Federal Land Assistance, Management and Enhancement (FLAME) Act Suppression Expenditures for Interior and Agriculture Agencies:

July 2012 Forecasts for Fiscal Year 2012

Report Date: June 19, 2012

Executive Summary

The US Department of Agriculture Forest Service (FS) is forecast to spend, with 80 percent confidence, between $729 million and $1.091 billion in Fiscal Year 2012, while the agencies of the Department of the Interior (DOI) are forecast to spend, with 80 percent confidence, between $328 million and $488 million. The median forecast for the FS is $910 million which is below the budgeted amount of $948 million, while the median forecast for DOI is $408 million. Compared to the September 2011 forecast for FY 2012, conditions have become more favorable for active seasons in all regions, and this is mainly attributable to persistent drought conditions in the Southwest and below normal precipitation and above normal temperatures in other parts of the West and part of the East. The FS forecast differs from the annual forecasts utilized in previous FLAME Act reports in that it uses monthly cost data, less regional aggregation, and is more accurate with tighter confidence bands. The DOI agency expenditures are expected to be about average in FY 2012; however, this represents an upward shift from the September 2011 forecast (median forecast of $183 million) primarily due to dry conditions in the Southwest. The DOI forecast differs from previous forecasts with the addition of ocean temperature information to an equation that includes regional drought measures and historical observations.

Overview

Forest Service wildland fire suppression expenditure forecasts have been made for summer fire seasons since 1998 and for annual totals since 2003. The Anti-Deficiency Act[1] requires that the FS expenditures for all activities stay within the budget allocation. To meet this requirement, the Rocky Mountain Research Station began providing monthly forecasts of annual FS suppression expenditures in 1998 for June, July, August, and September. Since FY 2003, the Rocky Mountain Research Station and the Southern Research Station have collaborated to provide early warning forecasts of annual FS suppression expenditures in the fall and spring of the fiscal year[2,3]. With the passage of the Federal Land Assistance and Management (FLAME) Act in 2009[4], both the FS and the DOI are required to produce forecasts of annual suppression expenditures three times during each fiscal year: March, May, and July, with a September outlook for the next fiscal year required when the next fiscal year budget is not approved by Congress and the President by that date. These FLAME forecasts are developed at the Southern

[1] Public Law 97-258 (September 13, 1982), 96 Statute 923, codified by 31 U.S.C. Section 1341.
[2] Prestemon, J.P., K.L. Abt, and K. Gebert. 2008. Suppression cost forecasts in advance of wildfire seasons. Forest Science 54(4):381-396.
[3] Abt, K.L., J.P. Prestemon, and K. Gebert. 2009. Wildfire suppression cost forecasts for the US Forest Service. Journal of Forestry 107(4):173-178.
[4] Public Law 111-88 (October 30, 2009), Title V, Sec. 502.h.3.

Research Station for both Departments. This report contains the July FLAME forecasts for the FS and the DOI.

Modeling

Modeling Framework for the July 2012 FLAME Act Forecast of FY 2012 Forest Service Expenditures

This forecast differs from previous FLAME Act reports in the use of monthly expenditure data rather than annual data, as well as less regional aggregation and more accuracy with tighter confidence bands. The modeling framework for the monthly forecasts includes ordinary least squares regressions of expenditures by month by region for the remainder of FY 2012 (Table A1); forecasts made from the regression equations with the most recent data; a forecast distribution simulation (Tables 1-3); and a forecast evaluation (Figure A1 and Table A2). The FS wildfire suppression expenditure regression models were developed for the months of May, June, July, August, and September for each region (or aggregate). Each of the equations contained in the current modeling system represents a statistical relationship between historical costs for that month and a set of predictor variables for that region and that month.

Slightly less aggregated than previous forecast efforts, equations were specified for the following regions or regional aggregates: (i) Region 1, (ii) Region 2, (iii) Region 3, (iv) Region 4, (v) Region 5, (vi) Region 6, (vii) Region 8 plus Region 9, and (viii) Region 10 plus the National Interagency Fire Center, Washington Office, and research stations, which we label in this report as "RFS." The statistical relationships that were identified with extensive research effort relate spending in the coming fiscal year to spending in previous months and years as well as current year to date spending, lagged measures of drought (Palmer indices), lagged measures of ocean temperatures (the Niño-3 sea surface temperature anomaly), and a time trend.

Data for modeling were monthly expenditures by FS region, and included FY 2003 to FY 2011, the only years for which consistent region-level data have been assembled. These data were retrieved from the Foundation Financial Information System (FFIS) database at the USDA National Finance Center obtained from Albuquerque Service Center Reports. To erase the effects of general price inflation, all costs were deflated to the value of a dollar in 2004 using the gross domestic product deflator – that is, models were estimated and costs were forecast in real dollar terms. After the forecast, we adjusted the forecast values to put them in current dollars. In estimating models to forecast the monthly expenditures by region, variables that significantly influenced expenditures included spending in previous months and years as well as current year-to-date spending (see footnote 8), weather and climate data from the US Department of Commerce, National Oceanic and Atmospheric Administration, including lagged measures of drought using the Palmer drought severity indices[5], and lagged measures of the Niño-3 sea surface temperature anomaly[6], and a time trend.

[5] US Department of Commerce, National Oceanic and Atmospheric Administration. 2012a. Palmer drought severity indices. Retrieved on April 9, 2012 from http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/palmer_drought/.
[6] US Department of Commerce, National Oceanic and Atmospheric Administration. 2012 billion. Niño-3 sea surface temperature anomaly. Retrieved on April 9, 2012 from http://www.cpc.ncep.noaa.gov/data/indices/sstoi.indices.

Equation estimates are shown in Table A.1, which indicates that most models had moderate to high R2s, ranging from 0.31 (Region 5 in August) to 0.96 (Region 2 in May). This means that between 31 and 96 percent of the variation in the expenditures is explained by the variables included in the regressions. Durbin-Watson statistics, which measure the relationship of the unexplained portion of the expenditures between two consecutive years, were all within the acceptable (insignificant) range. Figure A.1 provides a comparison of the observed historical FS suppression expenditures (2004-2011) with the forecast of these expenditures using the July 2012 monthly forecast model reported here.

