

# **South River Sediment Data**

December 11, 2001

# Sediment Samples

- Collected along 160 miles of River System
- Years available
  - 1977, 1978, 1979, 1980, 1981, 1987, 1997
  - 50, 35, 37, 38, 38, 52, 109 obs
- Hg\_Conc reported for all samples
  - Total Hg and Dry Weight reported in 1997 only
  - 109 observations of both

# 13 Observations Omitted from Analysis

- YR MILE HG                      YR MILE HG
- 1977 10 48.0                      1981 0 137.0
- 1977 10 40.0                      1981 0 105.0
- 1977 10 46.0                      1981 21 143.0
- 1979 0 30.8                        1981 21 219.0
- 1979 10 38.9                      1997 3 147.0
- 1980 0 36.5                        1997 9 65.8
- 1980 21 116.0

# Possible Data Entry Errors

- For 1997, Hg\_CONC and Total Hg and Dry Weight are reported.
- For most,  $\text{Hg\_Conc} = \text{TotHg}/\text{DryWgt}$
- For a few, this is not true
  - Difference  $> 0.01$
- Of these, only one difference is large
  - Difference  $> 3.0$

# Hg\_CONC ⌚ TOTHg/Drywgt

RATIO	HG_CONC
147.368	147.0
10.422	10.4
6.549	10.8
11.111	11.1
65.690	65.8
10.972	11.0
23.562	23.6

# Statistical Analysis

- Analysis of variance
- Rivermile and Year as factors
  - includes interaction
- For comparisons, rivermile grouped into intervals of
  - width 5 up to rivermile 20
  - width 10 thereafter

# Statistical Analysis

- Within each year, compare levels among rivermiles
- Within each rivermile,
  - compare levels among years
  - test for trends across years

# Statistical Analysis: Results

- ANOVA Summary

SOURCE	NDF	DDF	F	P_F
RMID	17	266	13.68	0.0001
YEAR	6	266	11.10	0.0001
RMID*YR	54	266	2.89	0.0001

- RSquare=0.65



# Hg Concentration in Sediment by Rivermile Interval and Year

Means \* 10, Rounded

YEAR / RMINT

	-10	-5	0	5	10	15	20	30	40	50	60	70	80	90	100	110	120	160
77	5	7	18	224			38			9		7			5		8	10
78	6	5	47	35	177		32			7		6			4		3	6
79	5	2	8	63	151		26			19		8			4		14	26
80	2	1	15	119	44		21			3	10	5		4	0	5		5
81	0	1	22	48	56		2			7	30	1		2	3	5		4
87			26	27	31	12	24											
97			40	101	75	56	48	17	2	2	2	1	1	1	2	12	3	

# Hg Concentration in Sediment by Rivermile Interval and Year

Year /	RMINT							Mean Hg * 10
	-10	-5	0	5	10	15	20	
77	5	7	18	224				38
78	6	5	47	35	177			32
79	5	2	8	63	151			26
80	2	1	15	119	44			21
81	0	1	22	48	56			2
87			26	27	31	12		24
97			40	101	75	56		48

# **Comparisons Across Years and Within Years**

**Within each river interval, compared last year (usually 1997) to base (usually 1977)**

**Within each year, compared each two rivermile intervals**

**Only significant comparisons shown**

# Comparisons Across Years

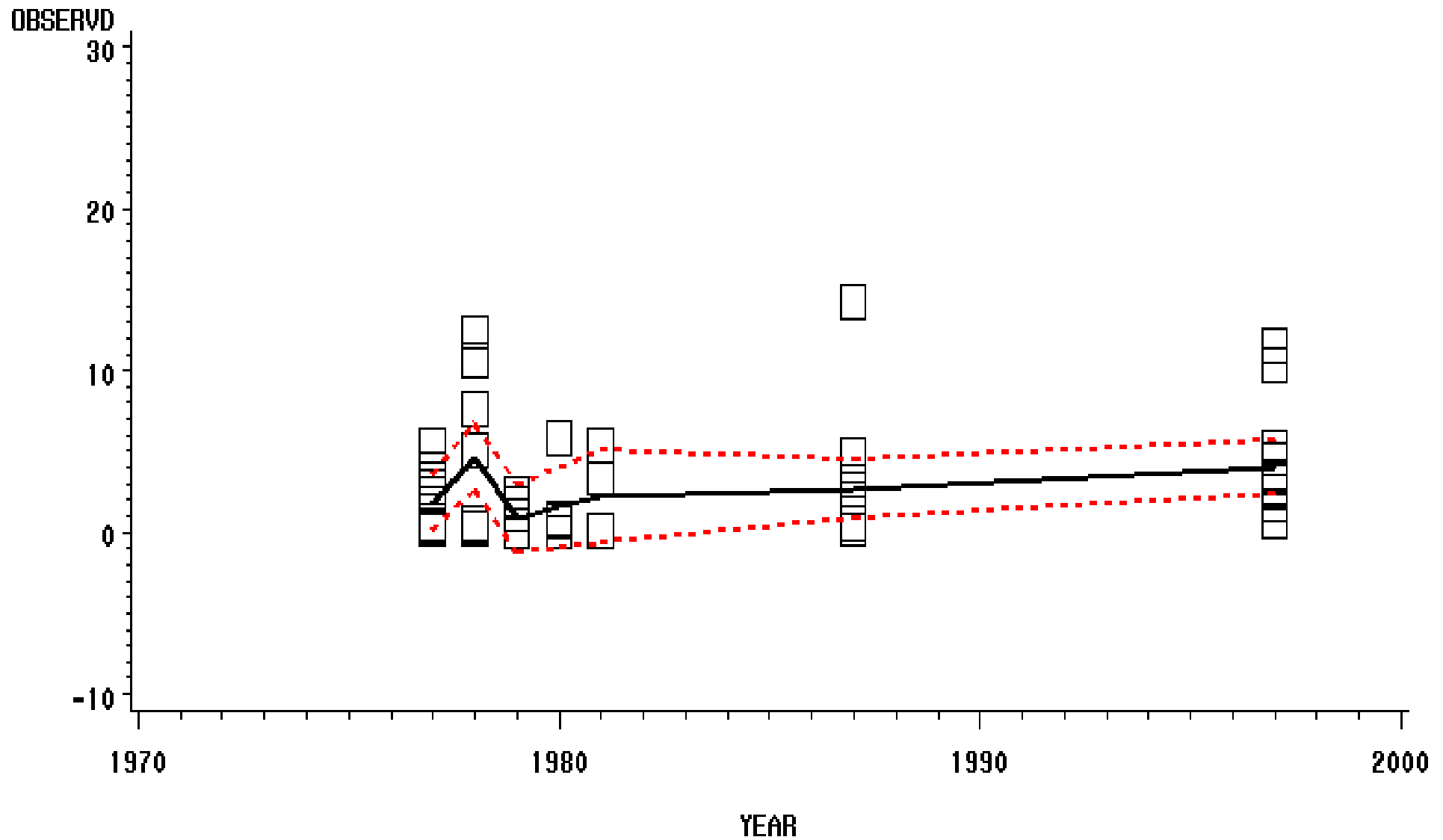
PARAM		EST	SE	P_T
RMINT	0, 1997-77	2.6	1.21	0.08
RMINT	5, 1997-77	-22.8	1.85	0.00
RMINT	10, 1997-78	-21.9	2.16	0.00
RMINT	15, 1997-87	5.7	1.3	0.00

TESTS FOR TREND OVER TIME IN Hg CONC  
 MODEL: HG\_CONC=RMID|YEAR

RMID	_JT_	_JTSTD_	P2_JT	SIGNIF
1	66.5	1.53959	0.12366	
2	349.0	0.09040	0.92797	
3	909.0	1.64342	0.10030	
4	283.0	0.17092	0.86429	
5	245.5	-1.11460	0.26502	
<b>6</b>	<b>111.5</b>	<b>2.08538</b>	<b>0.03703</b>	<b>**RMINT15</b>
7	612.5	1.94446	0.05184	
10	43.0	-0.91016	0.36274	
11	7.5	-1.63371	0.10232	
12	41.5	-1.11117	0.26650	
<b>14</b>	<b>6.0</b>	<b>-2.16401</b>	<b>0.03046</b>	<b>**RMINT90</b>
15	51.5	-0.73714	0.46104	
16	10.0	-1.08200	0.27925	
17	10.0	-1.02151	0.30701	
21	22.5	0.00000	1.00000	

