

APPENDIX L:

South Dakota Class I Area Monitoring Data Summary Tables and Charts

Includes the following subsections:

Subsection	IMPROVE Monitor	Class I Area(s) Represented
L.1	BADL1	Badlands NP and Mount Baldy WA
L.2	WICA1	Wind Cave NP

L.1. BADLANDS NP (BADL1)

The following tables and figures are presented in this section for Badlands NP represented by the BADL1 IMPROVE Monitor:

- **Table L.1-1: Annual Averages, 5-Year Period Averages, and Trends:** Table of averages and other metrics for the 20% least impaired days, the 20% most impaired days, and all sampled days is presented.
- **Figure L.1-1: Annual and 5-Year Period Averages for the 20% Most Impaired Visibility Days:** Line graphs depicting annual and period averages by component are presented.
- **Figure L.1-2: Annual and 5-Year Period Averages for the 20% Least Impaired Visibility Days:** Line graphs depicting annual and period averages by component are presented.
- **Figure L.1-3: 20% Most Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component for the 20% most impaired days are presented.
- **Figure L.1-4: 20% Least Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component are presented.
- **Figure L.1-5: 2000-2004 Monthly Average Aerosol Extinction, All Monitored Days:** Line graphs depicting monthly averages by year and component for the baseline period are presented.
- **Figure L.1-6: 2005-2009 Monthly Average Aerosol Extinction, All Monitored Days:** Line graphs depicting monthly averages by year and component for the progress period are presented.
- **Figure L.1-7: 2000-2004 Progress Period Extinction, All Sampled Days:** Stacked bar charts depicting daily averages by year and component for the baseline period are presented.
- **Figure L.1-8: 2000-2004 Progress Period Extinction, All Sampled Days:** Stacked bar charts depicting daily averages by year and component for the progress period are presented.

Table L.1-1
Badlands NP, SD (BADL1 Site)
Annual Averages, 5-Year Period Averages and Trends

Group	Baseline Period					Progress Period					2010	2000-2009 Trend Statistics*		Period Averages**			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009		Slope (change/yr.)	p-value	Baseline (B)	Progress (P)	Difference (P-B)	Percent Change
Deciview (dv)																	
Best 20% Days	7.4	7.5	6.7	6.3	6.6	7.0	6.2	7.1	7.6	6.1	6.3	0.0	0.2	6.9	6.8	-0.1	-1%
Worst 20% Days	18.1	17.6	16.2	17.8	15.9	16.3	17.5	16.6	17.3	15.1	16.6	-0.1	0.1	17.1	16.6	-0.5	-3%
All Days	12.2	12.2	11.1	11.5	10.9	11.4	11.5	11.8	12.2	10.5	10.9	-0.1	0.3	11.6	11.5	-0.1	-1%
Total Extinction (Mm-1)																	
Best 20% Days	21.1	21.2	19.6	18.8	19.4	20.4	18.7	20.3	21.5	18.5	18.8	-0.1	0.2	20.0	19.9	-0.1	-1%
Worst 20% Days	63.5	59.3	51.3	61.5	50.3	51.5	58.4	53.3	61.9	45.9	53.7	-0.9	0.2	57.2	54.2	-3.0	-5%
All Days	36.8	36.2	32.1	34.7	31.7	33.1	34.3	34.4	36.9	30.1	31.9	-0.3	0.2	34.3	33.8	-0.5	-2%
Ammonium Sulfate Extinction (Mm-1)																	
Best 20% Days	4.3	3.9	2.6	3.0	3.0	4.0	3.0	3.6	3.5	3.2	3.4	0.0	0.3	3.4	3.5	0.1	3%
Worst 20% Days	19.0	23.3	17.4	16.2	18.4	21.8	18.2	17.8	17.2	19.1	22.1	-0.1	0.3	18.9	18.8	-0.1	-1%
All Days	10.1	11.1	8.5	8.6	9.0	10.7	10.1	9.7	9.6	9.3	9.8	-0.1	0.4	9.4	9.9	0.5	5%
Ammonium Nitrate Extinction (Mm-1)																	
Best 20% Days	1.4	1.6	0.9	0.8	1.3	1.2	0.8	1.5	1.1	1.0	1.1	0.0	0.2	1.2	1.1	-0.1	-8%
Worst 20% Days	3.6	7.4	4.7	7.2	6.3	6.1	5.3	6.2	5.3	4.0	10.9	-0.2	0.2	5.8	5.4	-0.4	-7%
All Days	2.8	3.9	2.8	3.6	2.7	2.6	2.7	3.4	2.8	2.5	3.9	0.0	0.0	3.1	2.8	-0.3	-10%
Particulate Organic Mass Extinction (Mm-1)																	
Best 20% Days	1.9	1.9	1.8	1.8	1.6	2.0	1.4	1.8	4.1	1.5	1.3	0.0	0.2	1.8	2.2	0.4	22%
Worst 20% Days	18.7	7.9	7.4	16.2	8.6	5.8	13.2	10.6	17.2	5.7	4.7	-0.3	0.3	11.8	10.5	-1.3	-11%
All Days	7.2	4.4	4.0	6.1	4.4	4.1	5.2	5.3	8.6	3.4	3.2	-0.1	0.5	5.2	5.3	0.1	2%
Elemental Carbon Extinction (Mm-1)																	
Best 20% Days	0.8	0.9	0.9	0.6	0.7	0.8	0.6	0.6	0.3	0.5	0.5	0.0	0.0	0.8	0.6	-0.2	-25%
Worst 20% Days	4.0	2.6	1.9	2.9	1.6	2.1	2.7	2.0	1.6	1.2	1.4	-0.2	0.0	2.6	1.9	-0.7	-27%
All Days	2.0	1.6	1.2	1.5	1.1	1.3	1.4	1.2	0.8	0.8	0.9	-0.1	0.0	1.5	1.1	-0.4	-27%
Soil Extinction (Mm-1)																	
Best 20% Days	0.3	0.4	0.4	0.2	0.3	0.3	0.4	0.4	0.3	0.3	0.4	0.0	0.5	0.3	0.3	0.0	0%
Worst 20% Days	1.0	1.3	1.1	0.7	0.7	0.8	1.2	0.9	1.2	0.7	0.7	0.0	0.4	1.0	1.0	0.0	0%
All Days	0.6	0.8	0.7	0.5	0.5	0.6	0.6	0.6	0.7	0.5	0.6	0.0	0.5	0.6	0.6	0.0	0%
Coarse Mass Extinction (Mm-1)																	
Best 20% Days	1.3	1.6	1.9	1.3	1.4	1.1	1.4	1.5	1.1	1.0	1.2	0.0	0.2	1.5	1.2	-0.3	-20%
Worst 20% Days	6.1	5.9	7.3	7.0	3.5	3.9	6.8	4.7	6.3	4.0	2.8	-0.2	0.2	5.9	5.1	-0.8	-14%
All Days	3.1	3.5	3.8	3.5	2.9	2.7	3.2	3.2	3.0	2.4	2.4	-0.1	0.0	3.4	2.9	-0.5	-15%
Sea Salt Extinction (Mm-1)																	
Best 20% Days	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0%
Worst 20% Days	0.0	0.0	0.5	0.3	0.1	0.1	0.1	0.2	2.2	0.2	0.1	0.0	0.2	0.2	0.5	0.3	>100%
All Days	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.5	0.1	0.0	0.0	0.2	0.1	0.1	0.0	0%

*Values highlighted in blue (red) indicate statistically significant decreasing (increasing) annual trend. Significance is measured at the 85% confidence level (p-value ≤0.15).

**Values highlighted in blue indicate a decrease in the 5-year average, values highlighted in red indicate an increase.

"---" Indicates a missing year that did not meet RHR data completeness criteria.

Figure L.1-1
Badlands NP, SD (BADL1 Site)
Annual and 5-Year Period Averages
20% Most Impaired Visibility Days