The next step was to generate a forecast distribution so that we can incorporate the errors in the regression estimates and the other forecast variables. When generating a forecast distribution (Figure 1), we randomly sampled from equation error and coefficient distributions in ways that accounted for the uncertainties in the forecast. These Monte Carlo forecasts, which are repeated 15,000 times for the FS forecast, do not produce a precise estimate. Rather, they generate a distribution of estimates. This distribution can be summarized in many ways. The forecasts emanating from the Monte Carlo simulation are shown in the forecast density distributions (Figures 1 and 3), a table reporting a median forecast and the lower and upper bounds of likely observed costs (Table 1), a table of not-to-exceed costs by probability levels (Table 2), and a table showing where the median forecast value fell within the observed historical costs for other years, in real dollar terms (Table 3).

Figure 2 shows the forecasted median value of FS suppression expenditures by month with 80 percent confidence intervals compared with FY 2012 budgeted amount and FY 2012 May FLAME Act forecast. This figure includes spending to date at the end of April and wildland fire suppression cost pool. Spending to date includes monthly contributions to the cost pool through April then for the months May through September a monthly amount of $4 million is included. Figures 3a-3e shows the probability density for each of the months individually. As expected, as the date of the forecasted expenditures is further out, the confidence interval increases. As Table 2 shows, this model forecasts a 1 percent chance that FS suppression expenditures, including the cost pool, will fall below $578 million. In contrast, there is a 70 percent chance that these expenditures will fall below $986 million.

The forecast evaluation is shown in Table 4. Model fitness is reported in the Appendix of this report and is described in a graph (Figure A1) and a table (A2). The graph shows how well the July FLAME Act out-of-sample forecasts (produced by dropping the observation of the forecast year, and doing this iteratively over the historical data, a technique sometimes termed "jackknife") compared with observed expenditures for the FS. The root mean squared error of the model used in this forecast of FY 2012 expenditures, when applied to the 2004-2011 period, was $191 million and had a 2.5 percent positive bias, tending to over-forecast by about $24 million. (This bias was not used to downward-adjust this current May 2012 forecast for total expenditures forecast for FY 2012, however.) The model had a mean absolute percent error of about 17.2 percent, meaning that the typical forecast averaged 17.2 percent above or below expenditures actually incurred during the 2004-2011 period. Finally, this model correctly predicted the direction of change in suppression expenditures by the FS 100 percent of the time, year over year. Thus, the model always correctly predicted whether each year was higher or lower than the year before. The forecasted direction of change for FY 2012 is down, meaning wildfire suppression expenditures are expected to be less than they were in FY 2011.

Modeling Framework for the May 2012 Forecast of FY 2012 Department of the Interior Expenditures

The development of a forecast model for the DOI was constrained by a lack of long time series of regional or agency expenditure data for the Department. Therefore, DOI suppression expenditure data used in the July 2012 Current Year Model covered Department-wide expenditures for Fiscal Years 1985-2011. Although geographical and agency disaggregations were available for recent years (since the early 2000's), there are insufficient data for modeling by geographic region or agency within DOI.

We modeled aggregate DOI expenditures using a parsimonious model specification involving two Palmer H-indices (from Regions 2 and 8), the one year lag of DOI expenditures, and the two year lag of the Niño-3 sea surface temperature anomaly. This is different from previous models through the addition of the Niño-3 sea surface temperature anomaly measure. The estimated equation explained 82 percent of the variation ($R^2 = 0.82$) in annual DOI suppression expenditures over the historical time period, 1986-2011. The Durbin H-statistic indicated no evidence (p=2.21) of residual autocorrelation in the model estimation errors.

Model fitness for the July Current Year Forecast Model for DOI is reported in Appendix Table A4. As in the case of the FS July Current Year Forecast Model, the DOI May Current Year Forecast Model was evaluated by making jackknife forecasts of DOI expenditures. This July forecast model had a root mean squared error of about $61 million when calculated over 1986-2011. The model had a bias of -$1 million (-0.6 percent) calculated over 1986-2011 (and this forecast bias was not used to adjust the 2012 forecast). The model had a Mean Absolute Percent Error of about 20 percent for the 1986-2011 period. It correctly predicted the direction of change in suppression expenditure for the Agency from one year to the next about 77 percent of years 1986-2011.

Results

USDA Forest Service

The FY 2012 suppression expenditures are forecast to range, with 80 percent confidence, between $729 million and $1.091 billion. The median forecast is $910 million. These costs include $47 million in estimated wildland fire suppression cost pool contributions[7], an estimated $81 million spent to date[8] (Figure 1 and Table 1), and an estimated $80 million in pre-suppression costs[9]. The FS forecast in this report has a confidence interval with an 80 percent confidence band that is $362 million, which is less than half of that for the May FLAME Act forecast of $763 million in width. Figure 1 shows the forecasted wildfire suppression expenditures by month (with 80 percent confidence intervals) for FY 2012 compared to the

[7] Lichtenstein, Mark, Branch Chief, Budget and Planning, Fire and Aviation Management, USDA Forest Service. Emails dated August 25, 2011 and May 22, 2012 and on file with the Southern Research Station, 3041 Cornwallis Rd, Research Triangle Park, NC. The cost pools are drawn at the end of every month, except for October which is drawn at the end of November.
[8] Lichtenstein, Mark, Branch Chief, Budget and Planning, Fire and Aviation Management, USDA Forest Service. Email dated May 29, 2012 and on file with the Southern Research Station, 3041 Cornwallis Rd, Research Triangle Park, NC.
[9] The data used for the monthly forecasts includes the total costs to category NIFC WF (1302) rather than half the value that is included in the data for the annual forecasts.

FY 2012 wildland fire suppression budget[10] and May's annual forecast amount[11]. Table 1 shows these same data in tabular format, and includes the confidence levels of 90 and 95 percent by month and in total.