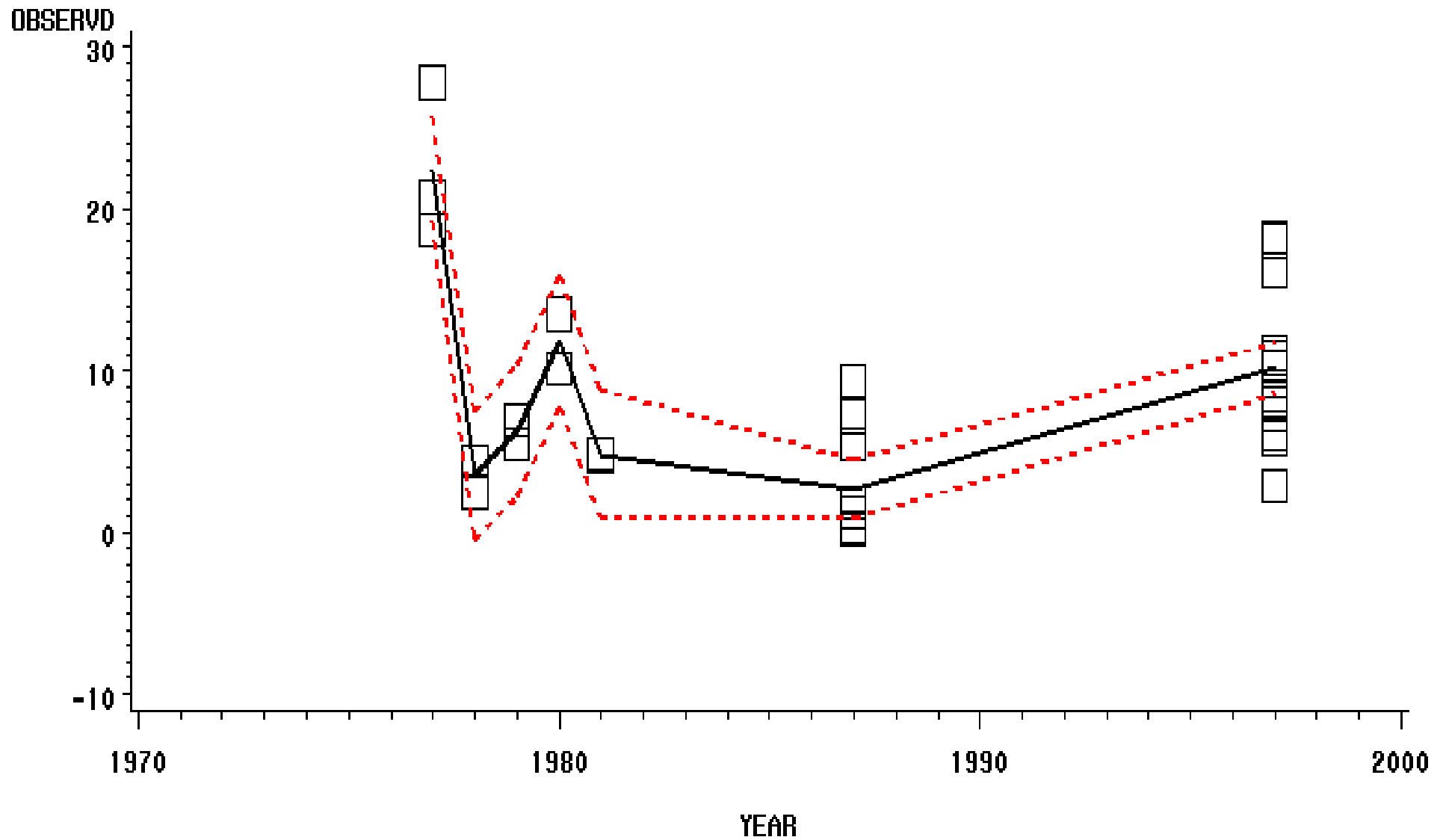
# Observed and Predicted Hg Conc in Sediment

MODEL: HG\_CONC=RMID;YEAR  
Hg>30 OMITTED  
RMID=3 RMLABEL=Rivermile -2.5 to 2.5



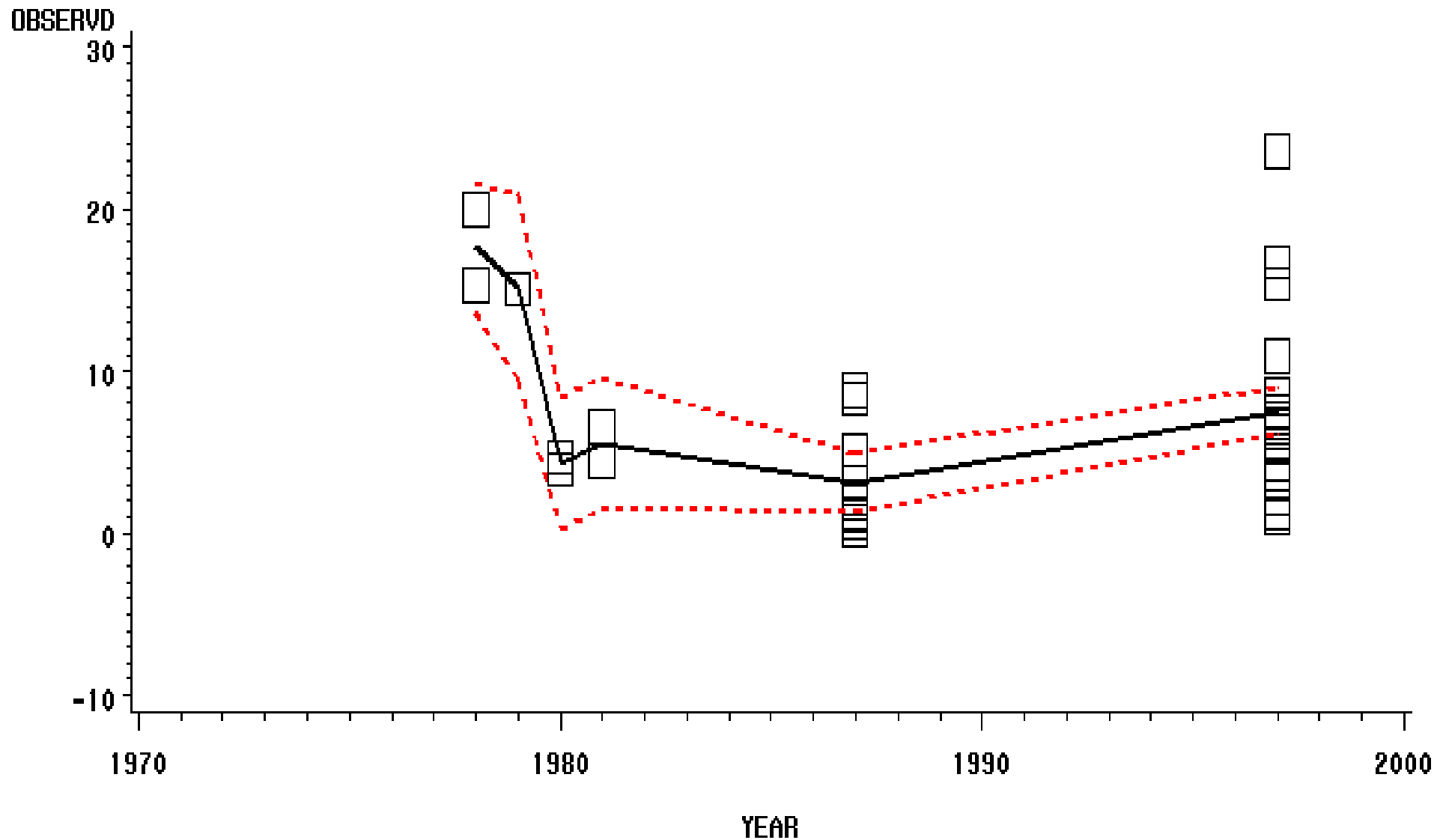
# Observed and Predicted Hg Conc in Sediment

MODEL: HG\_CONC=RMID;YEAR  
Hg>30 OMITTED  
RMID=4 RMLABEL=Rivermile 2.5 to 7.5



# Observed and Predicted Hg Conc in Sediment

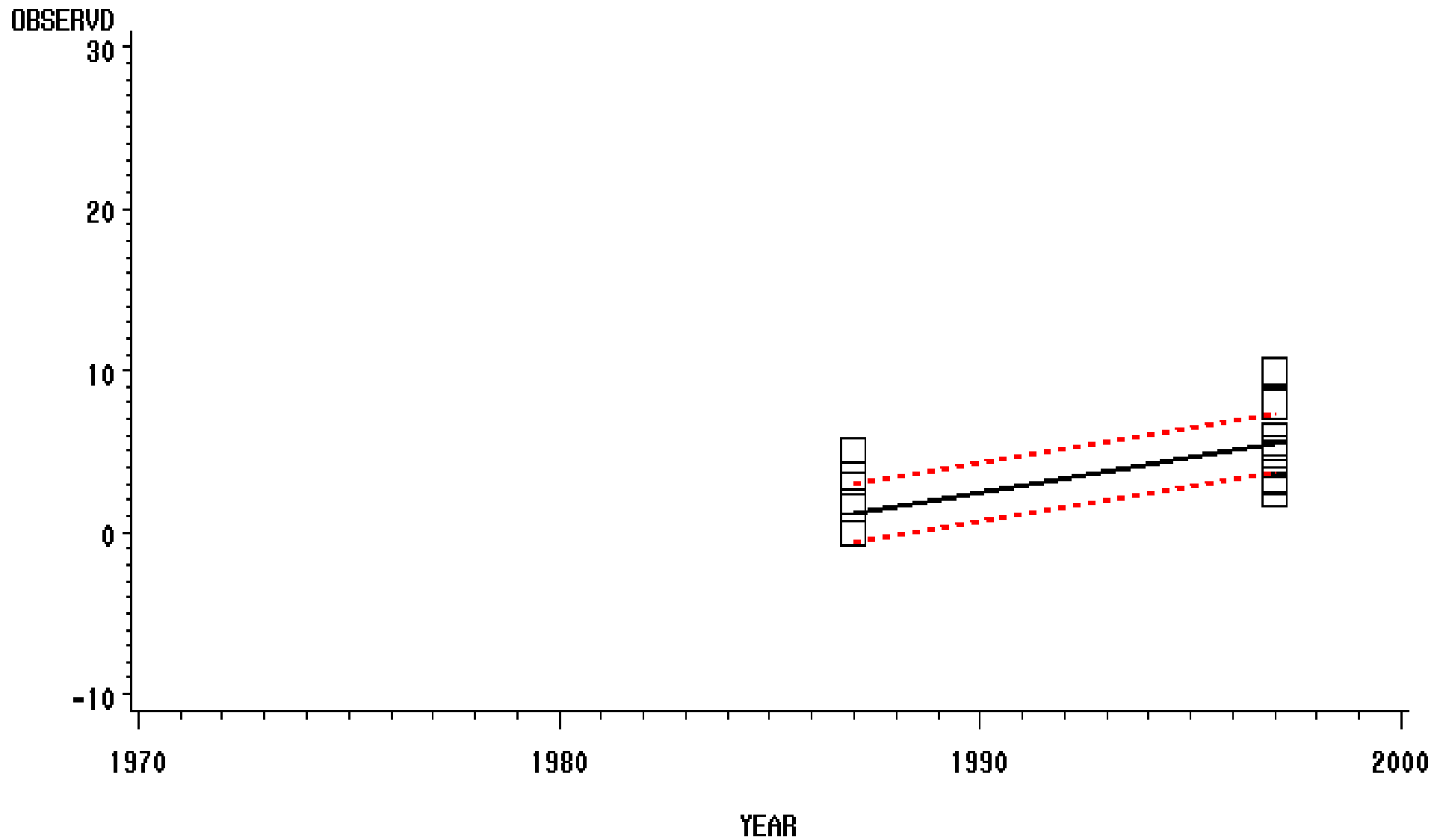
MODEL: HG\_CONC=RMID;YEAR  
Hg>30 OMITTED  
RMID=5 RMLABEL=Rivermile 7.5 to 12.5