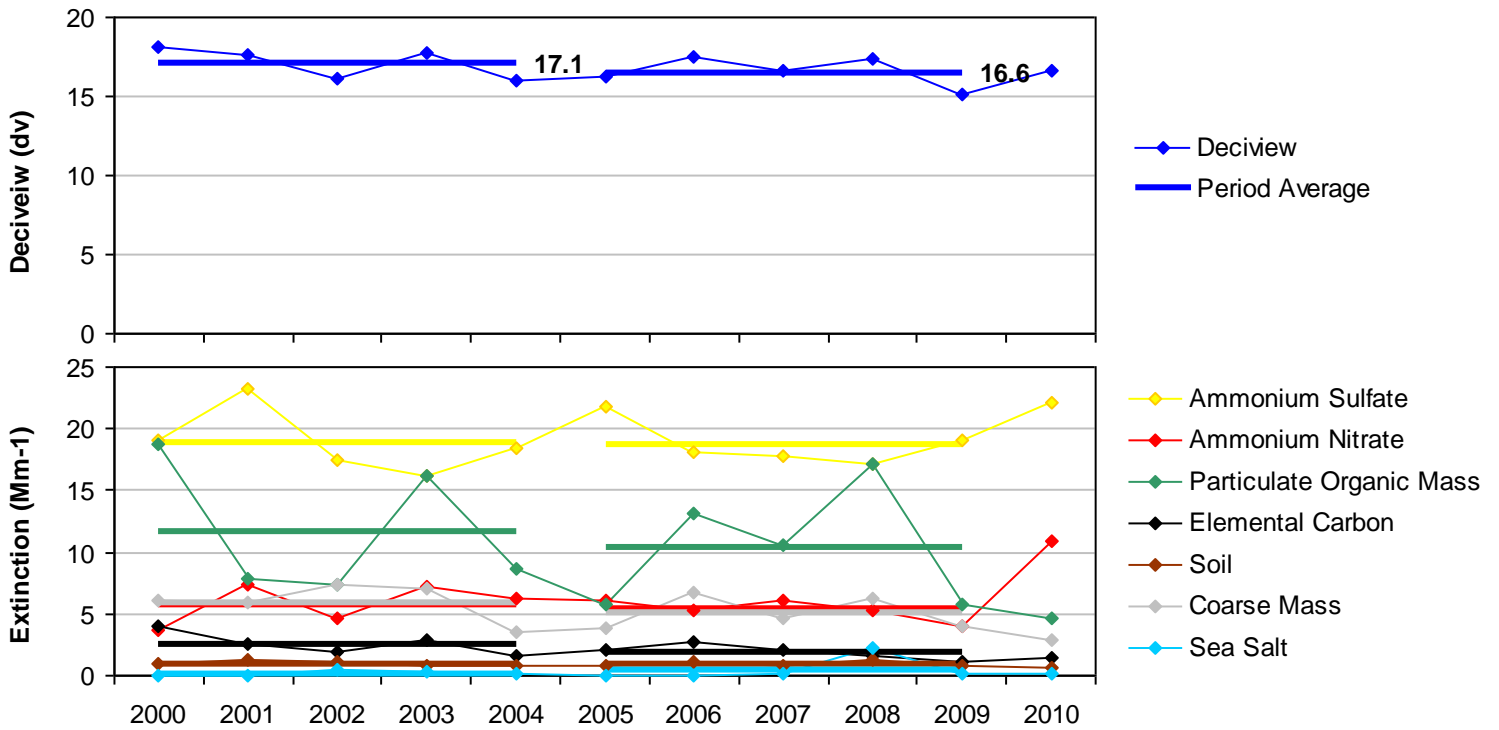


Figure L.1-2
Badlands NP, SD (BADL1 Site)
Annual and 5-Year Period Averages
20% Least Impaired Visibility Days

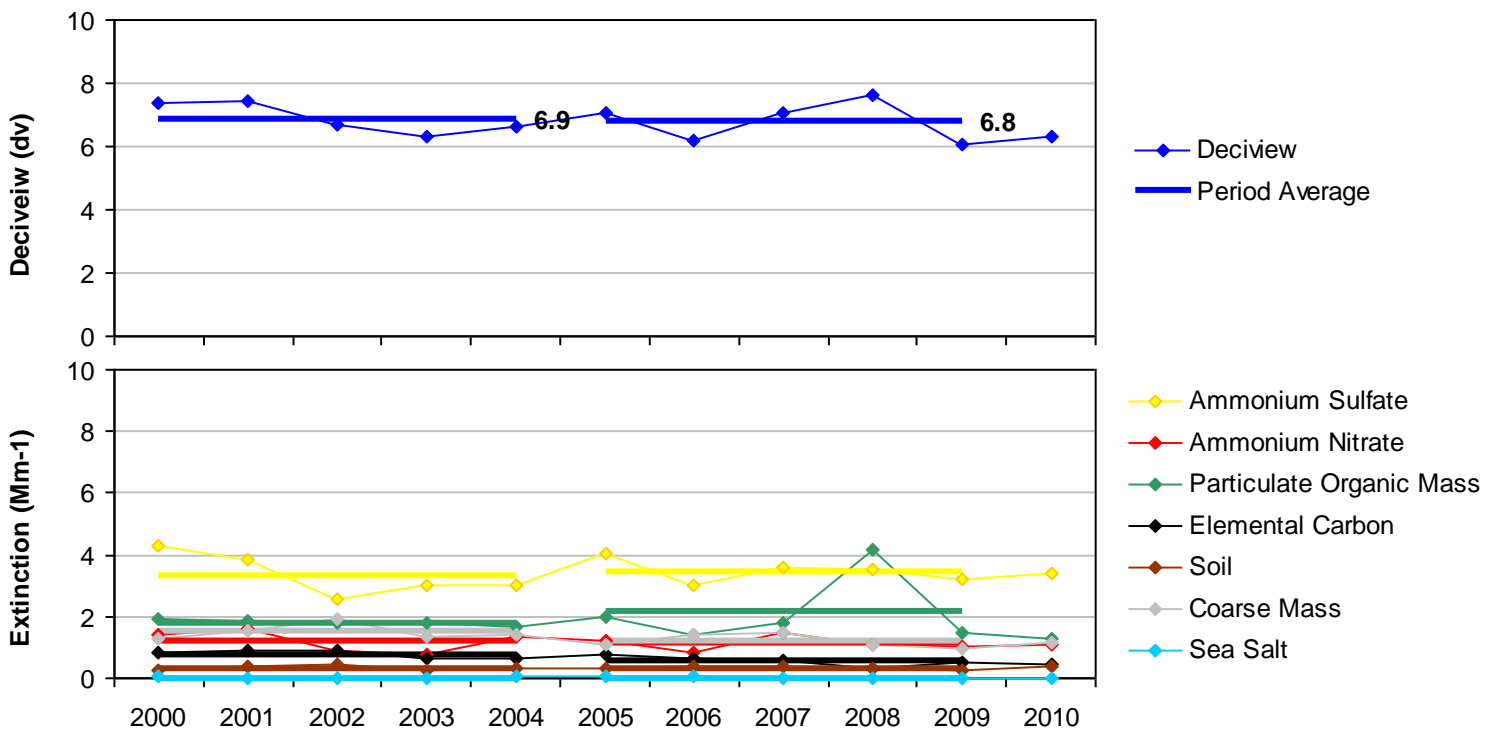


Figure L.1-3
Badlands NP, SD (BADL1 Site)
20% Most Impaired Visibility Days

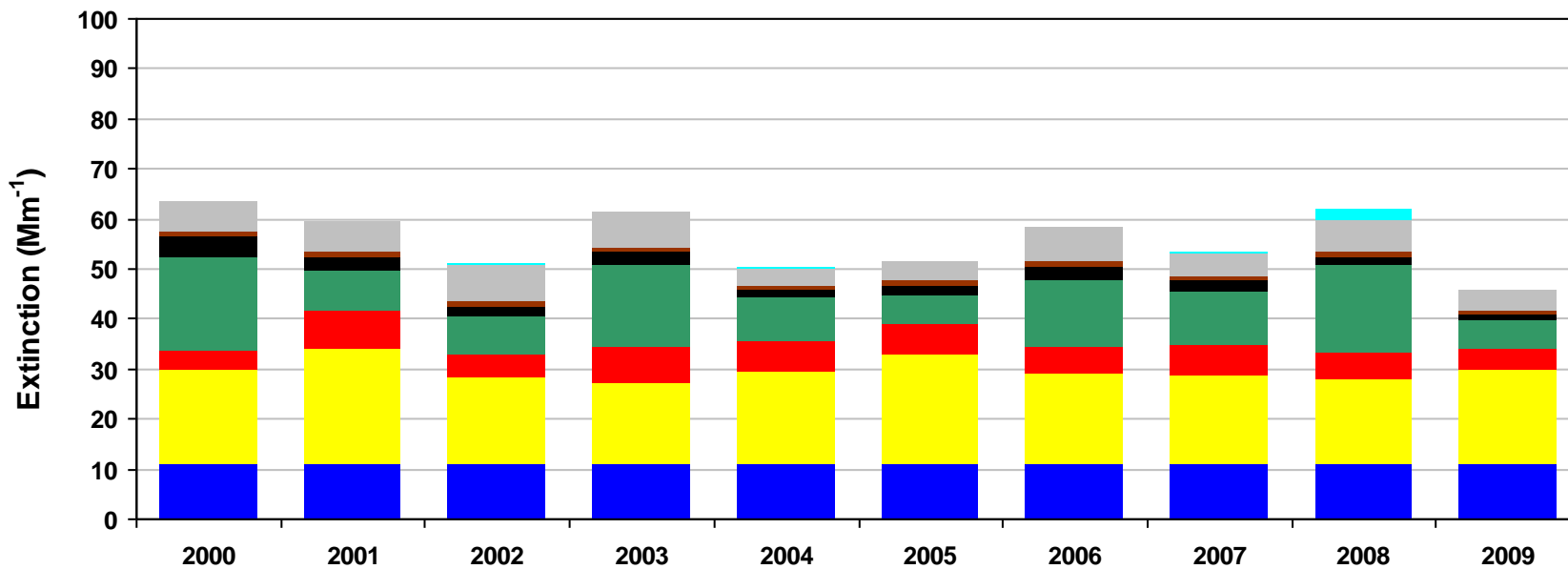
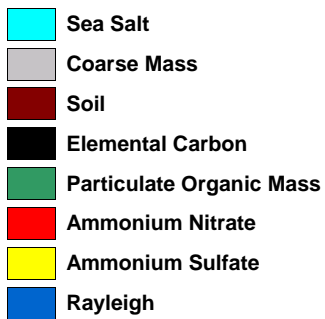
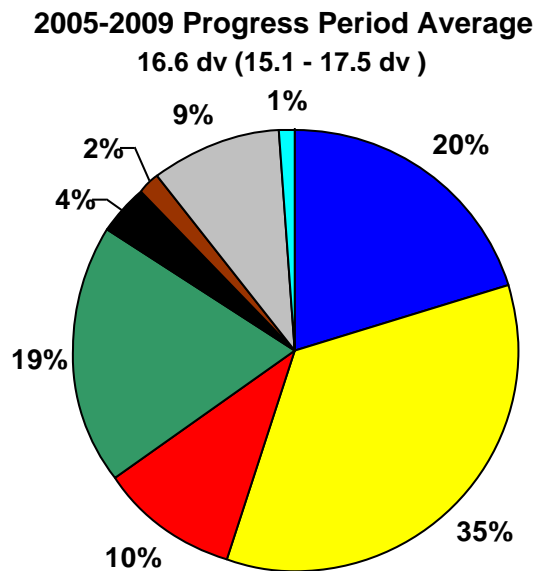
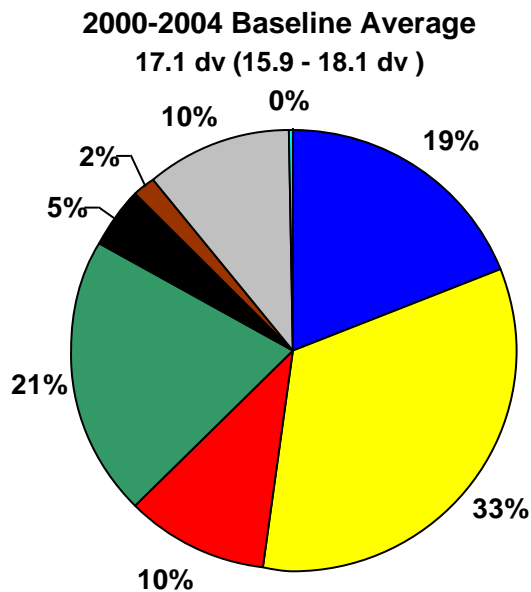