An analysis of historical real dollar expenditures in suppression contains information about the likely financial magnitude of spending for FY 2012 (Table 3), by month, and in total. Note that cost pool spending is not included in the analysis for this table. When compared to expenditures since 2003, May and June are expected to have expenditures in the upper tercile in 2012. July and August expenditures are in the middle tercile, and September expenditures are projected to be in the lower tercile. When compared with spending since 2003, total costs for the year are forecast to be in the middle tercile in 2012.

Department of the Interior

The FY 2012 suppression expenditures for the DOI are forecast to range, with 80 percent confidence, from $328 million to $488 million, with a median forecast of $408 million. The 90 percent confidence band spans $306 million to $512 million, while a 95 percent band spans $286 million to $531 million (Table 4). As in the FS forecast, uncertainty surrounding the DOI forecast for FY 2012 can be appreciated by examining the probability density (Figure 4). This density distribution was developed using 15,000 Monte Carlo random forecasts, each generated by adding random errors to the forecast model. The median forecast expenditure for the Department is comparable in real dollar terms to the observed expenditures of the first decade of the 2000's.

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[10] Personal communication, Mark Lichtenstein, Branch Chief, Budget and Planning, Fire and Aviation Management, USDA FS

[11] Prestemon, J.P and others. 2012. Federal Land Assistance, Management and Enhancement (FLAME) Act Suppression Expenditures for Interior and Agriculture Agencies: May 2012 Forecasts for FY 2012. http://fsweb.rtp.srs.fs.fed.us/local/fire/May 2012 FLAME Act Forecast Final 5/22/12(Post-Review).pdf [Date accessed: May 31, 2012].

Table 1. July 2012 FLAME Forecast of FY 2012 Suppression Expenditures of the USDA Forest Service, Cumulative by Month, Current (FY 2012) Dollars

	May	June	July	August	September
	2012 $ Million				
Median Estimate	151	295	411	731	910
Lower Bound, 80% Confidence Limit	132	236	301	566	729
Upper Bound, 80% Confidence Limit	170	354	524	896	1,091
Lower Bound, 90% Confidence Limit	126	218	270	517	679
Upper Bound, 90% Confidence Limit	176	371	553	942	1,144
Lower Bound, 95% Confidence Limit	121	203	241	476	631
Upper Bound, 95% Confidence Limit	180	385	579	985	1,192

Note: The values shown include the FY 2012 contributions to the Wildland Fire Suppression Cost Pool, expected to be $47 million, as well as spending through the end of April 2012 ($81 million).

Table 2. July 2012 FLAME Act Forecasts of FY 2012 Suppression Expenditures of the USDA Forest Service, by Percentiles, Current (FY 2012) Dollars

Probability (%) of Falling Below Indicated Realized Dollar Amount	Realized Dollar Amount (2012 $ Million)
1	578
5	679
10	729
20	792
30	837
40	875
50	910
60	946
70	986
80	1,031
90	1,091
95	1,144
99	1,248

* Note: This table includes the FY 2012 contributions to the Wildland Fire Suppression Cost Pool, expected to be $47 million.

Table 3. July 2012 FLAME Forecasts of FY 2012 Suppression Expenditures of the USDA Forest Service, by Tercile*

Time Period	Tercile of Costs Expected, Since 2003
May	Upper
June	Upper
July	Middle
August	Middle
September	Lower
Total	Middle

* Note: Historical wildland fire suppression cost pool expenditures are assumed to be zero in all year expenditure totals used in these rankings.

Table 4. July 2012 FLAME Forecast of Fiscal Year 2012 Suppression Expenditures of the Department of Interior, Current (FY 2012) Dollars

	2012 $ Million
Median Estimate	408
Lower Bound, 80% Confidence Limit	328
Upper Bound, 80% Confidence Limit	488
Lower Bound, 90% Confidence Limit	306
Upper Bound, 90% Confidence Limit	512
Lower Bound, 95% Confidence Limit	286
Upper Bound, 95% Confidence Limit	531