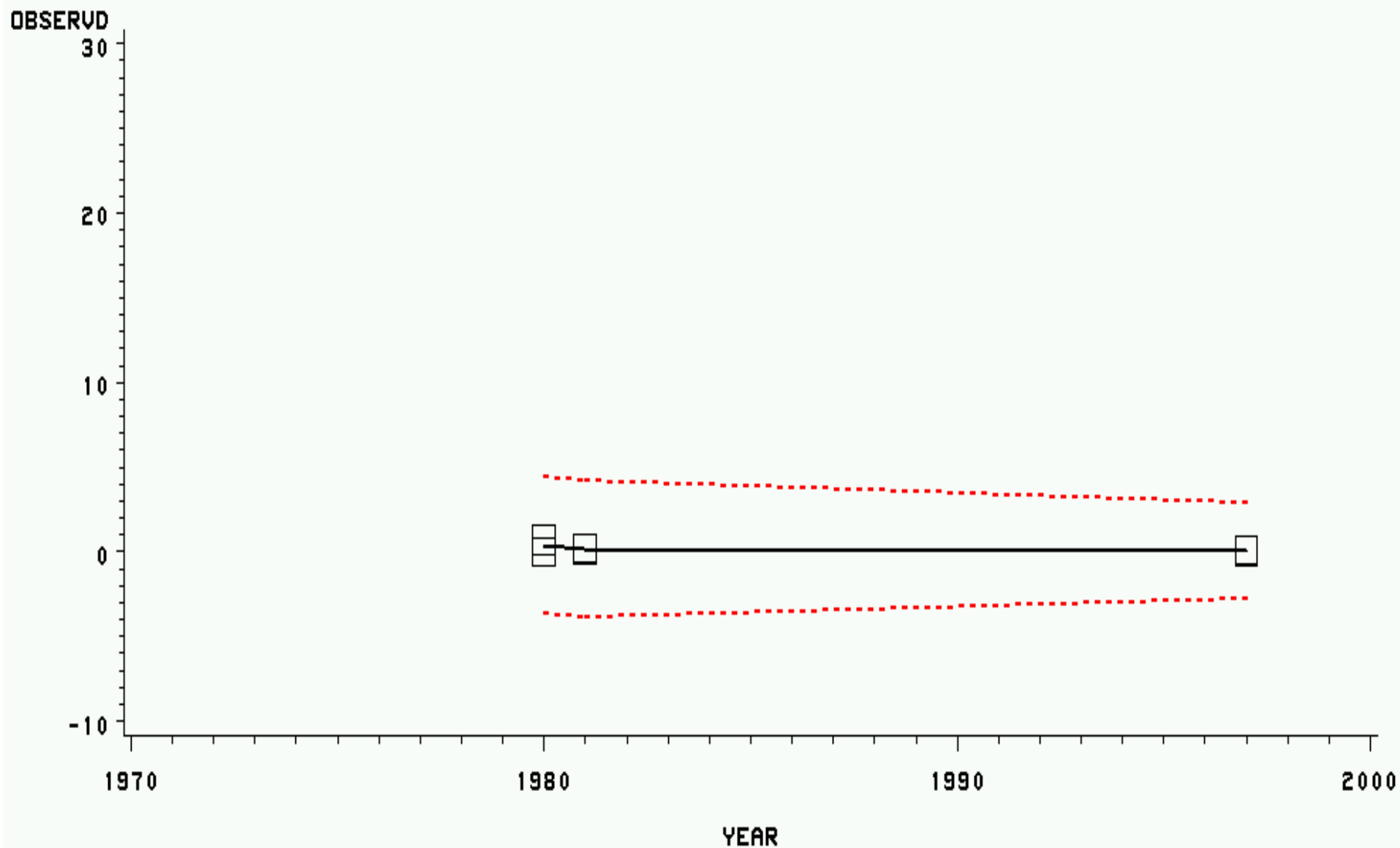
# Observed and Predicted Hg Conc in Sediment

MODEL: HG\_CONC=RMID;YEAR  
Hg>30 OMITTED  
RMID=6 RMLABEL=Rivermile 12.5 to 17.5



# Observed and Predicted Hg Conc in Sediment

MODEL: HG\_CONC=RMID|YEAR  
Hg>30 OMITTED  
RMID=14 RMLABEL=Rivermile 85 to 95



# Comparisons Within Years

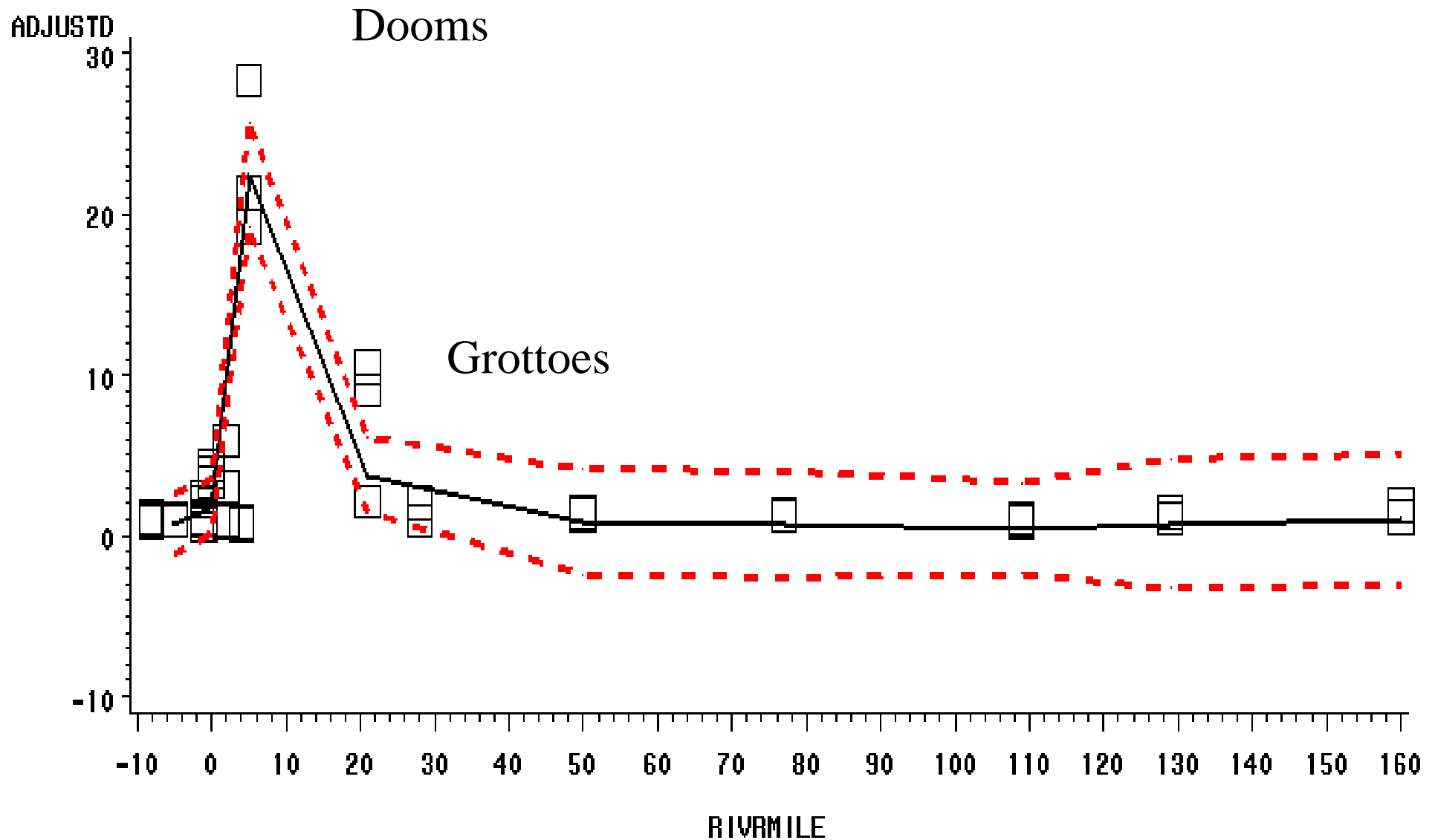
PARM				EST	SE	P_T
1978, RM	0	vs	<0	6.3	1.55	0.01
1977, RM	5	vs	0	38.9	1.89	0.00
1979, RM	5	vs	0	12.6	2.32	0.02
1980, RM	5	vs	0	25.0	2.42	0.00
<u>1997, RM</u>	<u>5</u>	<u>vs</u>	<u>0</u>	<u>7.1</u>	<u>1.16</u>	<u>0.00</u>
1978, RM	10	vs	0	29.7	2.29	0.00
1979, RM	10	vs	0	44.2	3.09	0.00
<u>1997, RM</u>	<u>10</u>	<u>vs</u>	<u>0</u>	<u>3.9</u>	<u>1.09</u>	<u>0.00</u>
1978, RM	10	vs	5	40.9	2.9	0.00
1979, RM	10	vs	5	31.4	3.54	0.01

