

## APPENDIX J:

### North Dakota Class I Area Monitoring Data Summary Tables and Charts

Includes the following subsections:

Subsection	IMPROVE Monitor	Class I Area(s) Represented
J.1	LOST1	Lostwood WA
J.2	THRO1	Theodore Roosevelt NP

## J.1. LOSTWOOD WA (LOST1)

The following tables and figures are presented in this section for the Lostwood WA represented by the LOST1 IMPROVE Monitor:

- **Table J.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 J.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 J.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 J.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 J.1-4: 20% Least Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component are presented.
- **Figure J.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 J.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 J.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 J.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 J.1-1**  
**Lostwood WA, ND (LOST1 Site)**  
**Annual Averages, 5-Year Period Averages and Trends**

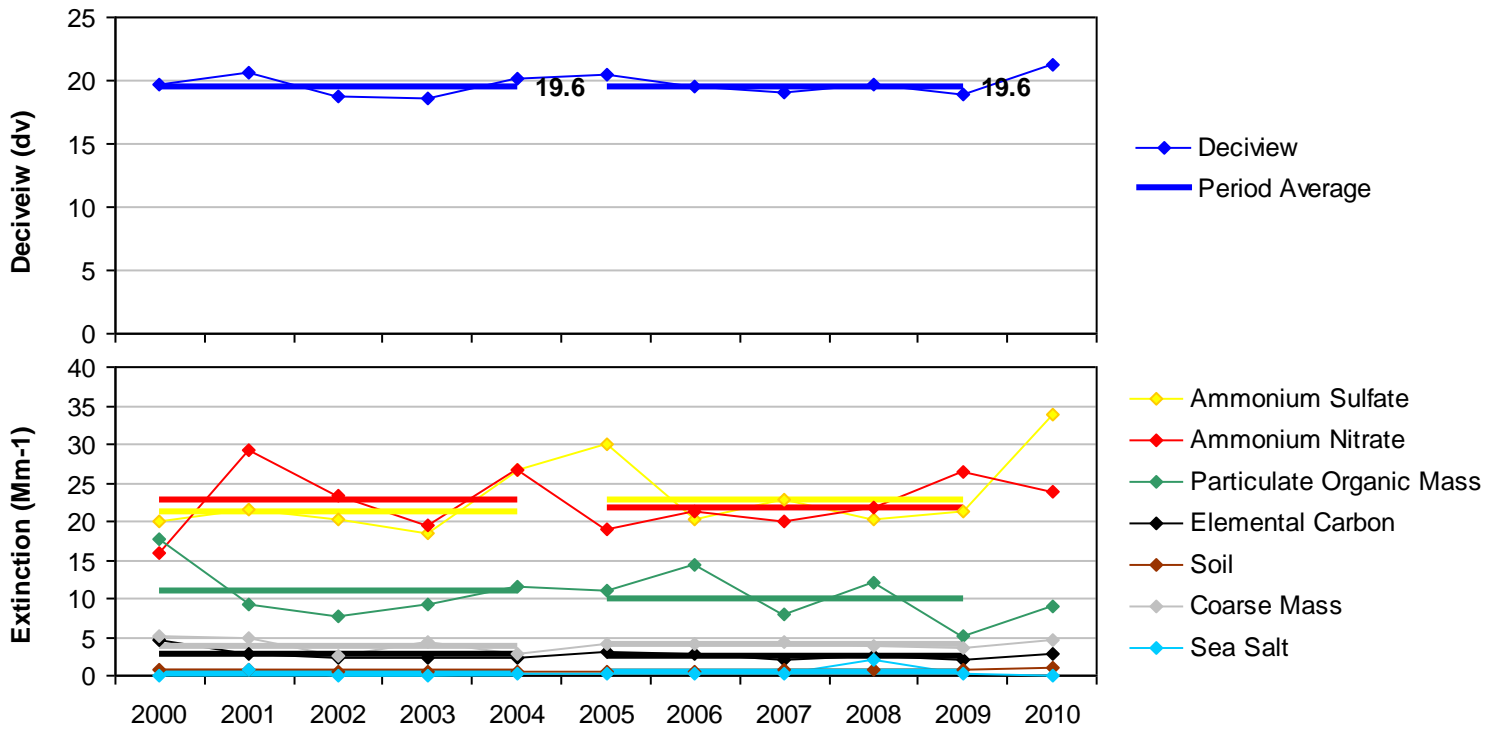
Group	Baseline Period					Progress Period					2010	2000-2009 Trend Statistics*		Period Averages**			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009		Slope (change/yr.)	p-value	Baseline (B)	Progress (P)	Difference (P -B)	Percent Change
<b>Deciview (dv)</b>																	
Best 20% Days	9.1	8.2	7.9	7.9	7.9	7.6	7.8	8.8	8.2	8.4	7.4	0.0	0.5	8.2	8.1	-0.1	-1%
Worst 20% Days	19.7	20.6	18.8	18.6	20.2	20.5	19.6	19.1	19.7	18.9	21.3	-0.1	0.3	19.6	19.6	0.0	0%
All Days	14.1	14.0	13.0	13.1	13.0	13.2	13.3	13.3	13.9	13.3	13.8	0.0	0.4	13.4	13.4	0.0	0%
<b>Total Extinction (Mm-1)</b>																	
Best 20% Days	25.0	22.8	22.2	22.2	22.2	21.6	22.2	24.3	23.0	23.4	21.2	0.0	0.5	22.9	22.9	0.0	0%
Worst 20% Days	75.3	80.2	67.6	65.6	81.7	78.9	74.8	69.3	74.5	70.0	86.3	-0.6	0.2	74.0	73.5	-0.5	-1%
All Days	44.5	44.9	39.9	40.0	41.7	42.0	41.8	40.6	43.9	41.2	45.2	-0.1	0.4	42.2	41.9	-0.3	-1%
<b>Ammonium Sulfate Extinction (Mm-1)</b>																	
Best 20% Days	5.3	4.7	3.8	3.9	4.3	4.7	4.0	5.4	4.4	5.2	4.4	0.1	0.3	4.4	4.8	0.4	9%
Worst 20% Days	20.0	21.5	20.1	18.6	26.8	29.9	20.2	22.9	20.3	21.3	34.0	0.1	0.2	21.4	22.9	1.5	7%
All Days	11.4	11.5	10.8	9.7	11.4	13.3	11.3	11.7	12.0	11.9	13.8	0.1	0.1	10.9	12.1	1.2	11%
<b>Ammonium Nitrate Extinction (Mm-1)</b>																	
Best 20% Days	2.4	1.6	1.8	1.7	1.8	1.7	1.8	1.5	1.1	1.7	1.1	0.0	0.1	1.9	1.5	-0.4	-21%
Worst 20% Days	16.0	29.3	23.3	19.4	26.7	19.0	21.4	20.0	21.9	26.3	23.7	0.4	0.4	22.9	21.7	-1.2	-5%
All Days	6.7	9.8	8.4	7.8	8.6	7.1	7.6	7.4	8.6	9.1	8.6	0.1	0.4	8.3	7.9	-0.4	-5%
<b>Particulate Organic Mass Extinction (Mm-1)</b>																	
Best 20% Days	2.9	1.9	2.0	2.5	2.0	1.6	2.0	2.1	2.2	1.8	1.3	0.0	0.2	2.3	1.9	-0.4	-17%
Worst 20% Days	17.8	9.2	7.6	9.1	11.6	11.0	14.5	8.0	12.2	5.0	9.1	-0.4	0.3	11.1	10.1	-1.0	-9%
All Days	8.7	5.5	4.7	5.9	5.3	5.1	6.1	4.8	5.7	3.6	5.1	-0.2	0.1	6.0	5.0	-1.0	-17%
<b>Elemental Carbon Extinction (Mm-1)</b>																	
Best 20% Days	0.8	0.7	0.7	0.7	0.5	0.7	0.9	0.7	0.7	0.7	0.7	0.0	0.3	0.7	0.7	0.0	0%
Worst 20% Days	4.5	2.8	2.3	2.4	2.2	3.2	2.8	2.1	2.5	2.0	2.8	-0.1	0.0	2.8	2.5	-0.3	-11%
All Days	2.1	1.6	1.4	1.6	1.2	1.7	1.7	1.3	1.4	1.4	2.0	-0.1	0.1	1.6	1.5	-0.1	-6%
<b>Soil Extinction (Mm-1)</b>																	
Best 20% Days	0.3	0.4	0.4	0.3	0.3	0.2	0.3	0.4	0.3	0.4	0.3	0.0	0.3	0.3	0.3	0.0	0%
Worst 20% Days	0.9	0.7	0.5	0.6	0.4	0.5	0.6	0.6	0.7	0.7	1.1	0.0	0.4	0.6	0.6	0.0	0%
All Days	0.6	0.7	0.5	0.5	0.5	0.4	0.5	0.5	0.6	0.6	0.7	0.0	0.5	0.6	0.5	-0.1	-17%
<b>Coarse Mass Extinction (Mm-1)</b>																	
Best 20% Days	2.2	2.5	2.4	2.2	2.2	1.6	2.1	3.1	3.1	2.5	2.2	0.0	0.2	2.3	2.5	0.2	9%
Worst 20% Days	5.2	4.7	2.6	4.3	2.7	4.1	4.2	4.4	3.9	3.5	4.6	-0.1	0.2	3.9	4.0	0.1	3%
All Days	3.9	4.5	3.0	3.4	3.6	3.2	3.5	3.7	3.8	3.4	3.8	0.0	0.4	3.7	3.5	-0.2	-5%
<b>Sea Salt Extinction (Mm-1)</b>																	
Best 20% Days	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0%
Worst 20% Days	0.0	0.9	0.1	0.0	0.3	0.2	0.2	0.2	2.1	0.1	0.0	0.0	0.2	0.3	0.6	0.3	100%
All Days	0.2	0.3	0.1	0.0	0.2	0.2	0.2	0.2	0.7	0.3	0.1	0.0	0.0	0.1	0.3	0.2	>100%

