded to only one of the 13 NFFL fuel models.

METHODS

We collected fire fuel load data each park. The sample of data collection points within each park was stratified by vegetation type to insure that data would be collected for vegetation types for which we had little or no previous fire fuel data. The number of data collection points per park ranged from 4 to 101, as follows:

Park	Points
ACAD	101
APCO	4
BOWA	9
COLO	16
FIIS	25
FRSP	13
GEWA	28
PETE	14
RICH	11
THST	8

At each point, field crews measured downed woody debris using Brown's transect lines (Brown, 1974) and an ocular estimation procedure (Burgan and Rothermel, 1984) as well as canopy cover, average stand height, and height to live crown base. Field data collection procedures are described in detail by Smith (2003). On average, it took a two-man field crew two hours to take and record measurements at each field location. We entered these data into MS Access databases (one for each park) each of which is linked to a corresponding map document created with ArcMap. These data are hyperlinked to the ArcMap points. This link automatically opens MS Access and displays the field data collected at each point along with three photos of the field plot showing the North and East transects along with the full view of the plot.

RESULTS AND DISCUSSION

Analysis of the fire fuel load data included comparing the field data to standard NFFL fire fuel model values following Brown's procedures (1974). We found that fuel loads in these parks were consistently lower than fuel loads reported by Anderson (1982). Undoubtedly, this is due to the fact that Anderson's work is based exclusively on data from the western United States where vegetation and forest characteristics are quite different from those in the eastern states. Therefore, we worked closely with NPS experts to crosswalk vegetation to fire fuel models based on their experience and Anderson's narrative descriptions.

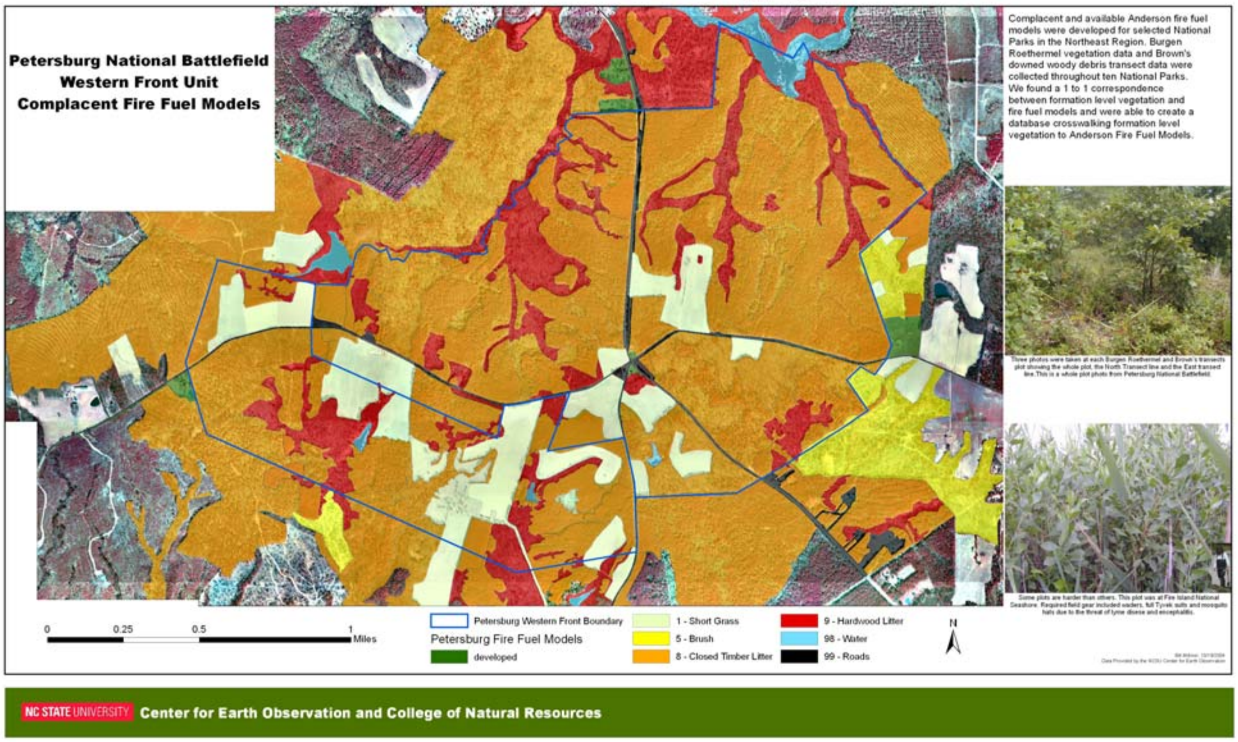
We produced final fire fuel load databases by assigning "complacent" and "available live fuel" fire fuel model values to each formation level vegetation polygon in the vegetation databases. Distinguishing between "complacent and "available live fuel" conditions is extremely important because fire behavior is affected by seasonal differences in vegetation. The "available live fuel" model represents the time period when previously unavailable fuels are available due to seasonal curing and drying of vegetation. For example, many shrub fields are considered to be a barrier to fire spread until a critical live fuel moisture threshold is reached.