Figure L.1-4
Badlands NP, SD (BADL1 Site)
20% Least Impaired Visibility Days

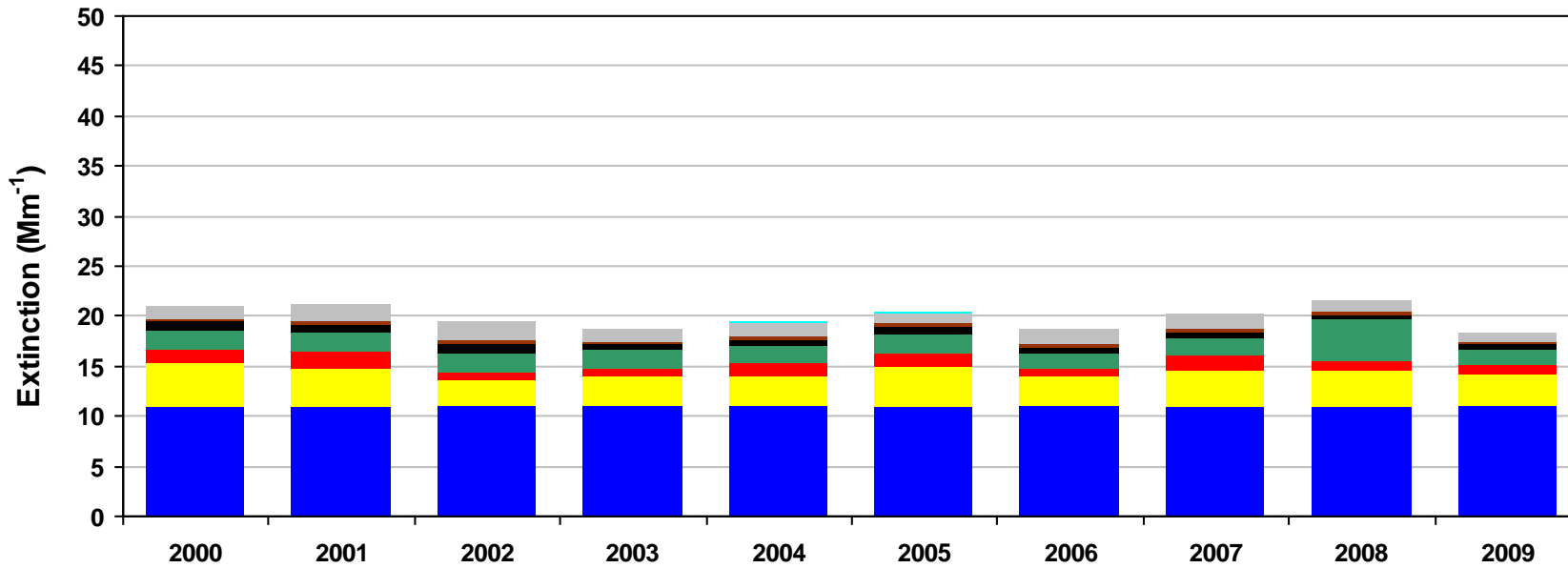
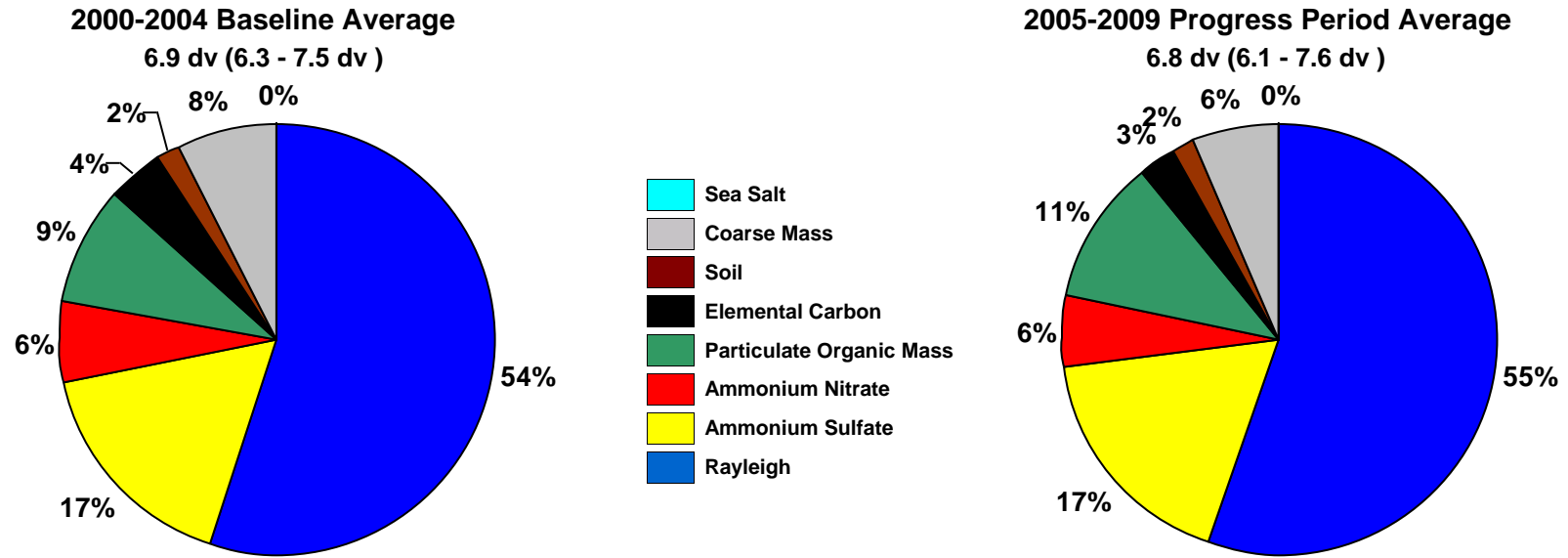


Figure L.1-5
Badlands NP, SD (BADL1 Site)
2000-2004 Monthly Average Aerosol Extinction, All Monitored Days

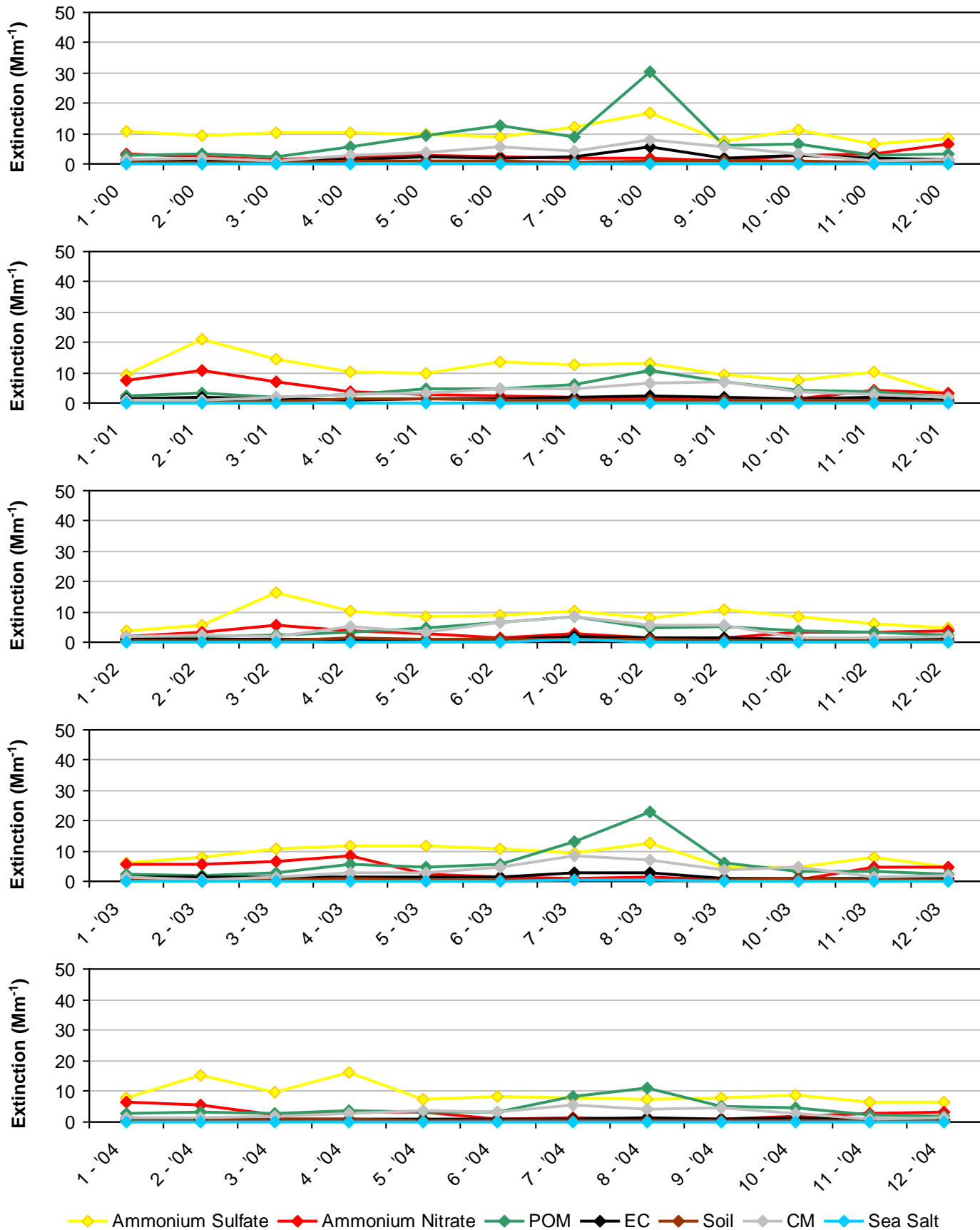


Figure L.1-6
Badlands NP, SD (BADL1 Site)
2005-2009 Monthly Average Aerosol Extinction, All Monitored Days