# Comparisons Within Years

PARM	EST	SE	P_T
1980, RM 10 vs 5	-21.7	2.9	0.01
<u>1997, RM 10 vs 5</u>	<u>-2.7</u>	<u>1.07</u>	<u>0.02</u>
<u>1997, RM 15 vs 5</u>	<u>-5.6</u>	<u>1.22</u>	<u>0.00</u>
<u>1997, RM 15 vs 10</u>	<u>-2.3</u>	<u>1.15</u>	<u>0.09</u>
1977, RM 20 vs 5	-38.2	2.05	0.00
1980, RM 20 vs 5	-25.9	2.64	0.00
<u>1997, RM 20 vs 5</u>	<u>-5.8</u>	<u>1.10</u>	<u>0.00</u>
1978, RM 20 vs 10	-36.2	2.51	0.00
1979, RM 20 vs 10	-40.5	3.24	0.00
1981, RM 20 vs 10	-15.5	2.89	0.06
<u>1997, RM 20 vs 10</u>	<u>-2.8</u>	<u>1.02</u>	<u>0.01</u>

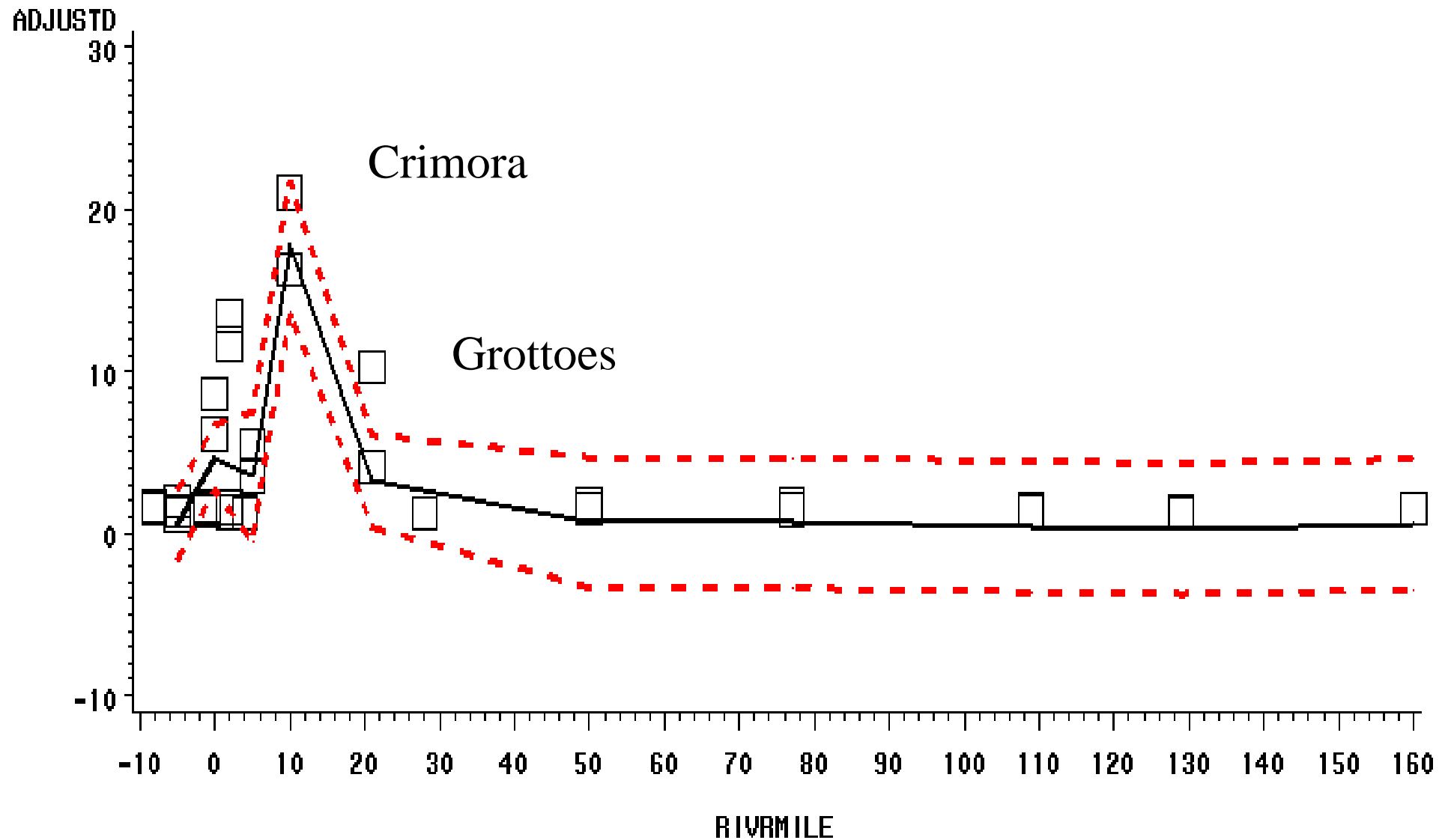
# Observed and Predicted Hg Conc in Sediment

MODEL: HG\_CONC=RMID;YEAR  
Hg>30 OMITTED  
YEAR=1977



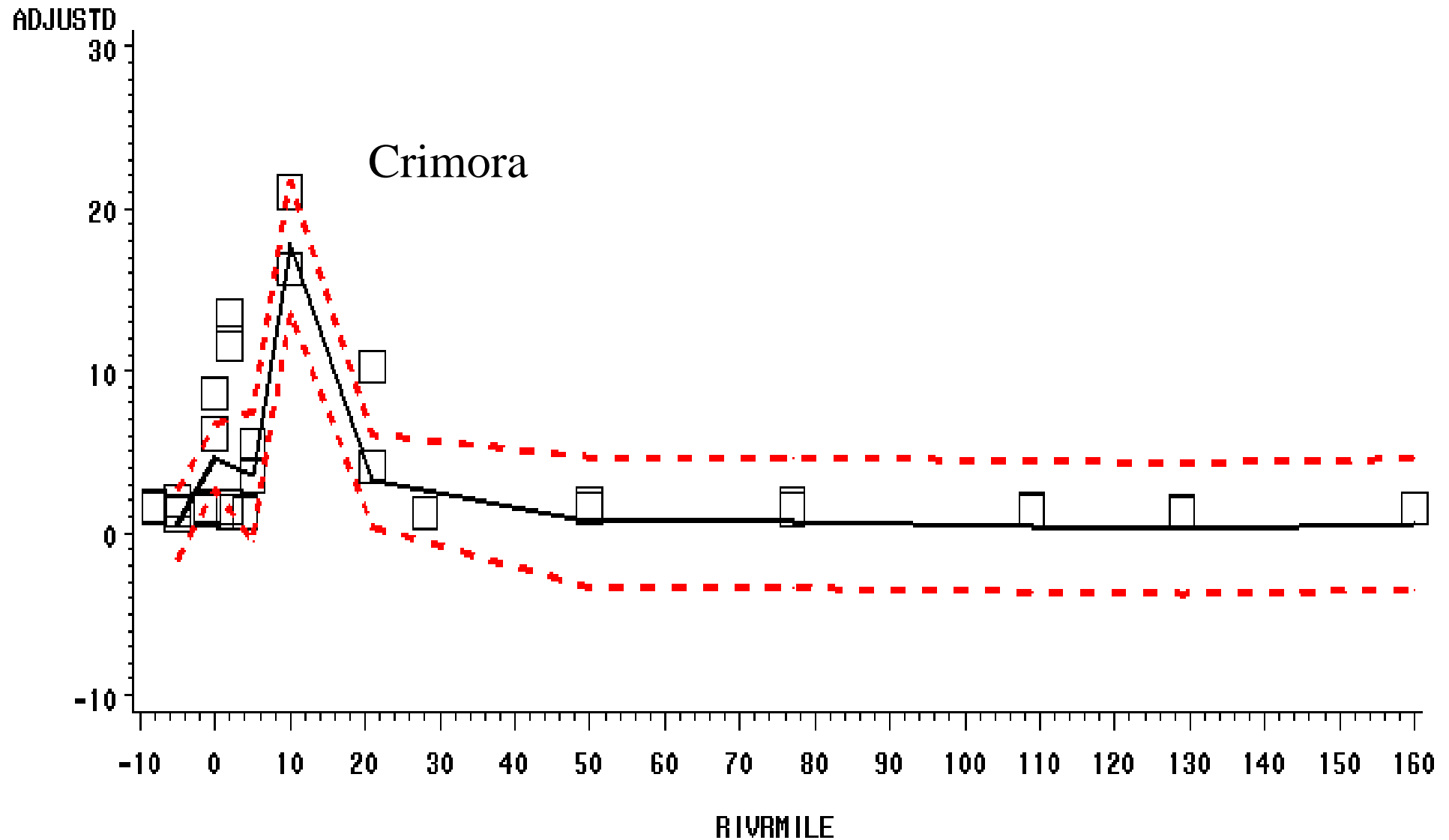
# Observed and Predicted Hg Conc in Sediment