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

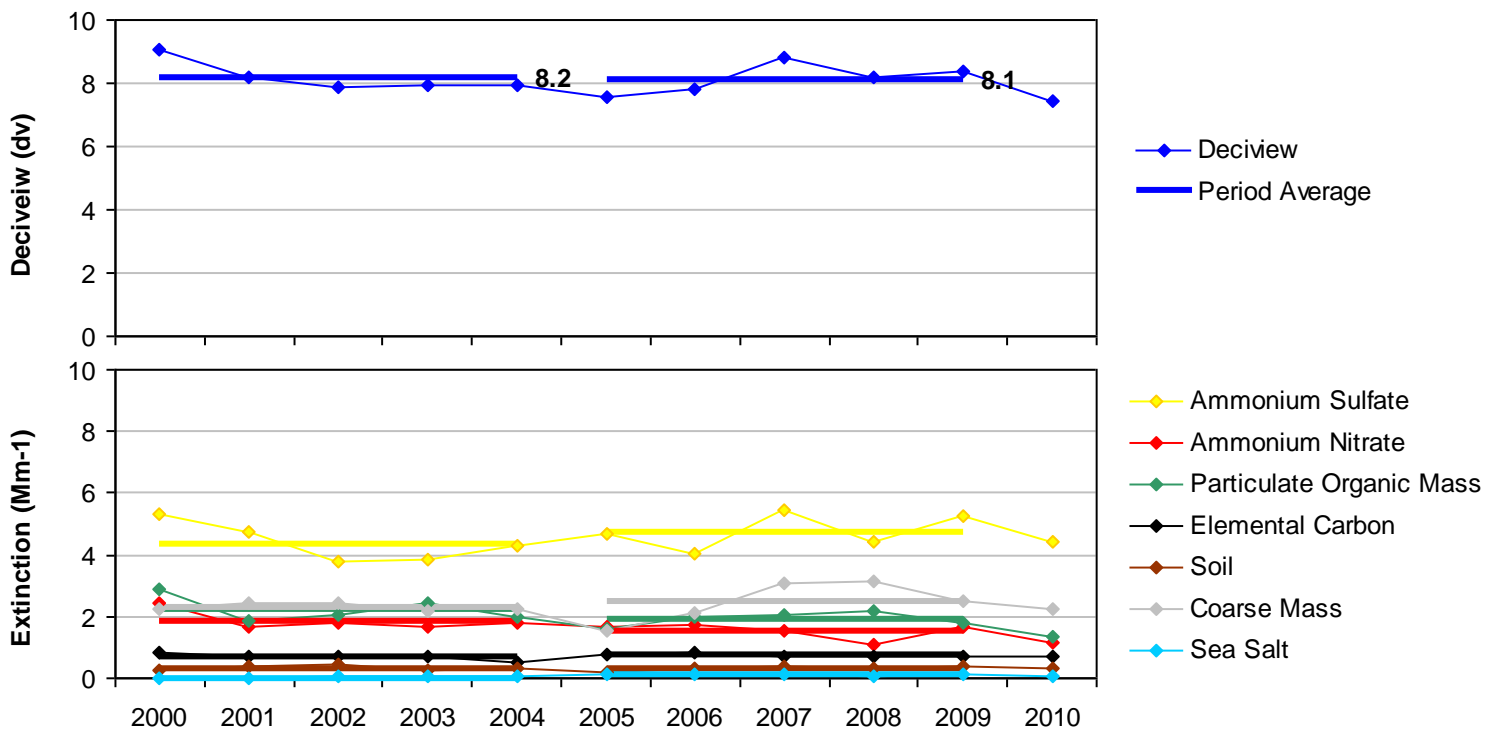
\*\*Values highlighted in blue indicate a decrease in the 5-year average, values highlighted in red indicate an increase.

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

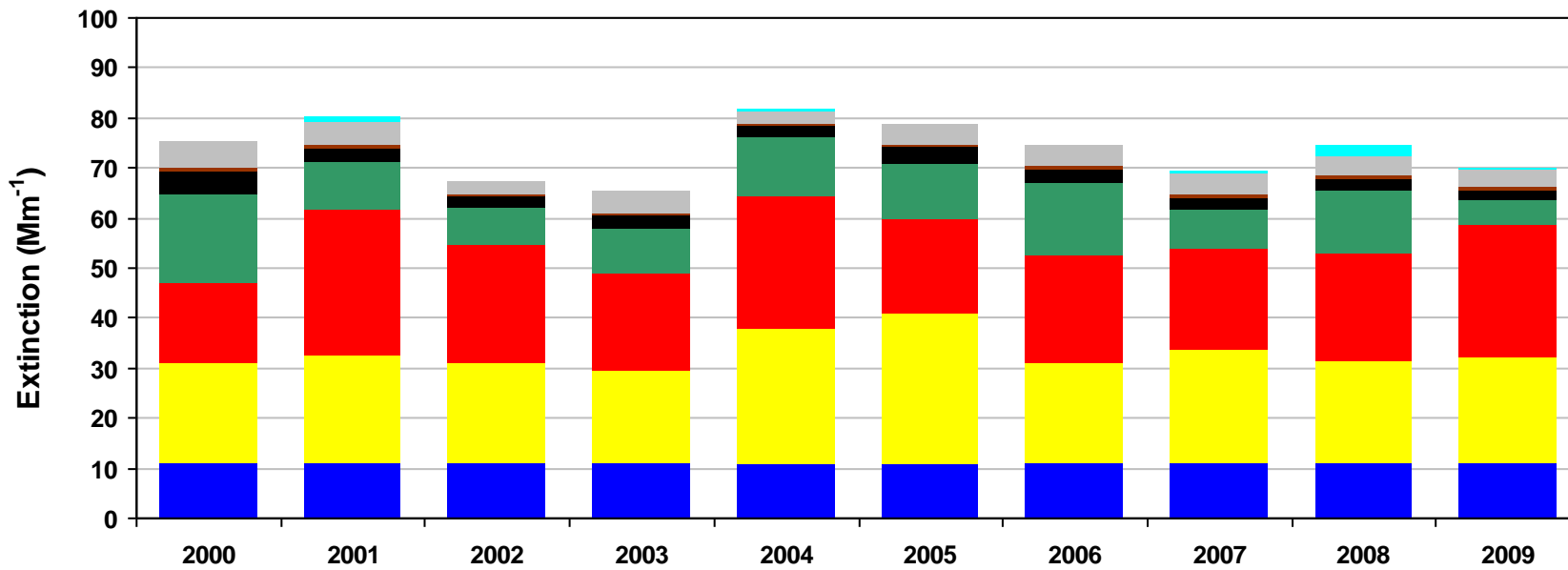
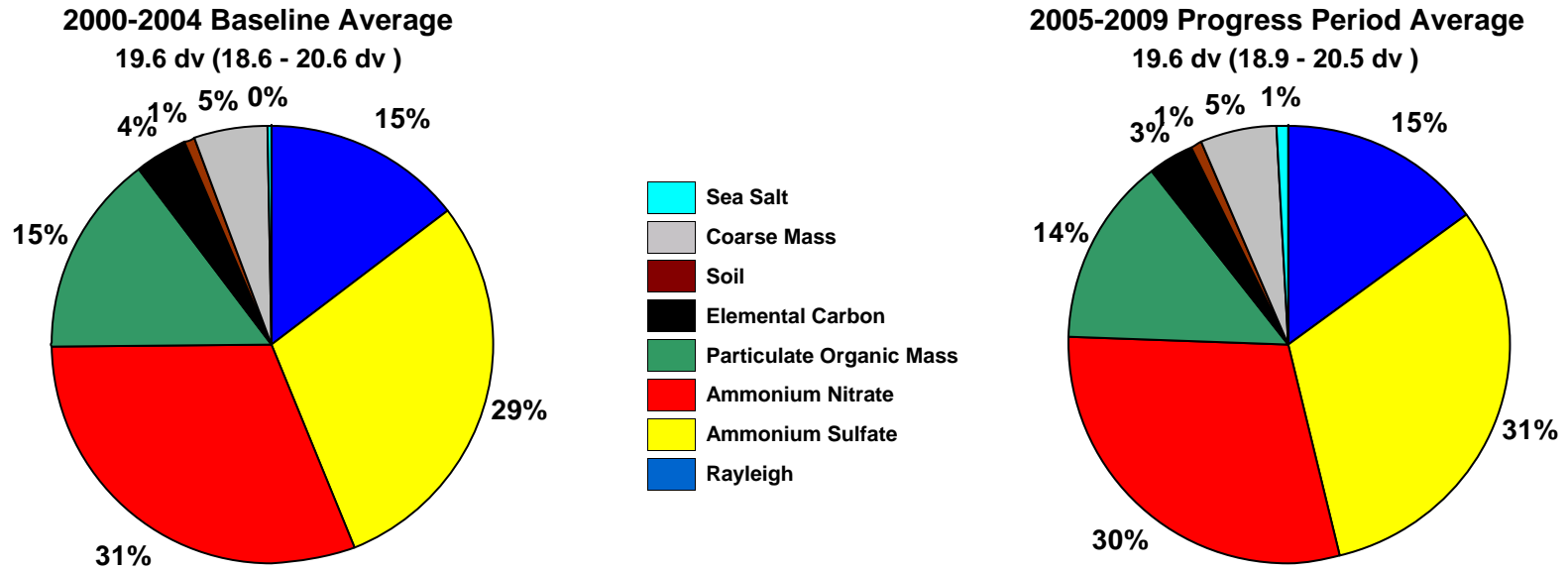
**Figure J.1-1**  
**Lostwood WA, ND (LOST1 Site)**  
**Annual and 5-Year Period Averages**  
**20% Most Impaired Visibility Days**