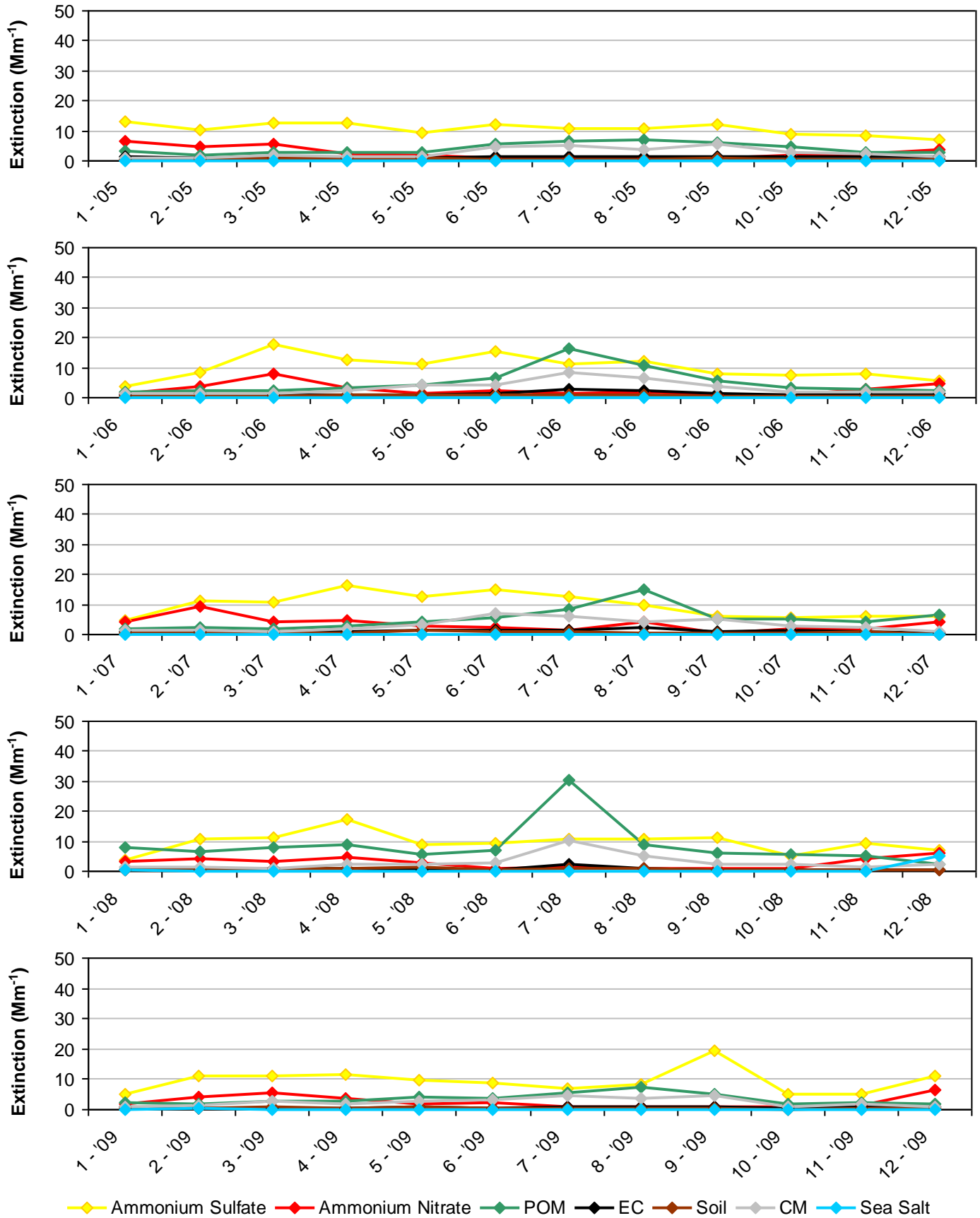


Figure L.1-7
Badlands NP, SD (BADL1 Site)
2000-2004 Progress Period Extinction, All Sampled Days

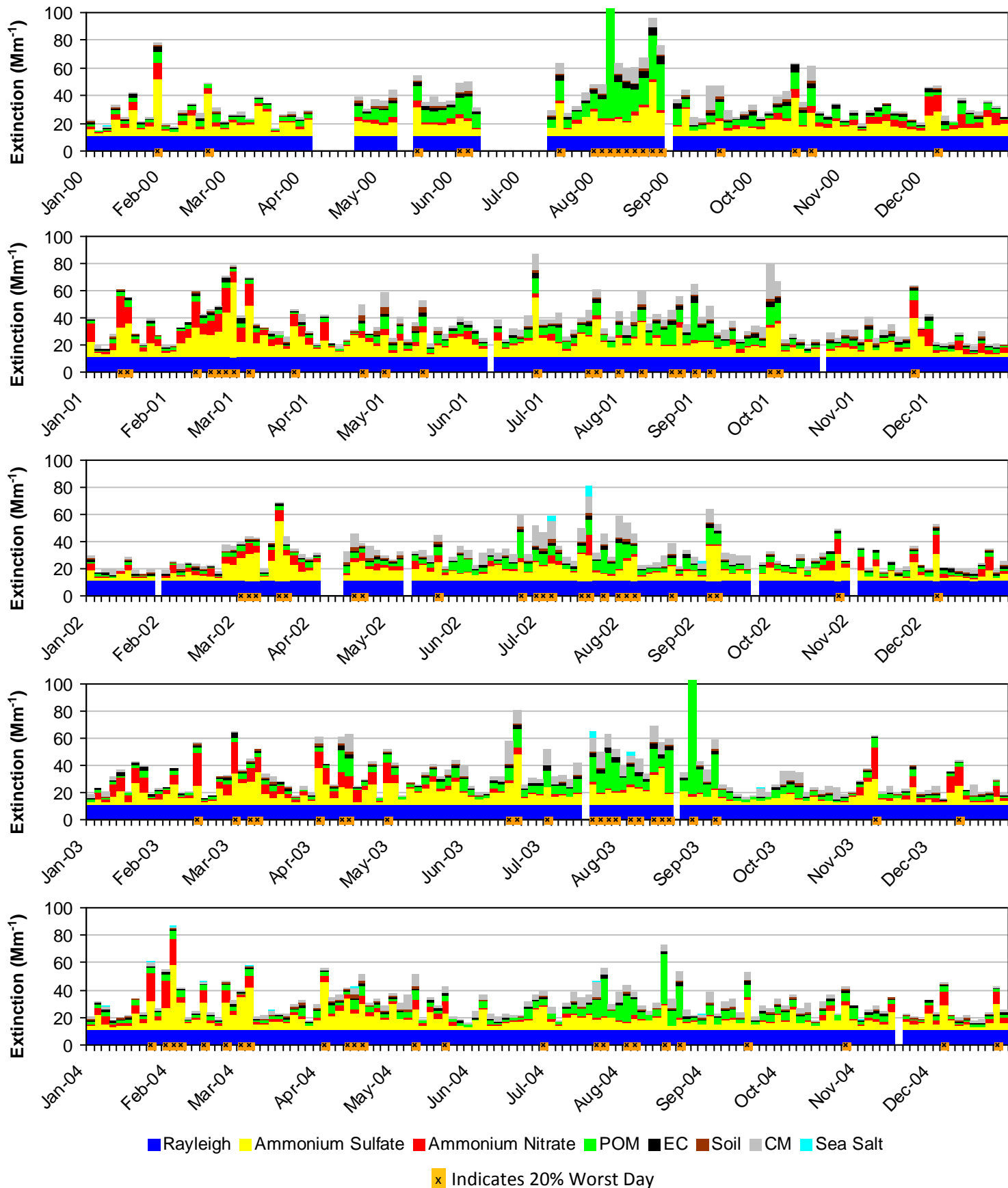
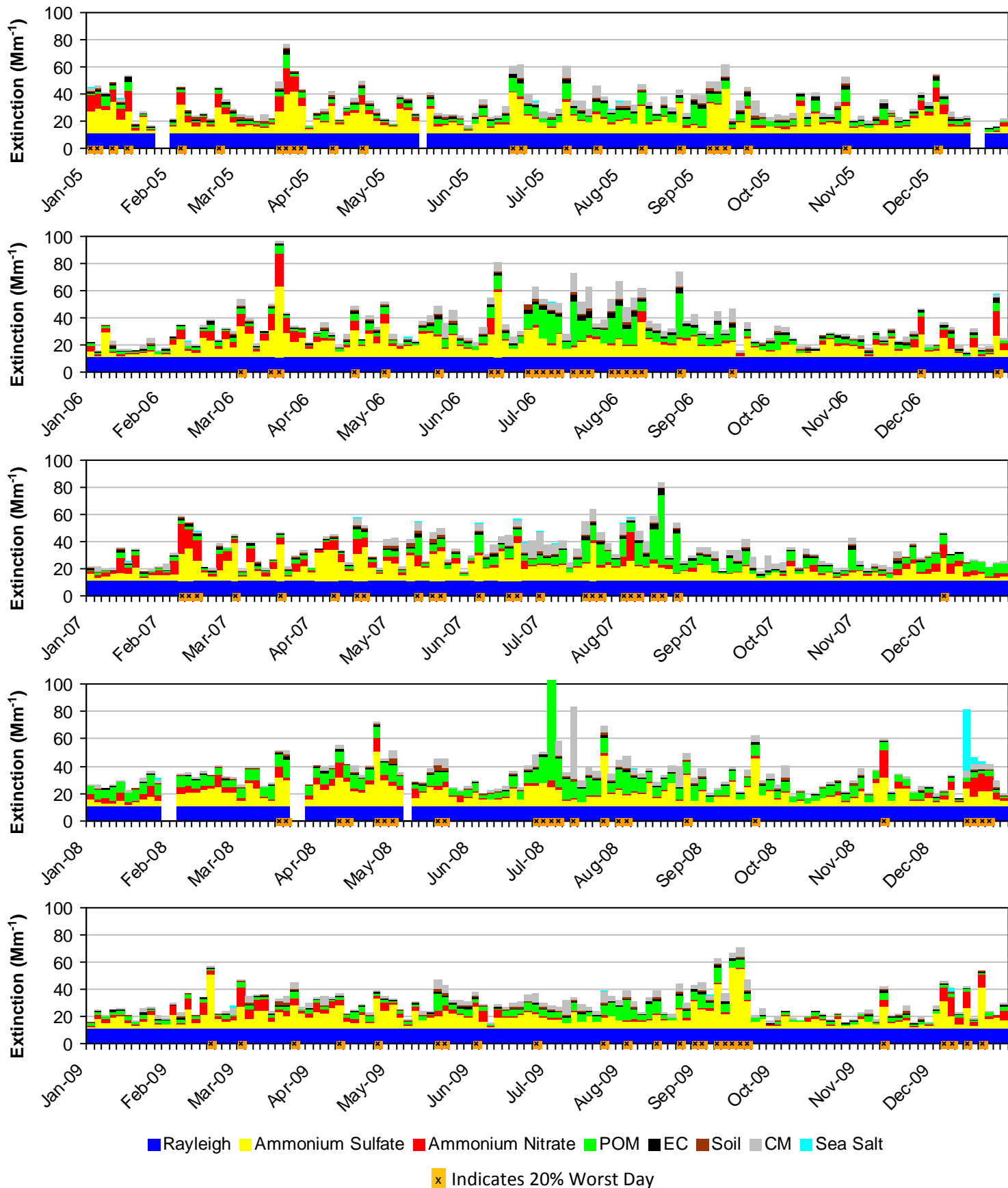


