South River Fish Tissue Update

May 23, 2006

Sampling Stations Prior to 2001

STATN	STAT_ID	Location
1	1BSTH026.12	Waynesboro City Park above Rife Loth Dam
3	1BSTH025.10	Waynesboro City Park north of DuPont footbridg
5	1BSTH020.44	Dooms, VA near Rt. 611 bridge (above dam)
6	1BSTH014.60	Crimora, VA near Rt. 612 bridge
7	1BSTH004.21	Grottoes, VA near Grand Caverns bridge
8	1BNTH004.10	Near Rt. 668 bridge below confluence with Midl R
9	1BSSF100.10	Lynwood, VA near Rt. 708 bridge
10	1BSSF078.24	Shenandoah, VA (boat ramp above dam)
16	1BSSF062.97	Newport Landing south of Alma, VA on Rt. 340
11	1BSSF054.20	Hamberg, VA near Rt. 211 bridge
17	1BSSF037.60	Fosters Landing near Rt. 664 bridge
12	1BSSF020.70	Bentonville Landing at Gooney Run
18	1BSSF010.18	Karo Landing at Gooney Run
15	1BSHN022.63	Berryville, VA near Rt. 7 bridge

New Stations

STATN STAT_ID Location

2001

21 1BSTH022.75 South River Hopeman Parkway, Waynesboro

22 1BSHN047.98 Rt. 624 bridge-downstream of Warren Pwr Dam

23 1BSHN038.48 Rt. I7/50 bridge

2002

33 1BSTH023.73 South River 2nd Street, Waynesboro

30 1BSSF063.17 SF Shenandoah - Newport Landing

29 1BSSF003.50 SF Shenandoah - Luray Ave Launch - Front Royal

2003-2005

27 1BNTH004.39 - North River

31 1BSTH014.49 - Crimora, VA – 0.11 miles upstream of Sta. 6 combined with Sta. 6 for analysis

34 2-XWT000.02 – Coursey Spring Fish Hatchery raceway

Fish Species Analyzed

- **Smallmouth Bass**
- **Largemouth Bass**
  - **Separately and combined**
- **Sunfish (including Redbreast)**
- **Redbreast Sunfish**
- **Sucker**
- **Rock Bass**

Examined but not analyzed

- **Rainbow trout, channel catfish**

Number of SMB by Station and Year

station	77	78	79	80	81	83	84	85	86	87	92	94	96	99	01	02	03	05
1		2		3		3	2	3		5				8	15	9		6
3						5	1	3	2	1		3	3	10	15	9		9
5			3	2	1	1	1	4	1	2				10		9		
6	1			1		3	2	1	4	10	3	4		10		9		9
7	3	5	9	7	9	7	5	9	6	6	1	4		10		9		
8		5	8	4	4	4	2	5	13	5	10	10		9		9		
9	6	8	8	10	10	9	7	10	9	9	1	1	2	10		51	5	9
10	6	4	2	6	5		7	9	10	7			1	10		9		9
11			3	8	4	21	6	26	16	21	2		5	10		9		9
12	9	10	10	8	9	11	10	14	16	6	10	6	5	10		9		9
14		1	3															
15	6	10	10	10	3	9	8	14	12	8	3		6	10	15	9		
16				10	7	2	15	8	10	5		2	4	10				
17				10	10	12	13	13	12	11	2	2	8	10		9		
18				6	8	9	1	8	15	4			8	10				
21															15			6
22															10			
23															20	9		9
27																		9
29																9		9
30																9		9
33																9		9

Mean Total Hg (X100) in SMB by Station and Year

station	77	78	79	80	81	83	84	85	86	87	92	94	96	99	01	02	03	05
1		27		13		11	35	18		21				21	24	18		33
3						44	42	29	37	13		34	67	52	50	53		51
5			107	43	69	38	60	80	151	54				221		268		
6	322			72		167	106	228	73	92	284	252		259		334		256
7	168	131	66	117	145	43	73	94	117	58	258	255		291		182		
8		31	31	37	11	21	21	16	20	19	36	31		31		47		
9	165	174	97	194	43	58	49	56	77	86	193	91	95	109		94	91	114
10	123	142	155	103	106		47	47	59	60			122	108		126		26
11			190	109	115	40	54	36	33	70	45		169	168		174		108
12	42	85	64	44	79	22	26	29	35	57	69	74	130	121		66		86
14		38	34															
15	36	26	15	21	19	12	12	7	11	13	44		64	64	61	72		
16				104	103	94	35	39	28	33		79	133	110				
17				84	77	31	32	39	33	45	84	66	125	143		130		
18				76	70	29	27	24	37	51			96	121				
21															168			145
22															74			
23															71	58		39
27																		26
29																142		68
30																129		103
33																155		114

Statistical Methods

- **Analysis of covariance (ANCOVA) of log(Hg) on log(length) was used**
  - **intercept adjusted for station and year**
  - **slope adjusted for station and year**
    - **insufficient data to adjust for station*year interaction**
  - **separate model fit to each species**

Statistical Methods

- **ANCOVA removes the effect of size from the Hg measurements, so as not to bias the results due to the effects of different sized fish being sampled in different years or at different stations.**

Statistical Methods

- **For tests of differences or trends in Hg levels over time, data from years 1977-1983 were combined to provide baseline**
  - **sparse data in early years.**
  - **Not all years were observed at all stations.**
- **ANOCOVA model retained all years separately.**

Mean Adjusted Total Hg (X100) in SMB by Station and Year

station	77	78	79	80	81	83	84	85	86	87	92	94	96	99	01	02	03	05	
1		27		13		20	37	18		26				20	21	18		33	
3						46	53	31	51	47		32	63	38	49	49		49	
5			134	50	106	108	75	91	146	111				215		195			D
6	340			102		124	109	198	95	167	219	208		233		208		247	C
7	157	131	75	131	173	61	77	128	120	126	223	235		221		158			G
8		46	41	48	37	18	19	37	25	16	27	21		20		20			
9	136	178	125	188	84	68	63	85	84	95	116	82	111	89		73	16	95	
10	111	143	170	117	98		74	60	63	70			129	94		80		22	
11			174	97	187	47	63	54	37	87	58		160	127		102		94	
12	41	71	59	42	62	26	49	36	42	61	55	59	137	89		75		62	
14		80	22																
15	25	26	18	19	16	11	15	10	11	15	35		62	46	51	38			
16				122	92	64	53	72	31	52		79	119	100					
17				72	65	27	33	33	47	54	67	59	110	90		64			
18				82	77	39	31	44	40	106			100	83					
21															152			148	
22															53				
23															45	46		40	HP
27																		20	
29																101		68	
30																97		90	
33																127		118	SS

Trends Over Time: SMB

- **At two stations (1, 12) total Hg levels are still higher in 2005 than at baseline.**
- **In most statistically significant cases, 2005 values are lower than in recent past.**
  - **Stations 1, 9 show increase 2002-2005**
- **Significant trends since 1994 are decreasing, with possible exception of station 1**
- **Some non-significant increases from 2002 to 2005 (stations 1, 3, 6, 9)**

Label	EST	Probt	SIGNIF
Station 1 05-78/83	0.108	0.0013	**
Station 1 TRN99-05	0.045	0.0208	**
Station 1 05-02	0.098	0.0016	**
Station 1 05-01	0.063	0.0150	**
Station 1 05-99	0.088	0.0070	**
Station 5 02-79/83	0.275	0.0007	**
Station 8 02-78/83	-0.078	0.0057	**
Station 9 05-77/83	-0.040	0.0127	**
Station 9 05-03	0.070	0.0440	**
Station 9 03-77/83	-0.112	<.0001	**
Station 9 03-99	-0.076	0.0244	**
Station 9 02-77/83	-0.033	<.0001	**
Station 10 05-77/82	-0.271	<.0001	**
Station 10 TRN96-05	-0.389	<.0001	**
Station 10 05-02	-0.246	<.0001	**
Station 10 05-99	-0.244	<.0001	**
Station 12 05-77/83	0.040	0.0090	**
Station 12 05-99	-0.071	0.0027	**
Station 12 02-77/83	0.061	<.0001	**
Station 12 02-96	-0.129	0.0002	**
Station 15 02-77/83	0.114	<.0001	**
Station 17 02-80/83	0.063	0.0003	**
Station 18 99-80/83	0.062	0.0041	**
Station 23 05-02	-0.053	0.0334	**
Station 23 05-01	-0.062	0.0094	**
Station 29 05-02	-0.099	0.0008	**

- is decrease

+ is increase

LOG(TOTAL HG) IN SMB
ESTIMATED CHANGE

LOG(Total Hg) in SMB
TESTS FOR TREND 1977-2005

station	STAT_ID	_JT_	Z_JT	P2_JT	SIGNIF
1	1BSTH026.12	860.0	1.29435	0.19554	
3	1BSTH025.10	994.0	0.99774	0.31841	
5	1BSTH020.44	396.5	3.54650	0.00039	**
6	1BSTH014.60	1111.0	4.35838	0.00001	**
7	1BSTH004.21	2658.5	4.80463	0.00000	**
8	1BNTH004.10	1370.0	-3.97749	0.00007	**
9	1BSSF100.10	5027.5	-5.05280	0.00000	**
10	1BSSF078.24	1126.5	-5.07409	0.00000	**
11	1BSSF054.20	5982.0	4.08741	0.00004	**
12	1BSSF020.70	7155.5	4.65985	0.00000	**
15	1BSHN022.63	5655.0	5.07078	0.00000	**
17	1BSSF037.60	4068.5	4.91112	0.00000	**
18	1BSSF010.18	1383.5	2.24493	0.02477	**
29	1BSSF003.50	47.0	-2.60491	0.00919	**
30	1BSSF063.17	63.0	-1.19208	0.23323	
33	1BSTH023.73	74.0	-0.22076	0.82528	

-is decrease

+is increase

LOG(Total Hg) in SMB
TESTS FOR TREND 1994-2005

station	STAT_ID	_JT_	Z_JT	P2_JT	SIGNIF
1	1BSTH026.12	393.0	1.09619	0.27299	
3	1BSTH025.10	644.0	0.99251	0.32095	
5	1BSTH020.44	69.5	-1.30639	0.19142	
6	1BSTH014.60	279.5	1.06718	0.28589	
7	1BSTH004.21	67.5	-3.39507	0.00069	**
8	1BNTH004.10	165.5	-0.99019	0.32208	
9	1BSSF100.10	1342.5	-1.62432	0.10431	
10	1BSSF078.24	90.5	-4.47059	0.00001	**
11	1BSSF054.20	120.5	-4.63164	0.00000	**
12	1BSSF020.70	284.0	-2.14917	0.03162	**
15	1BSHN022.63	320.5	-1.69651	0.08979	
16	1BSSF062.97	62.5	0.31707	0.75119	
17	1BSSF037.60	128.0	-2.96541	0.00302	**
18	1BSSF010.18	57.5	-1.68819	0.09137	
21	1BSTH022.75	97.0	-0.62280	0.53342	
23	1BSHN038.48	320.0	-0.87424	0.38199	
29	1BSSF003.50	47.0	-2.60491	0.00919	**
30	1BSSF063.17	63.0	-1.19208	0.23323	
33	1BSTH023.73	74.0	-0.22076	0.82528	

- is decrease

+is increase

LOG(Total Hg) in SMB
TESTS FOR TREND 1996-2005

station	STAT_ID	_JT_	Z_JT	P2_JT	SIGNIF
1	1BSTH026.12	393.0	1.09619	0.27299	
3	1BSTH025.10	527.5	0.19580	0.84477	
5	1BSTH020.44	69.5	-1.30639	0.19142	
6	1BSTH014.60	202.5	0.56883	0.56947	
7	1BSTH004.21	48.5	-3.02104	0.00252	**
8	1BNTH004.10	68.0	-0.75057	0.45291	
9	1BSSF100.10	1311.5	-1.59034	0.11176	
10	1BSSF078.24	90.5	-4.47059	0.00001	**
11	1BSSF054.20	120.5	-4.63164	0.00000	**
12	1BSSF020.70	105.5	-5.11579	0.00000	**
15	1BSHN022.63	320.5	-1.69651	0.08979	
16	1BSSF062.97	34.0	-1.55735	0.11939	
17	1BSSF037.60	81.5	-4.18433	0.00003	**
18	1BSSF010.18	57.5	-1.68819	0.09137	
21	1BSTH022.75	97.0	-0.62280	0.53342	
23	1BSHN038.48	320.0	-0.87424	0.38199	
29	1BSSF003.50	47.0	-2.60491	0.00919	**
30	1BSSF063.17	63.0	-1.19208	0.23323	
33	1BSTH023.73	74.0	-0.22076	0.82528	

- is decrease
+is increase

LOG(Total Hg) in SMB
TESTS FOR TREND 1999-2005

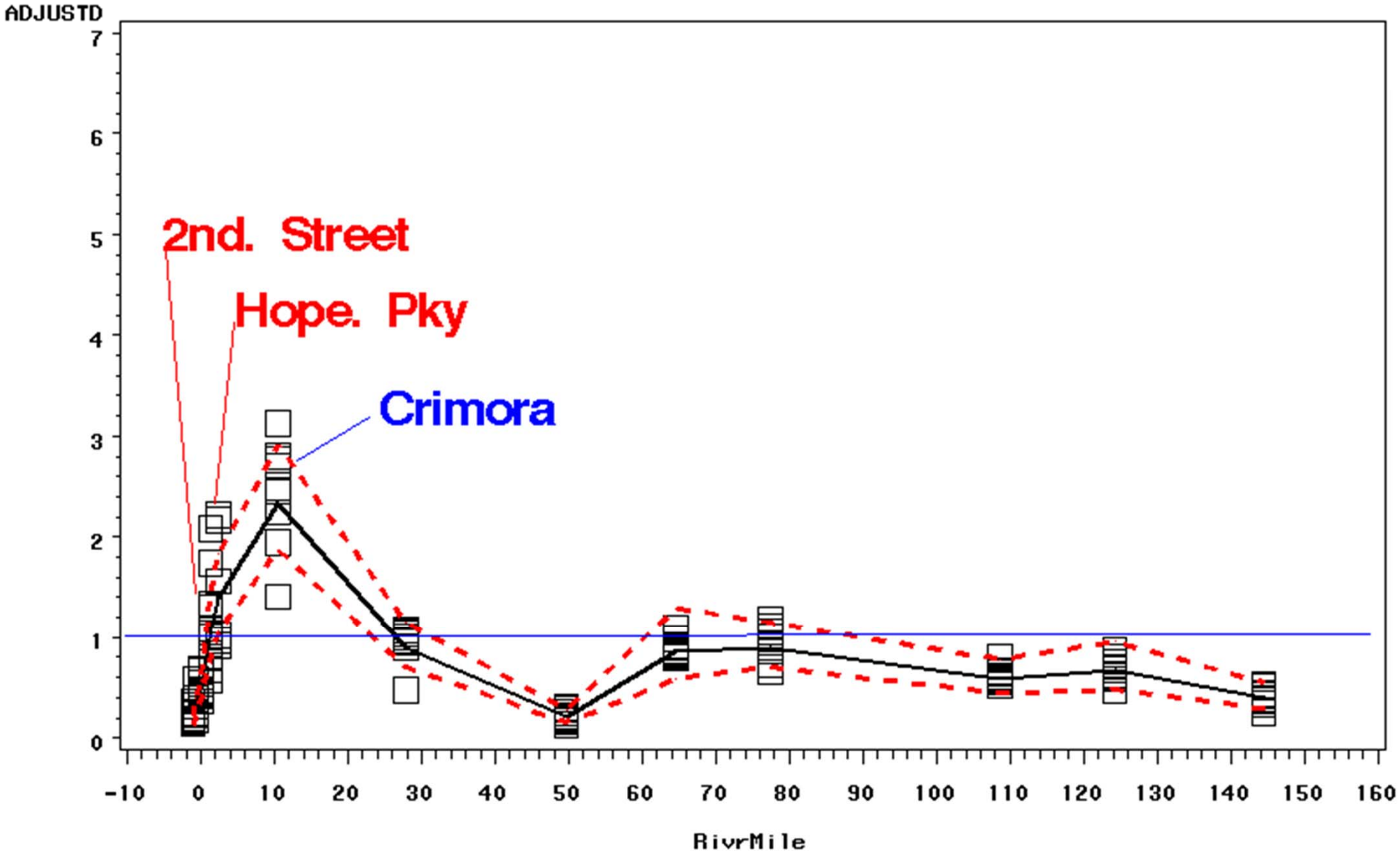
station	STAT_ID	_JT_	Z_JT	P2_JT	SIGNIF
1	1BSTH026.12	393.0	1.09619	0.27299	
3	1BSTH025.10	508.0	1.23198	0.21796	
5	1BSTH020.44	69.5	-1.30639	0.19142	
6	1BSTH014.60	202.5	0.56883	0.56947	
7	1BSTH004.21	48.5	-3.02104	0.00252	**
8	1BNTH004.10	68.0	-0.75057	0.45291	
9	1BSSF100.10	1295.0	-1.02778	0.30405	
10	1BSSF078.24	89.5	-4.19249	0.00003	**
11	1BSSF054.20	106.5	-3.47619	0.00051	**
12	1BSSF020.70	100.5	-3.72900	0.00019	**
15	1BSHN022.63	241.0	-1.26098	0.20732	
17	1BSSF037.60	48.5	-3.02104	0.00252	**
21	1BSTH022.75	97.0	-0.62280	0.53342	
23	1BSHN038.48	320.0	-0.87424	0.38199	
29	1BSSF003.50	47.0	-2.60491	0.00919	**
30	1BSSF063.17	63.0	-1.19208	0.23323	
33	1BSTH023.73	74.0	-0.22076	0.82528	