MODEL: HG\_CONC=RMID;YEAR  
Hg>30 OMITTED  
YEAR=1978



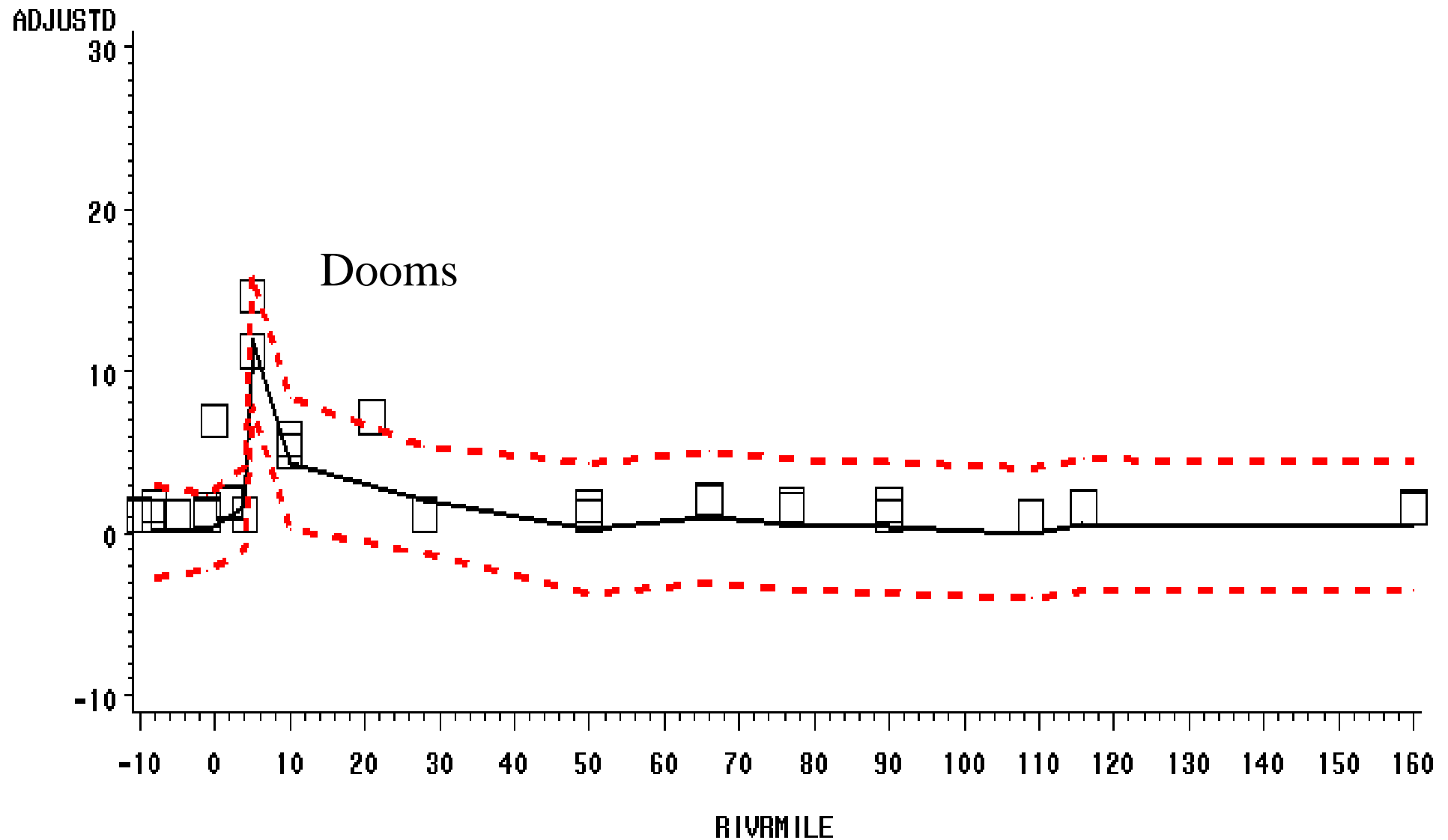
# Observed and Predicted Hg Conc in Sediment

MODEL: HG\_CONC=RMID;YEAR  
Hg>30 OMITTED  
YEAR=1978



# Observed and Predicted Hg Conc in Sediment

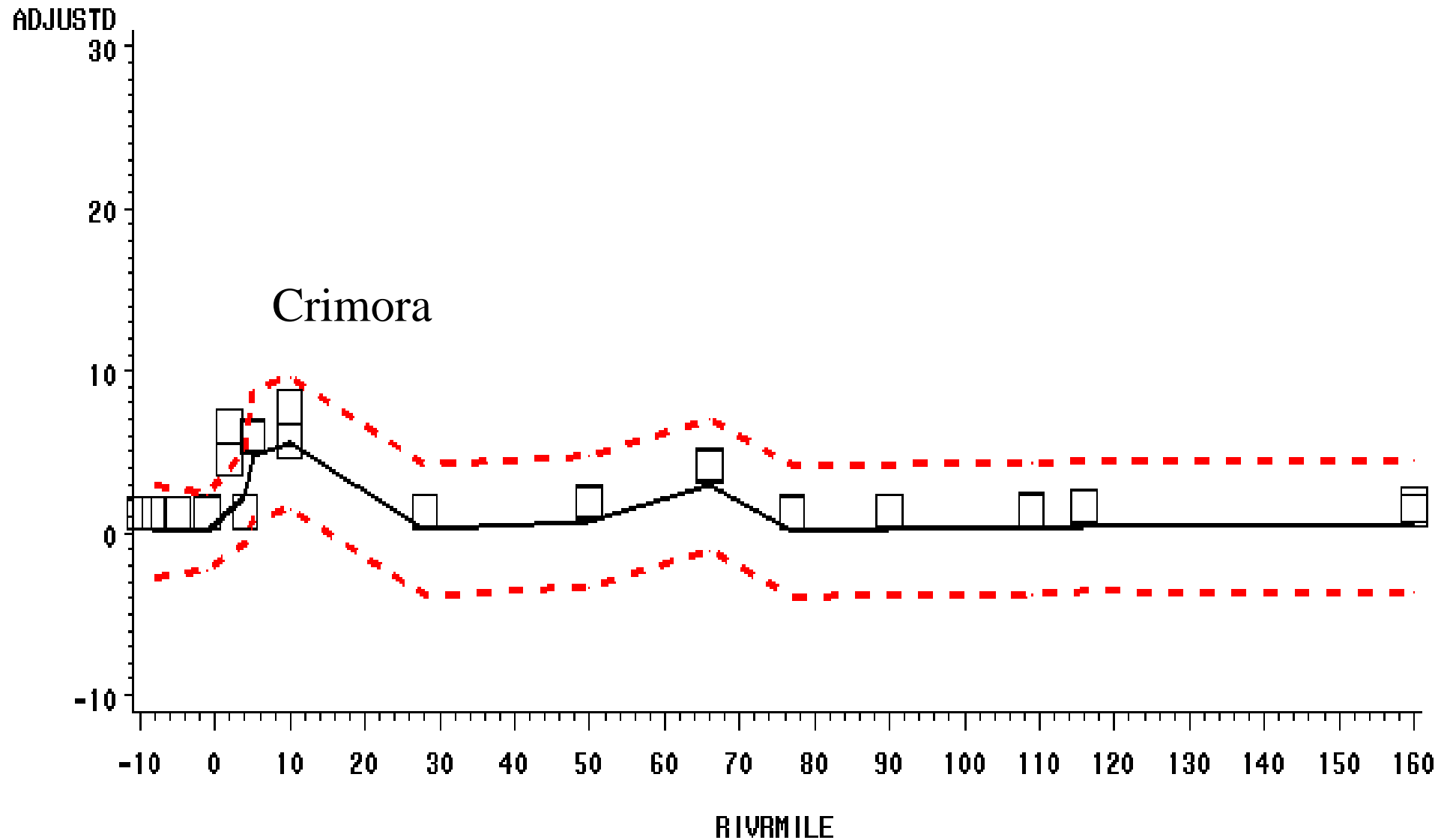
MODEL: HG\_CONC=RMID;YEAR  
Hg>30 OMITTED  
YEAR=1980





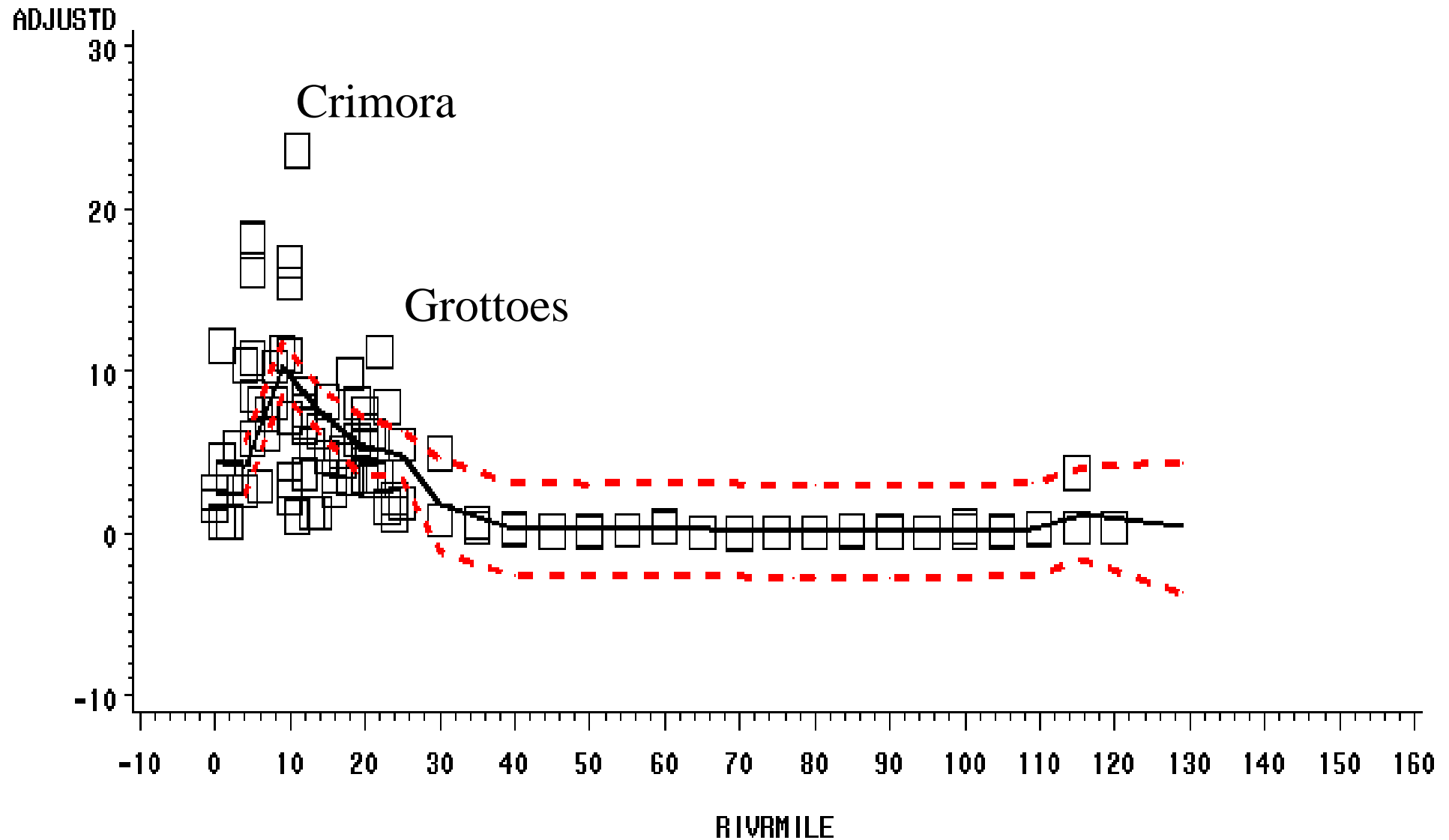
# Observed and Predicted Hg Conc in Sediment