Figure L.1-8
 Badlands NP, SD (BADL1 Site)
 2005-2009 Progress Period Extinction, All Sampled Days



L.2. WIND CAVE NP (WICA1)

The following tables and figures are presented in this section for the Wind Cave NP represented by the WICA1 IMPROVE Monitor:

- **Table L.2-1: Annual Averages, 5-Year Period Averages, and Trends:** Table of averages and other metrics for the 20% least impaired days, the 20% most impaired days, and all sampled days is presented.
- **Figure L.2-1: Annual and 5-Year Period Averages for the 20% Most Impaired Visibility Days:** Line graphs depicting annual and period averages by component are presented.
- **Figure L.2-2: Annual and 5-Year Period Averages for the 20% Least Impaired Visibility Days:** Line graphs depicting annual and period averages by component are presented.
- **Figure L.2-3: 20% Most Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component for the 20% most impaired days are presented.
- **Figure L.2-4: 20% Least Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component are presented.
- **Figure L.2-5: 2000-2004 Monthly Average Aerosol Extinction, All Monitored Days:** Line graphs depicting monthly averages by year and component for the baseline period are presented.
- **Figure L.2-6: 2005-2009 Monthly Average Aerosol Extinction, All Monitored Days:** Line graphs depicting monthly averages by year and component for the progress period are presented.
- **Figure L.2-7: 2000-2004 Progress Period Extinction, All Sampled Days:** Stacked bar charts depicting daily averages by year and component for the baseline period are presented.
- **Figure L.2-8: 2000-2004 Progress Period Extinction, All Sampled Days:** Stacked bar charts depicting daily averages by year and component for the progress period are presented.

Table L.2-1
Wind Cave NP, SD (WICA1 Site)
Annual Averages, 5-Year Period Averages and Trends

Group	Baseline Period					Progress Period					2010	2000-2009 Trend Statistics*		Period Averages**			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009		Slope (change/yr.)	p-value	Baseline (B)	Progress (P)	Difference (P-B)	Percent Change
Deciview (dv)																	
Best 20% Days	5.6	5.1	5.2	5.0	4.8	4.7	4.5	5.5	4.3	3.8	4.5	-0.2	0.0	5.1	4.6	-0.5	-10%
Worst 20% Days	16.1	15.3	16.6	16.1	15.1	15.7	16.3	16.5	15.1	13.9	15.3	-0.1	0.2	15.8	15.5	-0.3	-2%
All Days	10.0	9.7	10.0	9.9	9.3	9.6	9.9	10.5	9.5	8.5	9.1	-0.1	0.1	9.8	9.6	-0.2	-2%
Total Extinction (Mm-1)																	
Best 20% Days	17.6	16.7	16.9	16.5	16.3	16.1	15.8	17.4	15.5	14.7	15.7	-0.2	0.0	16.8	15.9	-0.9	-5%
Worst 20% Days	51.9	48.1	55.3	51.1	47.3	51.3	54.5	54.6	50.5	41.9	68.8	-0.2	0.3	50.7	50.6	-0.1	0%
All Days	29.6	28.4	30.1	29.5	27.6	28.7	29.9	31.4	28.8	25.4	31.2	-0.1	0.4	29.1	28.8	-0.3	-1%
Ammonium Sulfate Extinction (Mm-1)																	
Best 20% Days	3.1	2.6	2.3	2.5	2.4	2.7	2.3	3.2	2.1	2.1	2.5	-0.1	0.1	2.6	2.5	-0.1	-4%
Worst 20% Days	11.6	14.3	14.7	12.7	12.8	14.6	16.2	14.2	10.1	13.4	10.6	0.1	0.5	13.2	13.7	0.5	4%
All Days	6.8	7.3	7.1	6.8	6.5	7.6	7.7	7.8	6.6	6.6	5.9	0.0	0.4	6.9	7.3	0.4	6%
Ammonium Nitrate Extinction (Mm-1)																	
Best 20% Days	1.1	0.9	0.7	0.5	0.8	0.7	0.5	0.8	0.7	0.6	0.6	0.0	0.1	0.8	0.6	-0.2	-25%
Worst 20% Days	4.7	9.3	5.9	6.2	8.9	8.7	5.6	6.9	4.5	3.7	11.2	-0.2	0.1	7.0	5.9	-1.1	-16%
All Days	2.5	3.3	2.3	2.7	2.9	2.7	2.2	3.0	2.1	1.6	3.3	-0.1	0.1	2.7	2.3	-0.4	-15%
Particulate Organic Mass Extinction (Mm-1)																	
Best 20% Days	1.7	1.3	1.4	1.5	1.3	1.1	1.1	1.6	1.3	0.9	1.1	0.0	0.1	1.4	1.2	-0.2	-14%
Worst 20% Days	17.0	7.9	16.6	15.1	9.5	11.2	14.0	16.1	17.1	8.4	29.8	-0.1	0.5	13.2	13.4	0.2	2%
All Days	6.0	4.0	5.9	6.0	4.4	4.4	5.4	6.2	5.9	3.7	8.1	0.0	0.4	5.2	5.1	-0.1	-2%
Elemental Carbon Extinction (Mm-1)																	
Best 20% Days	0.9	0.6	0.7	0.6	0.7	0.7	0.6	0.6	0.4	0.4	0.4	0.0	0.0	0.7	0.5	-0.2	-29%
Worst 20% Days	3.7	2.2	3.1	2.4	3.2	2.8	3.3	2.8	2.5	1.6	3.6	-0.1	0.2	2.9	2.6	-0.3	-10%
All Days	1.8	1.3	1.4	1.4	1.4	1.4	1.6	1.4	1.2	0.9	1.4	0.0	0.2	1.5	1.3	-0.2	-13%
Soil Extinction (Mm-1)																	
Best 20% Days	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.3	0.2	0.2	0.0	0%
Worst 20% Days	1.0	0.8	1.0	0.7	0.8	0.8	1.0	1.0	1.0	1.2	0.7	0.0	0.1	0.9	1.0	0.1	11%
All Days	0.5	0.5	0.6	0.4	0.5	0.6	0.6	0.6	0.6	0.7	0.6	0.0	0.0	0.5	0.6	0.1	20%
Coarse Mass Extinction (Mm-1)																	
Best 20% Days	0.7	1.0	1.5	1.1	0.9	0.8	1.1	0.9	0.8	0.6	0.8	0.0	0.2	1.1	0.8	-0.3	-27%
Worst 20% Days	3.9	3.5	4.1	4.0	2.1	3.1	4.3	3.6	4.4	3.4	2.9	0.0	0.4	3.5	3.8	0.3	9%
All Days	2.1	2.1	2.7	2.2	1.7	1.8	2.4	2.2	2.3	1.8	2.0	0.0	0.5	2.2	2.1	-0.1	-5%
Sea Salt Extinction (Mm-1)																	
Best 20% Days	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0%
Worst 20% Days	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	1.0	0.2	0.1	0.0	0.0	0.0	0.3	0.3	0%
All Days	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0%

*Values highlighted in blue (red) indicate statistically significant decreasing (increasing) annual trend. Significance is measured at the 85% confidence level (p-value ≤0.15).

**Values highlighted in blue indicate a decrease in the 5-year average, values highlighted in red indicate an increase.

"---" Indicates a missing year that did not meet RHR data completeness criteria.