- is decrease

+is increase

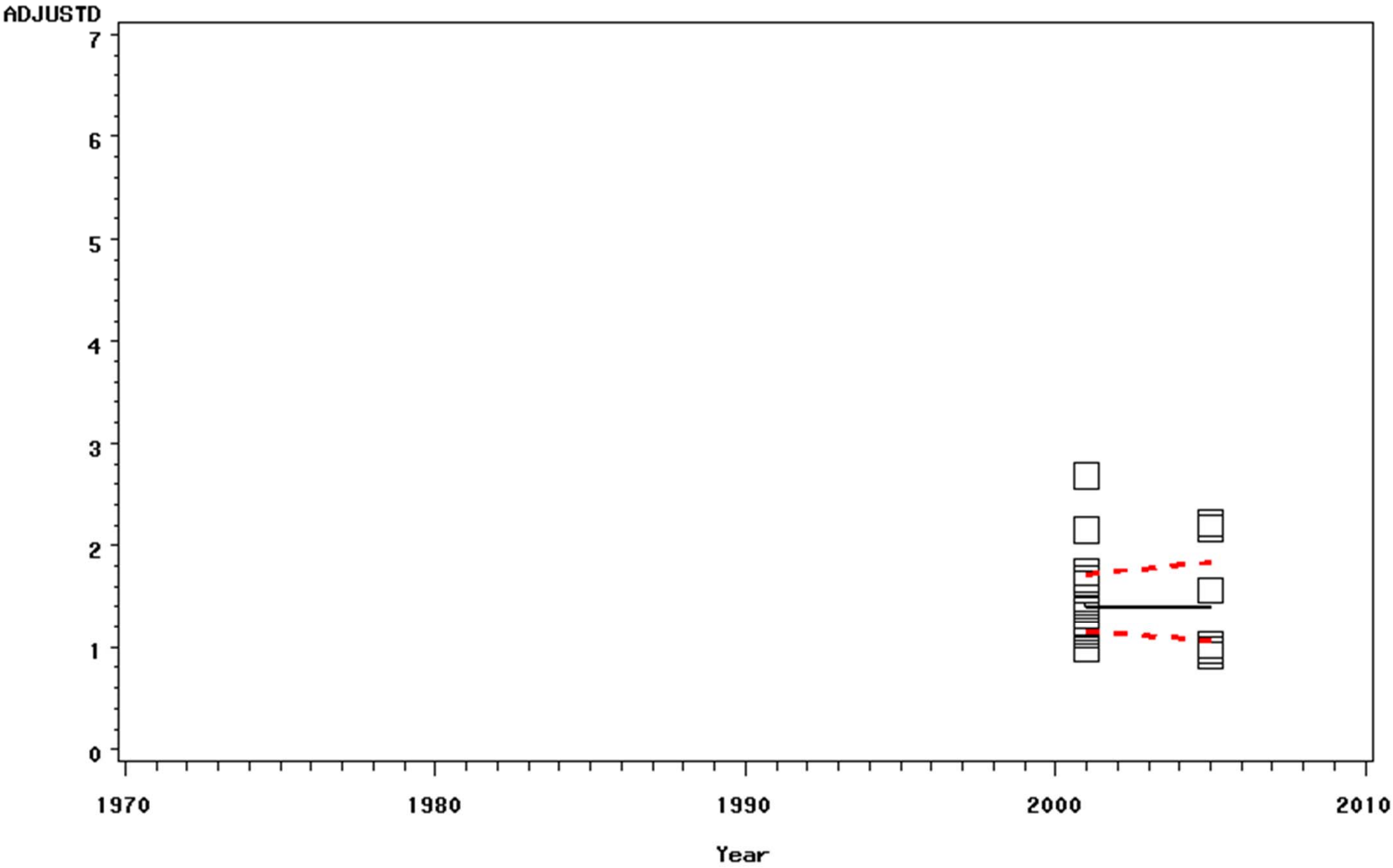
Adjusted and Predicted Total Hg in Smallmouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
Year=2005



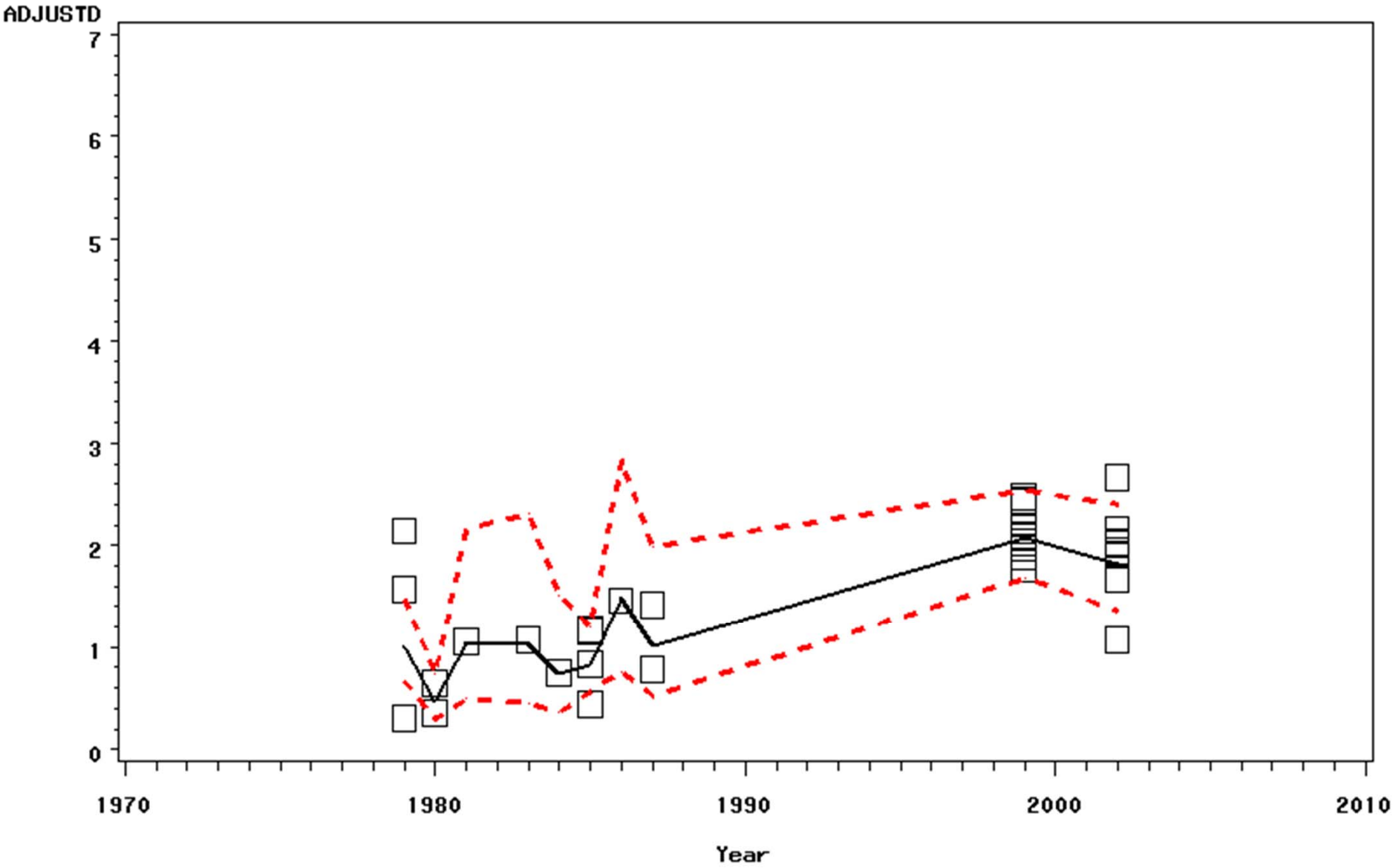
Adjusted and Predicted Total Hg in Smallmouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=21 Stat_ID=1BSTH022.75 Location=Waynesboro near Hopeman Pkwy. bridge



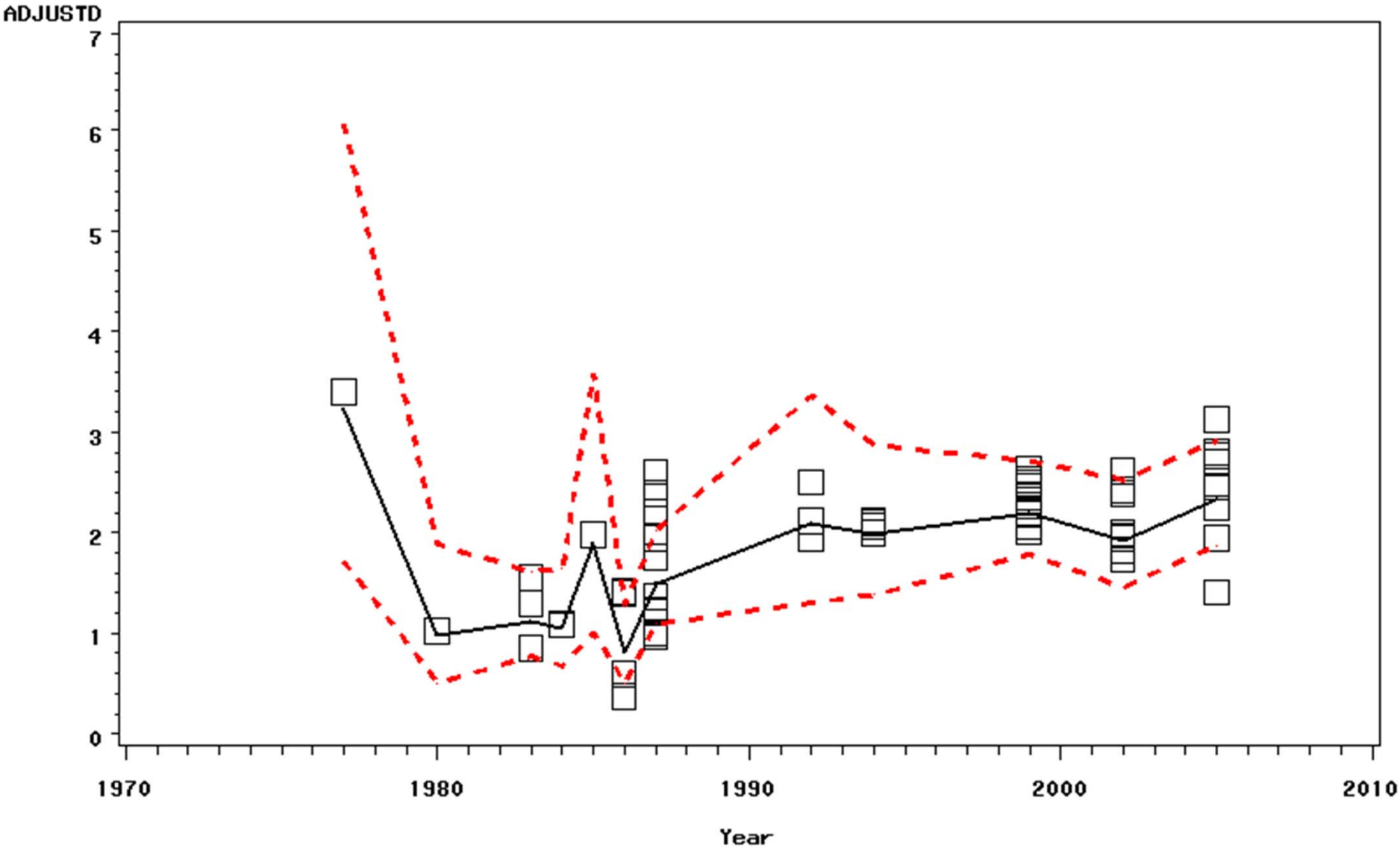
Adjusted and Predicted Total Hg in Smallmouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=5 Stat_ID=1BSTH020.44 Location=Dooms, VA near Rt. 611 bridge (above dam)



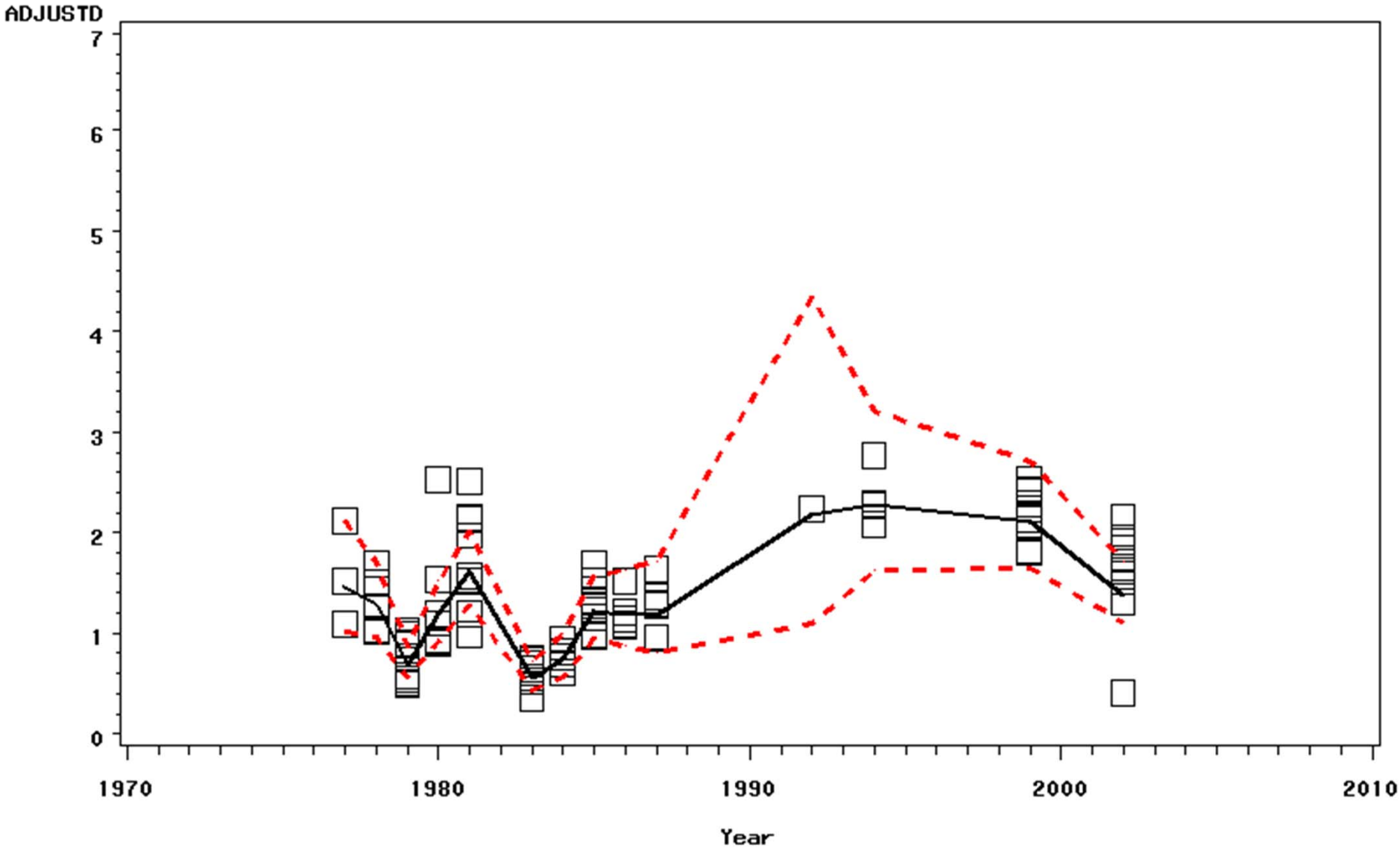
Adjusted and Predicted Total Hg in Smallmouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=6 Stat_ID=1BSTH014.60 Location=Crimora, VA near Rt. 612 bridge