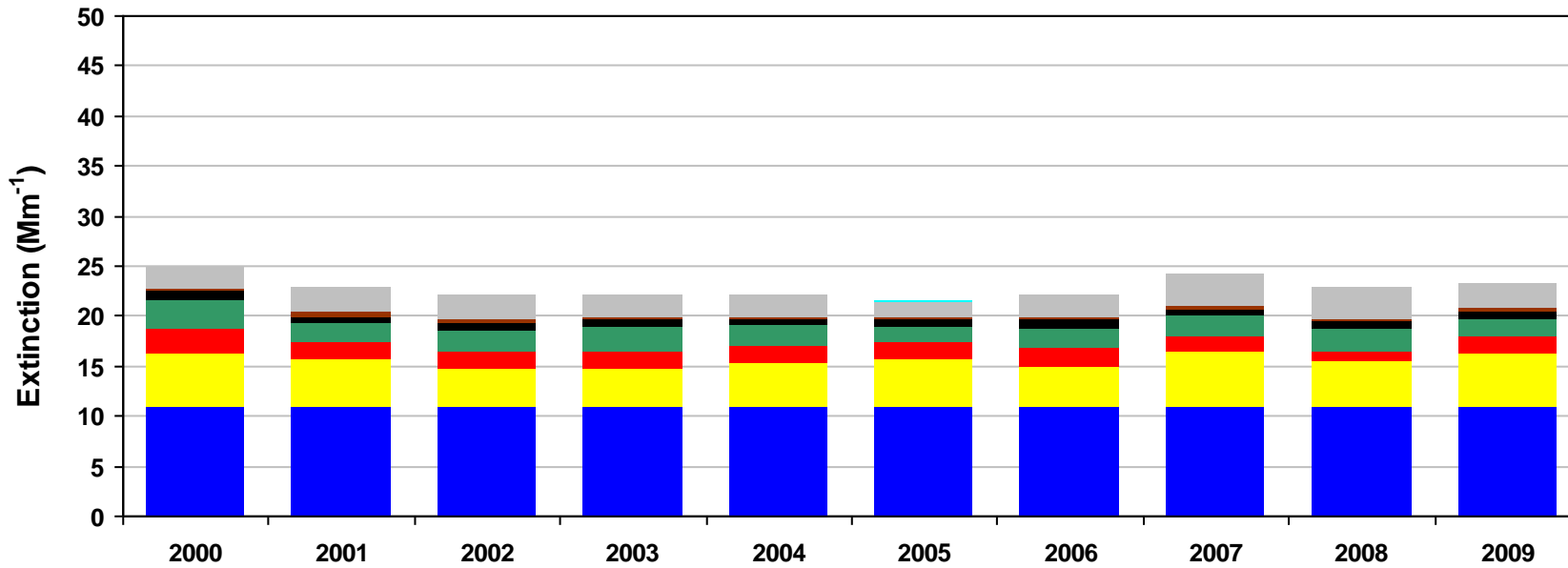
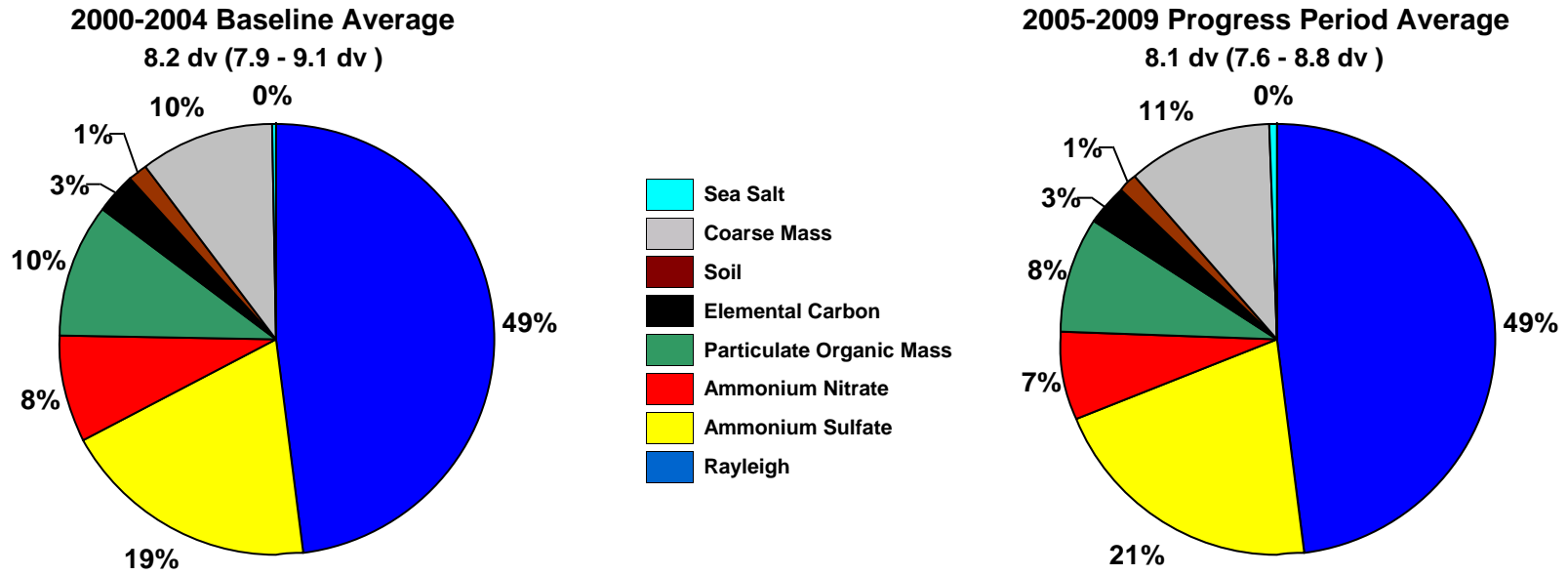
**Figure J.1-2**  
**Lostwood WA, ND (LOST1 Site)**  
**Annual and 5-Year Period Averages**  
**20% Least Impaired Visibility Days**



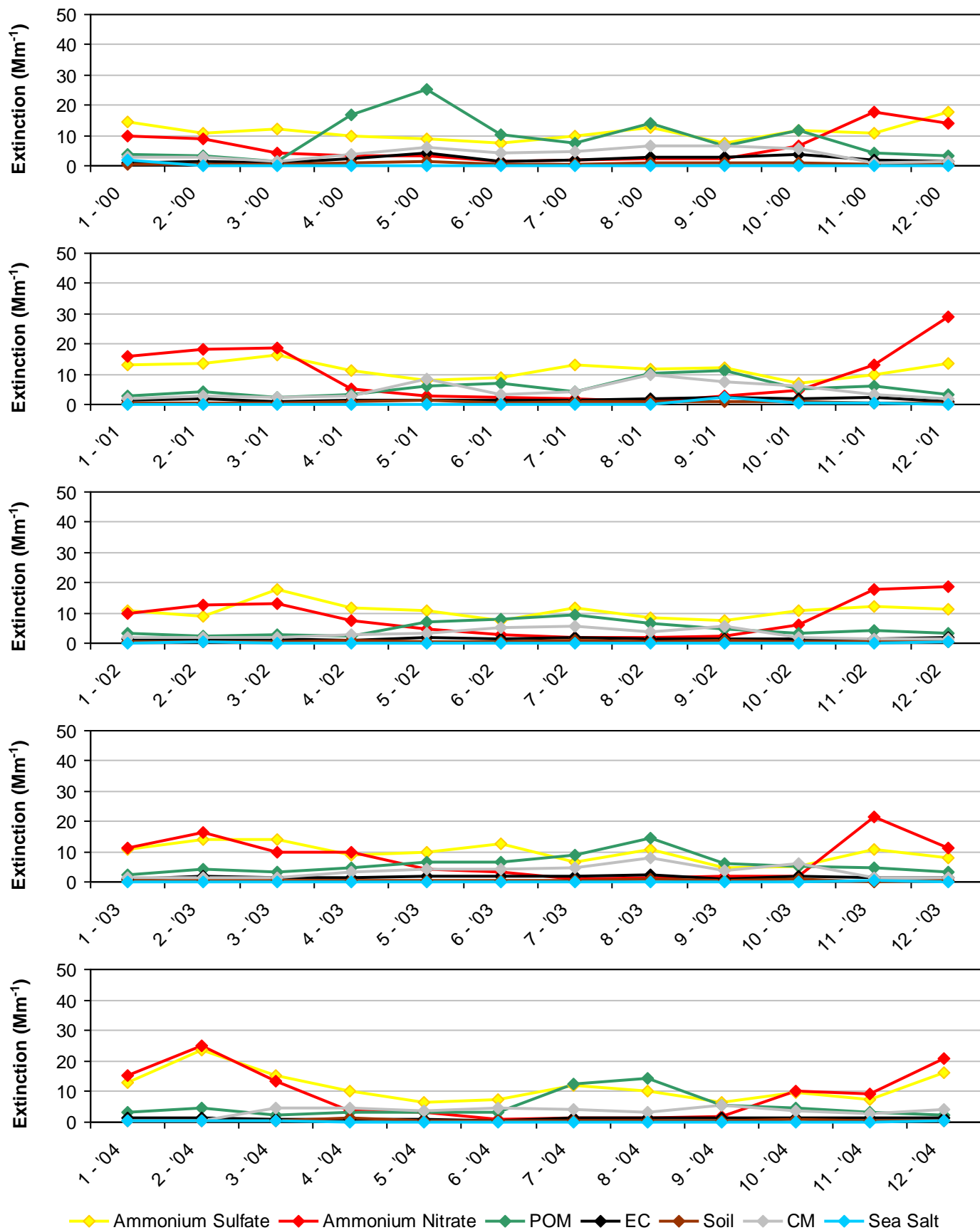
**Figure J.1-3  
Lostwood WA, ND (LOST1 Site)  
20% Most Impaired Visibility Days**