Figure L.2-1
Wind Cave NP, SD (WICA1 Site)
Annual and 5-Year Period Averages
20% Most Impaired Visibility Days

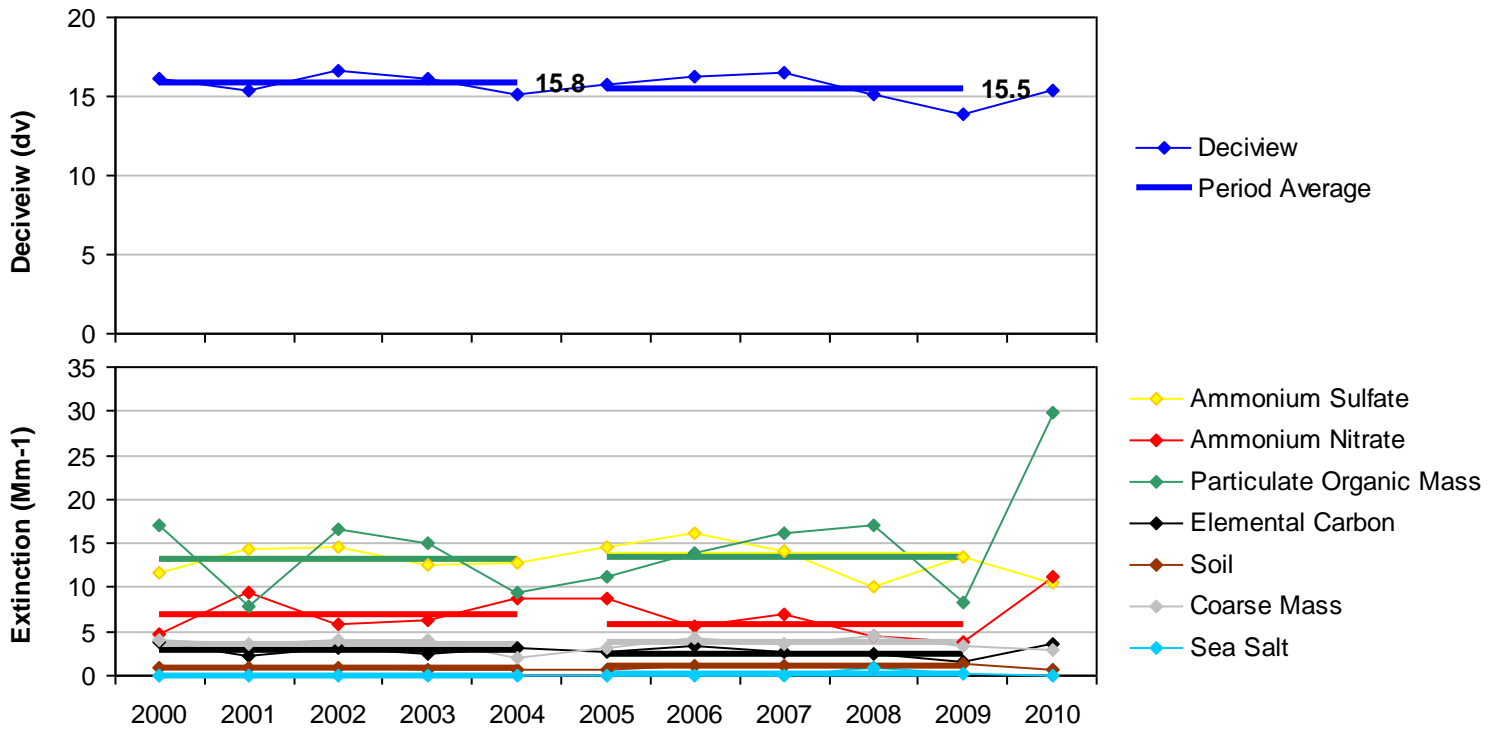


Figure L.2-2
Wind Cave NP, SD (WICA1 Site)
Annual and 5-Year Period Averages
20% Least Impaired Visibility Days