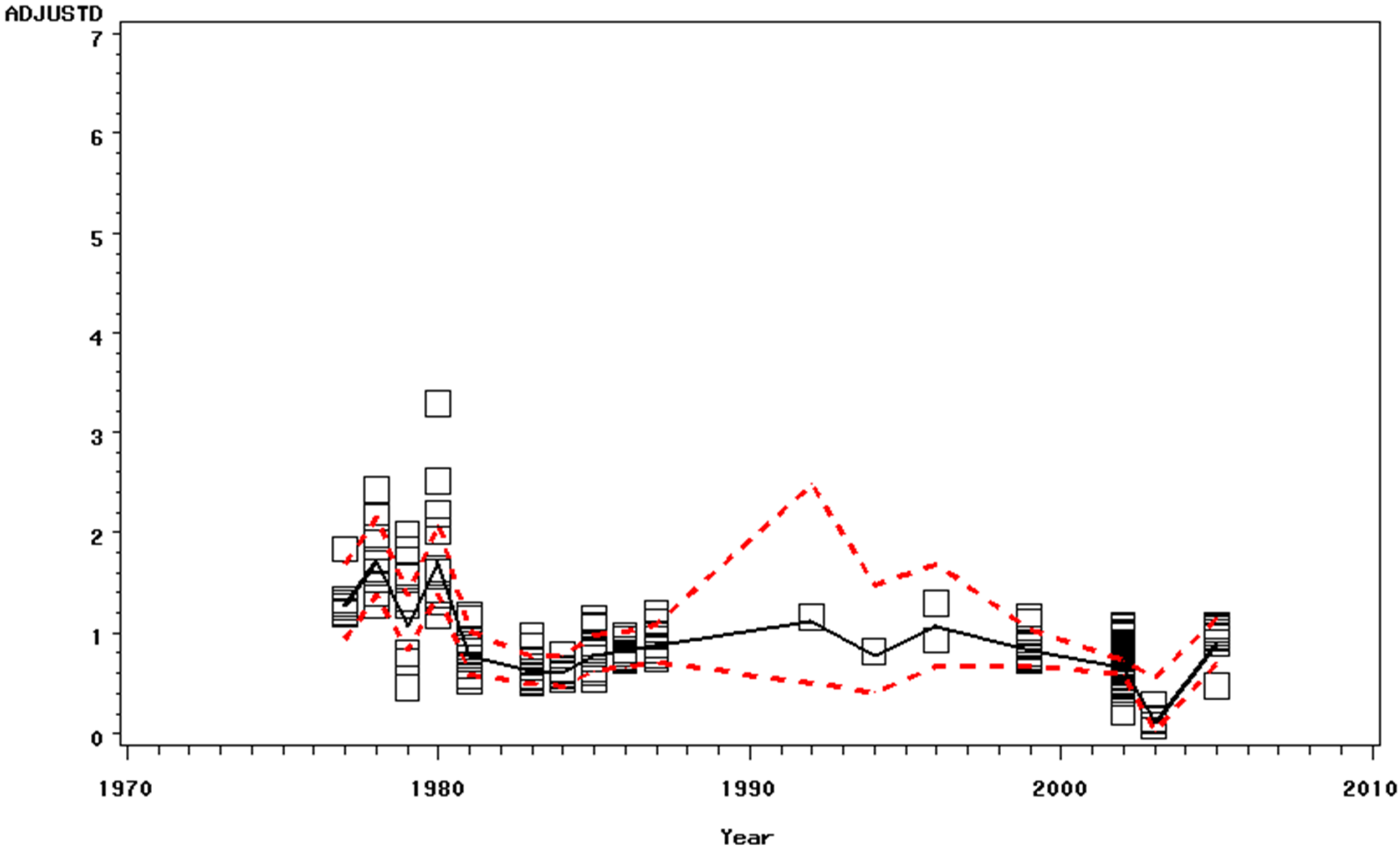
Adjusted and Predicted Total Hg in Smallmouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=7 Stat_ID=1BSTH004.21 Location=Grottoes, VA near Grand Caverns bridge



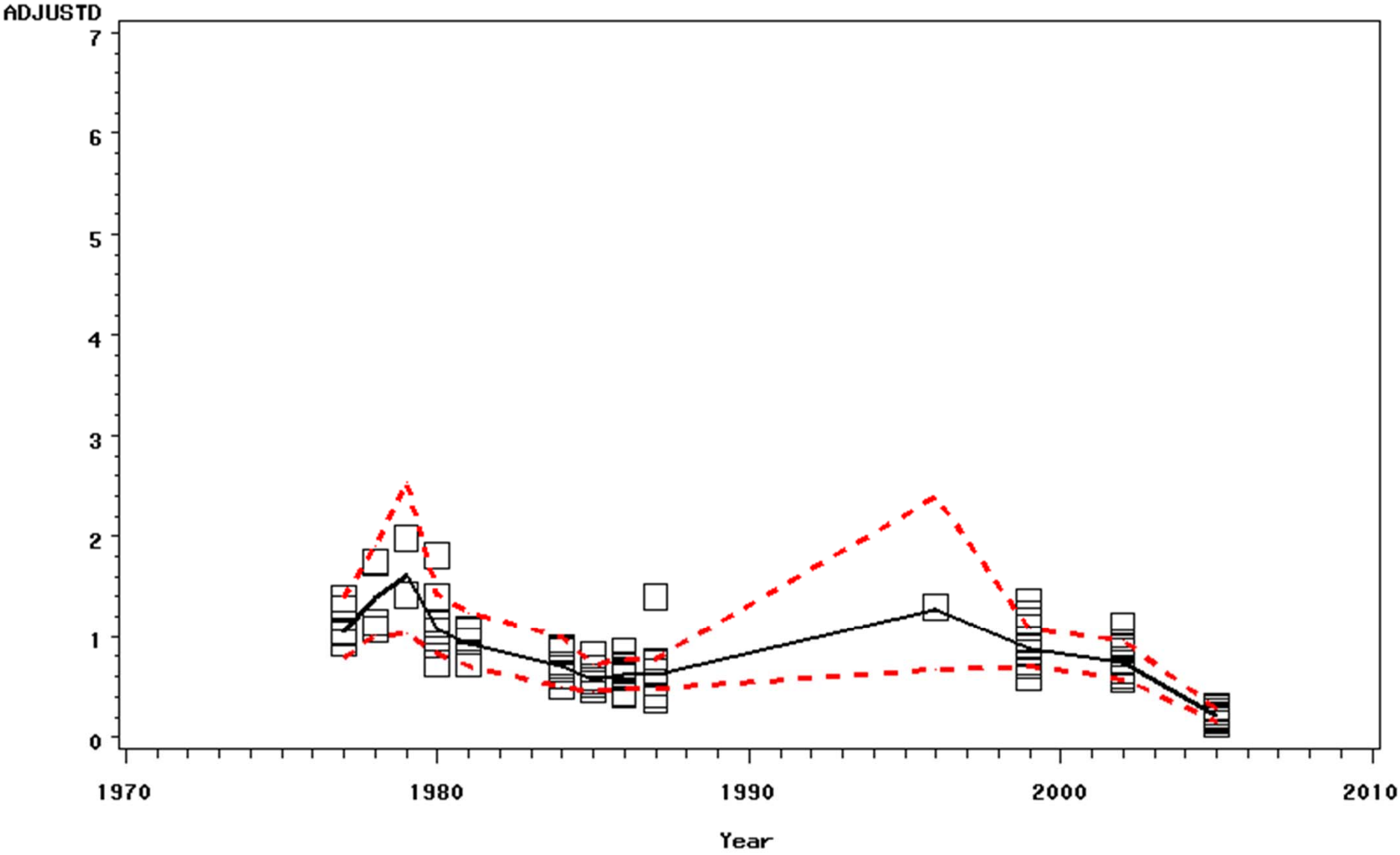
Adjusted and Predicted Total Hg in Smallmouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=9 Stat_ID=1BSSF100.10 Location=Lynwood, VA near Rt. 708 bridge



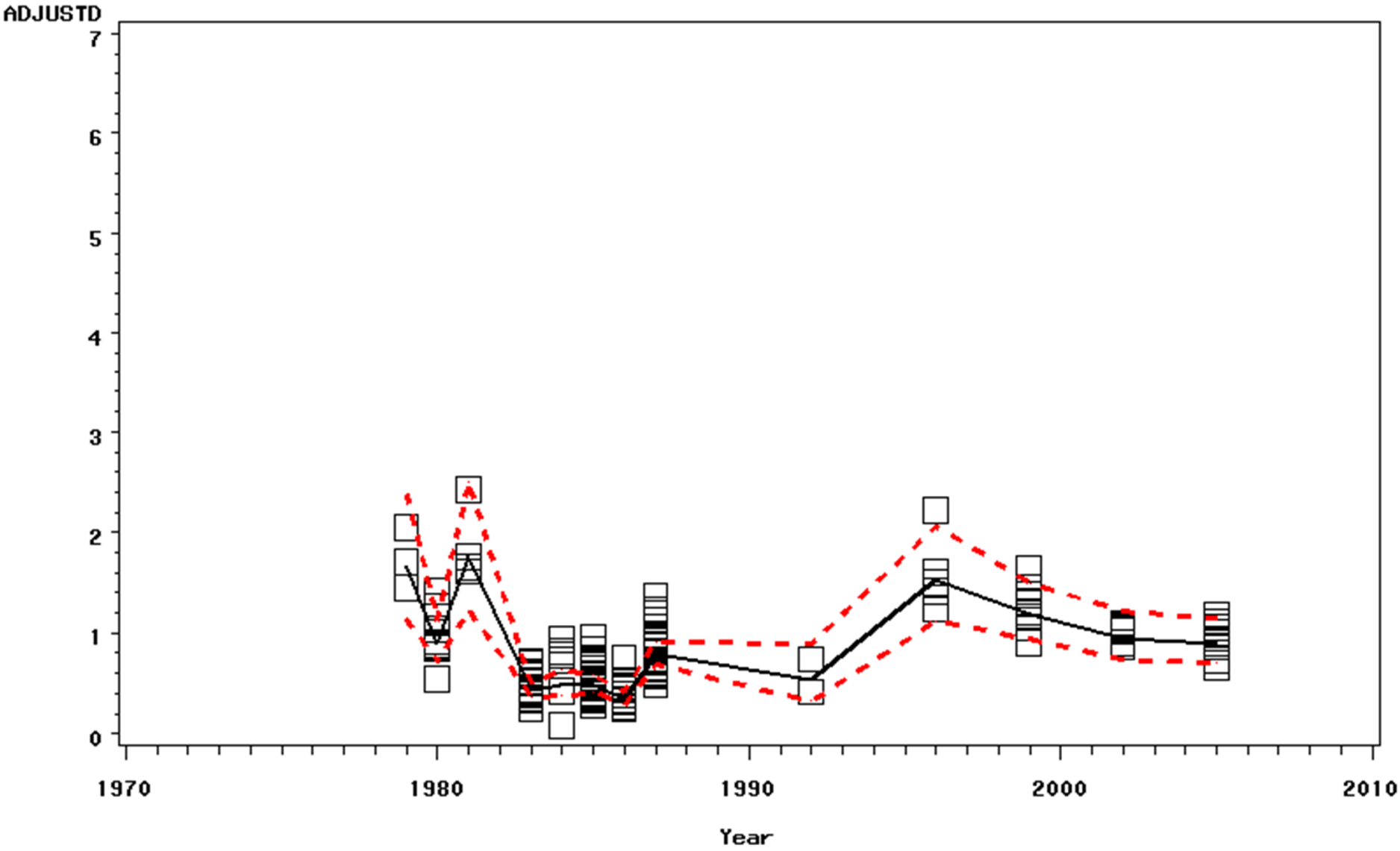
Adjusted and Predicted Total Hg in Smallmouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=10 Stat_ID=1BSSF078.24 Location=Shenandoah, VA (boat ramp above dam)



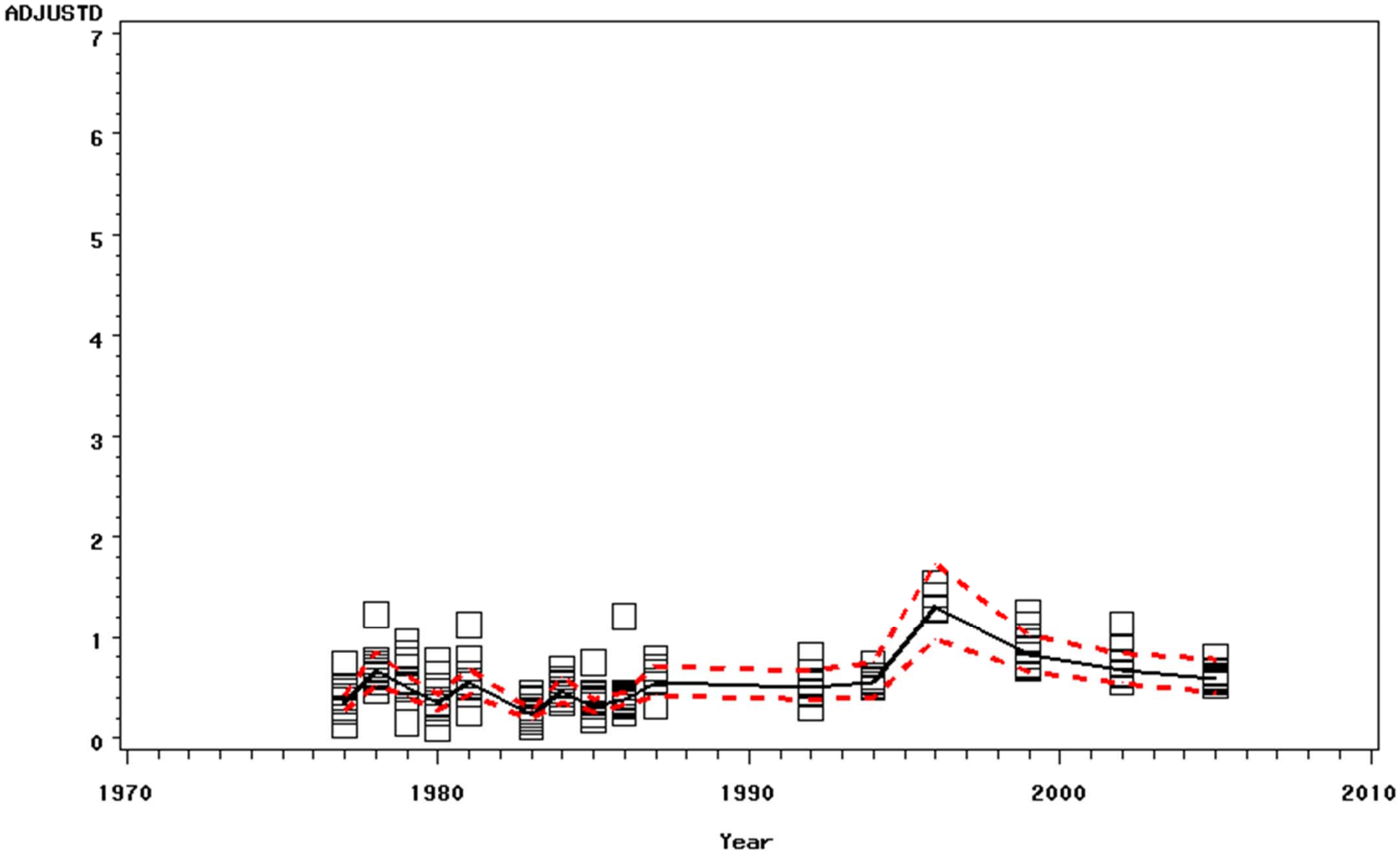
Adjusted and Predicted Total Hg in Smallmouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=11 Stat_ID=1BSSF054.20 Location=Hamburg, VA near Rt. 211 bridge



Adjusted and Predicted Total Hg in Smallmouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=12 Stat_ID=1BSSF020.70 Location=Bentonville Landing near Rt. 613 bridge



Largemouth Bass Results

- **LMB were collected at only a few stations in 2005**
  - **Dooms, Grottoes, Foster's Landing**

Number of LMB by Station and Year

station	77	78	79	80	81	83	84	85	86	87	92	94	96	99	02	05
1					1	2				1	8	6	1			
3							2						1			
5	4	1	2	1	6	2	3			3	2	7	4			9
6	1	2	1	3	1	5	1	1	4	2		6	1			
7	1	2	1		1	4							6			7
8					4					1			4			
9							2					2	3			
10	4	7	9	4	5	8	5	1	4	1	10	10	8	10	9	
11	6	10	7	2	6	8	11		8	7	11	10	4		9	
12				2	1	1				1						
14	1	2	2													
15		1			7	1					2					
16					4	4	2	1		6		7	3			
17										1	2					9
18				4	2	2	7	2		3	6	10	2	10		
21															9	
23															9	
29															9	

Mean Total Hg (X100) in LMB by Station and Year

station	77	78	79	80	81	83	84	85	86	87	92	94	96	99	02	05
1					4	13				2	36	22	28			
3							57						103			
5	76	123	64	35	126	52	80			139	133	173	246			233
6	56	187	23	129	233	130	95	289	104	166		255	220			
7	99	113	28		213	63							235			266
8					27					2			56			
9							62					105	96			
10	111	138	97	123	57	43	65	121	76	56	94	117	163	130	127	
11	135	90	124	111	140	164	78		69	74	123	92	171		109	
12				50	54	139				53						
14	64	81	17													
15		22			9	12					58					
16					99	53	49	119		86		80	183			
17										82	78					92
18				87	44	54	85	63		47	115	90	130	87		
21															176	
23															74	
29															91	

Mean Adjusted Total Hg (X100) in LMB by Station and Year

station	77	78	79	80	81	83	84	85	86	87	92	94	96	99	02	05
1					4	17				3	33	22	26			
3							58						101			
5	63	113	64	46	129	60	77			124	148	154	267			233
6	41	128	20	145	212	123	87	197	107	178		254	194			
7	109	114	25		223	111							250			253
8					32					2			52			
9							63					111	94			
10	111	138	103	127	72	43	72	56	83	137	87	96	159	97	78	
11	132	92	136	125	165	108	82		67	90	84	82	193		82	
12				57	52	49				225						
14	70	8	3													
15		16			6	12					69					
16					94	54	55	79		109		79	168			
17										126	74					84
18				91	80	43	88	44		66	80	96	126	77		
21															157	
23															37	
29															63	

