

Statistical Analysis of South River Fish and Sediment

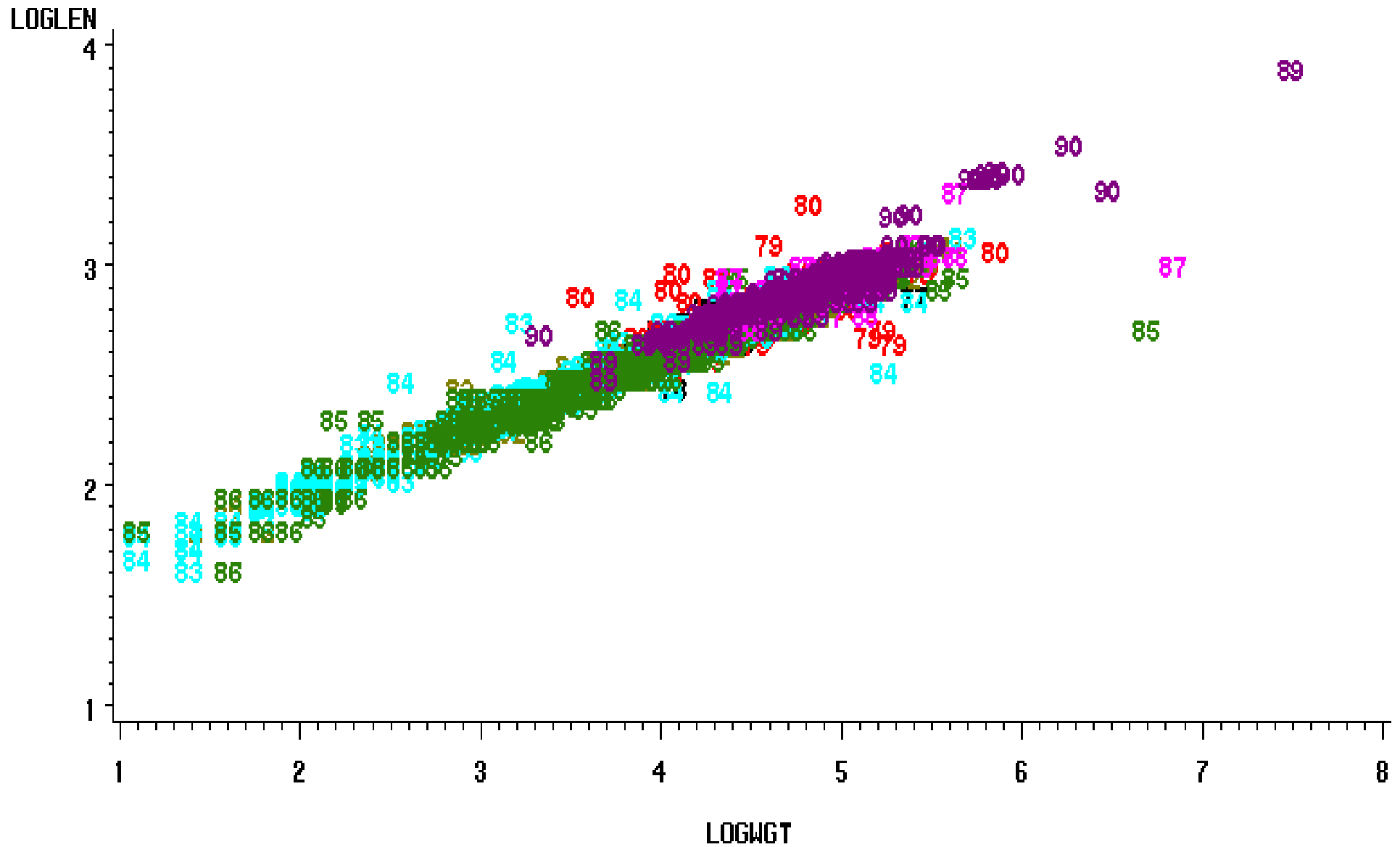
October 3, 2001

Fish Species Modeled

- Smallmouth Bass
- Largemouth Bass
- Bass (Smallmouth + largemouth)
- Sunfish
- Redbreast
- Redbreast + Sunfish
- Rock Bass

Log(Length) vs Log(Weight)

STATION 1 TO 23
SUNFISH



Statistical Methods : Fish

- **Analysis of covariance (ANCOVA) of $\log(\text{Hg})$ on $\log(\text{length})$ was used**
 - intercept adjusted for station and year
 - slope adjusted for station and year
 - separate model fit to each species
 - ANCOVA models explained **78-93%** of the variation in data.