As a result of this effort, we have created a fairly comprehensive database of complacent and available fuel loads by vegetation type that could be used to crosswalk formation level vegetation from other sites to NFFL fuel models (Appendix A). We also have a large database of Brown's and Burgan and Rothermel data that could be used to create custom fire fuel models for eastern landscapes or, at least, to generate numbers more useful in determining fire fuel models for National Parks in the east. The field plot photos were very helpful in crosswalking the vegetation to the fire fuel models. In future work we will take an additional field photo looking up at the canopy of the field plot to help in characterizing canopy closure and crown bulk density.

For ACAD and FIIS we created the full suite of data needed for FARSITE (fuels, canopy cover, elevation, aspect, slope, stand height, crown base height, and crown bulk density). With this data, a user only needs to input local conditions such as weather and wind to run a full FARSITE simulation.

An example fire fuel map of the Eastern Front Unit of Petersburg National Battlefield is shown below.

Anderson Fire Fuel Model Mapping



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Appendix A. Formation-Level Vegetation and Associated Fire Fuel Models

	Fire Fuel Model	
Formation-Level Vegetation Class	Complacent	Available Live
Mitchell codes:		
1.1.1 Developed Deciduous	1	1
1.1.2 Developed Coniferous	3	3
1.1.3 Developed Mixed	9	9
1.2 Developed Open Land	1	1
Anderson lulc codes:		
11	blank	blank
12	blank	blank
13	blank	blank
14	99	99
15	blank	blank
16	blank	blank
17	1	1
51	98	98
52	98	98
53	98	98
54	1	1
NVCS formation codes:		
I.A.4.N.a	8	9
I.A.8.C.x	8	9
I.A.8.N.b	8	9
I.A.8.N.c	8	9
I.B.2.N.a	9	9
I.B.2.N.d	9	9
I.B.2.N.e	9	9
I.B.2.N.g	9	9
I.C.3.N.a	8	9
I.C.3.N.b	8	9
I.C.3.N.d	8	9
II.A.4.N.a	8	9
II.A.4.N.b	8	9

	Fire Fuel Model	
Formation-Level Vegetation Class	Complacent	Available Live
II.A.4.N.f	8	9
II.B.2.N.a	9	9
II.B.2.N.f	9	9
III.A.2.N.a	5	6
III.A.2.N.f	5	5
III.A.2.N.g	5	5
III.B.2.N.a	5	6
III.B.2.N.d	5	5
III.B.2.N.e	6	6
III.B.2.N.f	5	5
III.B.2.N.g	6	6
III.B.2.N.h	1	1
IV.A.1.N.a	2	3
IV.A.1.N.b	5	5
IV.A.1.N.g	5	5
IV.B.2.N.a	5	5
V.A.5.N.c	1	1
V.A.5.C.x	1	1
V.A.5.N.c	1	1
V.A.5.N.e	1	1
V.A.5.N.k	1	1
V.A.5.N.l	1	1
V.A.5.N.n	1	1
V.A.7.C.a	1	2
V.B.2.N.d	1	3
V.B.2.N.g	1	3
V.C.2.N.a	1	3
VI.B.1.N.c	1	1
V.I.C.2.N.a	98	98
VII.A.2.N.a	1	1
VII.C.2.N.d	98	98
VII.C.4.N.d	98	98
Agricultural	1	1
Beach	99	99

	Fire Fuel Model	
Formation-Level Vegetation Class	Complacent	Available Live
Boardwalk/Dock	blank	blank
Building	blank	blank
Land Use	blank	blank
lawn_cut grass	1	1
mosquito ditch	98	98
No Data	blank	blank
Residence/Building	blank	blank
Road	99	99

	Fire Fuel Model	
Formation-Level Vegetation Class	Complacent	Available Live
Rock Pile or Jetty	blank	blank
Sand Road/Path	blank	blank
Small Island with Vegetation	blank	blank
Sparseley Vegetated Sand	blank	blank
Water	98	98

Bill Millinor is a Research Associate at North Carolina State University's Center for Earth Observation. He focuses on GIS research and development for inventory and monitoring and fire projects for the National Park Service (NPS). He just completed a four year project to develop formation level vegetation maps and corresponding fire fuel maps for more than ten National Parks. He has also worked on the creation of orthophoto mosaics for more than thirty National Parks to be used in park management and research applications. He is currently focusing on methods for timely updating of fire fuels and vegetation databases and on setting up ArcIMS and ArcSDE servers for distribution of NPS GIS data.

Dr. Hugh A. Devine chairs the University GIS faculty at N.C. State University in Raleigh, North Carolina. In addition, he is a Professor in the Parks, Recreation and Tourism Management Department and holds appointments in both the Forestry and Landscape Architecture Departments at N.C. State. His research and teaching focus on the application of geographic analysis to public land management and community planning activities with a strong emphasis on the management of National Parks.