LOG(Total Hg) in LMB
TESTS FOR TREND 1977-2005

station	STAT_ID	_JT_	Z_JT	P2_JT	SIGNIF
1	1BSTH026.12	91.0	0.41004	0.68178	
3	1BSTH025.10	2.0	1.41421	0.15730	
5	1BSTH020.44	699.0	4.73080	0.00000	**
6	1BSTH014.60	266.0	3.24276	0.00118	**
7	1BSTH004.21	172.0	3.41797	0.00063	**
8	1BNTH004.10	25.0	1.62019	0.10519	
9	1BSSF100.10	14.0	1.29940	0.19381	
10	1BSSF078.24	2295.5	0.41921	0.67506	
11	1BSSF054.20	1975.5	-2.81914	0.00482	**
12	1BSSF020.70	6.5	1.45095	0.14679	
15	1BSHN022.63	35.5	2.13103	0.03309	**
16	1BSSF062.97	223.0	2.04486	0.04087	**
17	1BSSF037.60	32.5	-0.09141	0.92716	
18	1BSSF010.18	664.0	1.81500	0.06952	

- is decrease
+ is increase

LOG(Total Hg) in LMB

TESTS FOR TREND 1994-2005

station	STAT_ID	_JT_	Z_JT	P2_JT	SIGNIF
1	1BSTH026.12	12.5	1.00000	0.31731	
5	1BSTH020.44	121.5	1.86800	0.06176	
6	1BSTH014.60	7.5	-1.50000	0.13361	
7	1BSTH004.21	40.0	0.14286	0.88640	
9	1BSSF100.10	3.5	-0.59235	0.55362	
10	1BSSF078.24	245.0	-2.38653	0.01701	**
11	1BSSF054.20	120.5	-0.34526	0.72990	
16	1BSSF062.97	33.0	2.39317	0.01670	**
18	1BSSF010.18	86.5	-1.82804	0.06754	

TESTS FOR TREND 1996-2005

station	STAT_ID	_JT_	Z_JT	P2_JT	SIGNIF
5	1BSTH020.44	40.0	0.15430	0.87737	
7	1BSTH004.21	40.0	0.14286	0.88640	
10	1BSSF078.24	74.5	-4.49593	0.00001	**
11	1BSSF054.20	21.0	-2.77746	0.00548	**
18	1BSSF010.18	23.0	-2.14834	0.03169	**

- is decrease
+ is increase

TESTS FOR TREND 1999-2005

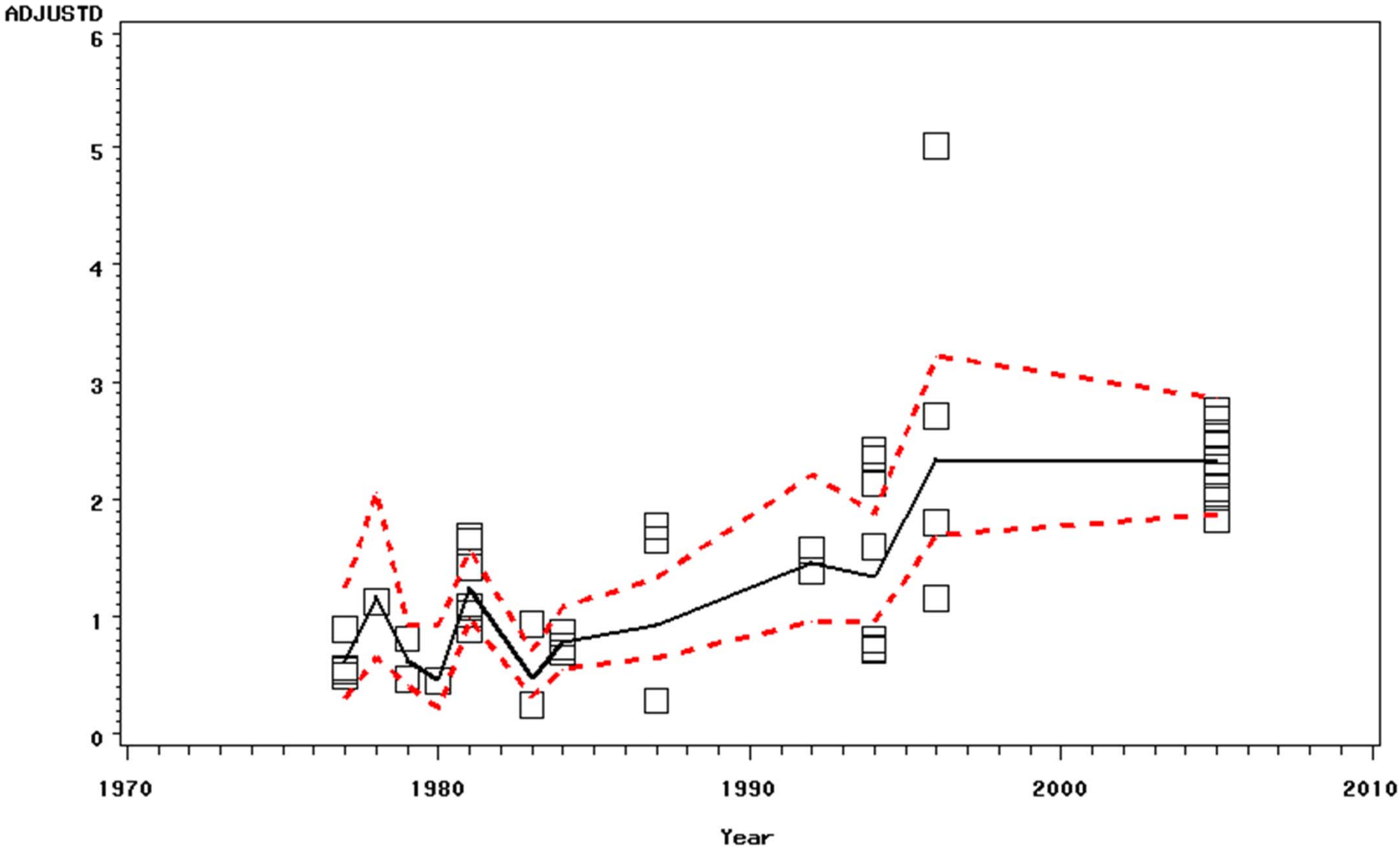
station	STAT_ID	_JT_	Z_JT	P2_JT	SIGNIF
10	1BSSF078.24	55.5	-2.44949	0.014306	**

- is decrease
+ is increase

Except for station 16, 1994-1996, all significant trends are decreasing.

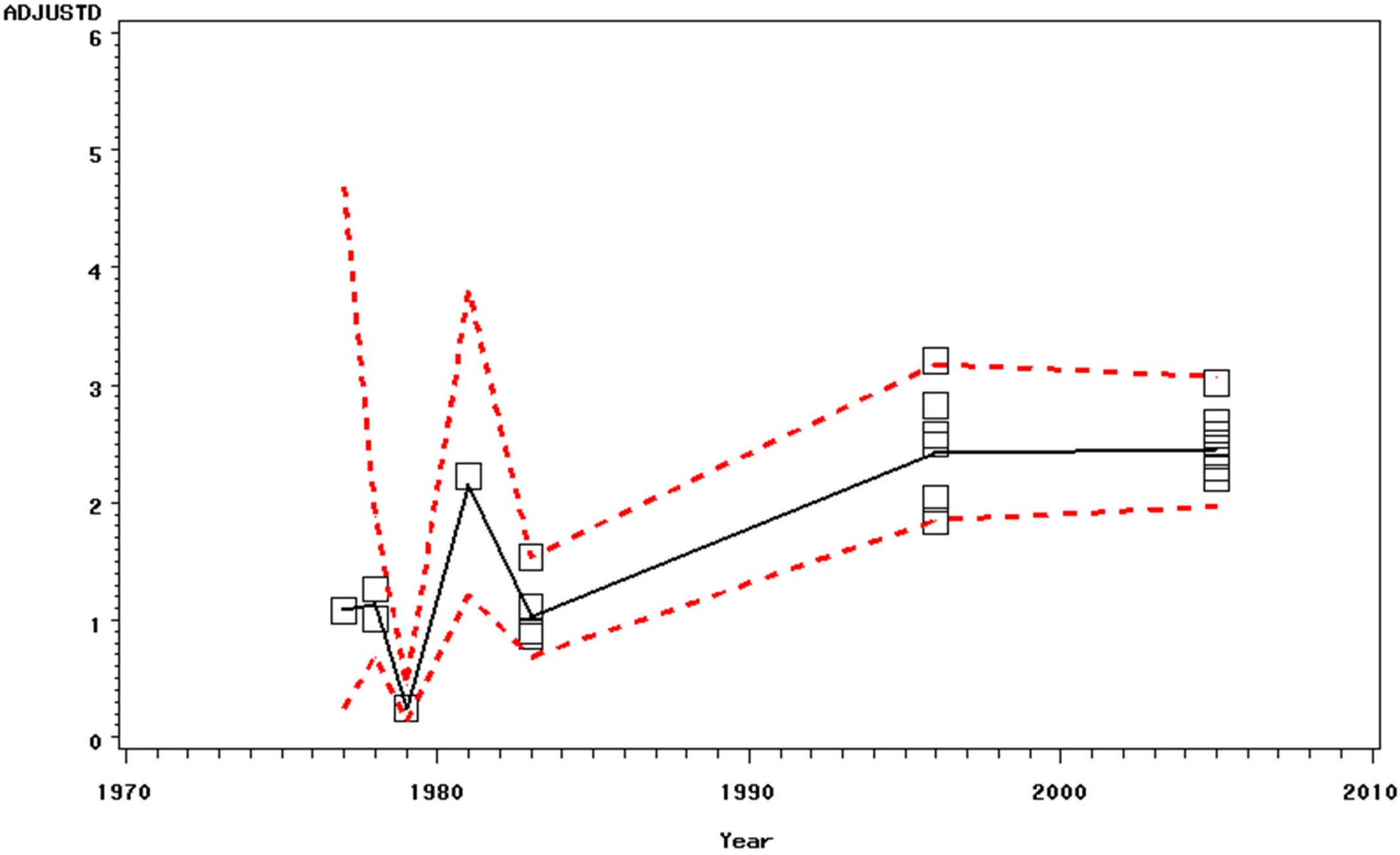
Adjusted and Predicted Total Hg in Largemouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=5 Stat_ID=1BSTH020.44 Location=Dooms, VA near Rt. 611 bridge (above dam)



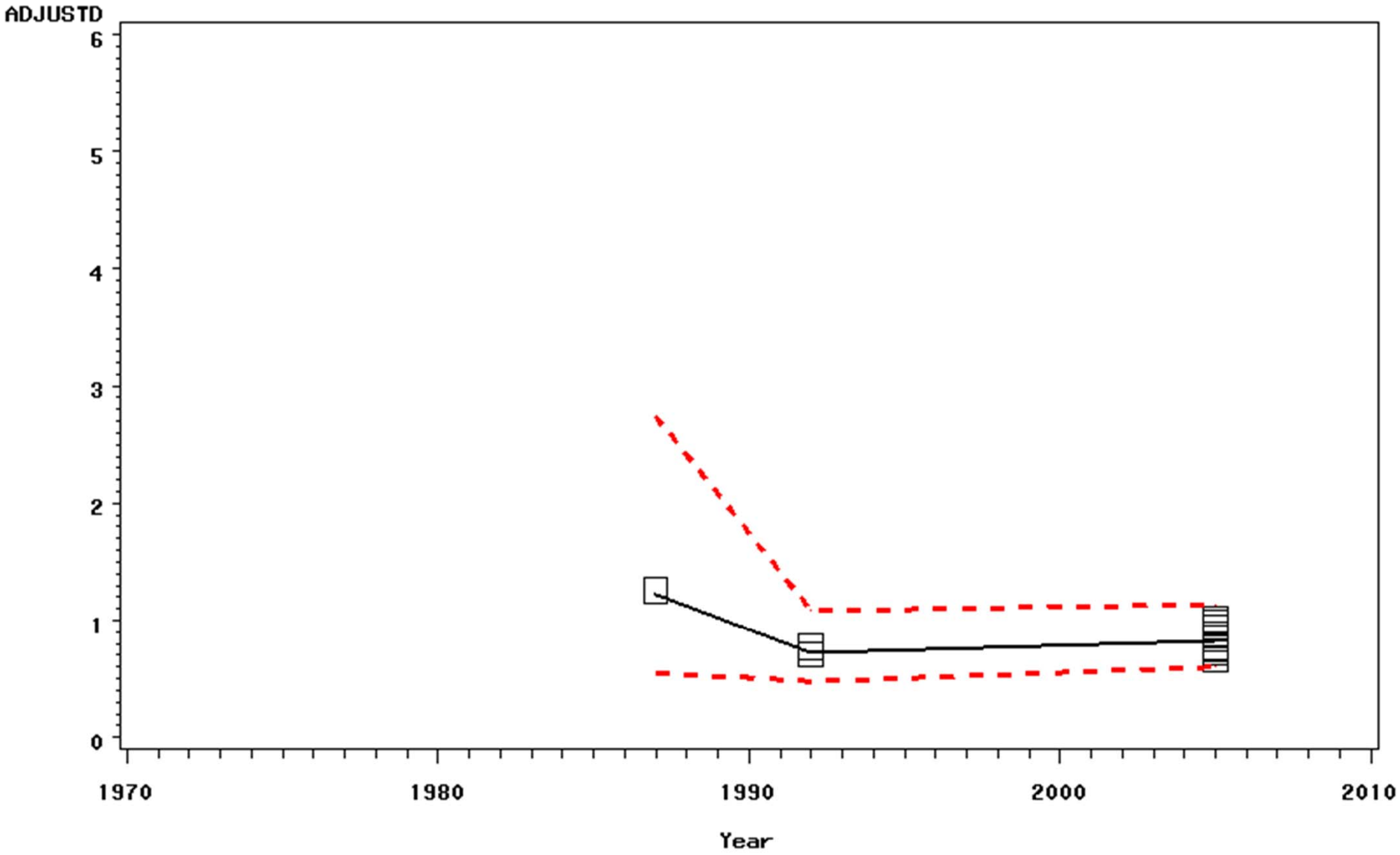
Adjusted and Predicted Total Hg in Largemouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=7 Stat_ID=1BSTH004.21 Location=Grottoes, VA near Grand Caverns bridge



Adjusted and Predicted Total Hg in Largemouth Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=17 Stat_ID=1BSSF037.60 Location=Fosters Landing near Rt. 684 bridge

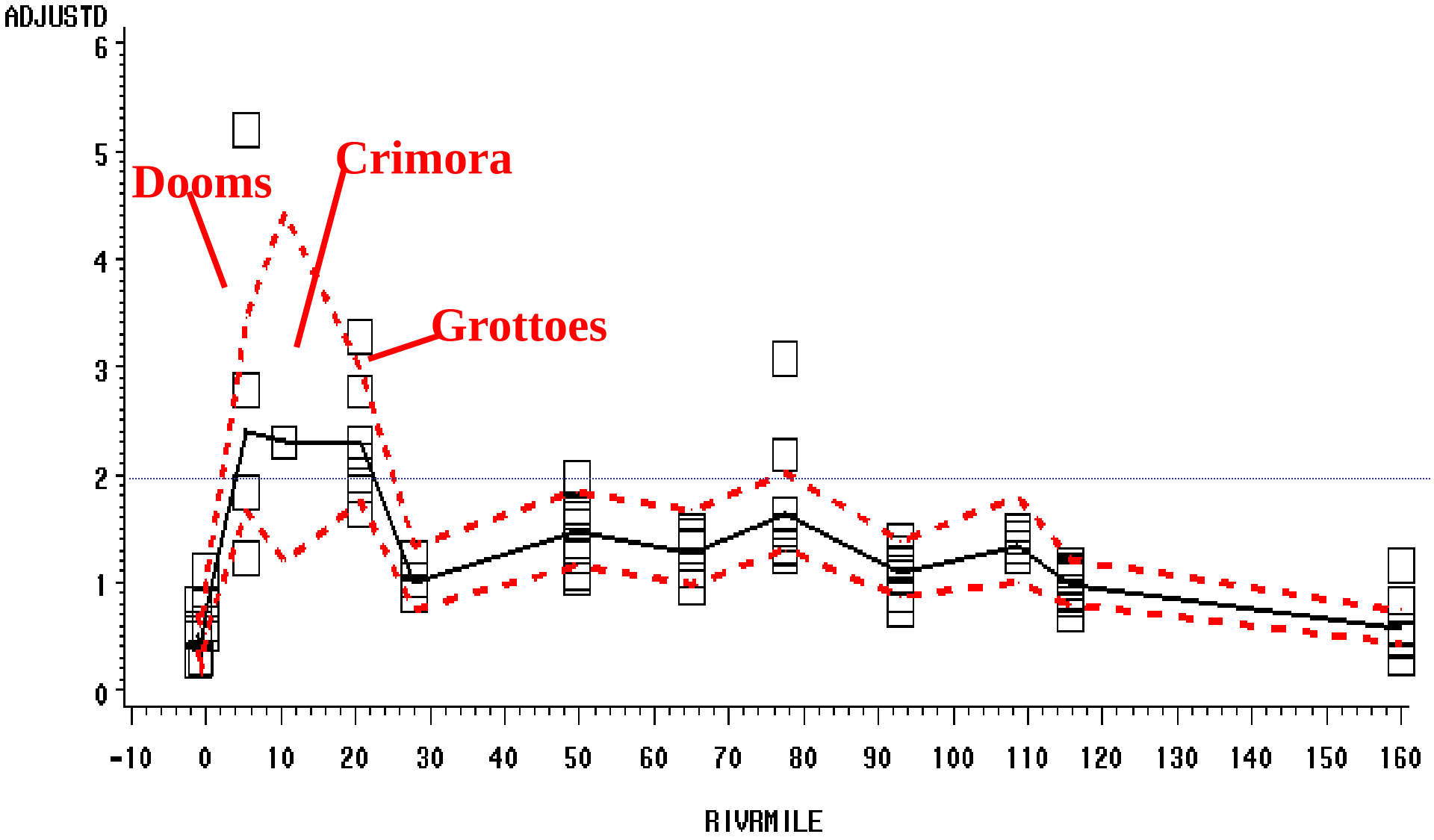


SMB and LMB Combined

- **Data from both types of bass combined reveal much the same picture as each separately**
- **A few graphs will illustrate this**