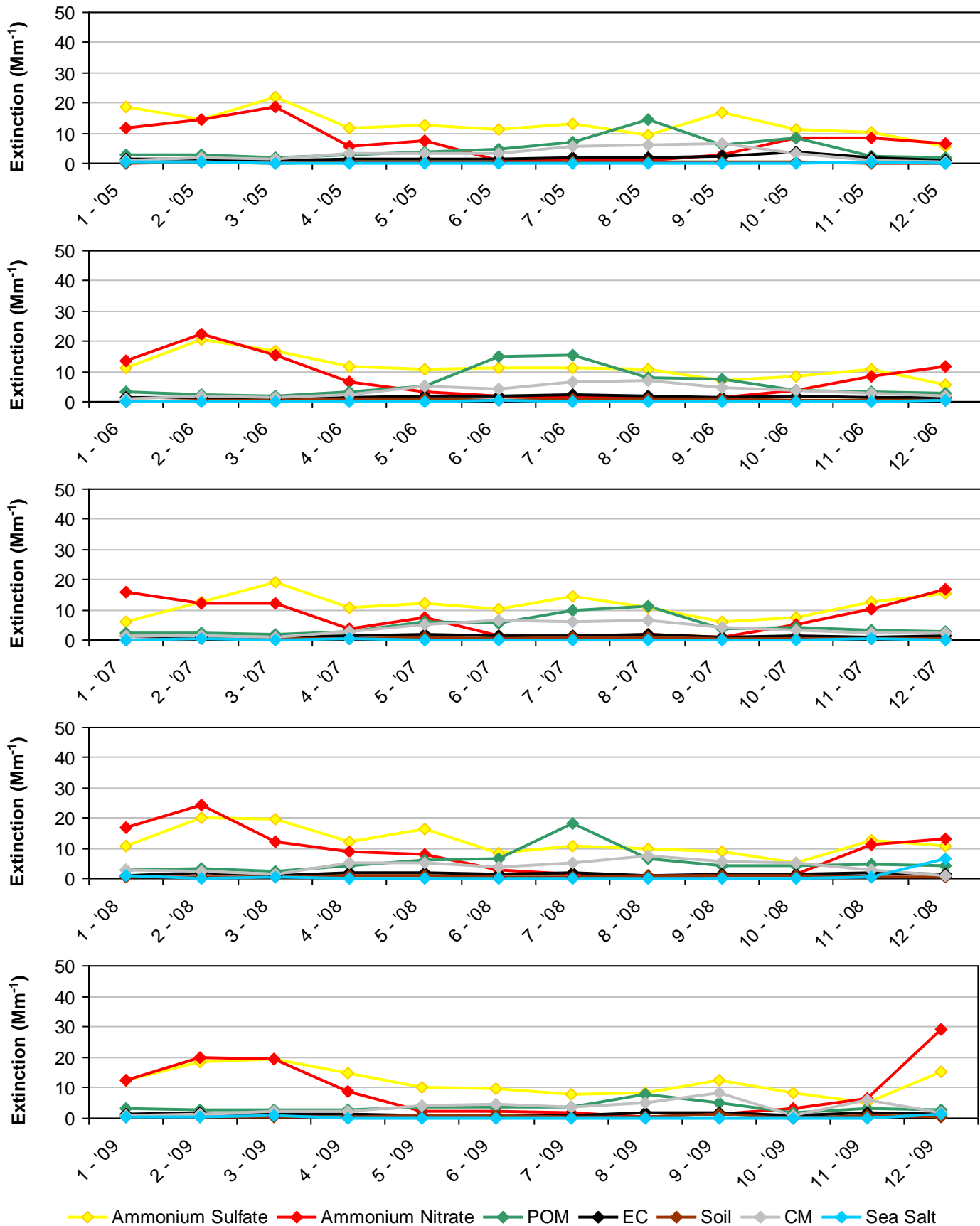
**Figure J.1-4**  
**Lostwood WA, ND (LOST1 Site)**  
**20% Least Impaired Visibility Days**



**Figure J.1-5**  
**Lostwood WA, ND (LOST1 Site)**  
**2000-2004 Monthly Average Aerosol Extinction, All Monitored Days**

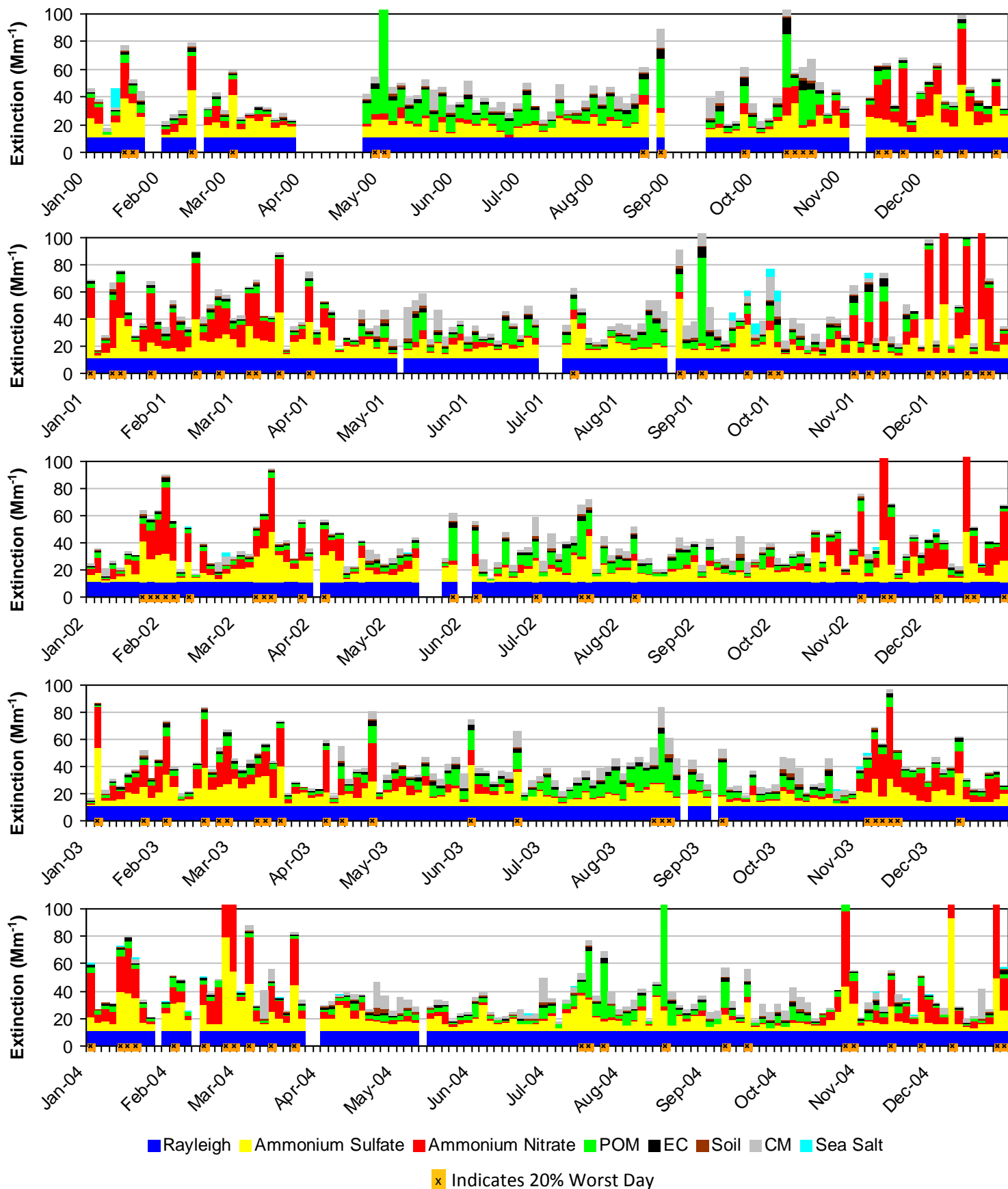


**Figure J.1-6**  
**Lostwood WA, ND (LOST1 Site)**  
**2005-2009 Monthly Average Aerosol Extinction, All Monitored Days**



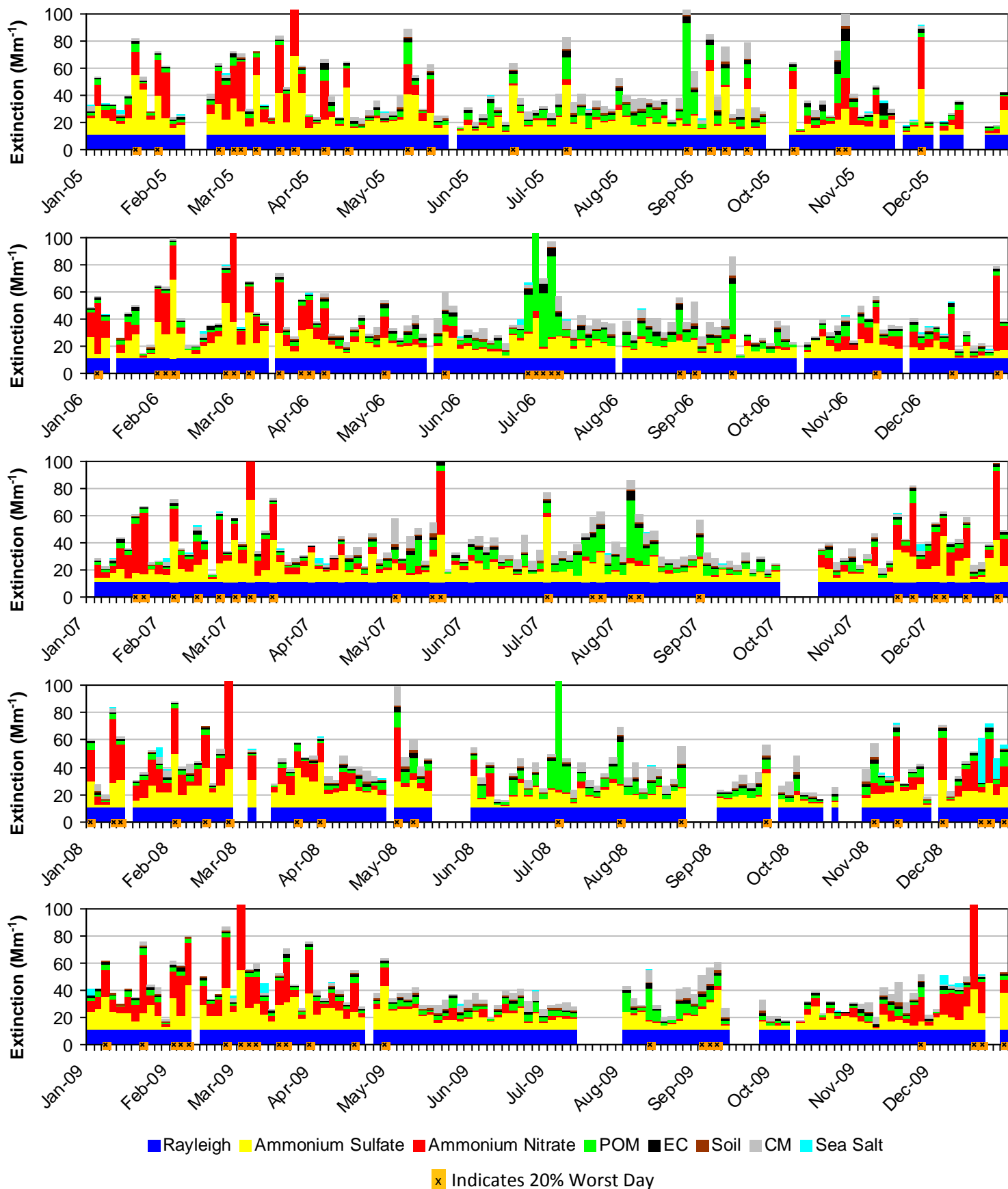


**Figure J.1-7**  
**Lostwood WA, ND (LOST1 Site)**  
**2000-2004 Progress Period Extinction, All Sampled Days**



■ Rayleigh   
 ■ Ammonium Sulfate   
 ■ Ammonium Nitrate   
 ■ POM   
 ■ EC   
 ■ Soil   
 ■ CM   
 ■ Sea Salt  
x Indicates 20% Worst Day

**Figure J.1-8**  
**Lostwood WA, ND (LOST1 Site)**  
**2005-2009 Progress Period Extinction, All Sampled Days**



## J.2. THEODORE ROOSEVELT NP (THRO1)

The following tables and figures are presented in this section for the Theodore Roosevelt NP represented by the THRO1 IMPROVE Monitor:

- **Table J.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 J.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 J.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 J.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 J.2-4: 20% Least Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component are presented.
- **Figure J.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 J.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 J.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 J.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 J.2-1**  
**Theodore Roosevelt NP, ND (THRO1 Site)**  
**Annual Averages, 5-Year Period Averages and Trends**

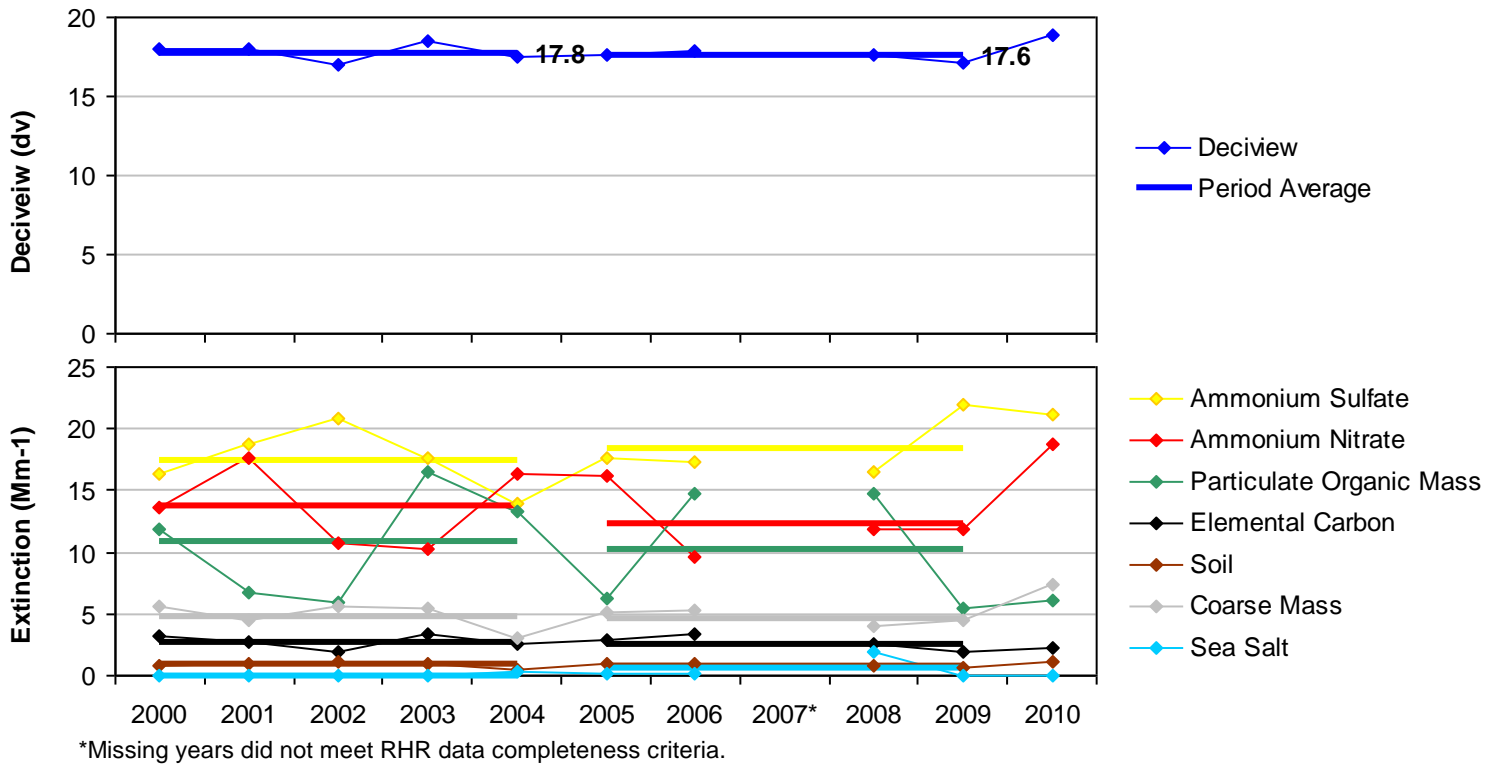
Group	Baseline Period					Progress Period					2010	2000-2009 Trend Statistics*		Period Averages**			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009		Slope (change/yr.)	p-value	Baseline (B)	Progress (P)	Difference (P-B)	Percent Change
<b>Deciview (dv)</b>																	
Best 20% Days	8.2	7.8	7.8	7.5	7.5	6.8	6.5	---	6.6	7.0	6.3	-0.2	0.0	7.8	6.7	-1.1	-14%
Worst 20% Days	18.1	18.0	17.0	18.4	17.5	17.6	17.9	---	17.6	17.2	18.8	-0.1	0.1	17.8	17.6	-0.2	-1%
All Days	12.8	12.5	11.9	12.5	11.9	11.9	12.1	---	12.0	11.6	12.1	-0.1	0.0	12.3	11.9	-0.4	-3%
<b>Total Extinction (Mm-1)</b>																	
Best 20% Days	23.0	21.9	21.9	21.3	21.2	19.9	19.3	---	19.4	20.3	18.9	-0.4	0.0	21.9	19.7	-2.2	-10%
Worst 20% Days	62.4	62.4	57.1	65.2	61.1	60.1	62.3	---	63.4	57.3	67.7	-0.2	0.3	61.6	60.8	-0.8	-1%
All Days	38.3	37.7	35.3	37.9	35.5	35.5	36.6	---	36.7	34.4	37.3	-0.2	0.1	36.9	35.8	-1.1	-3%
<b>Ammonium Sulfate Extinction (Mm-1)</b>																	
Best 20% Days	4.9	3.6	3.8	3.5	3.2	3.6	2.5	---	3.3	4.1	3.2	-0.1	0.1	3.8	3.4	-0.4	-11%
Worst 20% Days	16.4	18.8	20.8	17.7	14.0	17.7	17.3	---	16.6	22.0	21.1	0.0	0.5	17.5	18.4	0.9	5%
All Days	9.7	9.9	9.8	9.1	8.0	9.4	9.5	---	9.3	10.7	9.8	0.0	0.5	9.3	9.7	0.4	4%
<b>Ammonium Nitrate Extinction (Mm-1)</b>																	
Best 20% Days	1.6	1.4	1.9	1.6	1.2	1.0	0.9	---	0.7	1.0	0.6	-0.1	0.0	1.5	0.9	-0.6	-40%
Worst 20% Days	13.6	17.7	10.7	10.3	16.4	16.1	9.5	---	11.8	11.9	18.7	-0.3	0.2	13.7	12.3	-1.4	-10%
All Days	5.3	6.1	5.1	5.3	5.6	4.9	4.2	---	4.9	4.6	6.4	-0.1	0.0	5.5	4.7	-0.8	-15%
<b>Particulate Organic Mass Extinction (Mm-1)</b>																	
Best 20% Days	1.9	1.8	2.2	1.8	2.1	1.6	1.4	---	1.5	1.5	1.4	-0.1	0.0	2.0	1.5	-0.5	-25%
Worst 20% Days	11.8	6.7	5.9	16.4	13.4	6.3	14.7	---	14.7	5.4	6.1	0.0	0.5	10.8	10.3	-0.5	-5%
All Days	5.6	4.1	3.8	6.5	5.2	4.0	5.6	---	5.4	3.3	3.9	-0.1	0.3	5.0	4.6	-0.4	-8%
<b>Elemental Carbon Extinction (Mm-1)</b>																	
Best 20% Days	1.2	0.8	0.8	0.9	0.9	1.0	1.1	---	0.7	0.6	0.7	0.0	0.2	0.9	0.9	0.0	0%
Worst 20% Days	3.3	2.7	1.9	3.4	2.5	2.8	3.3	---	2.5	1.9	2.3	-0.1	0.2	2.7	2.6	-0.1	-4%
All Days	2.1	1.7	1.4	1.9	1.5	1.9	1.9	---	1.5	1.2	1.5	-0.1	0.1	1.7	1.6	-0.1	-6%
<b>Soil Extinction (Mm-1)</b>																	
Best 20% Days	0.3	0.5	0.4	0.3	0.4	0.3	0.3	---	0.3	0.3	0.3	0.0	0.0	0.4	0.3	-0.1	-25%
Worst 20% Days	0.8	1.0	1.2	1.0	0.5	0.9	1.0	---	0.8	0.7	1.1	0.0	0.1	0.9	0.8	-0.1	-11%
All Days	0.6	0.8	0.8	0.6	0.7	0.7	0.7	---	0.6	0.5	0.7	0.0	0.2	0.7	0.6	-0.1	-14%
<b>Coarse Mass Extinction (Mm-1)</b>																	
Best 20% Days	2.1	2.7	1.7	2.1	2.4	1.3	1.9	---	1.8	1.8	1.7	0.0	0.1	2.2	1.7	-0.5	-23%
Worst 20% Days	5.6	4.5	5.6	5.4	3.0	5.1	5.3	---	4.1	4.4	7.3	-0.1	0.1	4.8	4.7	-0.1	-2%
All Days	4.0	4.0	3.3	3.4	3.4	3.5	3.6	---	3.4	3.0	3.9	-0.1	0.2	3.6	3.4	-0.2	-6%
<b>Sea Salt Extinction (Mm-1)</b>																	
Best 20% Days	0.0	0.0	0.0	0.1	0.1	0.1	0.1	---	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0%
Worst 20% Days	0.0	0.0	0.0	0.0	0.3	0.2	0.1	---	2.0	0.1	0.1	0.0	0.0	0.1	0.6	0.5	>100%
All Days	0.0	0.2	0.0	0.0	0.1	0.1	0.1	---	0.5	0.1	0.0	0.0	0.1	0.2	0.1	0.1	100%