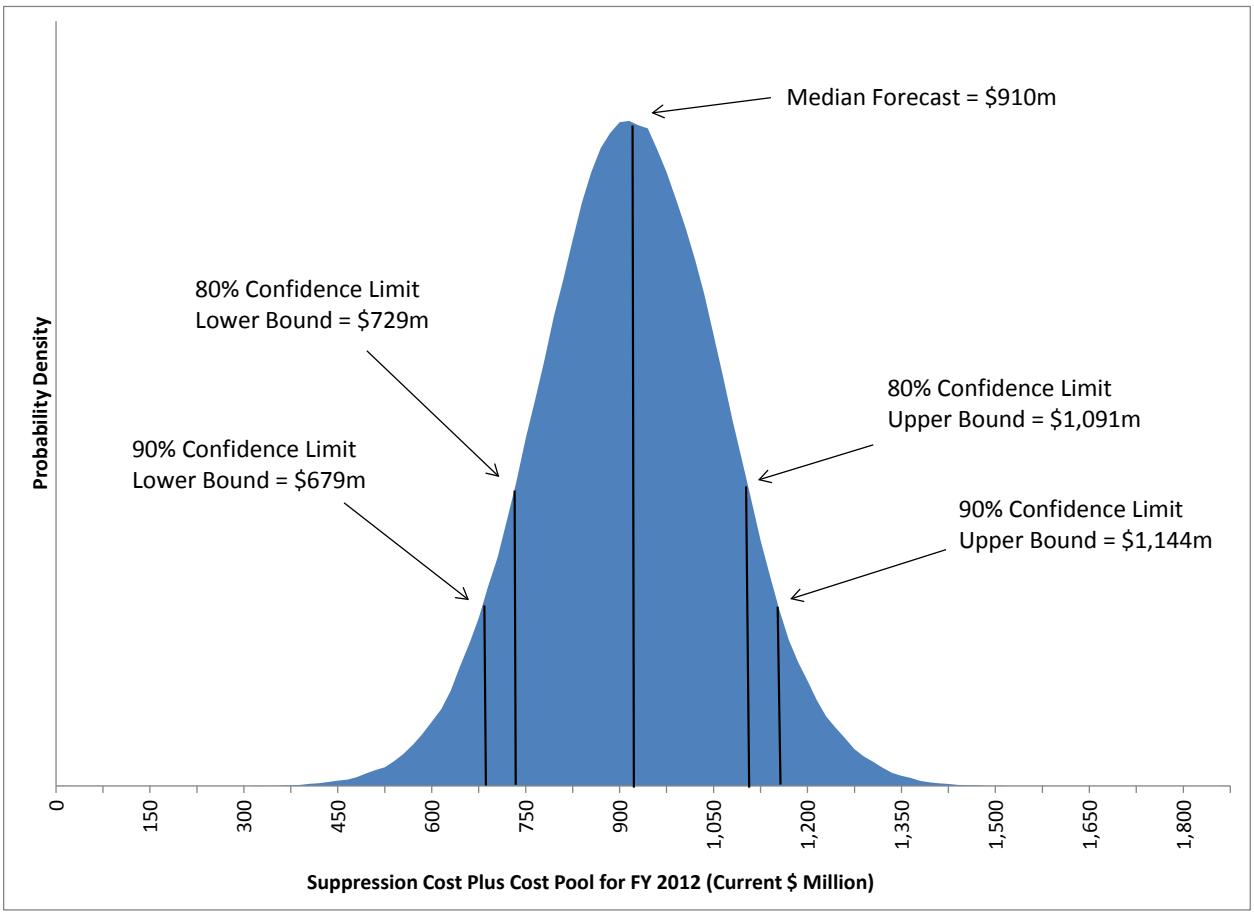

Figure 1. The USDA Forest Service suppression expenditure forecast probability density, Fiscal Year 2012, July 2012 FLAME forecast. (Note: FY 2012 wildland fire suppression cost pool expenditures are included at their expected level of $47 million in this probability density display.)

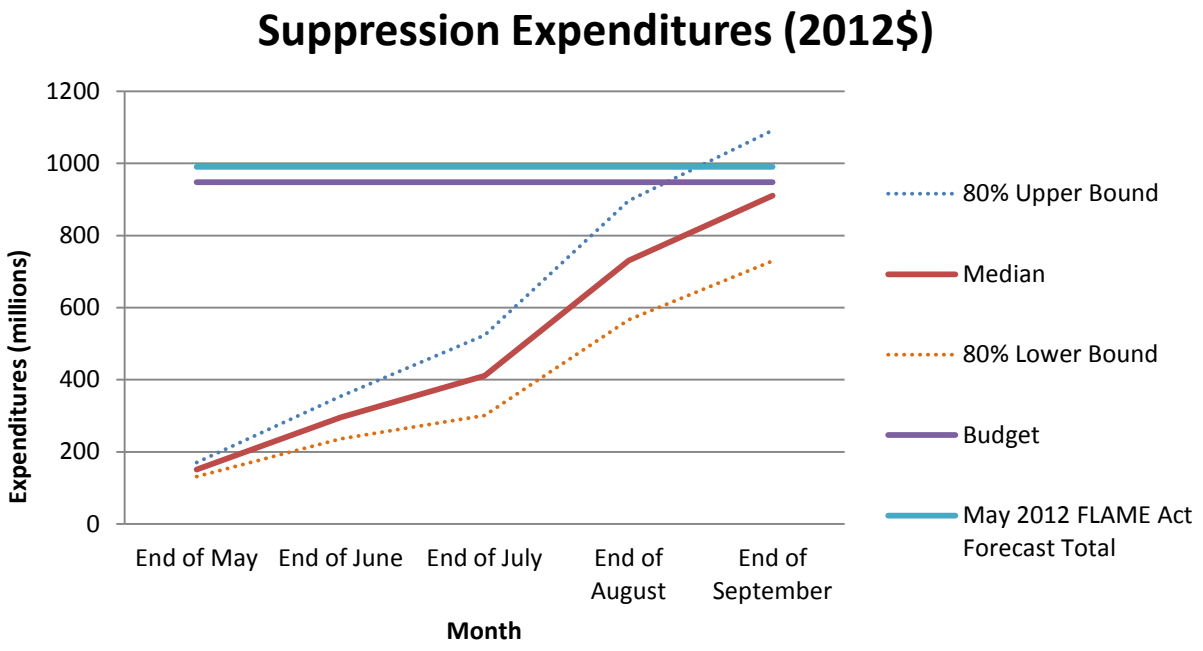

Figure 2. Forecasted median value of USDA Forest Service suppression expenditures by month with 80% confidence intervals compared with FY 2012 budgeted amount and FY 2012 May FLAME Act forecast. (Note: Includes spending to date at the end of April and wildland fire suppression cost pool. Spending to date includes monthly contributions to the cost pool through April then for the months May through September a monthly amount of $4 million is included.)