MODEL: HG\_CONC=RMID;YEAR  
Hg>30 OMITTED  
YEAR=1981



# Observed and Predicted Hg Conc in Sediment

MODEL: HG\_CONC=RMID;YEAR  
Hg>30 OMITTED  
YEAR=1997



# High Hg for Fish, Sediment

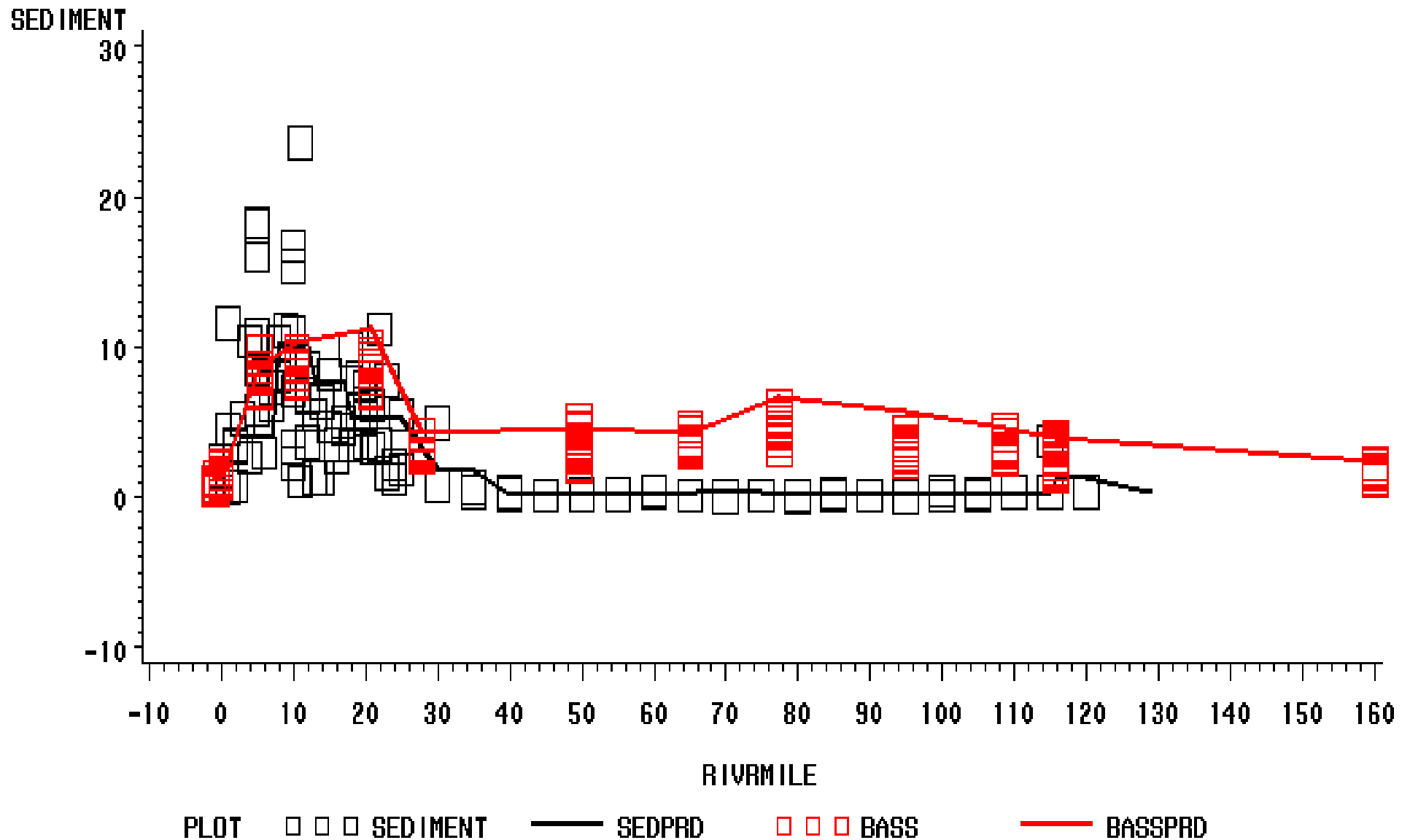
- **Dooms, VA near Rt. 611 bridge  
(above dam)**
  - **rivermile 5**
- ***Crimora, VA near Rt. 612  
bridge***
  - ***rivermile 10***
- ***Grottoes, VA near Grand  
Caverns bridge***
  - **rivermile 20**

# Correlation of Tissue, Sediment

- **The same areas seem to have high Hg in both fish and sediment data**
- **Overlay plots for visual comparison**
  - **tissue responses multiplied by 4 to preserve scale**
- **1981, 1997/99 most compelling**
  - **(Note: used 99 sediment data, 97 tissue data)**

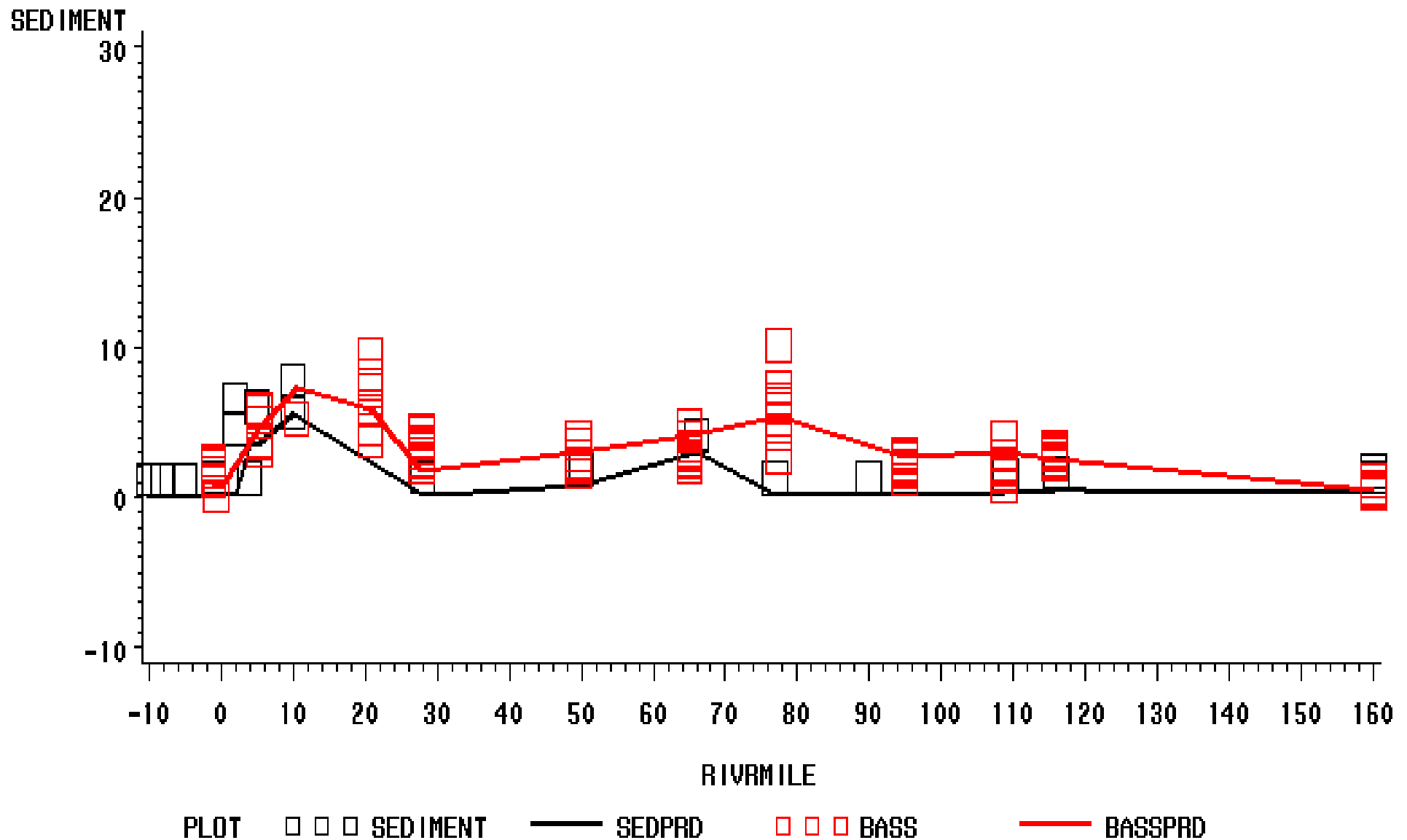
# Observed & Predicted Sediment & Bass Data