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

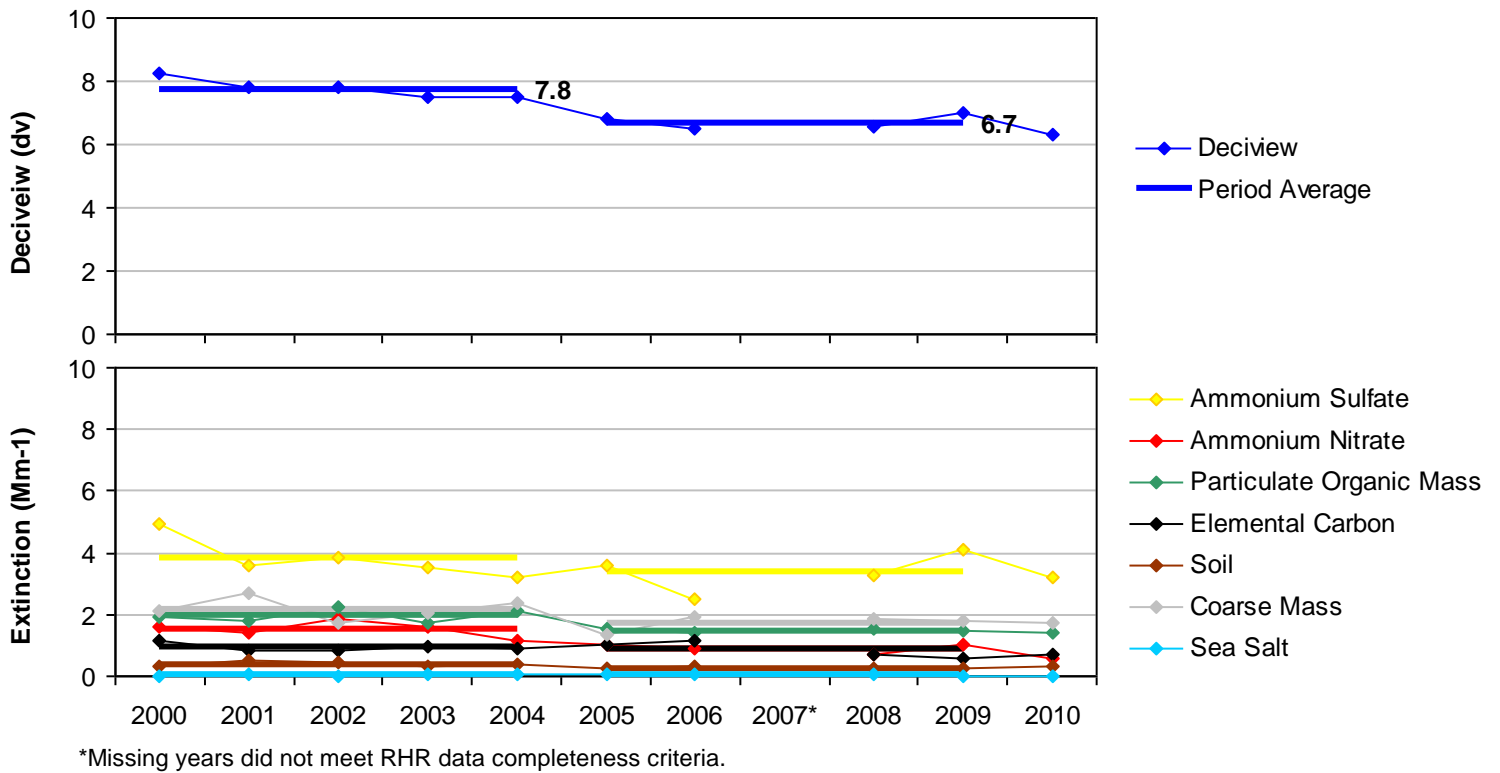
\*\*Values highlighted in blue indicate a decrease in the 5-year average, values highlighted in red indicate an increase.

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

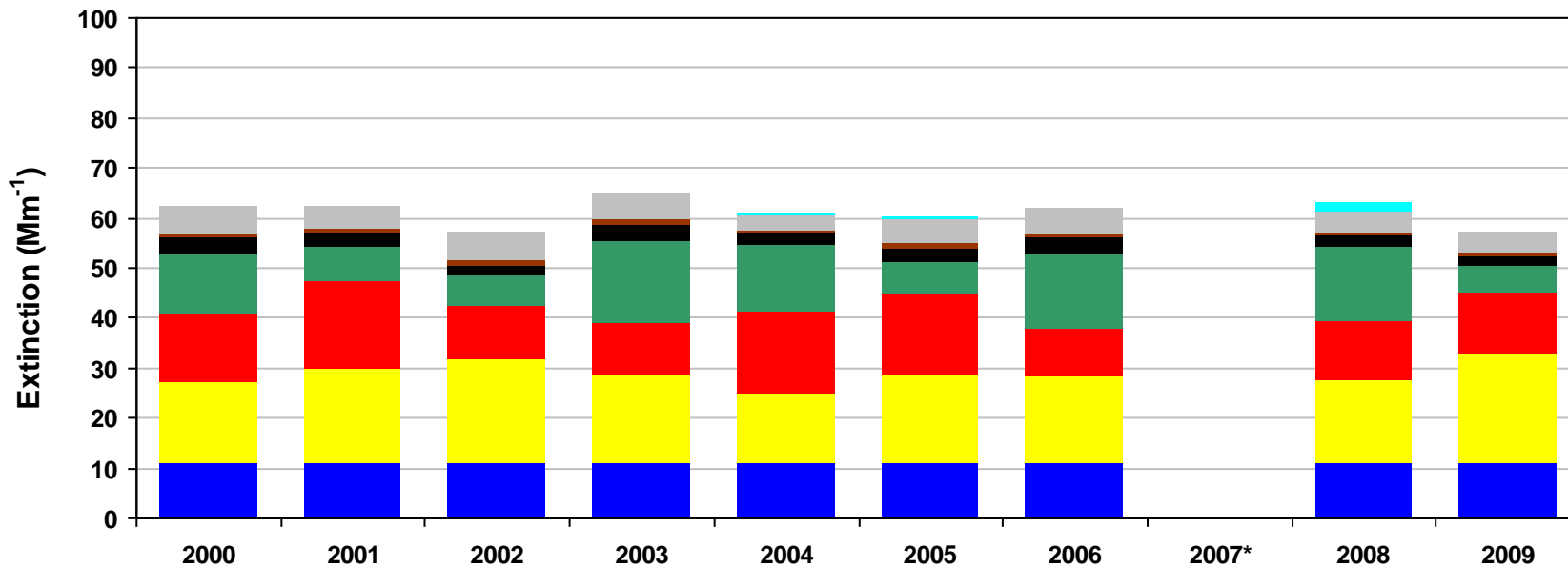
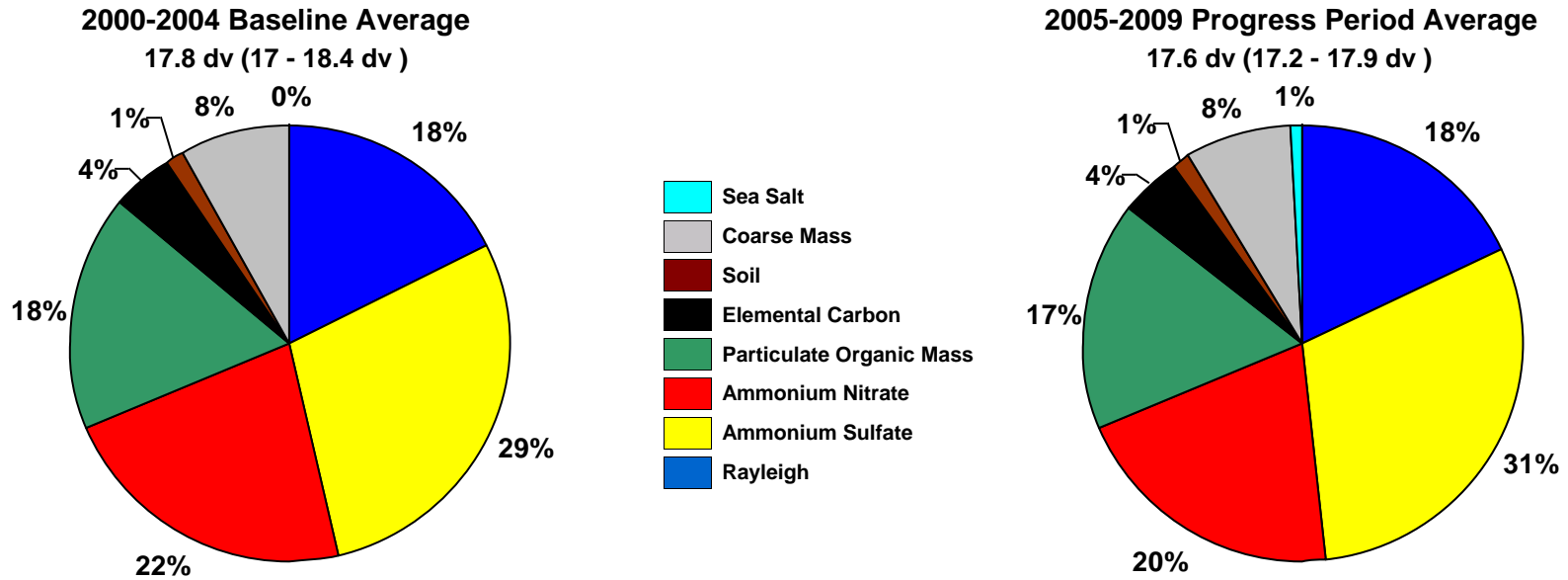
**Figure J.2-1**  
**Theodore Roosevelt NP, ND (THRO1 Site)**  
**Annual and 5-Year Period Averages**  
**20% Most Impaired Visibility Days**



**Figure J.2-2**  
**Theodore Roosevelt NP, ND (THRO1 Site)**  
**Annual and 5-Year Period Averages**  
**20% Least Impaired Visibility Days**



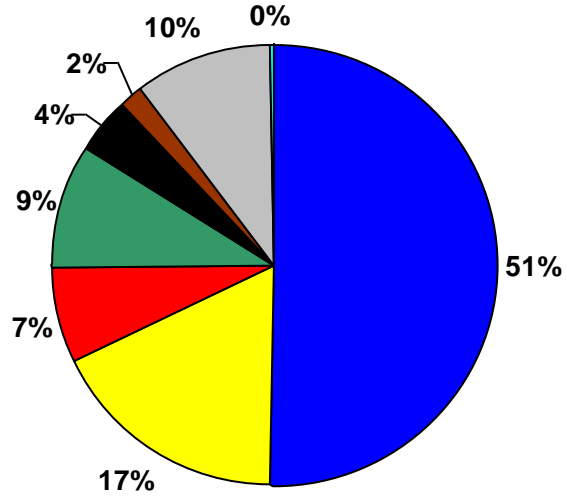
**Figure J.2-3**  
**Theodore Roosevelt NP, ND (THRO1 Site)**  
**20% Most Impaired Visibility Days**