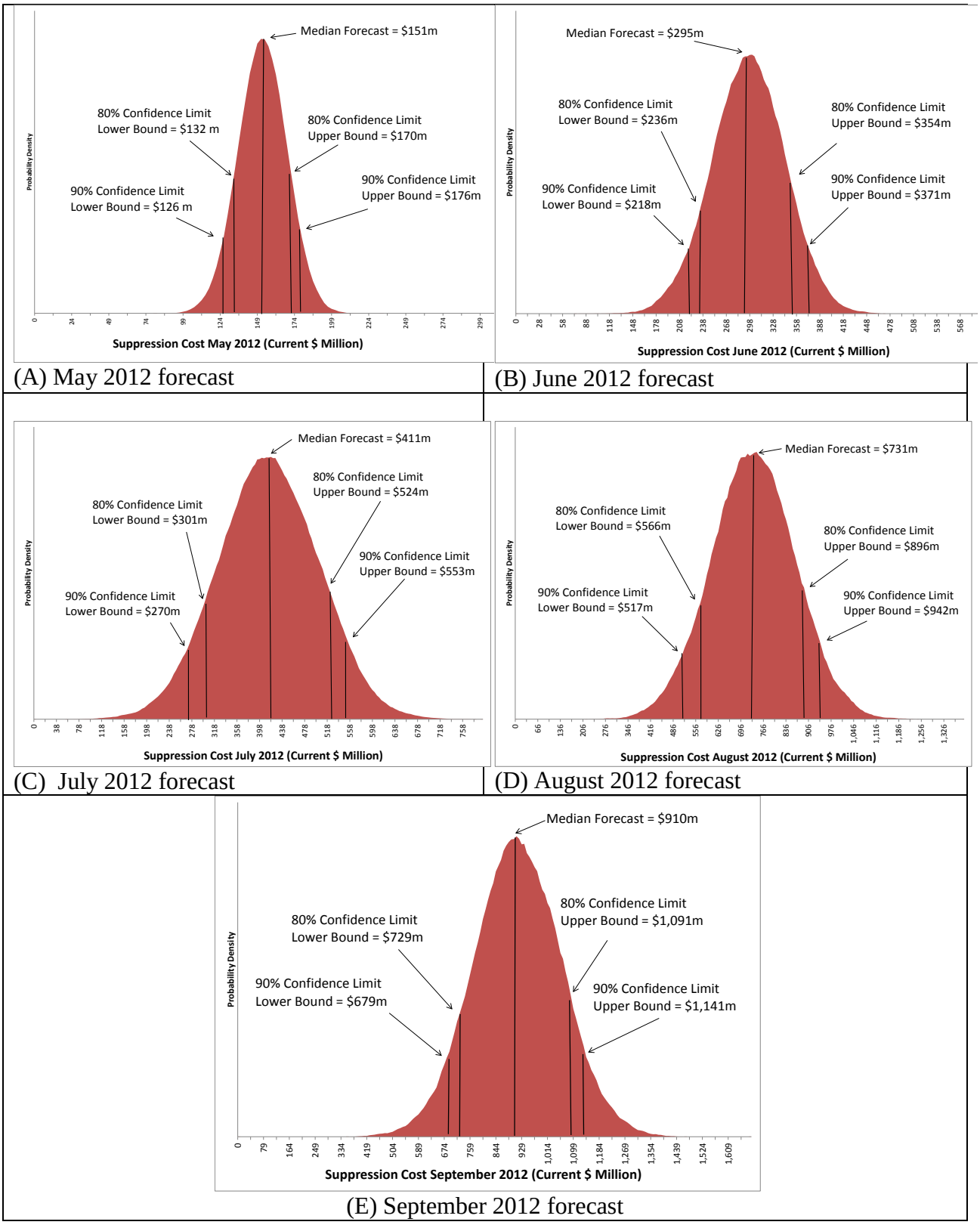

Figure 3. The USDA Forest Service cumulative monthly forecast distributions for May to September 2012 from the July 2012 FLAME forecast model.

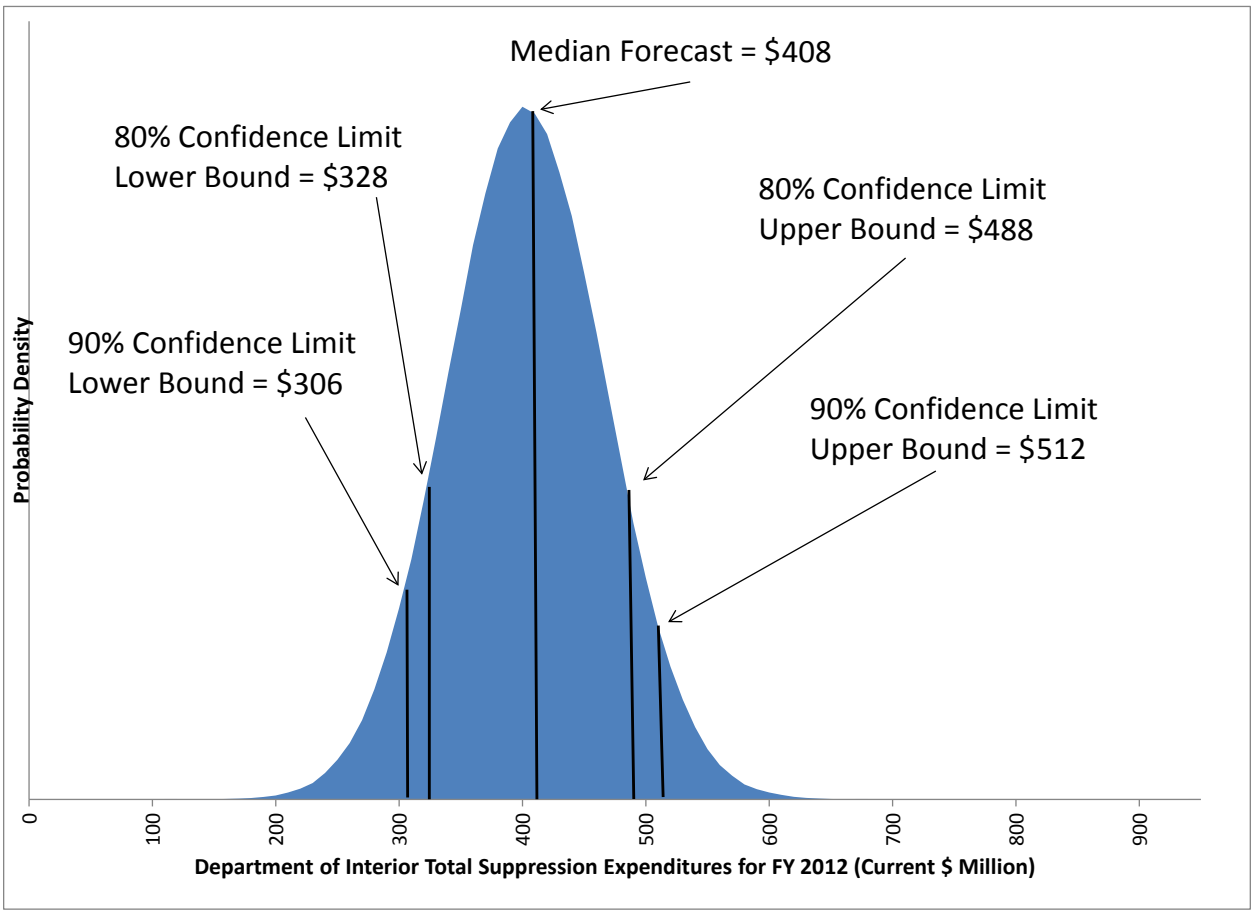

Figure 4. Department of Interior suppression expenditure forecast probability density, FY 2012, July 2012 FLAME forecast.