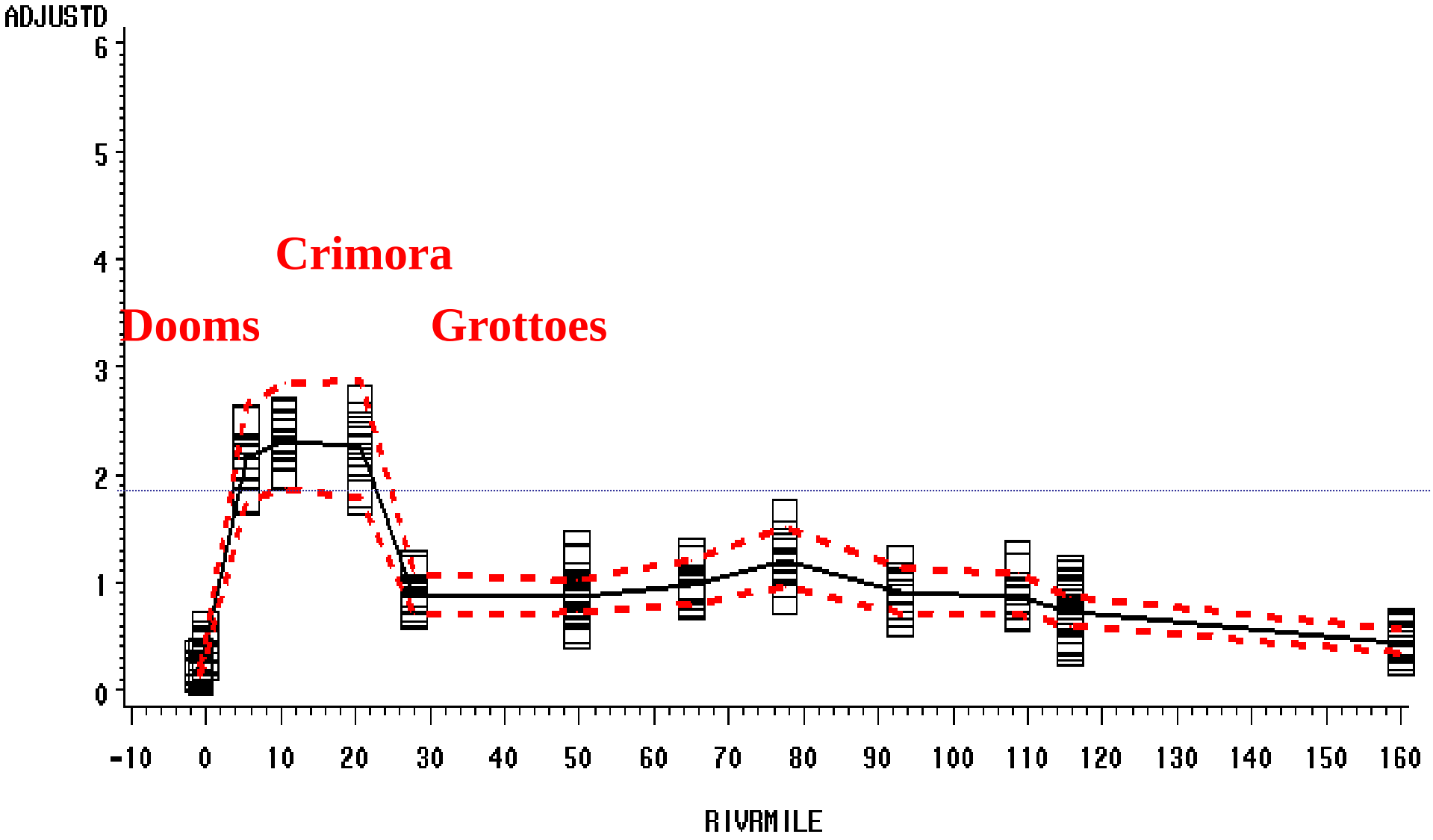
Adjusted and Predicted Total Hg in Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
YEAR=1996



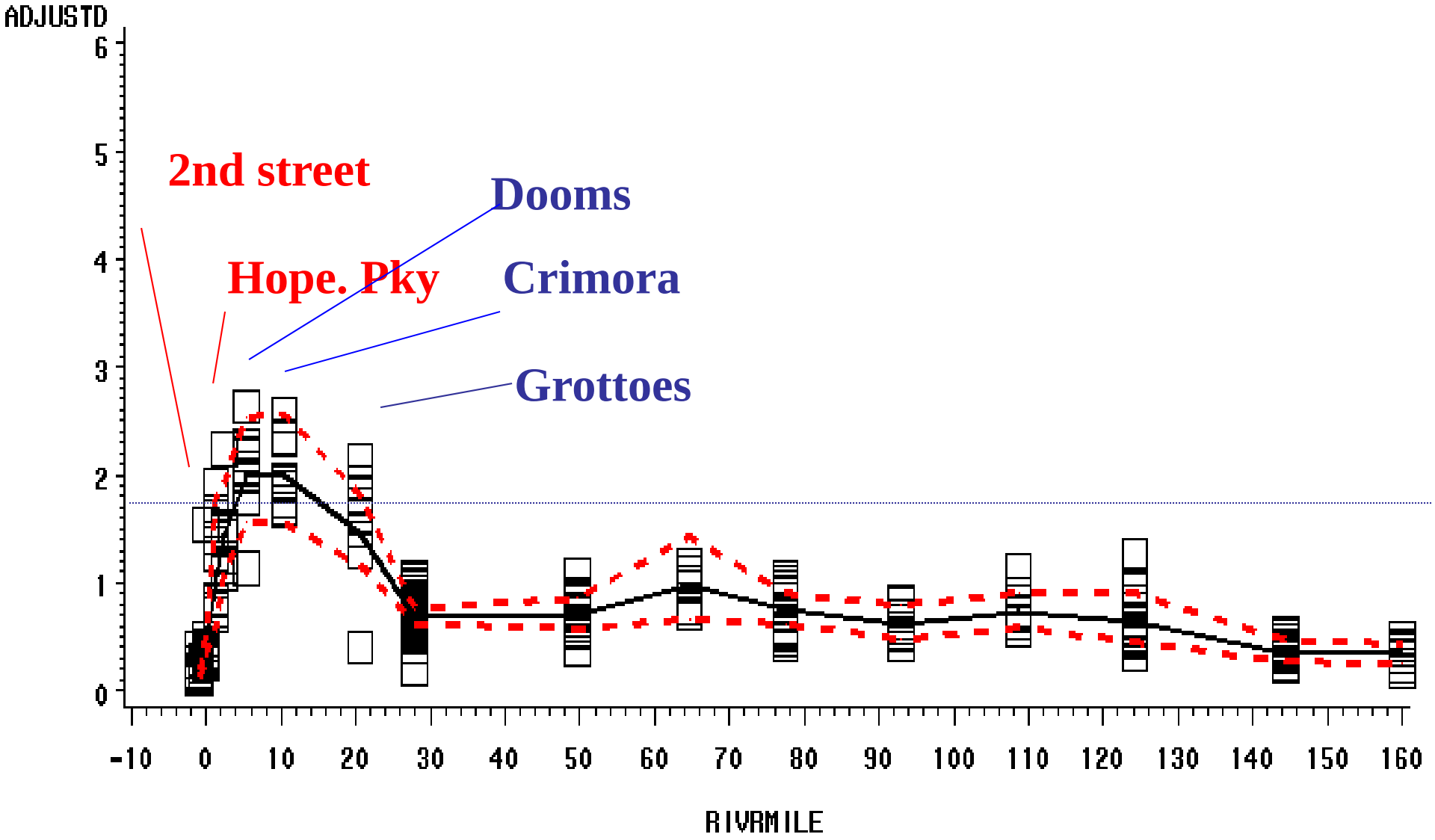
Adjusted and Predicted Total Hg in Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
YEAR=1999



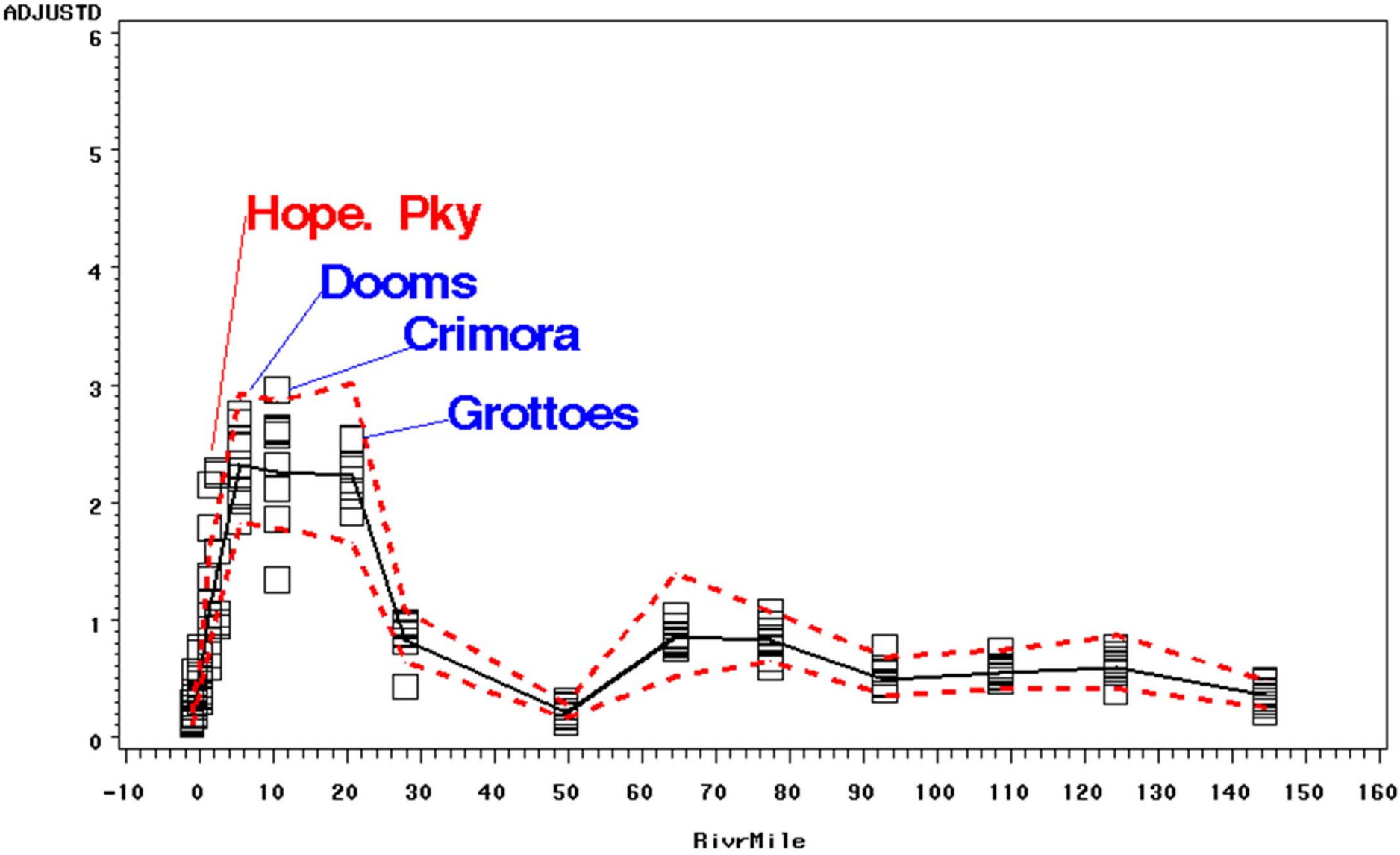
Adjusted and Predicted Total Hg in Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
YEAR=2002



Adjusted and Predicted Total Hg in Bass

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
Year=2005

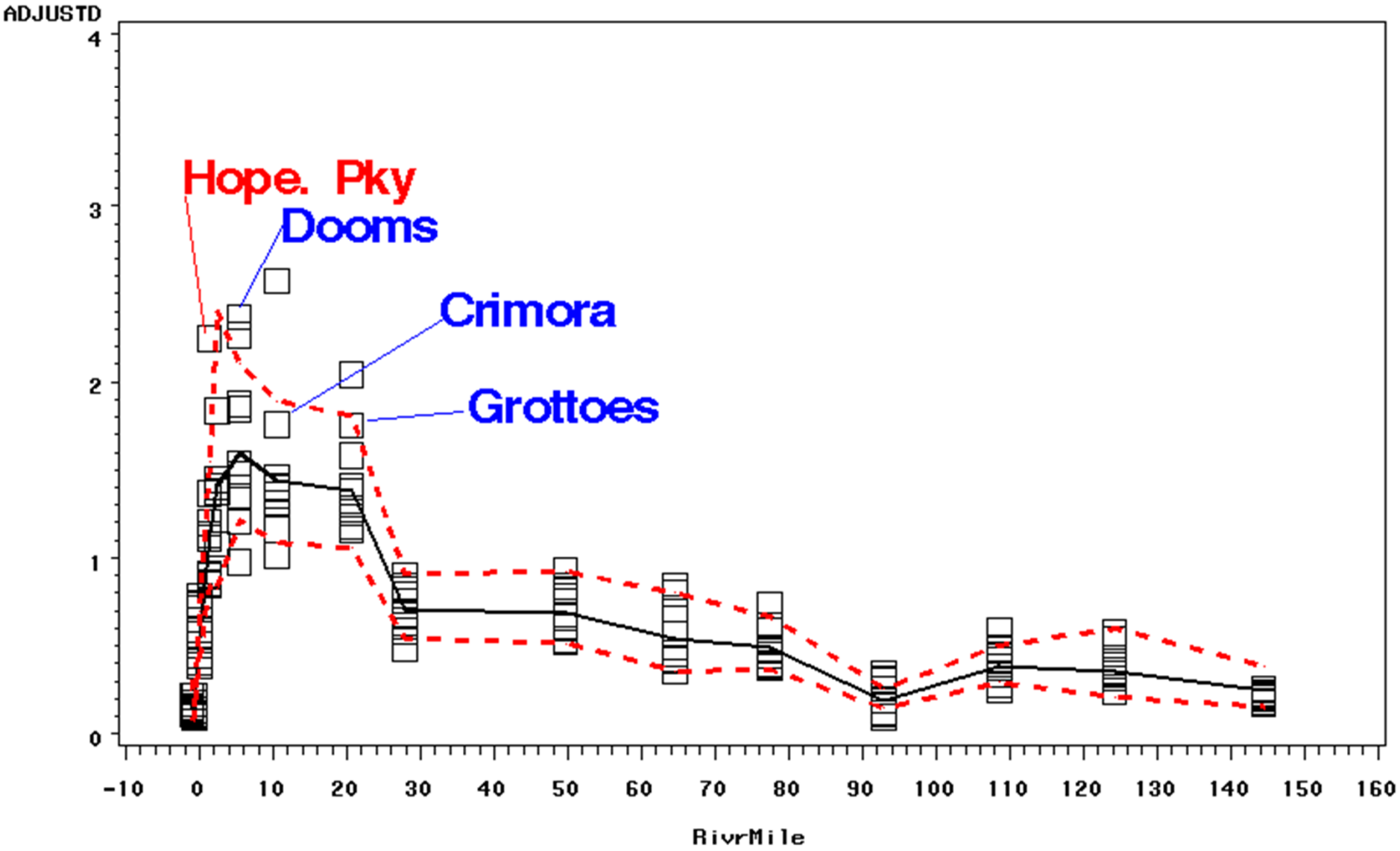


Sunfish (incl. Redbreast)

- **Results for sunfish are analogous to those for bass**
- **A few plots will illustrate this**