Hg>30 Omitted  
YEAR=1997



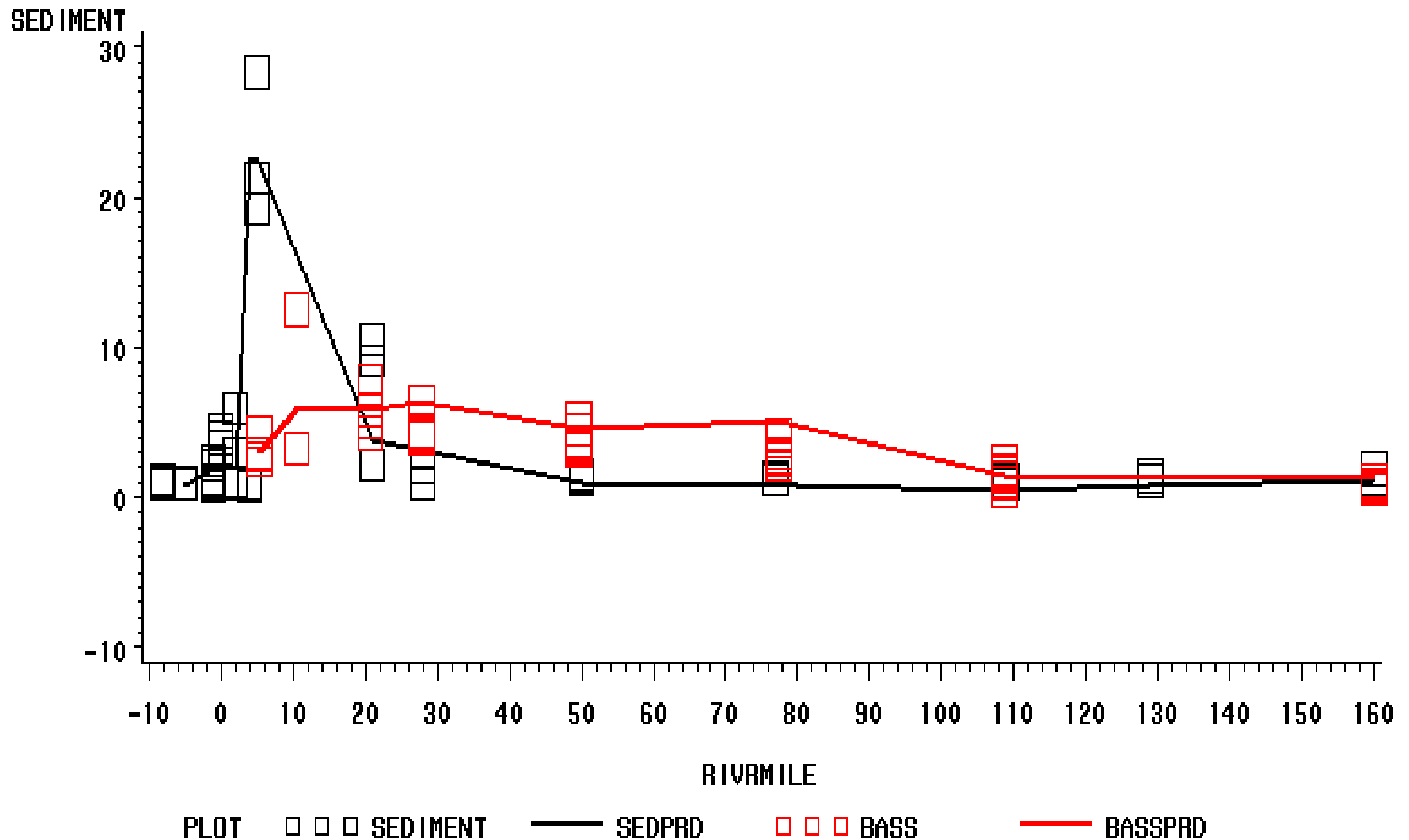
# Observed & Predicted Sediment & Bass Data

Hg>30 Omitted  
YEAR=1981



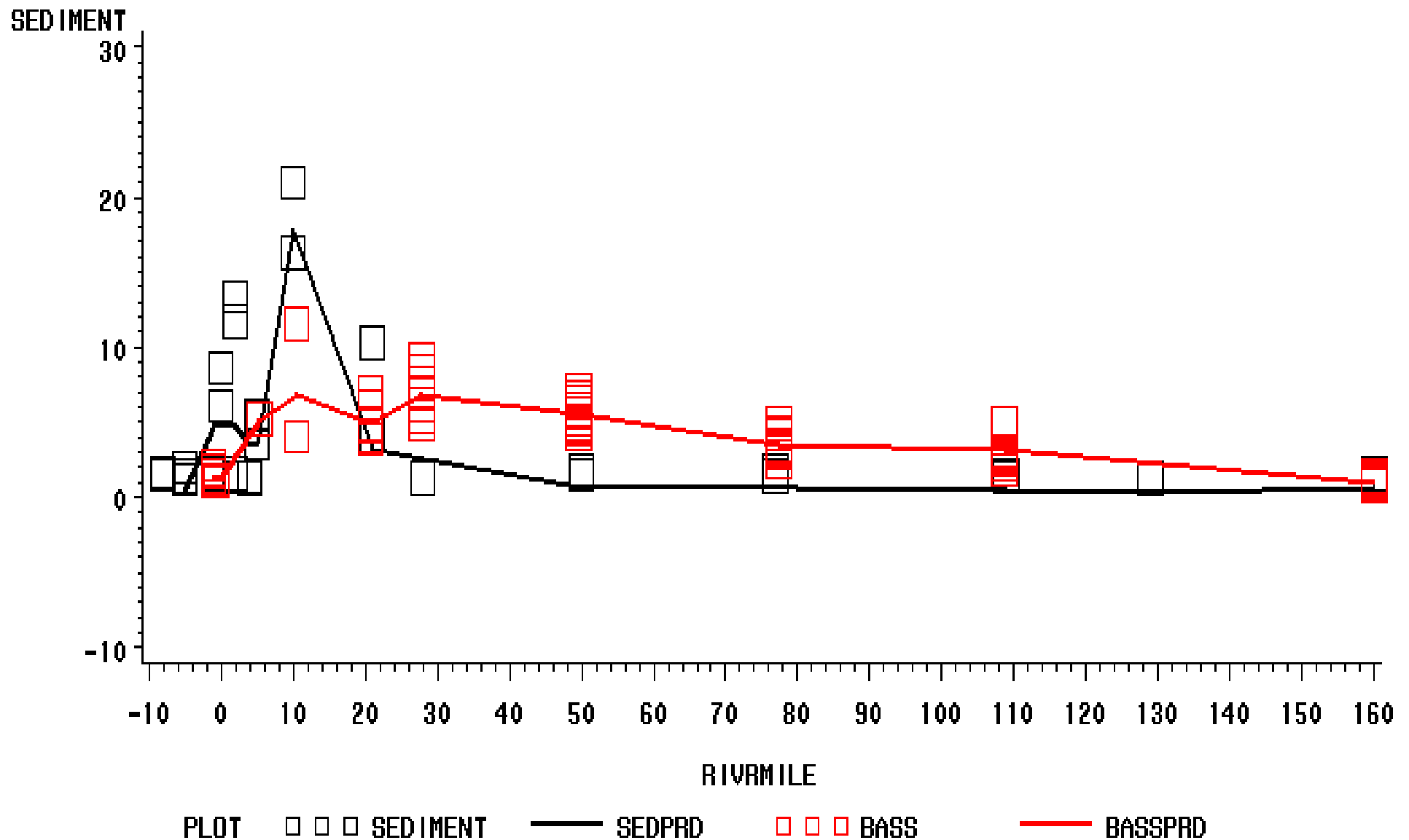
# Observed & Predicted Sediment & Bass Data