Appendix: Model Estimates and Forecast Evaluation Statistics

Table A1. Ordinary Least Squares Regression Equation Estimates Used in the July 2012 FLAME Act Forecast of FY 2012 Suppression Expenditures of the USDA Forest Service.

Month	Dependent Variable	Independent Variables	Coefficient	Std. Error	t-Statistic	Prob.	R^2	Durbin-Watson
May	Region 1 Cost	Constant	-2,556,624	1,658,579	-1.5415	0.1245	0.92	2.63
		Westwide Palmer H-Index Weighted Mean March (t-1)	345,895	145,957	2.3698	0.0186		
		Ln(Region 1 Cost in April (t))	-248,287	40,603	-6.1149	0.0000		
		Ln(Region 1 Cost in May (t-1))	884,180	344,948	2.5632	0.0110		
	Region 2 Cost	Constant	214,541	93,760	2.2882	0.0230	0.96	2.52
		Westwide Palmer H-Index Weighted Mean March (t)	296,006	34,161	8.6650	0.0000		
		Ln(Region 1 Cost in April (t-1))	86,160	14,369	5.9963	0.0000		
	Region 3 Cost	Constant	13,717,538	2,219,846	6.1795	0.0000	0.81	1.74
		Westwide Palmer H-Index Weighted Mean March (t)	4,165,196	1,041,420	3.9995	0.0001		
		Niño-3 SSTA April (t)	-16,860,054	5,273,815	-3.1969	0.0016		
	Region 4 Cost	Constant	339,991	198,059	1.7166	0.0873	0.74	2.63
		Region 4 Cost in April (t)	1.0093	0.2738	3.6862	0.0003		
		Region 4 Cost through April (t-1)	-0.1344	0.0653	-2.0571	0.0407		
	Region 5 Cost	Constant	7,081,247	1,681,389	4.2115	0.0000	0.71	2.34
		Region 5 Palmer H-Index March (t)	-1,602,252	475,886	-3.3669	0.0009		
		Region 5 Cost in May (t-1)	-0.4490	0.2433	-1.8457	0.0661		
	Region 6 Cost	Constant	1,095,587	117,599	9.3163	0.0000	0.95	1.84
		Region 6 Cost in May (t-1)	-0.3213	0.0403	-7.9776	0.0000		
		Region 6 Palmer H-Index March (t-1)	278,216	47,841	5.8154	0.0000		
	Region 8 + Region 9 Cost	Constant	-1,723,204	1,039,760	-1.6573	0.0987	0.93	2.46
		Region 8 + Region 9 Annual Cost (t-1)	0.2107	0.0227	9.2600	0.0000		
	Region 10 + RFS Cost	Constant	44,740,151	5,966,753	7.4982	0.0000	0.73	1.74
		Westwide Palmer H-Index Weighted Mean March (t)	12,108,518	2,804,447	4.3176	0.0000		
		Constant	349,528	100,041	3.4938	0.0006		

Month	Dependent Variable	Independent Variables	Coefficient	Std. Error	t-Statistic	Prob.	R^2	Durbin-Watson
June	Region 1 Cost	Region 1 Annual Cost (t-1)	0.0016	0.0006	2.7275	0.0068	0.69	3.02
		Region 1 Palmer H-Index March (t)	-70,587	36,092	-1.9557	0.0516		
	Region 2 Cost	Constant	1,453,441	435,796	3.3351	0.0157	0.68	2.01
		Westwide Palmer H-Index Weighted Mean March (t)	578,315	189,212	3.0564	0.0223		
		Region 2 Cost through April (t)	0.2401	0.0968	2.4804	0.0478		
	Region 3 Cost	Constant	53,776,882	11,956,142	4.4978	0.0000	0.52	1.05
		Westwide Palmer H-Index Weighted Mean March (t)	15,621,537	5,619,534	2.7799	0.0059		
	Region 4 Cost	Constant	850,659	223,687	3.8029	0.0002	0.82	2.99
		Region 4 Cost in April (t-1)	-0.8943	0.2051	-4.3591	0.0000		
		Westwide Palmer H-Index Weighted Mean March (t)	-334,896	112,072	-2.9882	0.0031		
	Region 5 Cost	Constant	-9,492,374	4,877,007	-1.9464	0.0528	0.82	2.25
		Region 5 Cost in January	6.0173	1.0742	5.6017	0.0000		
	Region 6 Cost	Constant	-1,335,174	818,609	-1.6310	0.1540	0.69	2.39
		Region 6 Cost through April (t)	0.2300	0.0635	3.6251	0.0110		
		Niño-3 SSTA January (t)	-1,539,090	642,261	-2.3964	0.0536		
	Region 8 + Region 9 Cost	Constant	5,554,385	2,428,071	2.2876	0.0230	0.73	1.75
		Region 8 + Region 9 Cost in January (t)	-0.3403	0.0789	-4.3107	0.0000		
	Region 10 + RFS Cost	Constant	-14,700,000,000	5,070,000,000	-2.8992	0.0041	0.79	1.28
		Ln(Region 10 + RFS Annual Cost (t-1))	906,334	390,561	2.3206	0.0211		
		Time	7,310,799	2,531,685	2.8877	0.0042		
July	Region 1 Cost	Constant	2,601,788	2,858,395	0.9102	0.3636	0.74	2.04
		Region 1 Annual Cost (t-1)	-0.0399	0.0158	-2.5255	0.0122		
		Region 1 Cost in April (t)	3.8934	1.9062	2.0425	0.0422		
	Region 2 Cost	Constant	3,320,000,000	496,000,000	6.6984	0.0000	0.88	1.90
		Time	-1,651,484	246,921	-6.6883	0.0000		
		Westwide Palmer H-Index Weighted Mean March (t)	2,298,151	449,539	5.1122	0.0000		
	Region 3 Cost	Constant	27,187,139	3,313,785	8.2043	0.0000	0.66	0.94
		Niño-3 SSTA April (t-1)	45,940,483	12,385,157	3.7093	0.0003		
	Region 4 Cost	Constant	5,938,916	2,778,211	2.1377	0.0335	0.62	1.51
		Westwide Palmer H-Index Weighted Mean March (t)	-2,954,615	1,303,372	-2.2669	0.0243		
		Niño-3 SSTA April (t)	-13,971,715	6,600,354	-2.1168	0.0353		
	Region 5 Cost	Constant	-552,000,000	306,000,000	-1.8036	0.1214	0.66	2.99
		Niño-3 SSTA February (t)	-92,316,360	31,939,759	-2.8903	0.0277		
		Ln(Region 5 Cost through April (t))	78,105,402	40,379,267	1.9343	0.1012		
	Region 6 Cost	Constant	-3,081,380	5,315,728	-0.5797	0.5627	0.81	1.61
		Region 6 Annual Cost (t-1)	0.1029	0.0416	2.4754	0.0140		
		Region 6 Cost in March (t)	-1.5473	0.7595	-2.0373	0.0427		
	Region 8 + Region 9 Cost	Constant	1,490,506	1,371,462	1.0868	0.2782	0.93	2.47
		Westwide Palmer H-Index Weighted Mean March (t)	3,115,857	478,531	6.5113	0.0000		
		Region 8 + Region 9 Annual Cost (t-1)	0.1918	0.0293	6.5557	0.0000		
	Region 10 + RFS Cost	Constant	62,315,665	11,936,463	5.2206	0.0000	0.48	2.84
		Westwide Palmer H-Index Weighted Mean March (t)	14,399,735	5,610,284	2.5667	0.0109		