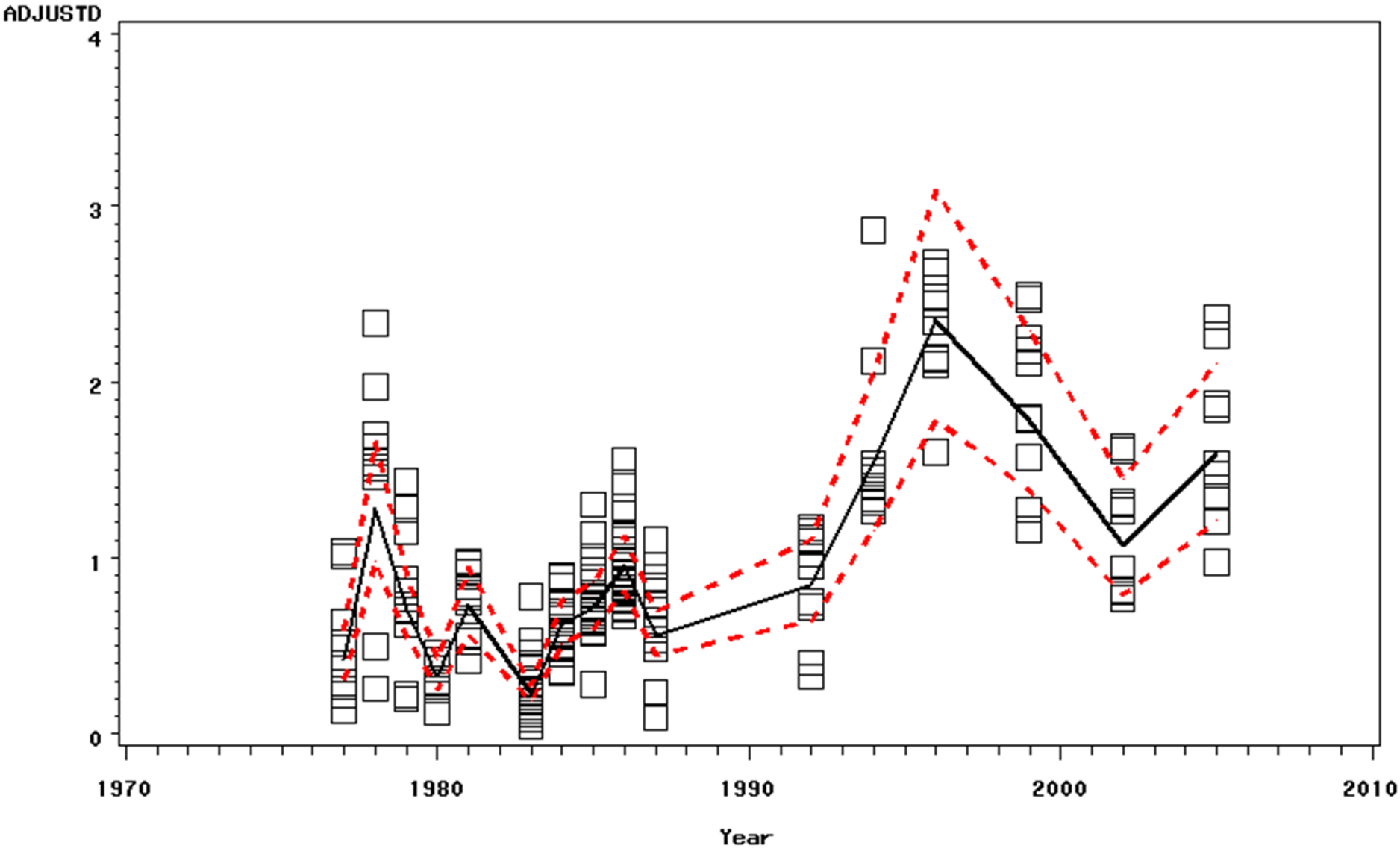
Adjusted and Predicted Total Hg in SUNFISH

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
Year=2005



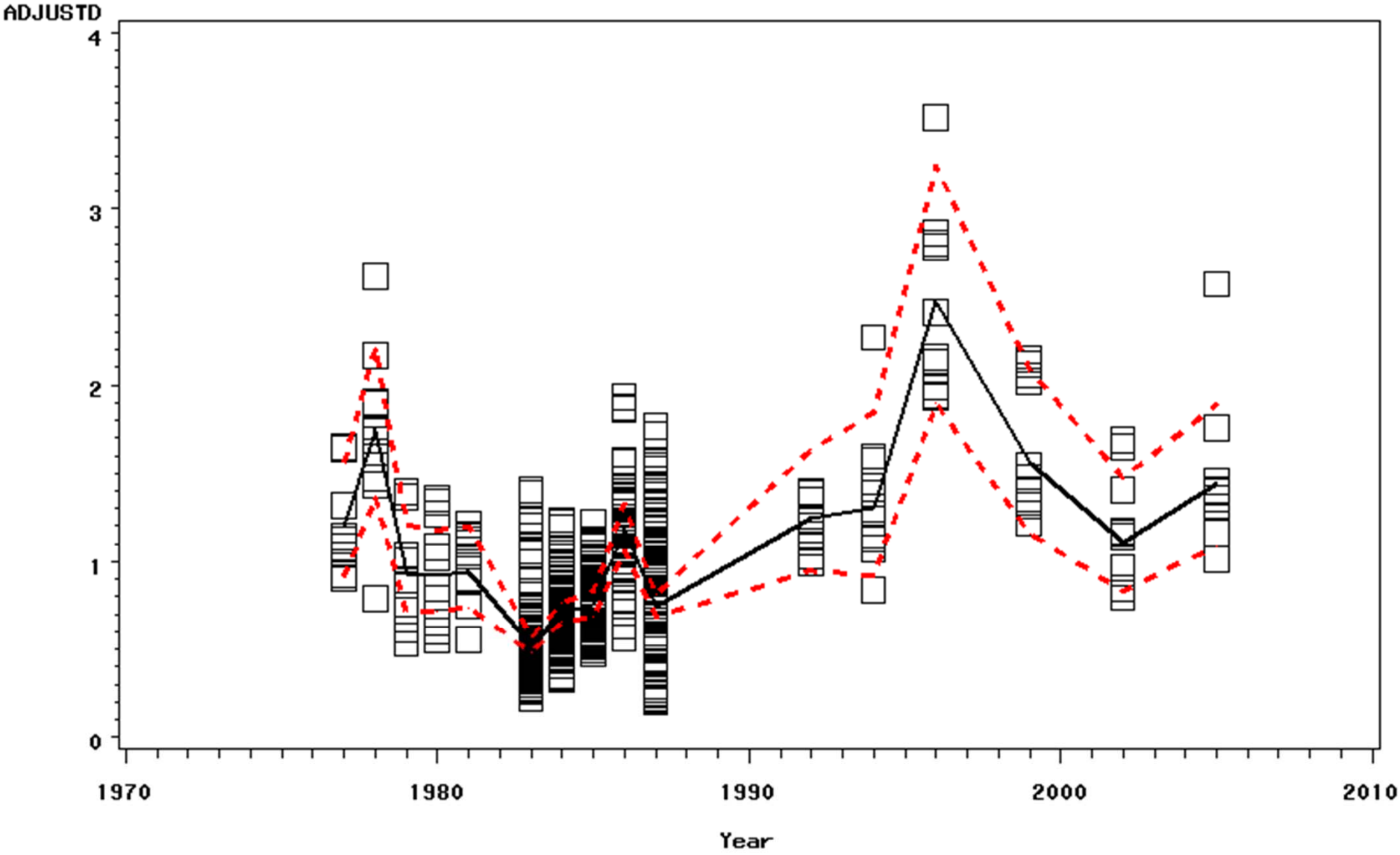
Adjusted and Predicted Total Hg in SUNFISH

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=5 Stat_ID=1BSTH020.44 Location=Dooms, VA near Rt. 611 bridge (above dam)



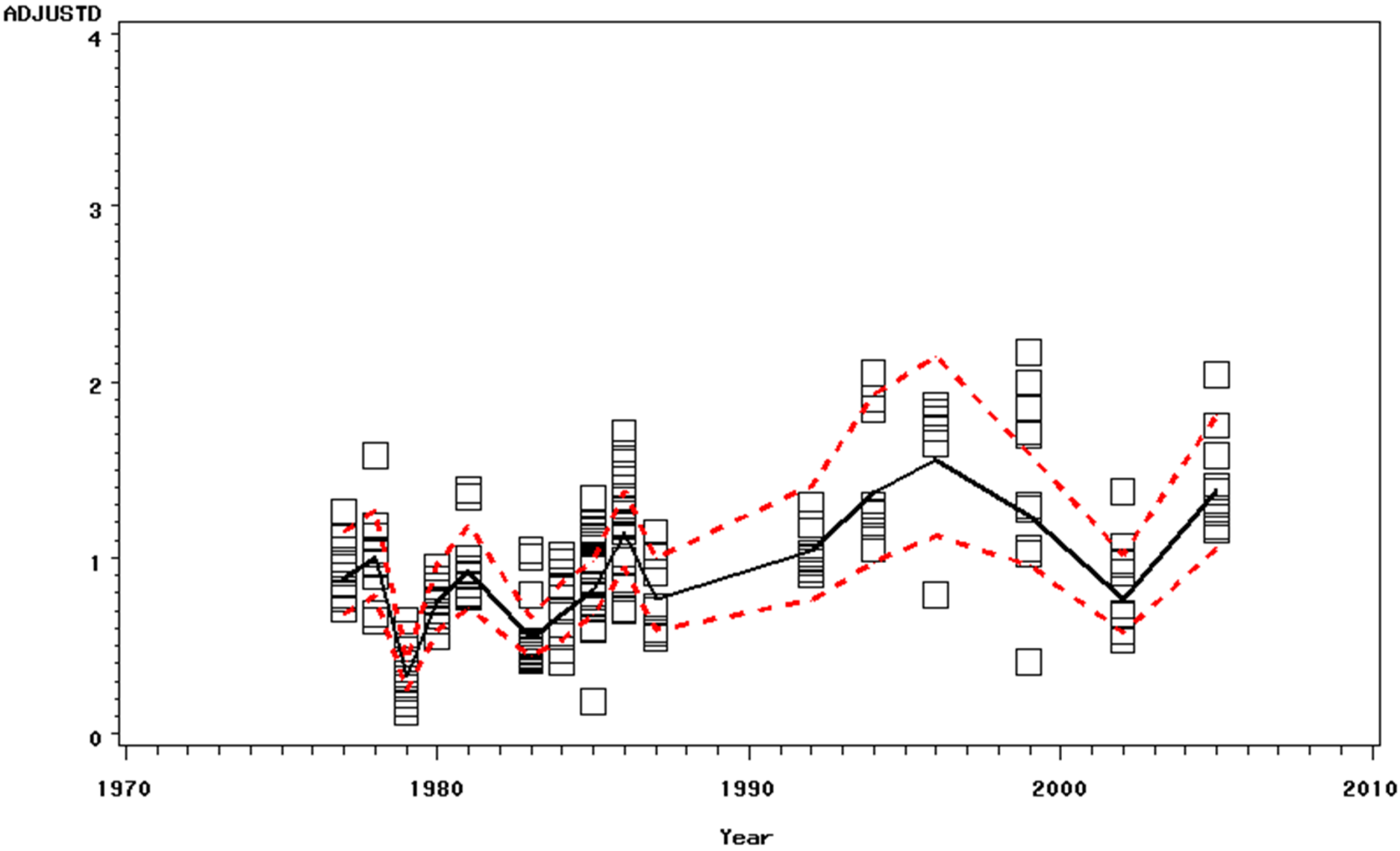
Adjusted and Predicted Total Hg in SUNFISH

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=6 Stat_ID=1BSTH014.60 Location=Crimora, VA near Rt. 612 bridge



Adjusted and Predicted Total Hg in SUNFISH

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=7 Stat_ID=1BSTH004.21 Location=Grottoes, VA near Grand Caverns bridge

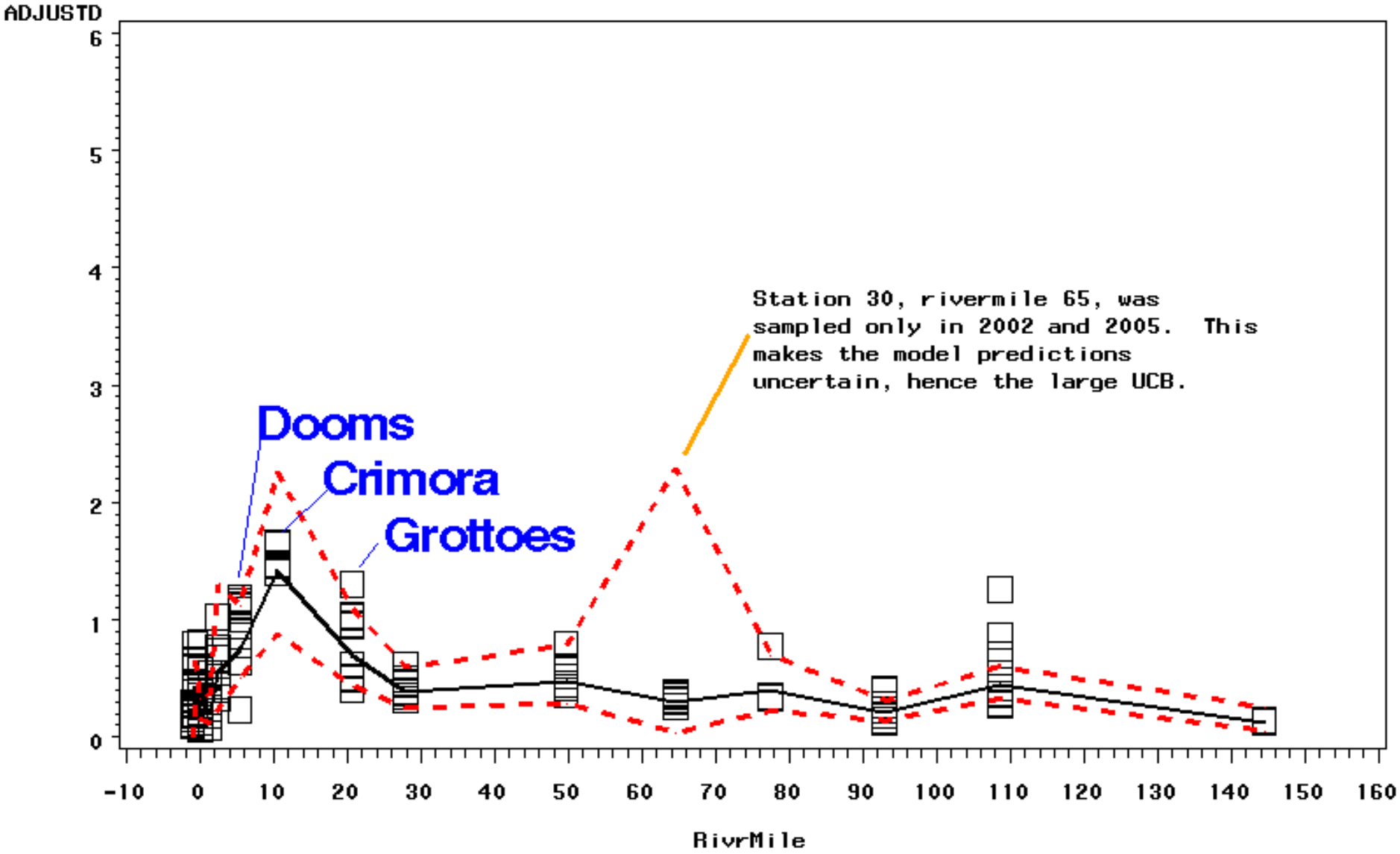


Sucker

- **Again, results are similar to those for bass and sunfish**
- **A few plots will illustrate the claim**
- **One very large total Hg value of *74 ppm* in 2005, station 8 (1BNTH004.10), was omitted from analysis**

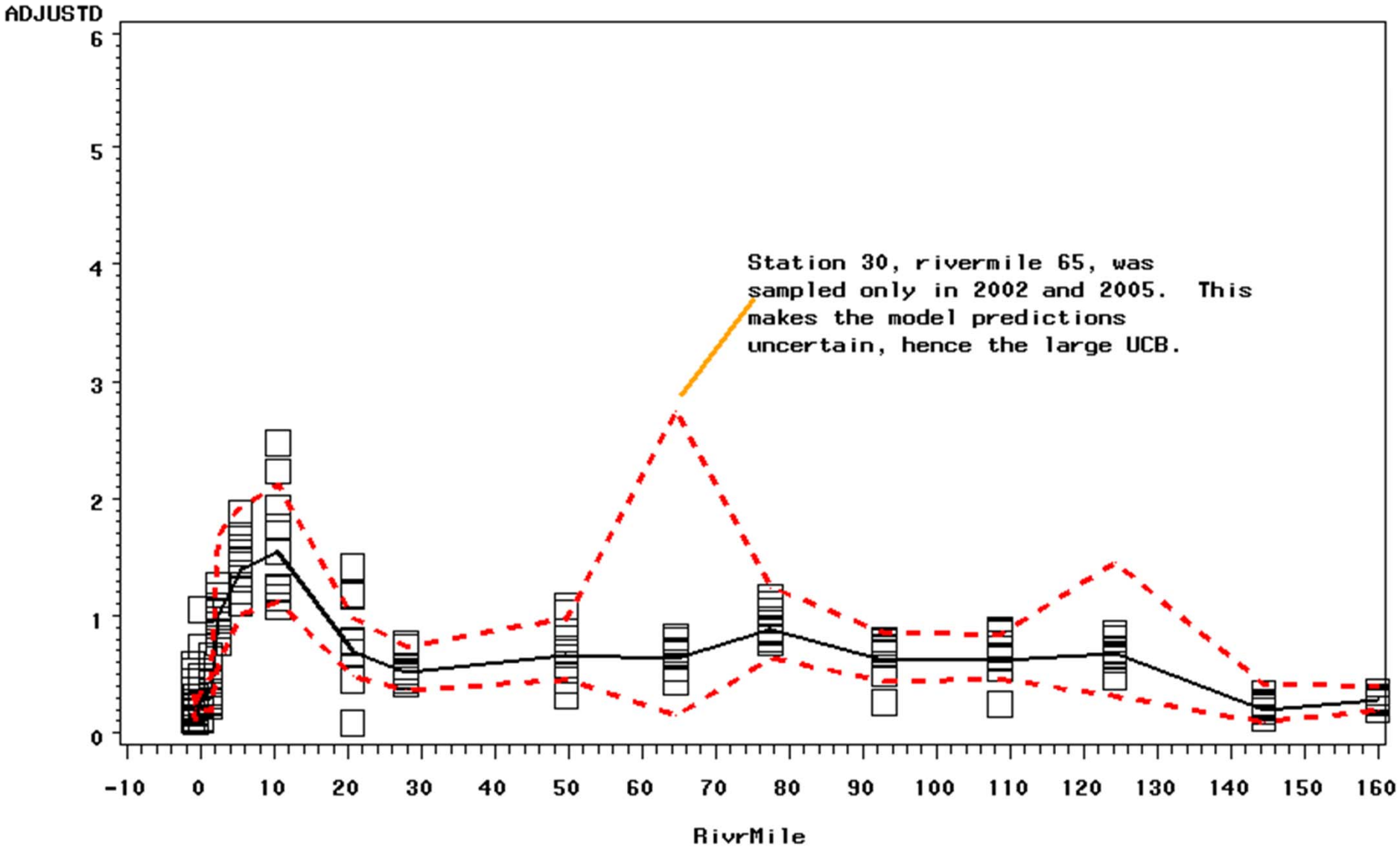
Adjusted and Predicted Total Hg in SUCKER