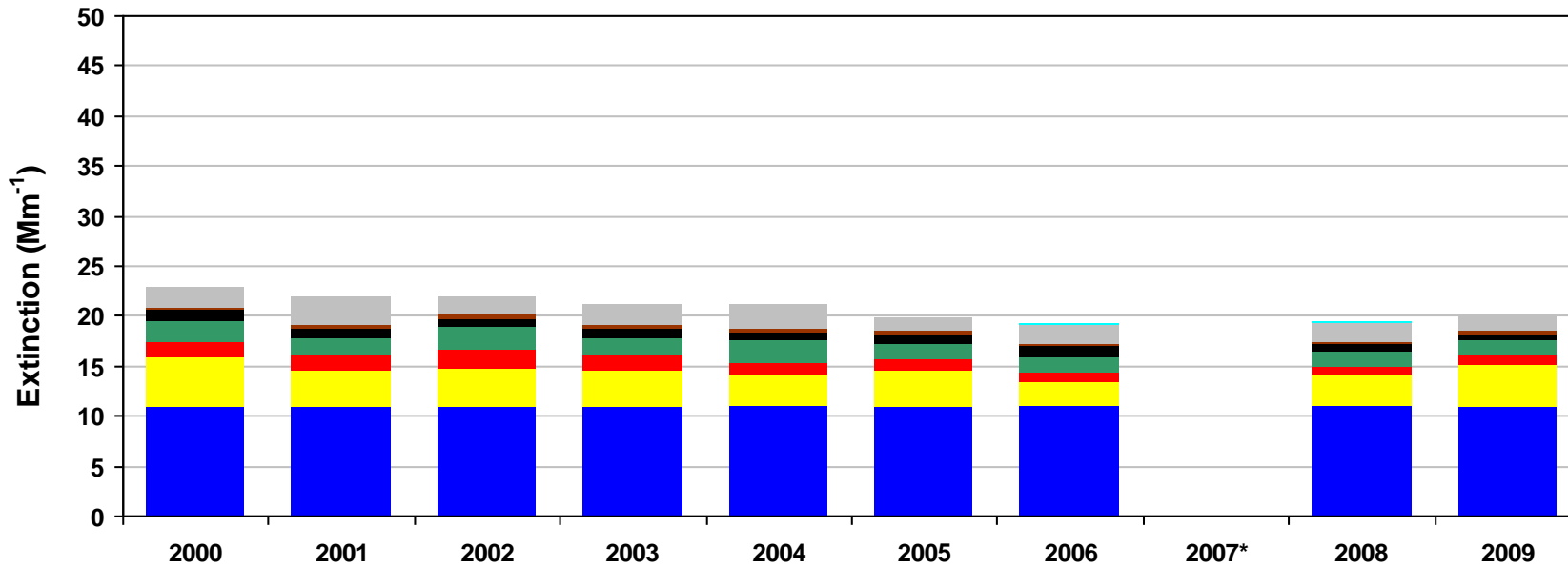
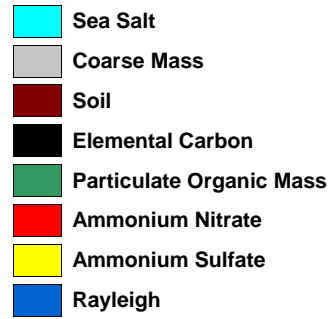
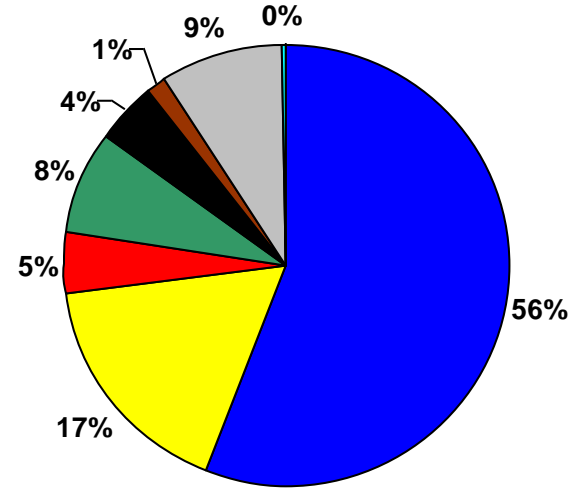
\*Missing years did not meet RHR data completeness criteria. Only complete years are included in 5-year average pie charts.

**Figure J.2-4**  
**Theodore Roosevelt NP, ND (THRO1 Site)**  
**20% Least Impaired Visibility Days**

**2000-2004 Baseline Average**  
 7.8 dv (7.5 - 8.2 dv)

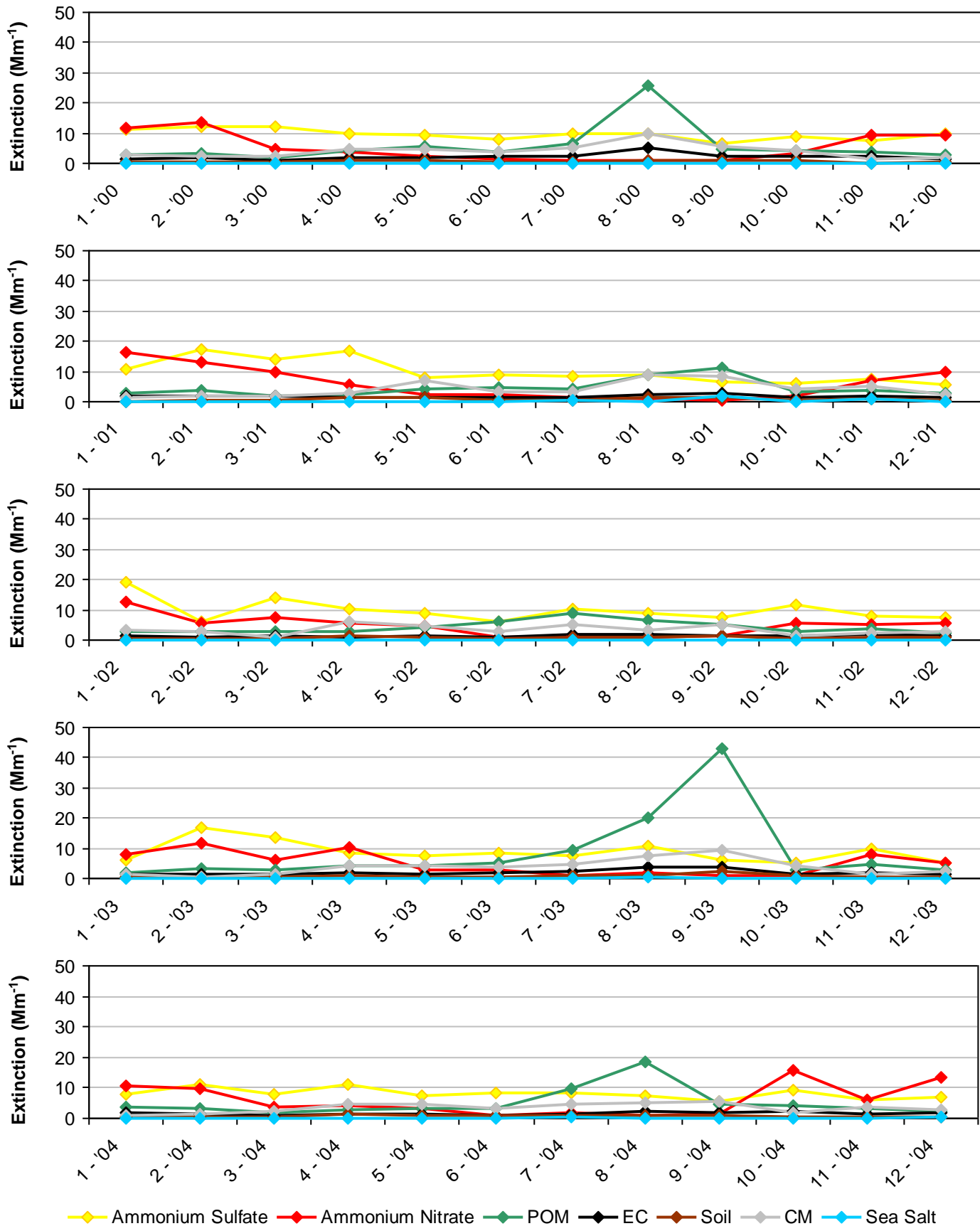


**2005-2009 Progress Period Average**  
 6.7 dv (6.5 - 7 dv)



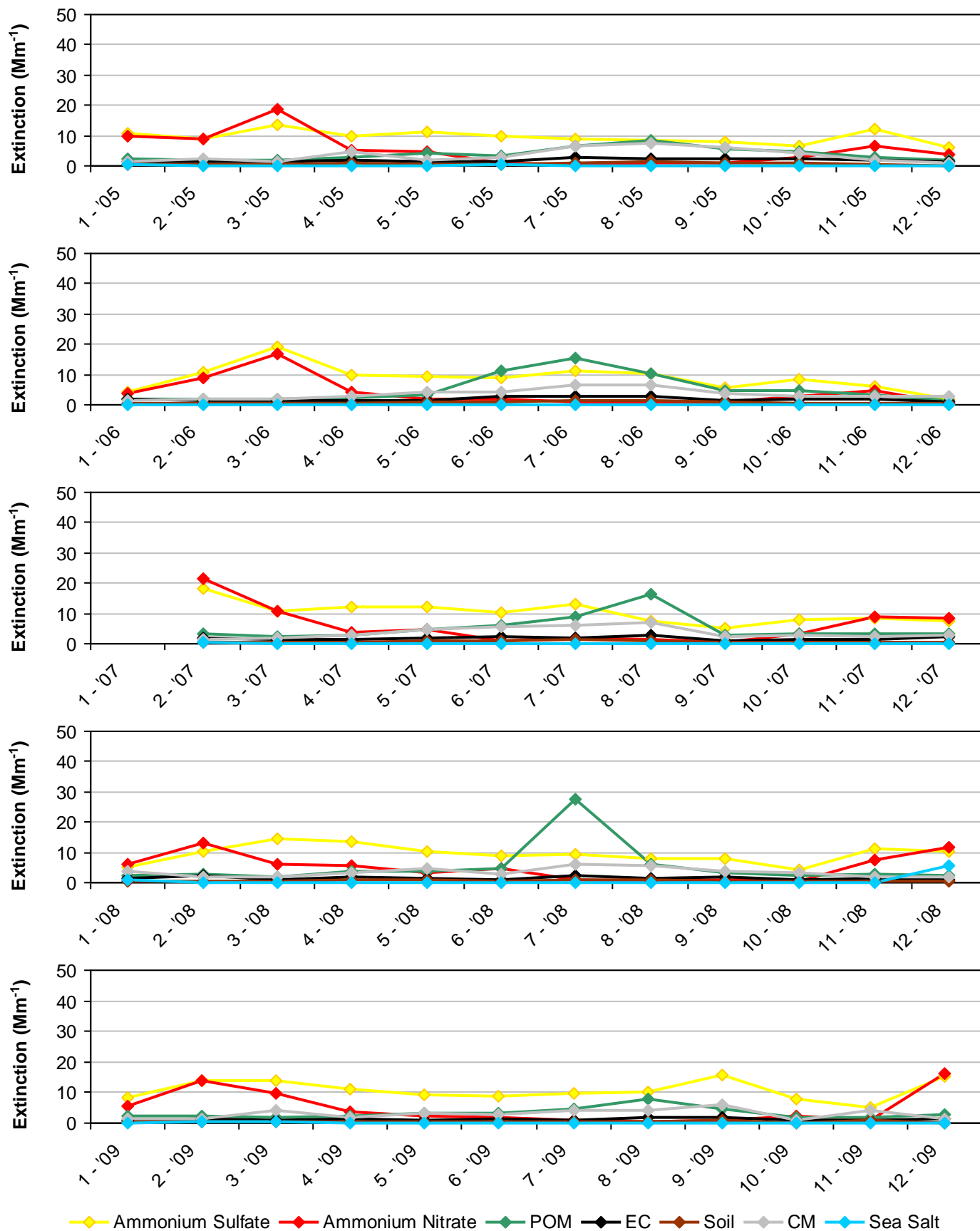
\*Missing years did not meet RHR data completeness criteria. Only complete years are included in 5-year average pie charts.