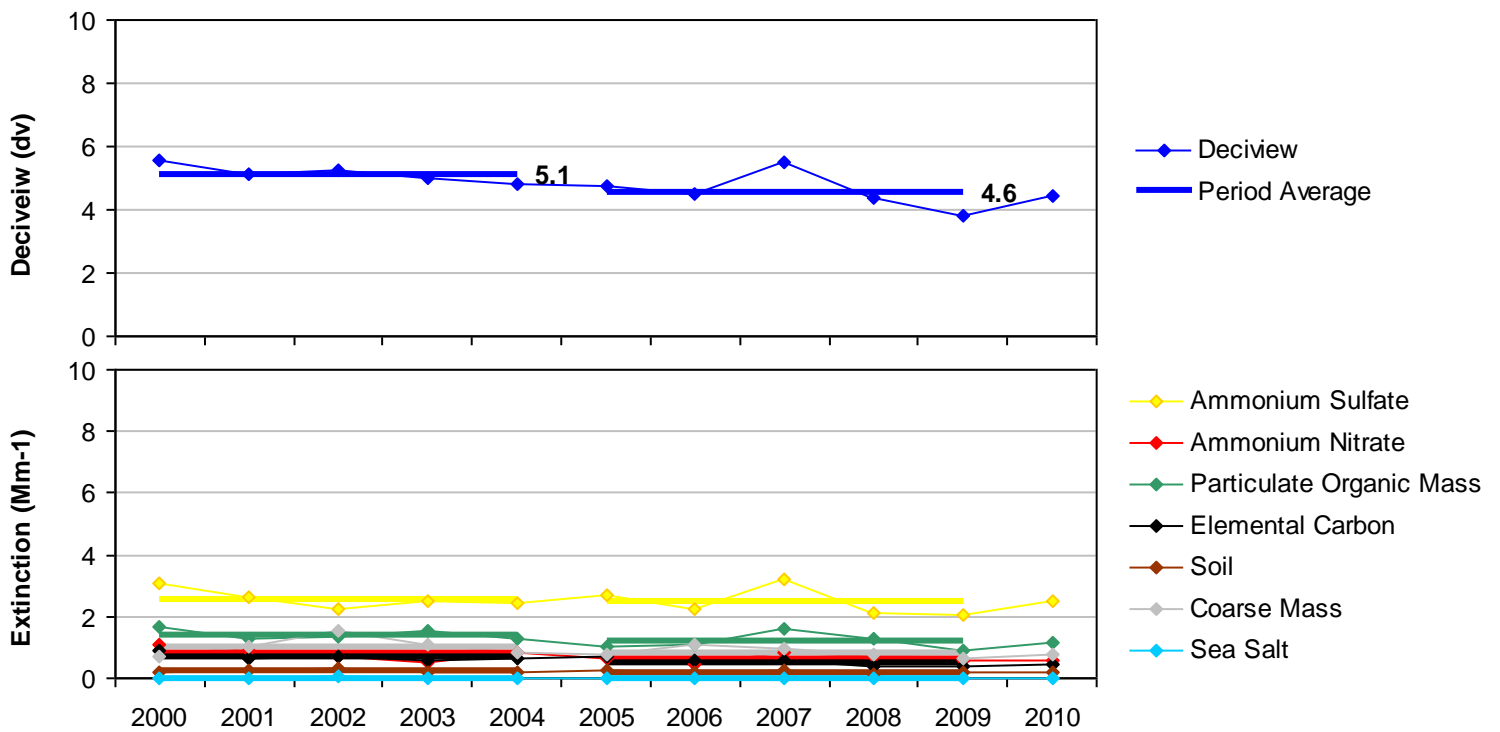


Figure L.2-3
Wind Cave NP, SD (WICA1 Site)
20% Most Impaired Visibility Days

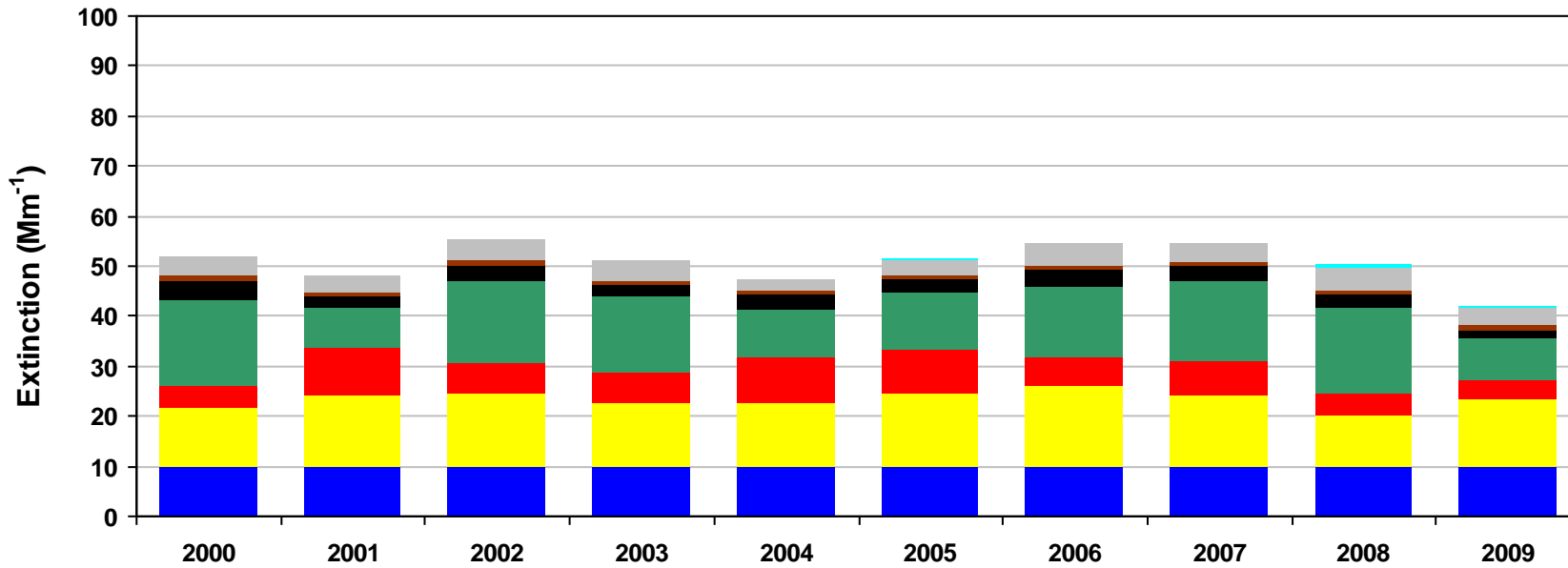
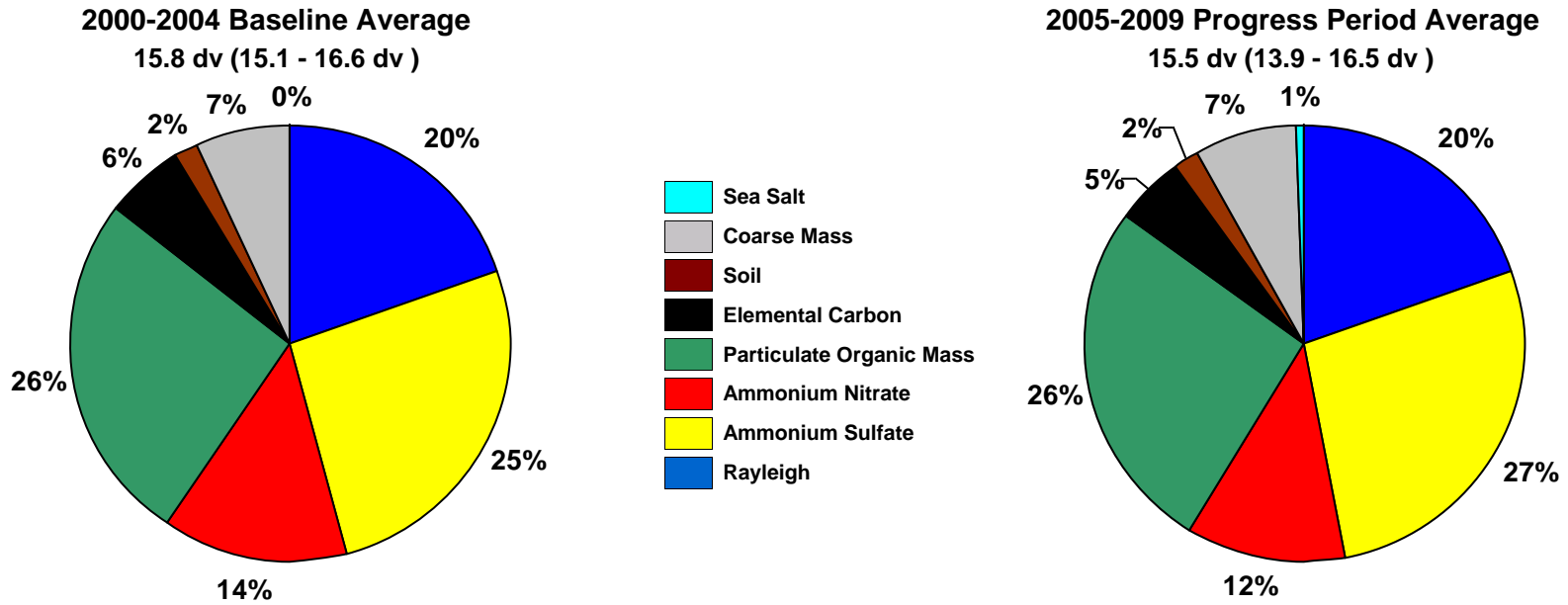
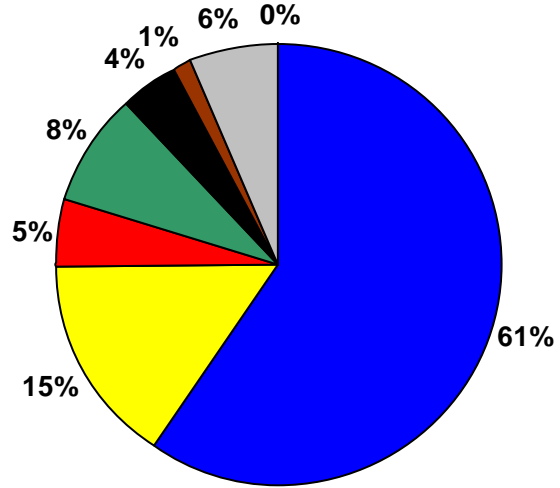


Figure L.2-4
Wind Cave NP, SD (WICA1 Site)
20% Least Impaired Visibility Days

2000-2004 Baseline Average
 5.1 dv (4.8 - 5.6 dv)



2005-2009 Progress Period Average
 4.6 dv (3.8 - 5.5 dv)

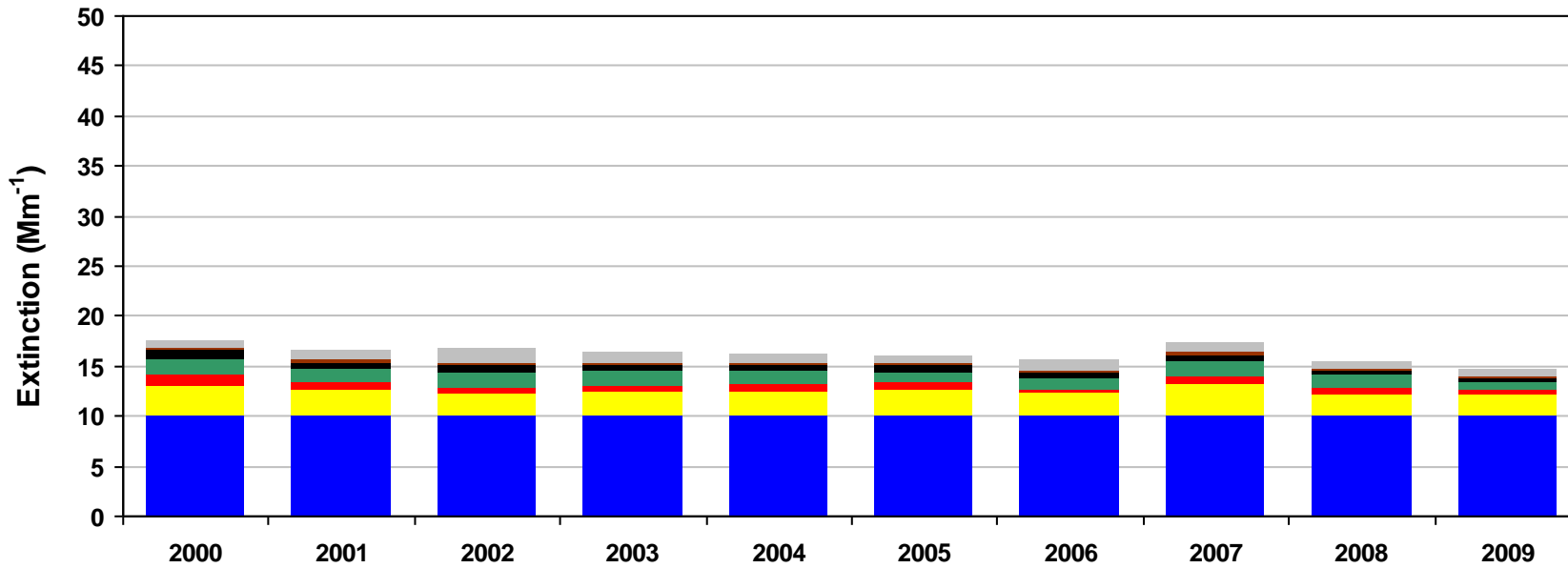
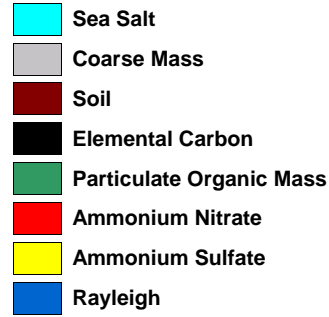
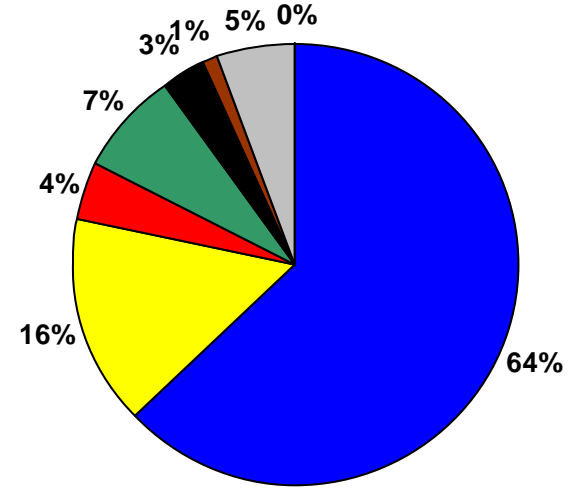


Figure L.2-5
Wind Cave NP, SD (WICA1 Site)
2000-2004 Monthly Average Aerosol Extinction, All Monitored Days