Month	Dependent Variable	Independent Variables	Coefficient	Std. Error	t-Statistic	Prob.	R^2	Durbin-Watson
August	Region 1 Cost	Constant	30,400,000,000	9,850,000,000	3.0864	0.0023	0.62	1.60
		Time	-15,116,433	4,904,243	-3.0823	0.0023		
		Region 2 Cost in December (t-1)	-16.2952	8.1764	-1.9930	0.0474		
	Region 2 Cost	Constant	3,600,000,000	1,440,000,000	2.5092	0.0127	0.47	2.21
		Time	-1,791,880	715,698	-2.5037	0.0129		
	Region 3 Cost	Constant	14,204,120	2,606,705	5.4491	0.0000	0.55	2.04
		Niño-3 SSTA April (t-1)	28,344,951	9,742,468	2.9094	0.0040		
	Region 4 Cost	Constant	39,539,982	6,578,280	6.0107	0.0000	0.66	0.95
		Region 4 Palmer H-Index March (t-1)	7,845,762	2,990,060	2.6239	0.0092		
		Niño-3 SSTA January (t)	12,345,756	5,781,571	2.1354	0.0337		
	Region 5 Cost	Constant	-345,000,000	230,000,000	-1.5006	0.1772	0.31	1.55
		Ln(Region 5 Cost through April (t))	54,145,640	30,363,744	1.7832	0.1177		
	Region 6 Cost	Constant	17,747,044	12,360,219	1.4358	0.2011	0.63	1.03
		Ln(Region 6 Cost through April (t))	8,335,681	2,694,224	3.0939	0.0213		
		Region 6 Palmer H-Index March (t)	10,180,179	5,537,252	1.8385	0.1156		
	Region 8 + Region 9 Cost	Constant	12,809,021	4,888,728	2.6201	0.0093	0.61	1.03
		Region 8 + Region 9 Cost in April (t)	-1.0108	0.4297	-2.3523	0.0195		
		Westwide Palmer H-Index Weighted Mean March (t)	3,141,442	1,891,838	1.6605	0.0981		
	Region 10 + RFS Cost	Constant	89,384,161	17,414,733	5.1327	0.0000	0.53	1.17
		Westwide Palmer H-Index Weighted Mean March (t-1)	19,828,539	7,055,646	2.8103	0.0053		
September	Region 1 Cost	Constant	24,100,000,000	13,100,000,000	1.8465	0.0660	0.33	1.86
		Time	-12,002,907	6,510,887	-1.8435	0.0665		
	Region 2 Cost	Constant	4,720,903	647,104	7.2954	0.0000	0.67	1.75
		Niño-3 SSTA April (t-1)	9,034,504	2,418,529	3.7355	0.0002		
	Region 3 Cost	Constant	2,876,926	911,606	3.1559	0.0018	0.70	1.93
		Region 3 Cost in March (t)	3.1939	0.7815	4.0866	0.0001		
	Region 4 Cost	Constant	25,422,648	4,206,418	6.0438	0.0000	0.71	1.98
		Region 4 Cost in March (t)	-12.2015	3.2784	-3.7218	0.0002		
		Region 4 Cost in April (t)	-17.7775	7.5002	-2.3703	0.0185		
	Region 5 Cost	Constant	58,917,265	12,663,765	4.6524	0.0000	0.42	1.72
		Niño-3 SSTA February (t-1)	-51,367,010	22,708,602	-2.2620	0.0246		
	Region 6 Cost	Constant	41,228,248	8,087,263	5.0979	0.0000	0.32	2.31
		Niño-3 SSTA April (t-1)	55,468,080	30,225,865	1.8351	0.0677		
	Region 8 + Region 9 Cost	Constant	6,810,215	2,050,495	3.3213	0.0010	0.41	2.10
		Region 8 Palmer H-Index March (t-1)	3,126,208	1,411,028	2.2156	0.0276		
	Region 10 + RFS Cost	Constant	137,000,000	42,042,996	3.2588	0.0013	0.45	1.67
		Westwide Palmer H-Index Weighted Mean March (t)	47,196,499	19,760,725	2.3884	0.0177		

Table A2. Jackknife Forecast Evaluation of the Ordinary Least Squares Regression Model Used in the July 2012 FLAME Act Forecast of FY 2012 Suppression Expenditures of the USDA Forest Service, Calculated Over Data from 2004-2011