**Figure J.2-5**  
**Theodore Roosevelt NP, ND (THRO1 Site)**  
**2000-2004 Monthly Average Aerosol Extinction, All Monitored Days**



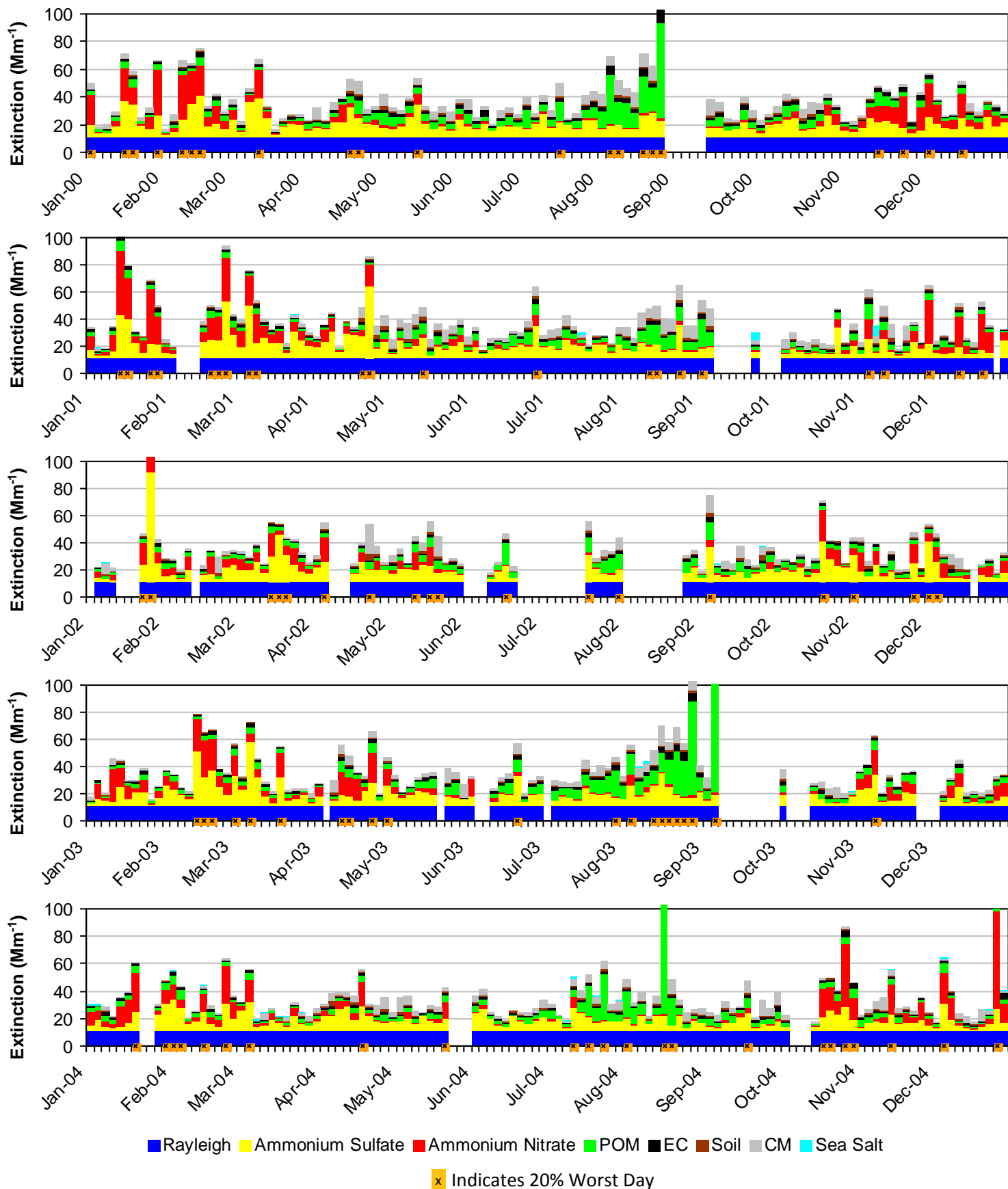


**Figure J.2-6**  
**Theodore Roosevelt NP, ND (THRO1 Site)**  
**2005-2009 Monthly Average Aerosol Extinction, All Monitored Days**



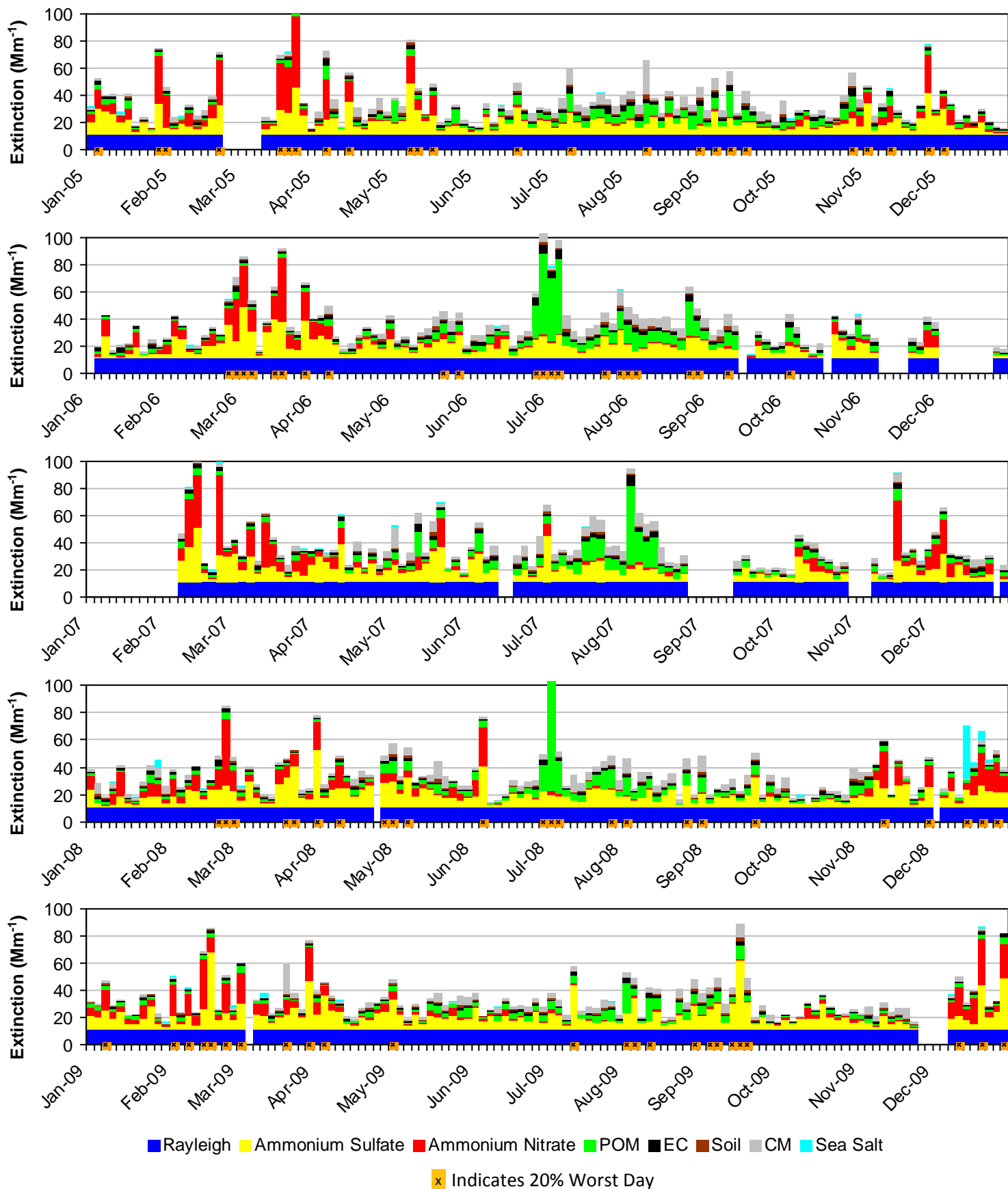
\*Note that monthly averages for the year 2007 are shown here, but this year did not meet RHR data completeness criteria.

**Figure J.2-7**  
**Theodore Roosevelt NP, ND (THRO1 Site)**  
**2000-2004 Progress Period Extinction, All Sampled Days**



■ Rayleigh   
 ■ Ammonium Sulfate   
 ■ Ammonium Nitrate   
 ■ POM   
 ■ EC   
 ■ Soil   
 ■ CM   
 ■ Sea Salt  
x Indicates 20% Worst Day

**Figure J.2-8**  
**Theodore Roosevelt NP, ND (THRO1 Site)**  
**2005-2009 Progress Period Extinction, All Sampled Days**



\*Note that daily averages for the year 2007 are shown here, but this year did not meet RHR data completeness criteria.