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
Year=2005



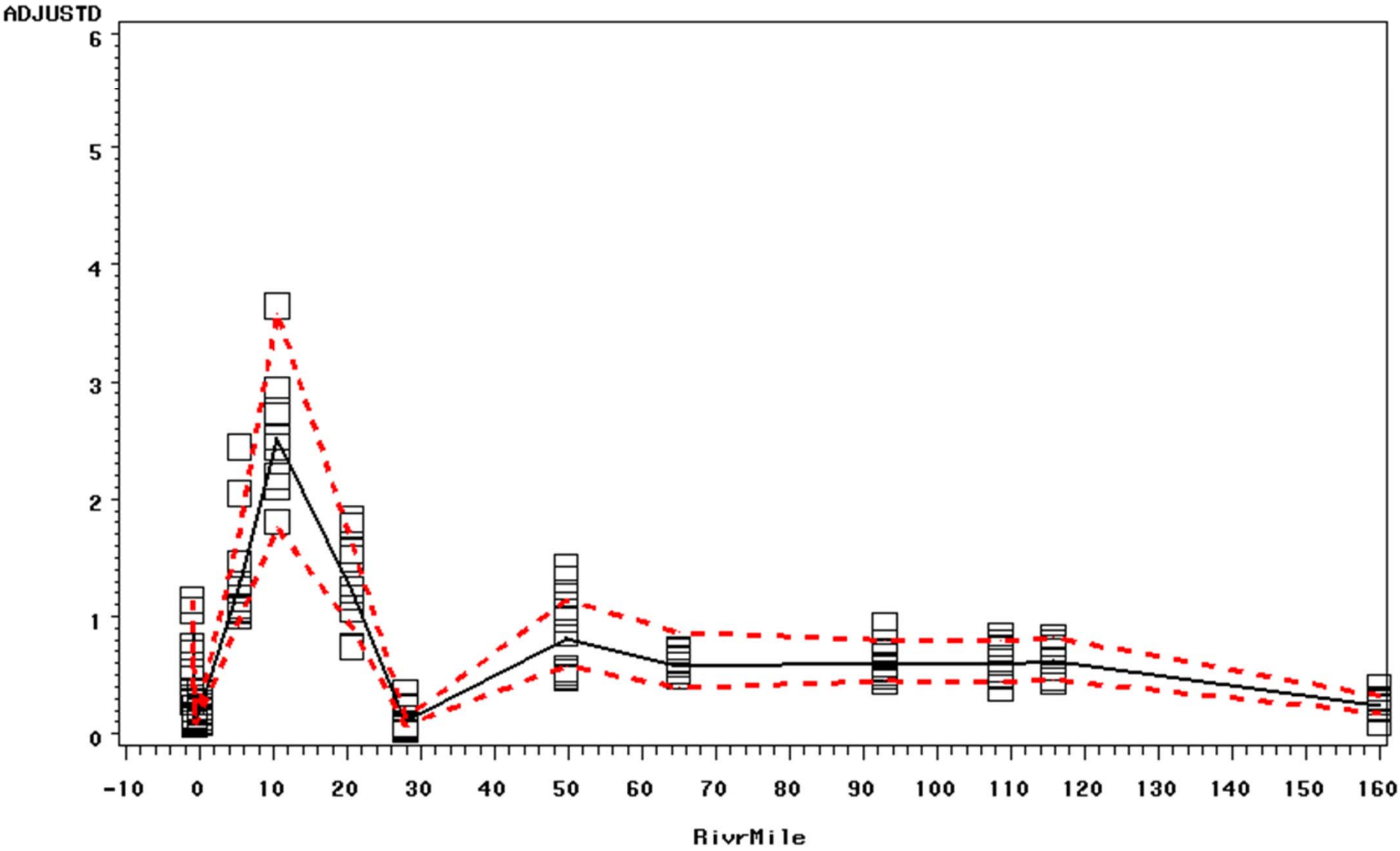
Adjusted and Predicted Total Hg in SUCKER

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
Year=2002



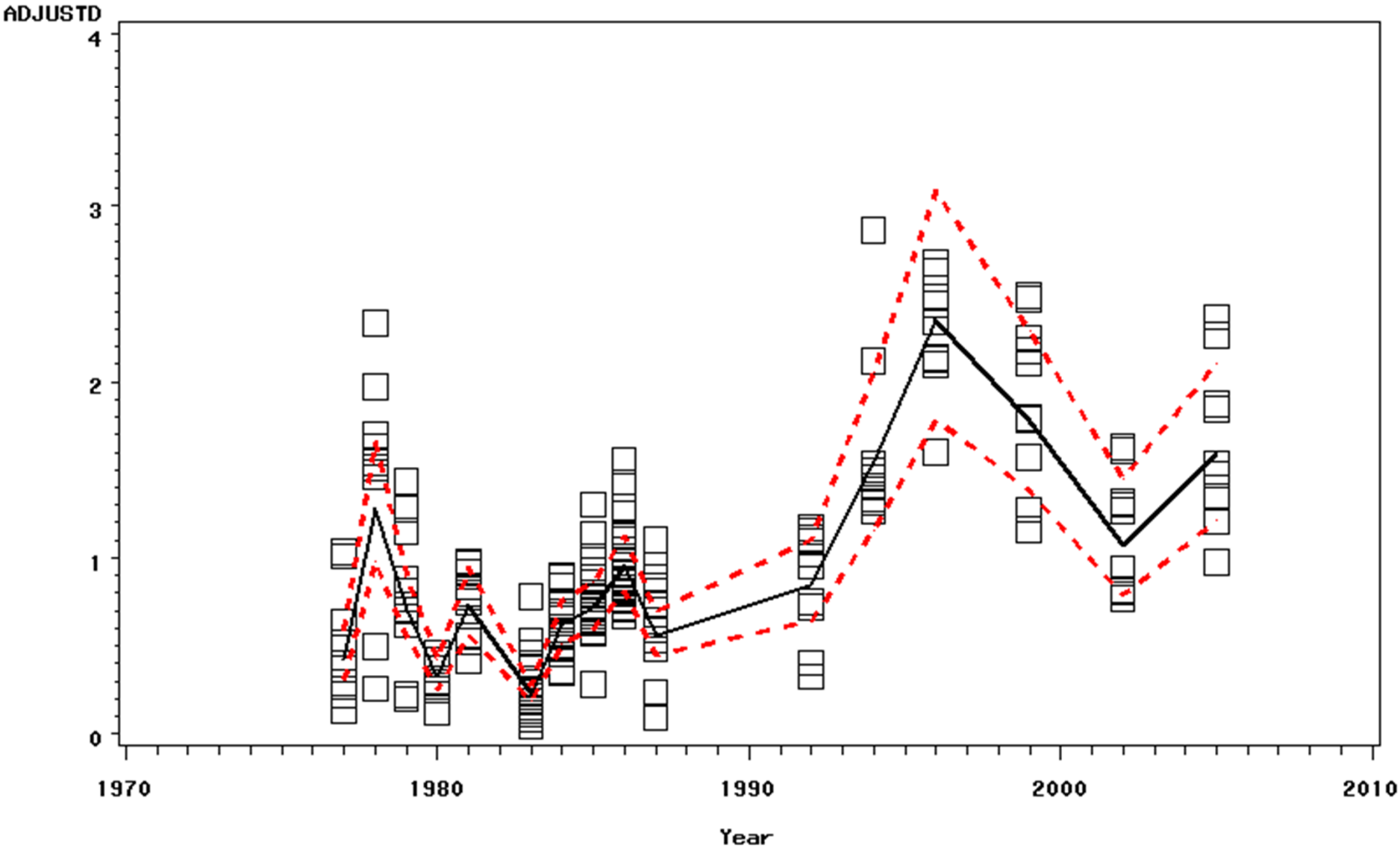
Adjusted and Predicted Total Hg in SUCKER

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
Year=1999



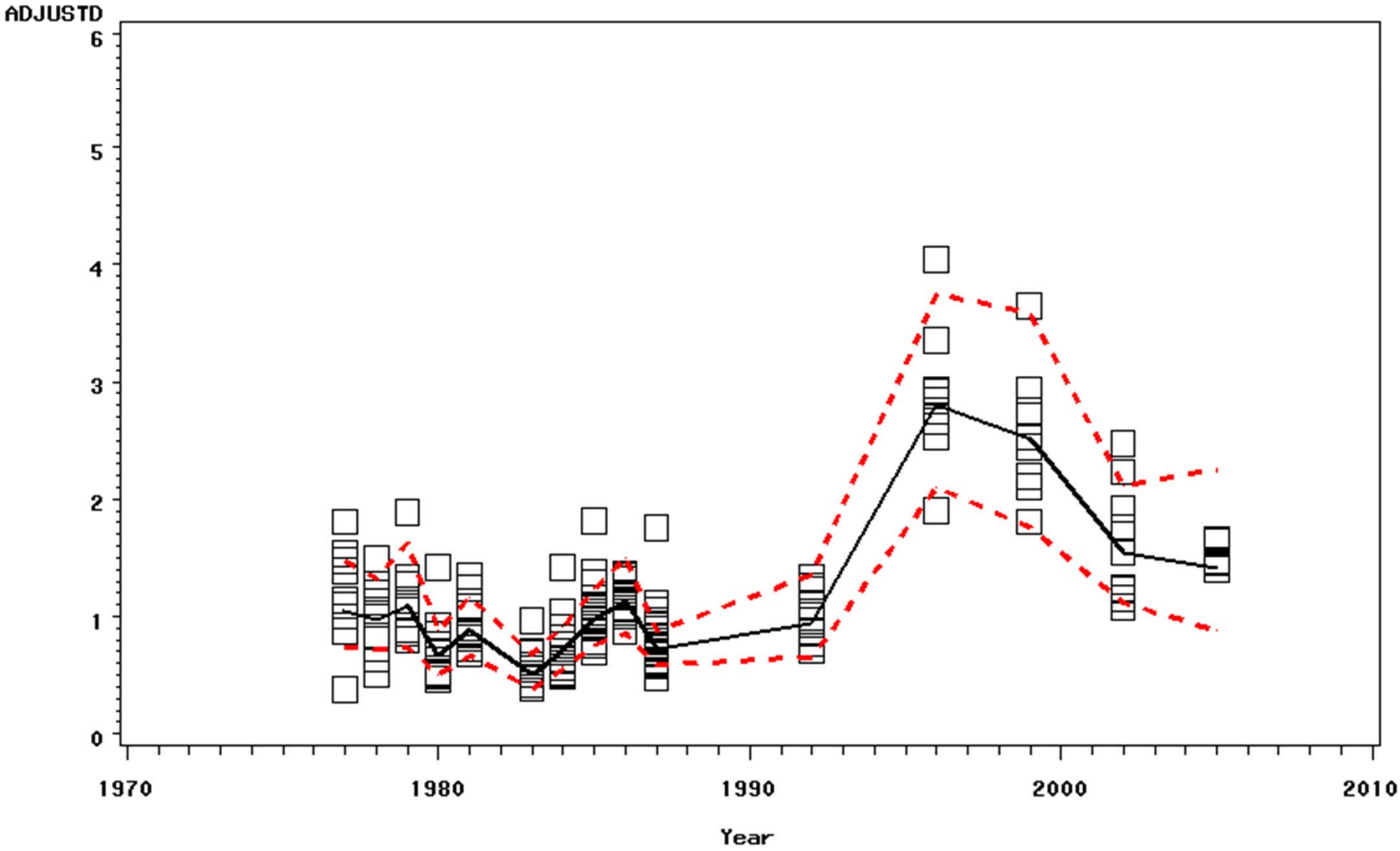
Adjusted and Predicted Total Hg in SUNFISH

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=5 Stat_ID=1BSTH020.44 Location=Dooms, VA near Rt. 611 bridge (above dam)



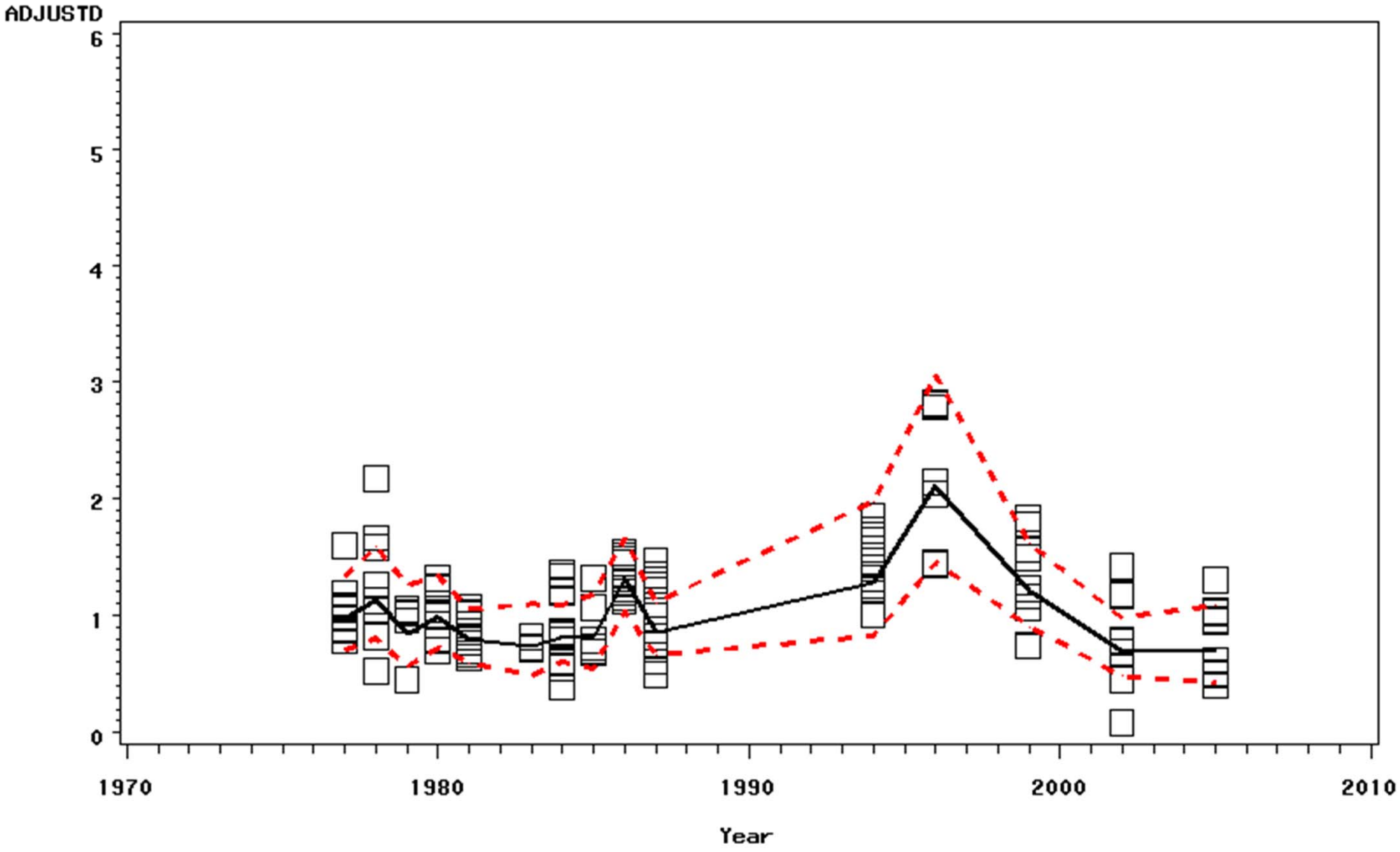
Adjusted and Predicted Total Hg in SUCKER

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=6 Stat_ID=1BSTH014.60 Location=Crimora, VA near Rt. 612 bridge



Adjusted and Predicted Total Hg in SUCKER

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=7 Stat_ID=1BSTH004.21 Location=Grottoes, VA near Grand Caverns bridge