Hg>30 Omitted  
YEAR=1977



# Observed & Predicted Sediment & Bass Data

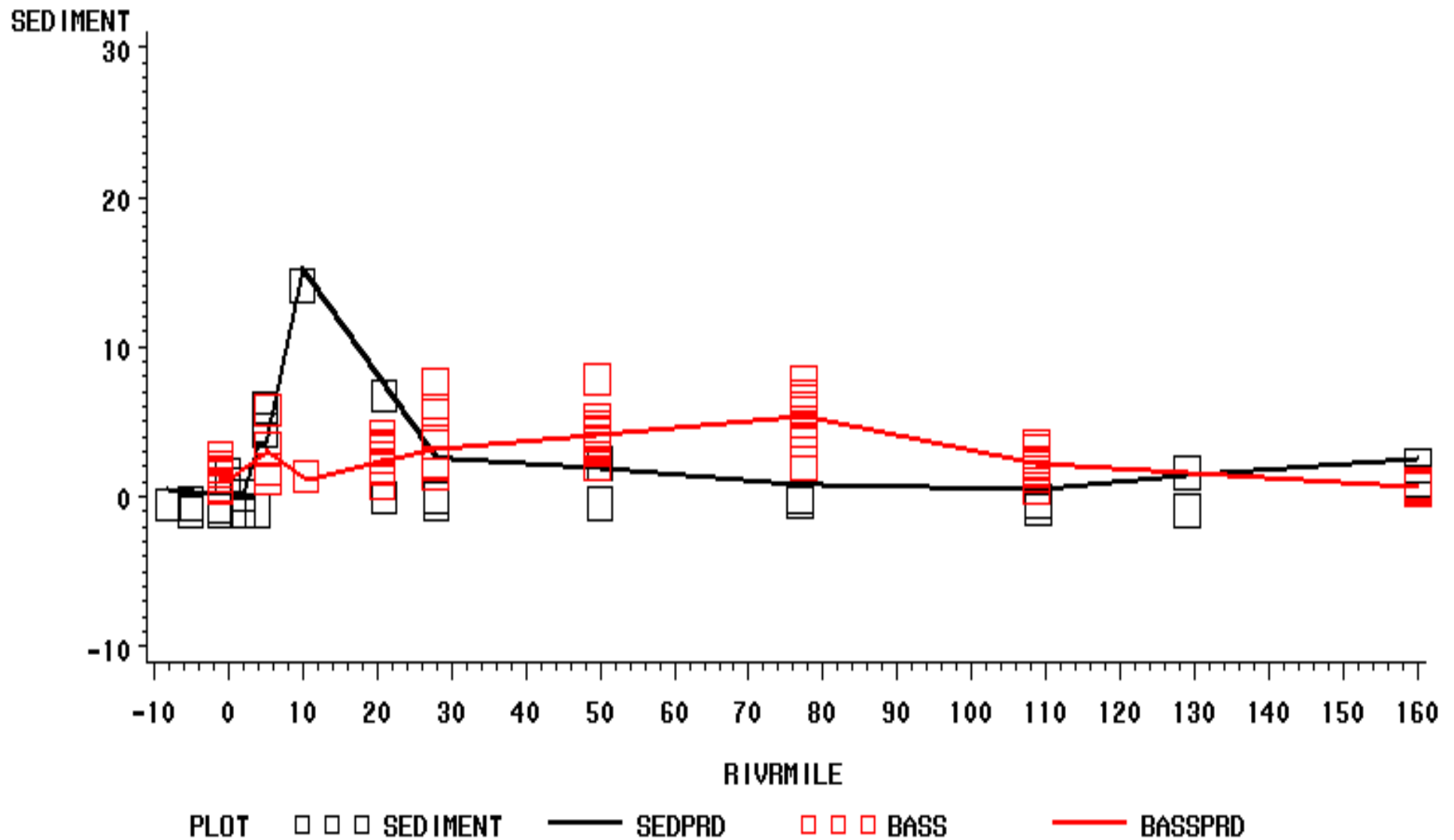
Hg>30 Omitted  
YEAR=1978





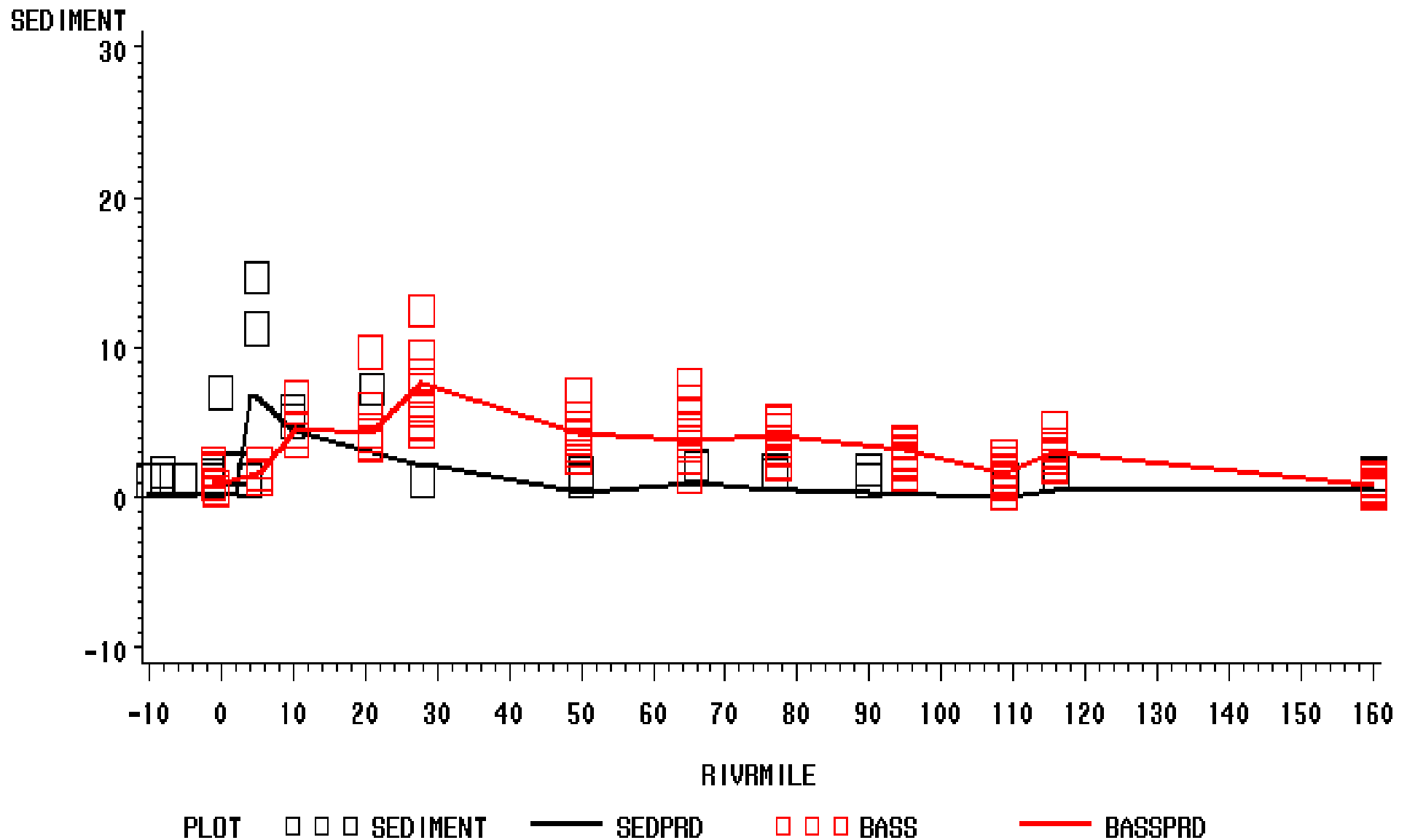
# Observed & Predicted Sediment & Bass Data

Hg>30 Omitted  
YEAR=1979



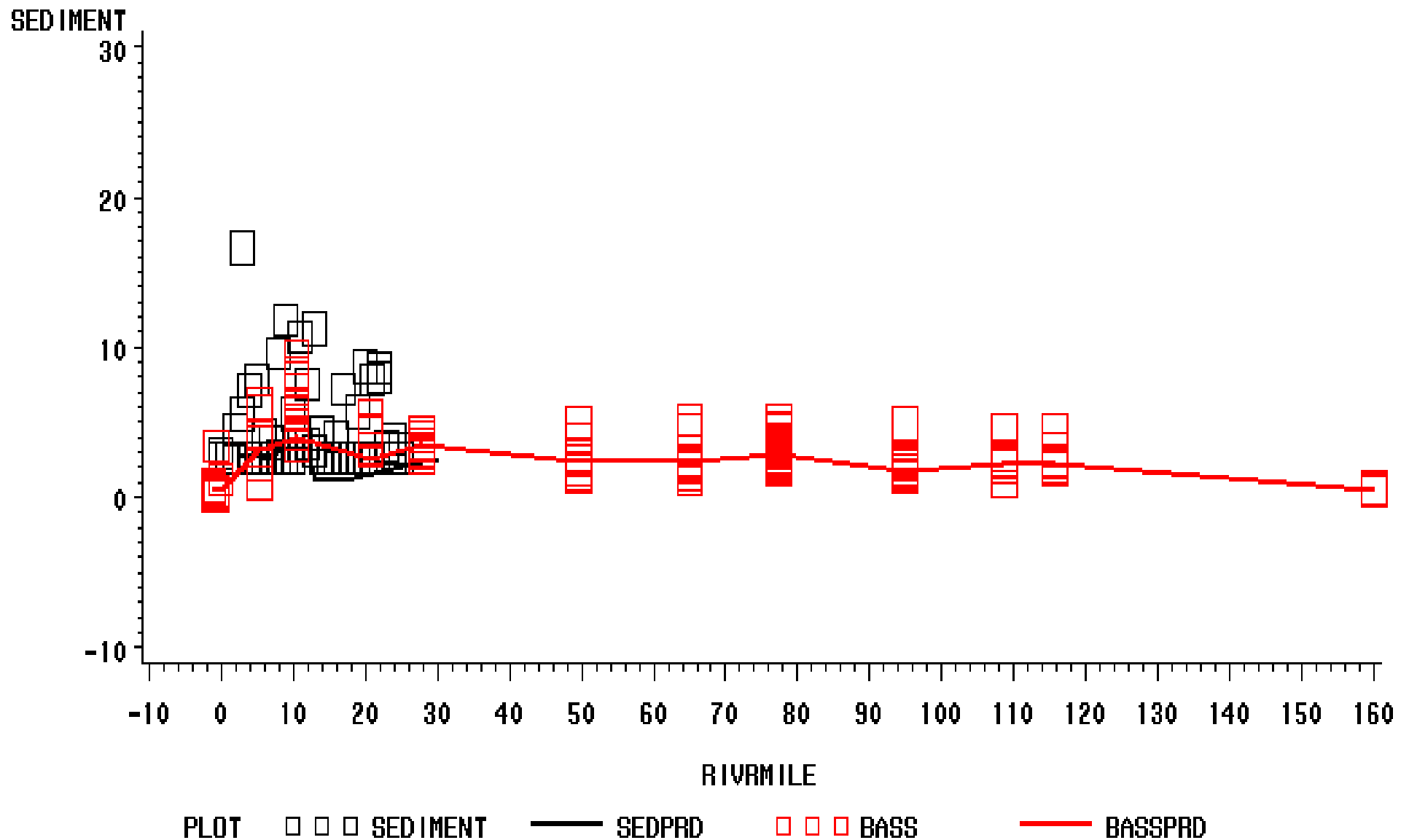
# Observed & Predicted Sediment & Bass Data

Hg>30 Omitted  
YEAR=1980



# Observed & Predicted Sediment & Bass Data

Hg>30 Omitted  
YEAR=1987



# Correlation of Tissue, Sediment

- **Formal correlation of Bass tissue and sediment samples done on predicted values at each year, rivermile interval**
- **Only 1981, 1987 and 1997 show significant correlation ( $R^2 = 55$  to  $65\%$ )**

# Conclusions

- **Sediment and fish tissue data agree in 1997/99 statistically significant increases**
- **Significant correlation in 1981, 87, 97**
- **Most increased sediment Hg in the Dooms, Crimora, Grottoes locale**
  - **rivermiles 5-20**
- **Future sampling should emphasize this stretch of river**