Diagnostic	Calculated 2004-2011
Root Mean Squared Error, 2004-2011 (2012$)	190,709,702
Bias, 2004-2011, Predicted Minus Actual (2012$)	23,623,502
Bias (%)	2.5
Mean Absolute Percent Error, 2004-2011	17.2
Correct Direction of Change %, 2004-2011	100

Table A3. Ordinary Least Squares Regression Equation Estimates Used in the July 2012 FLAME Act Forecast of FY 2012 Suppression Expenditures of the Department of the Interior.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	-62314027	31722729	-1.96433	0.0629
DOI Costs (t-1)	0.534351	0.112707	4.74105	0.0001
Palmer H Index Region 2, May 2012	-11455800	5342805	-2.14415	0.0439
Palmer H Index Region 8, May 2012	-37489214	8357893	-4.48549	0.0002
Niño-3 SSTA March (t-2)	43605763	14396265	3.028964	0.0064
Observations	26			
R-squared	0.8231			
Equation Error	47936796			
Durbin-Watson Statistic	2.209793			

Table A4. Jackknife Forecast Evaluation of the Ordinary Least Squares Regression Model Used in the July 2012 FLAME Act Forecast of FY 2012 Suppression Expenditures of the Department of the Interior, Calculated Over Data from 1986-2011

Diagnostic	Calculated 1986-2011
Root Mean Squared Error, 1986-2011 (2012$)	60,502,594
Bias, 1986-2011, Predicted Minus Actual (2012$)	-1,483,674
Bias (%)	-0.6
Mean Absolute Percent Error, 1986-2011	20.1
Correct Direction of Change %, 1986-2011	76.9

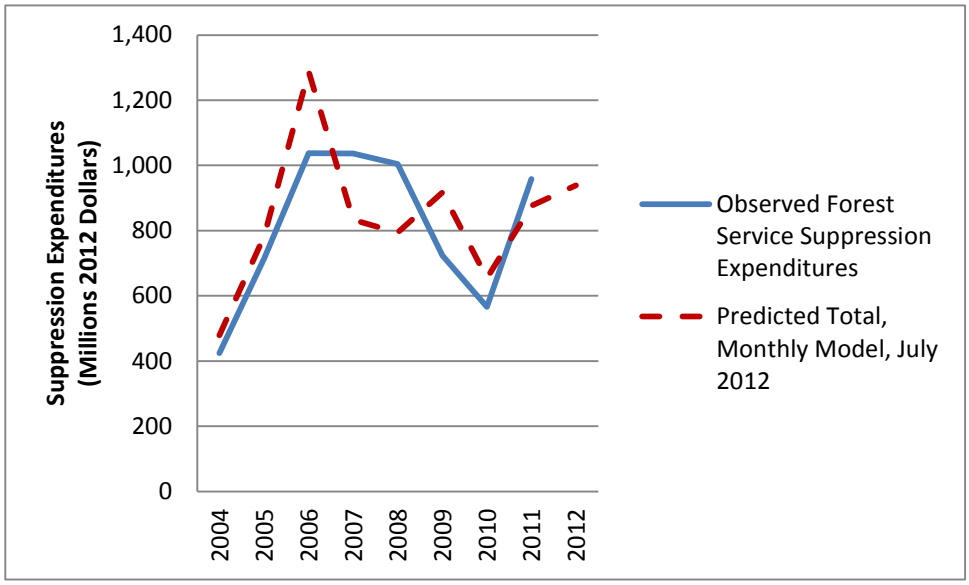

Figure A.1. Observed historical USDA Forest Service suppression expenditures (2004-2011) and the forecast of these expenditures using the July 2012 FLAME Act forecast model. Forecasts of expenditures for each fiscal year are sums across the point estimates of each region or region aggregate's costs generated with a jackknife procedure. (Note: Values are in 2012 dollars and include the wildland fire suppression cost pool expenditures and NIFC WF presuppression costs.)

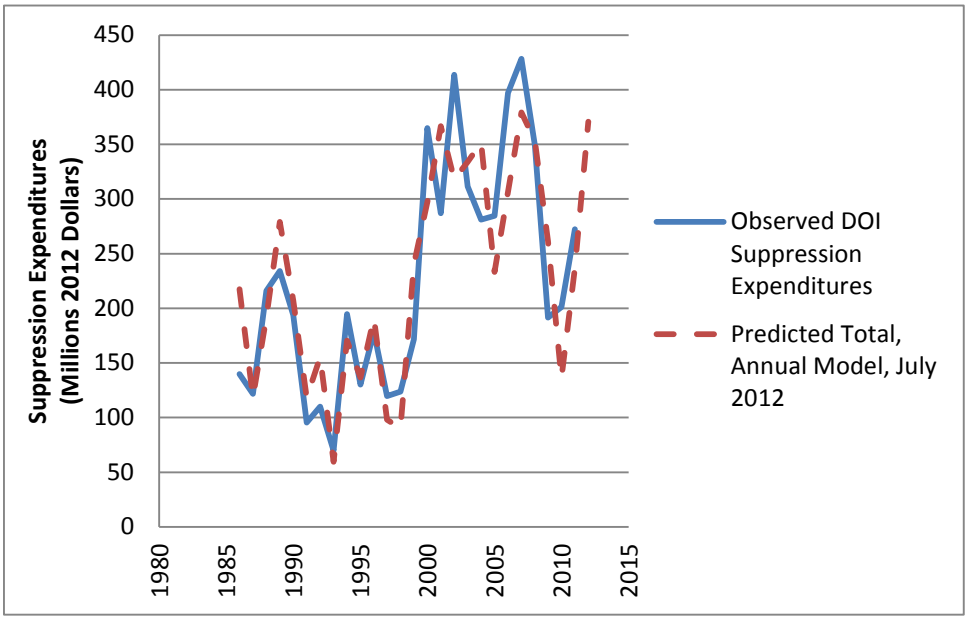

Figure A.2. Observed historical Department of the Interior suppression expenditures (1986-2011) and the forecast of these expenditures using the July 2012 FLAME Act forecast model.