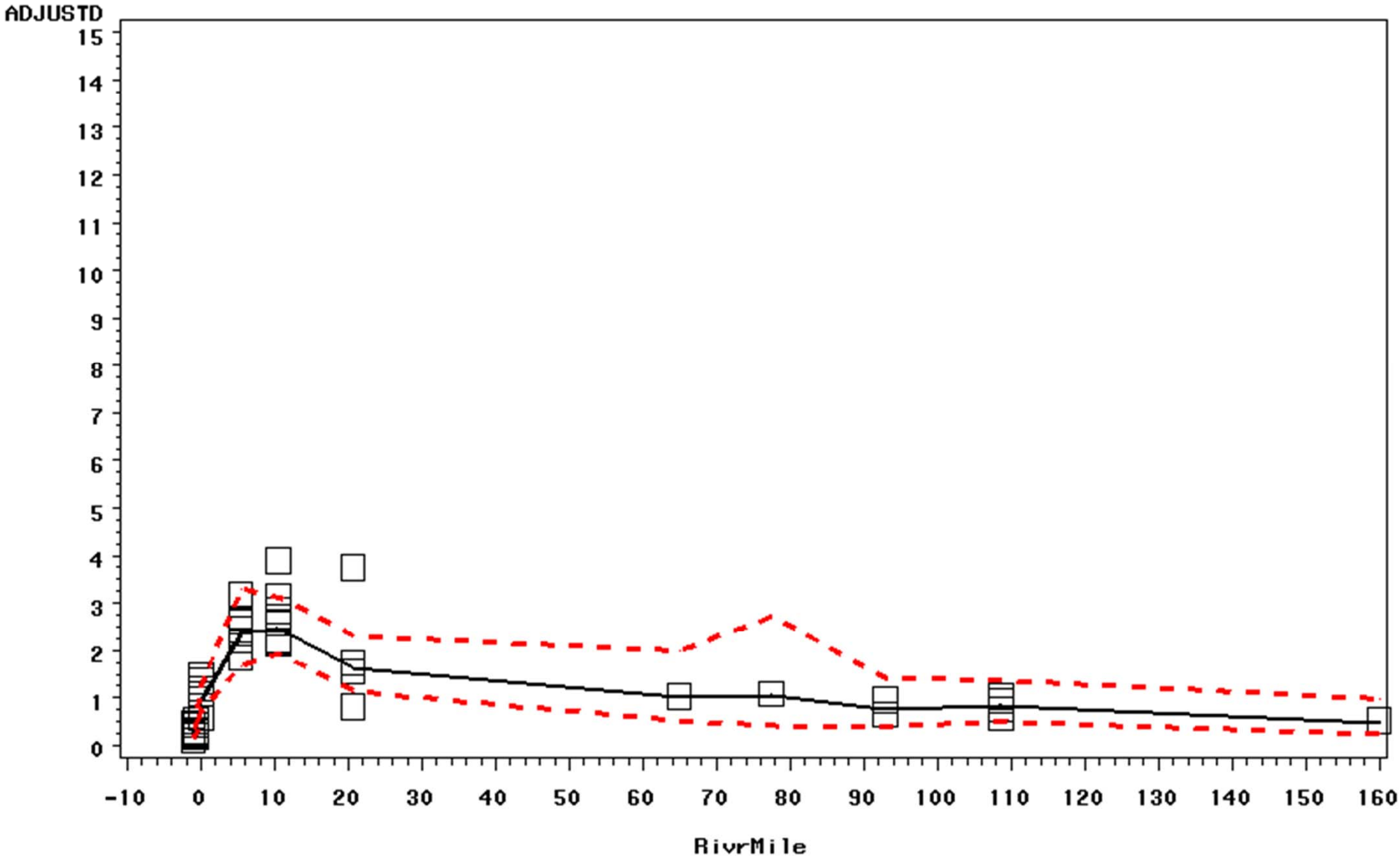


Rock Bass

- **Rock Bass have not been collected since 1999 and only in two locations in that year**
- **Data sparser, but general patterns observed in other species up to 1996 or 1999 also observed in rock bass**

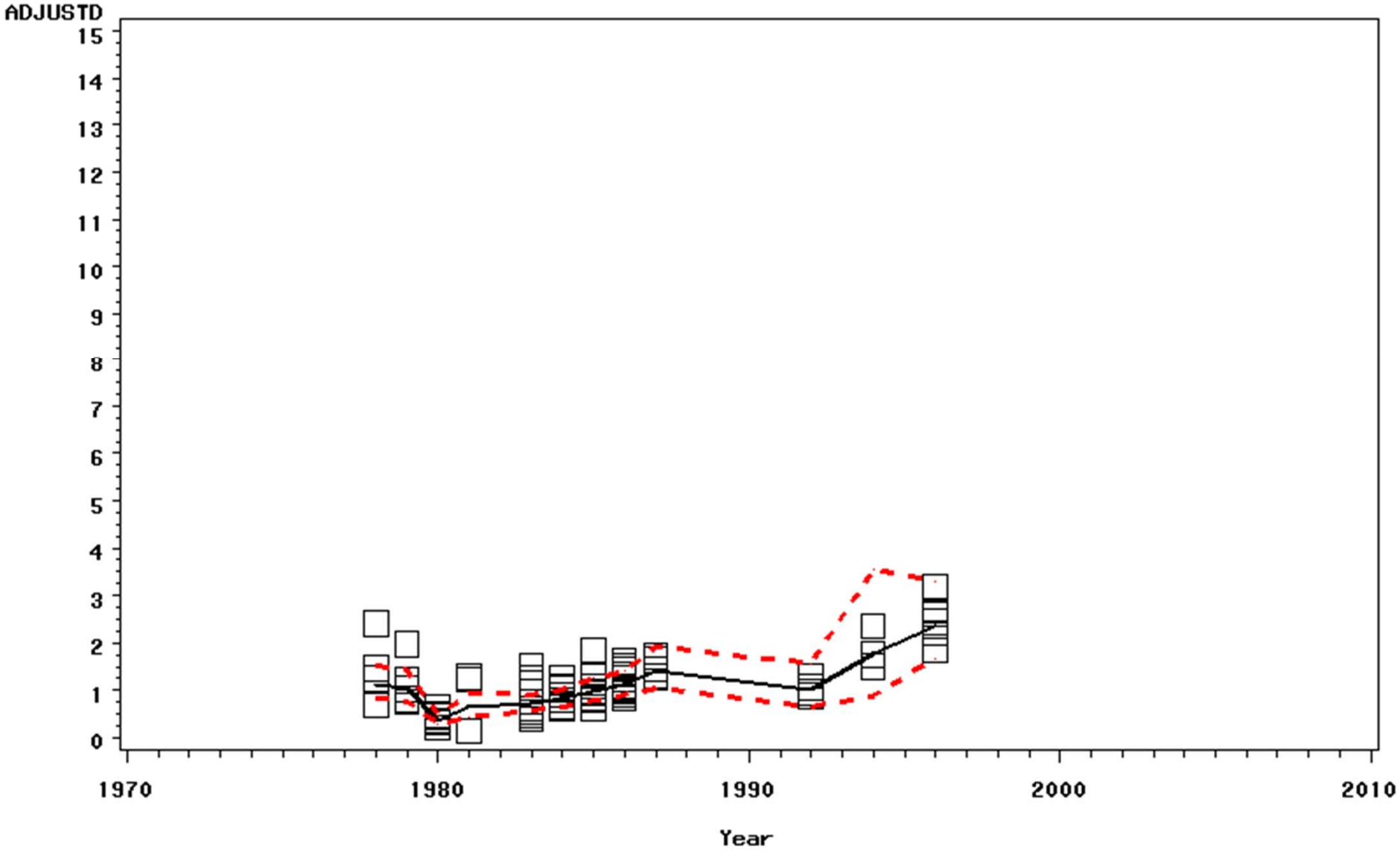
Adjusted and Predicted Total Hg in ROCKBASS

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
Year=1996



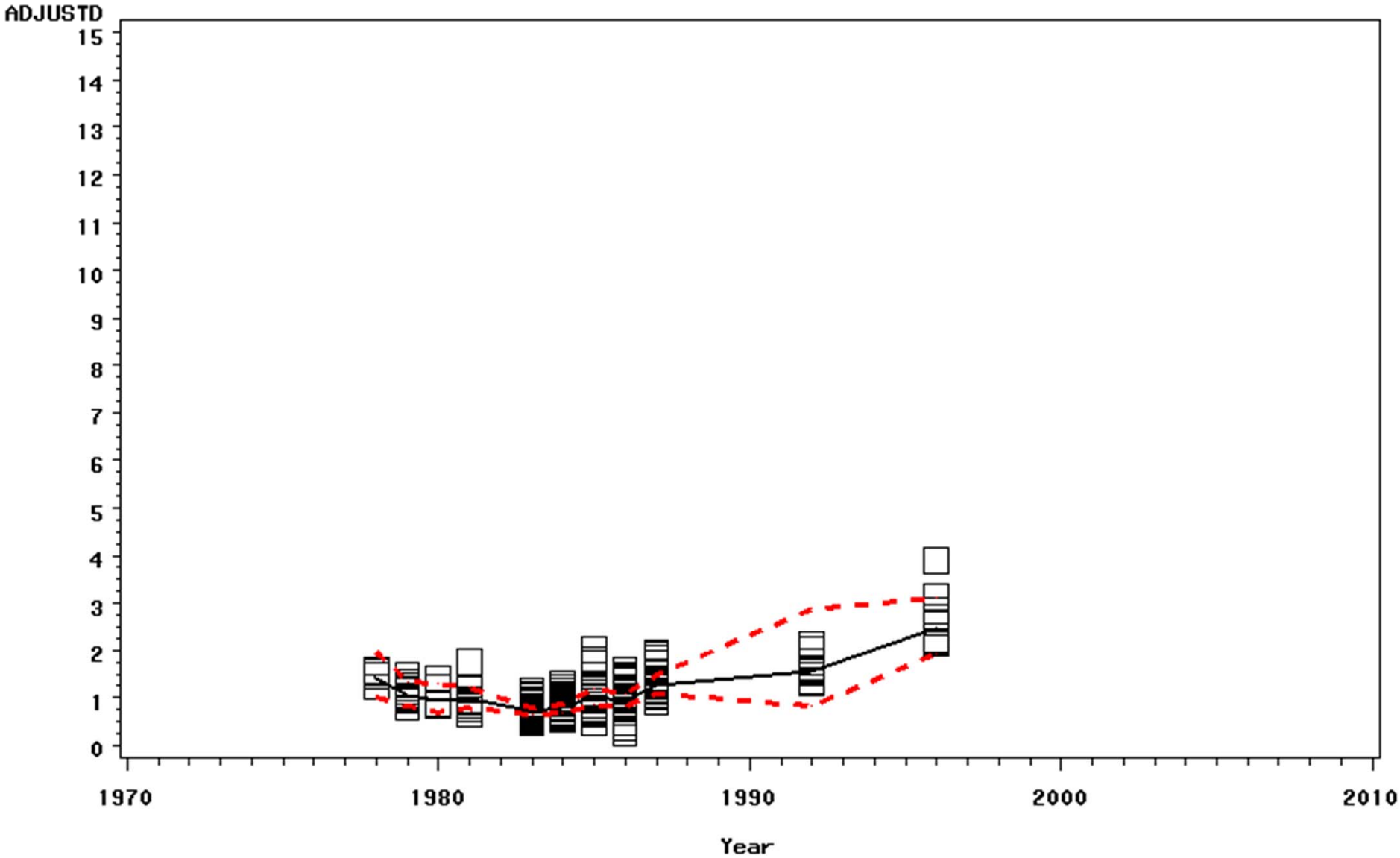
Adjusted and Predicted Total Hg in ROCKBASS

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=5 Stat_ID=1BSTH020.44 Location=Dooms, VA near Rt. 611 bridge (above dam)



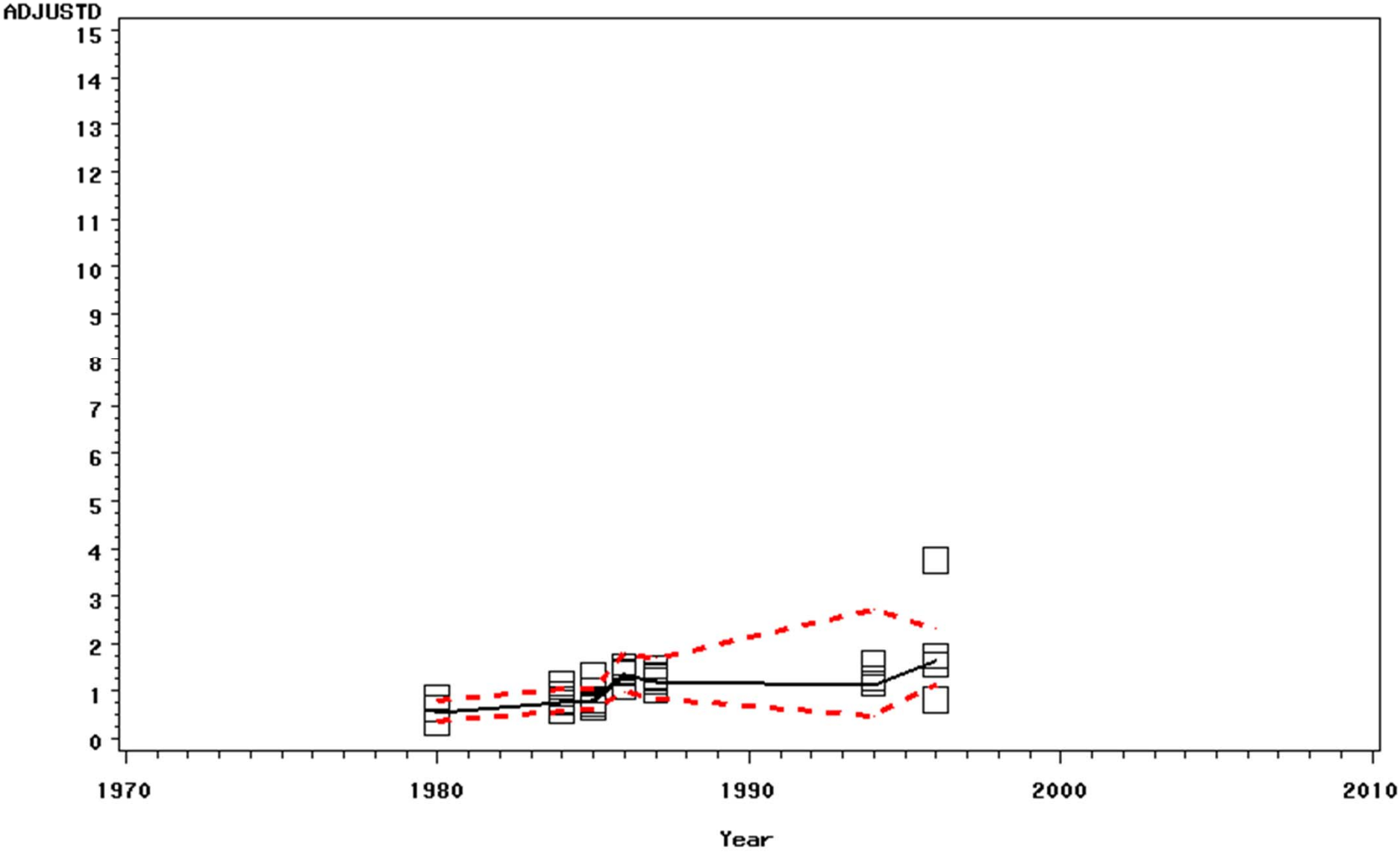
Adjusted and Predicted Total Hg in ROCKBASS

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=6 Stat_ID=1BSTH014.60 Location=Crimora, VA near Rt. 612 bridge



Adjusted and Predicted Total Hg in ROCKBASS

MODEL: LOGTHG=STATION|YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=7 Stat_ID=1BSTH004.21 Location=Grottoes, VA near Grand Caverns bridge



Rainbow Trout

Mean Total Hg in Rainbow Trout by Station and Year

station	1999	2002	2004	2005
3	0.07	0.10		0.10
7		0.10		0.10
34			0.10	

Number of Rainbow Trout by Station and Year

station	99	02	04	05
3	19	9		8
7		6		9
34			9	

No analysis done or needed

Channel Catfish

Mean Total Hg in CATFISH by Station and Year

station	1984	1986	1987	1999	2002	2005
6	0.23					
8	0.23	0.12				
9	0.65					
10			0.14	0.68	1.72	
11	0.16			0.72	0.52	0.83
15		0.11	0.05			
16	0.62		0.37			
17	0.21					
18			0.36	0.56		
20				0.85		
23					0.30	0.31
29					0.56	0.53

Channel Catfish

Mean Total Hg in CATFISH by Station and Year

Number of CATFISH by Station and Year

station	84	86	87	99	02	05
6	2					
8	9	12				
9	3					
10			2	8	5	
11	2			10	8	9
15		8	5			
16	7		3			
17	4					
18			5	10		
20				9		
23					9	9
29					7	9

Conclusions

- **Total Hg levels continue to decrease from 1996 highs at almost every sampling station**
  - **Smallmouth, largemouth, sunfish, sucker**
  - **Rock bass not collected after 1999, only at two stations that year**
- **Hg levels remain above baseline (77-83 avg) values at several stations**
- **Hg levels somewhat elevated at 2nd street, rise more at Hopeman Pky, continue to rise until Dooms or Crimora or Grottoes, then fall until Lynwood (1BSSF100.10), then flat.**