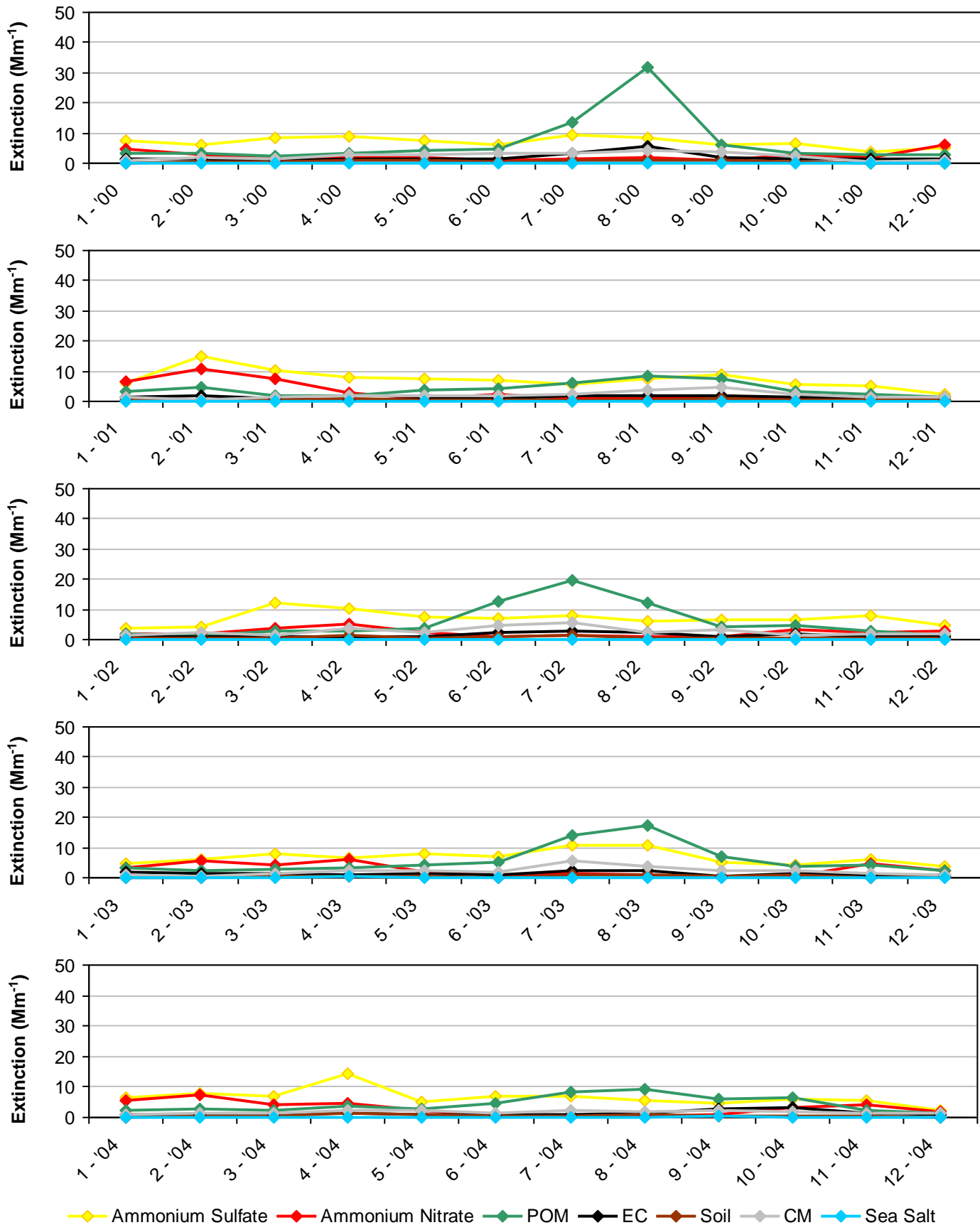


Figure L.2-6
Wind Cave NP, SD (WICA1 Site)
2005-2009 Monthly Average Aerosol Extinction, All Monitored Days

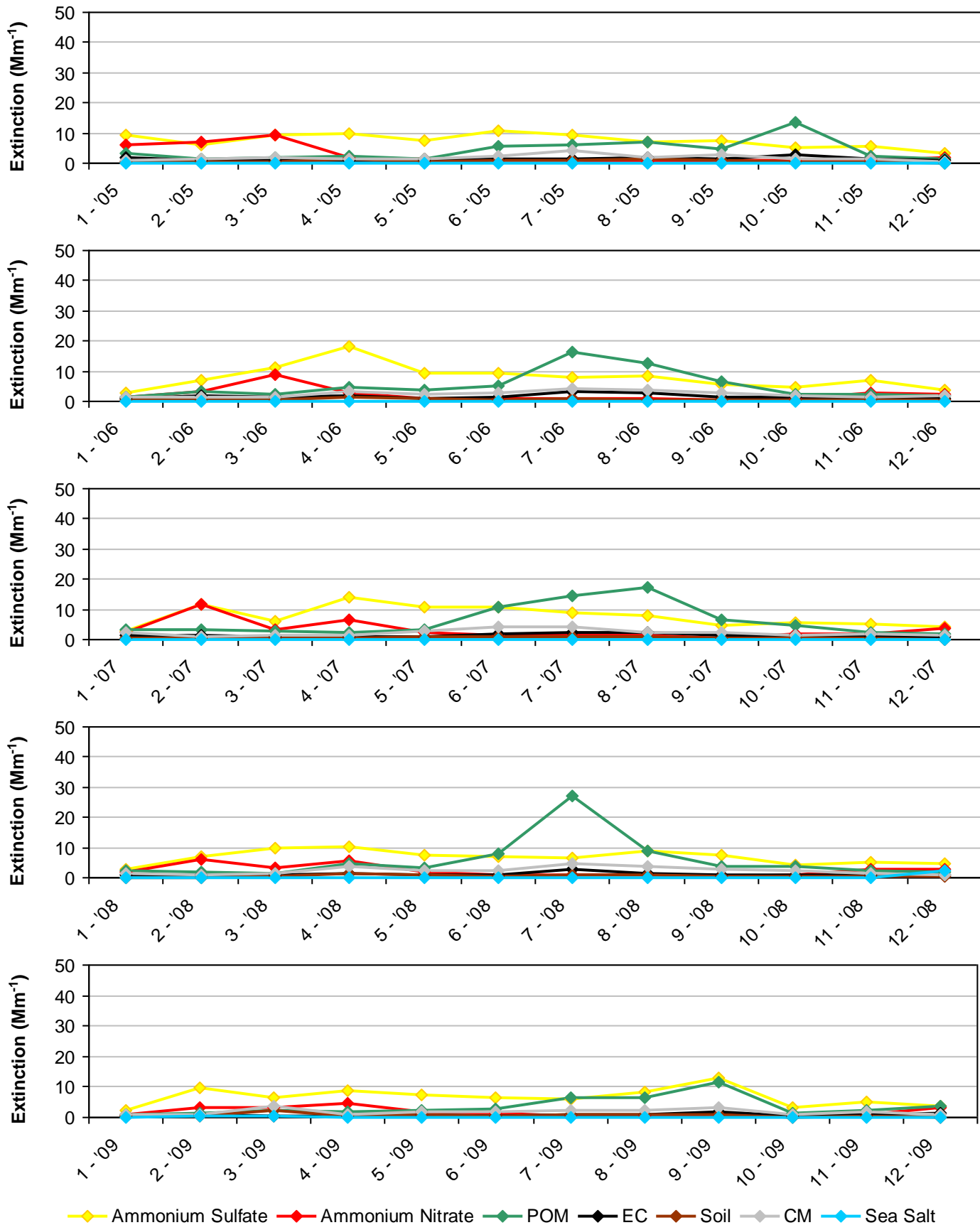


Figure L.2-7
Wind Cave NP, SD (WICA1 Site)
2000-2004 Progress Period Extinction, All Sampled Days

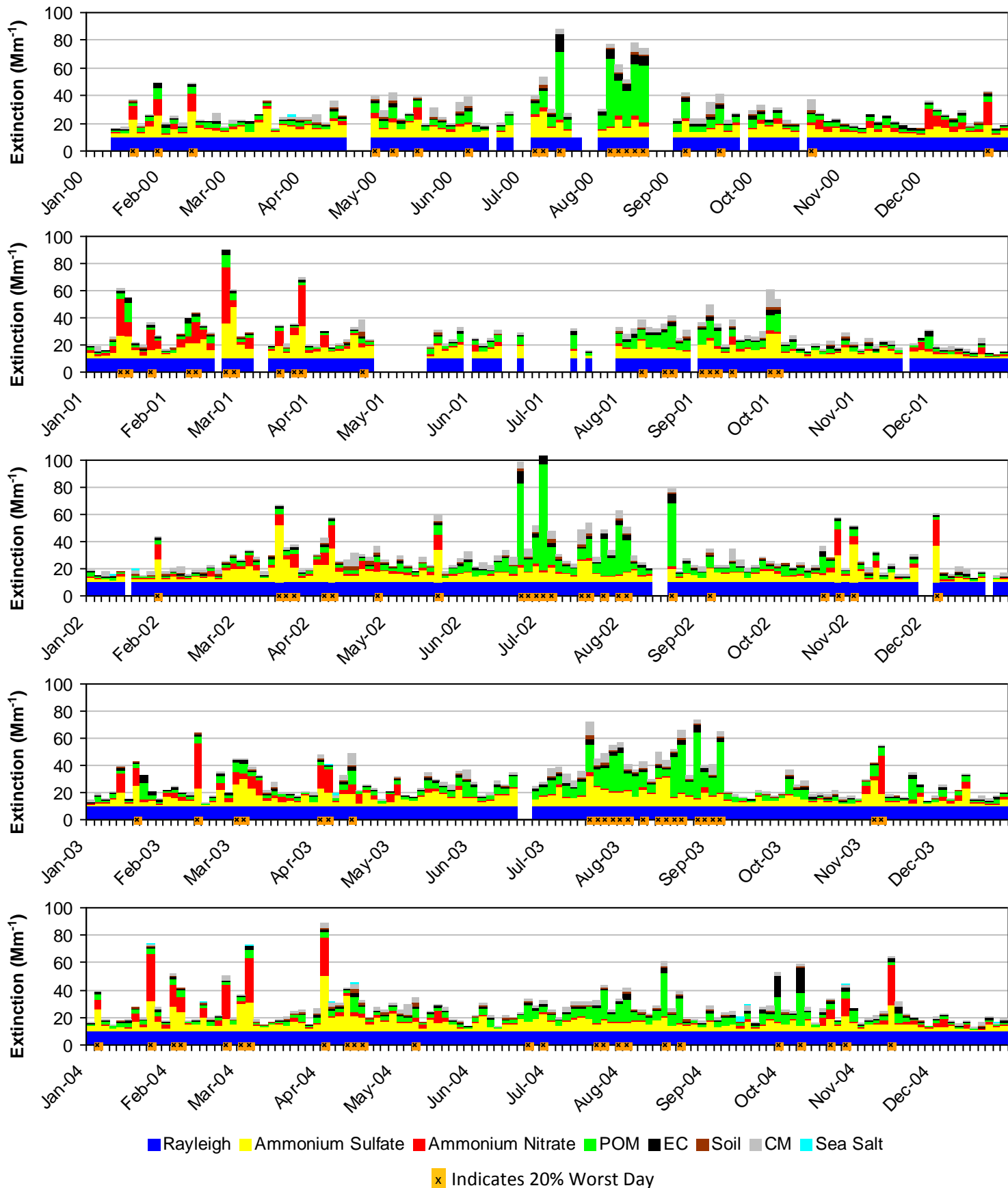


Figure L.2-8
Wind Cave NP, SD (WICA1 Site)
2005-2009 Progress Period Extinction, All Sampled Days