Statistical Methods : Fish

- **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.**

Results for Sunfish/Redbreast Change in Log(Tot Hg)

• Station Base	EST	T	P_T	SIG
• Sta 3 94/96-77/83	0.104	6.91	0.0001	*
• Sta 5 94-77/83	0.161	8.41	0.0001	*
• Sta 6 94-77/83	0.051	2.70	0.0070	*
• Sta 7 94/96-77/83	0.094	6.25	0.0001	*
• Sta 10 94/96-77/83	0.074	5.76	0.0001	*
• Sta 18 94/96-80/83	0.070	5.14	0.0001	*

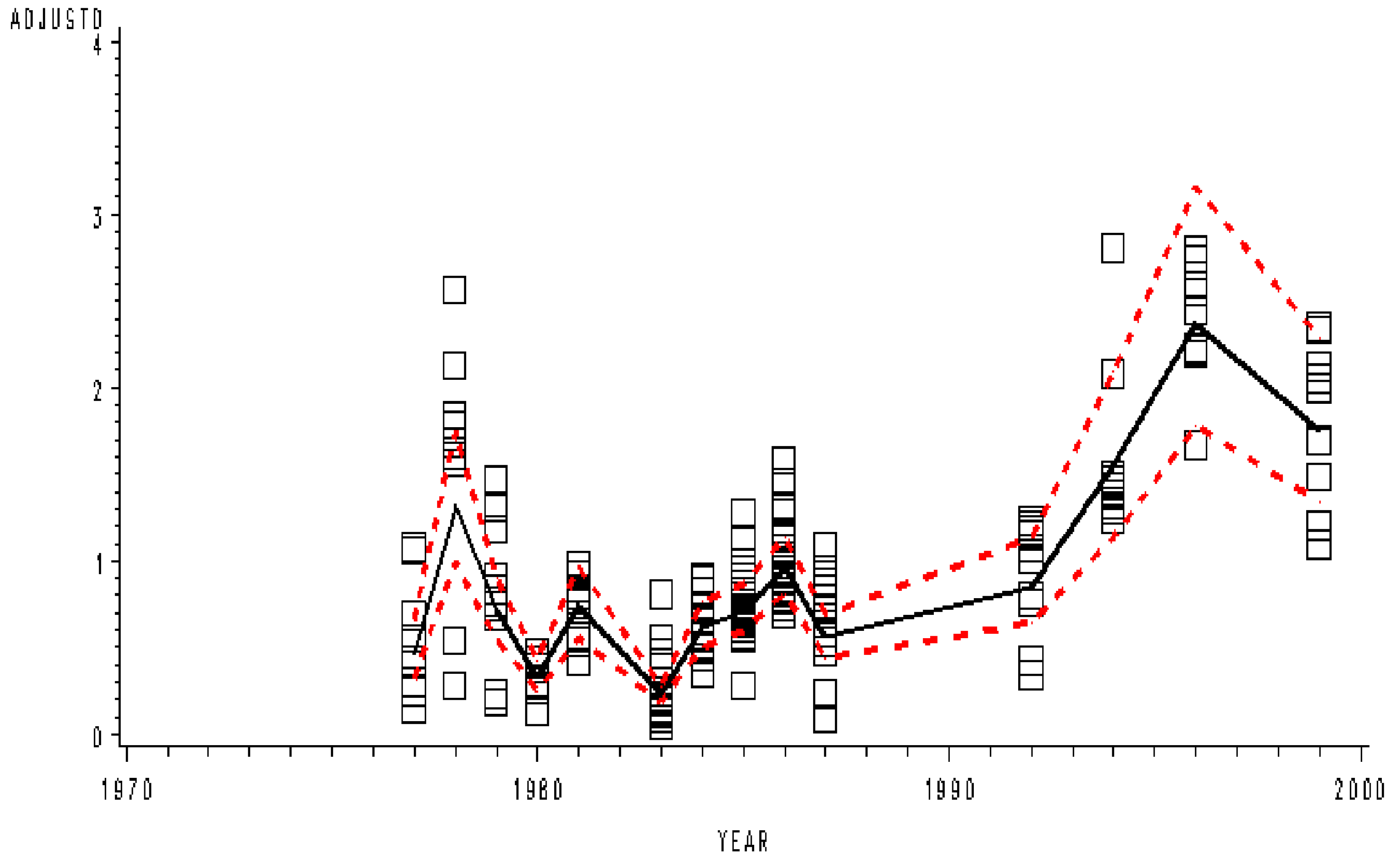
Results for Sunfish/Redbreast

Trends over time

•	STAT	STAT_ID	_JTSTD_	PVAL	SIG
•	3	1BSTH025.10	5.3393	0.00000	**
•	5	1BSTH020.44	8.4365	0.00000	**
•	6	1BSTH014.60	9.5965	0.00000	**
•	7	1BSTH004.21	6.7543	0.00000	**
•	8	1BNTH004.10	-2.9799	0.00288	**
•	10	1BSSF078.24	5.4779	0.00000	**
•	11	1BSSF054.20	11.1595	0.00000	**
•	12	1BSSF020.70	5.7264	0.00000	**
•	17	1BSSF037.60	4.6682	0.00000	**
•	18	1BSSF010.18	6.0089	0.00000	**

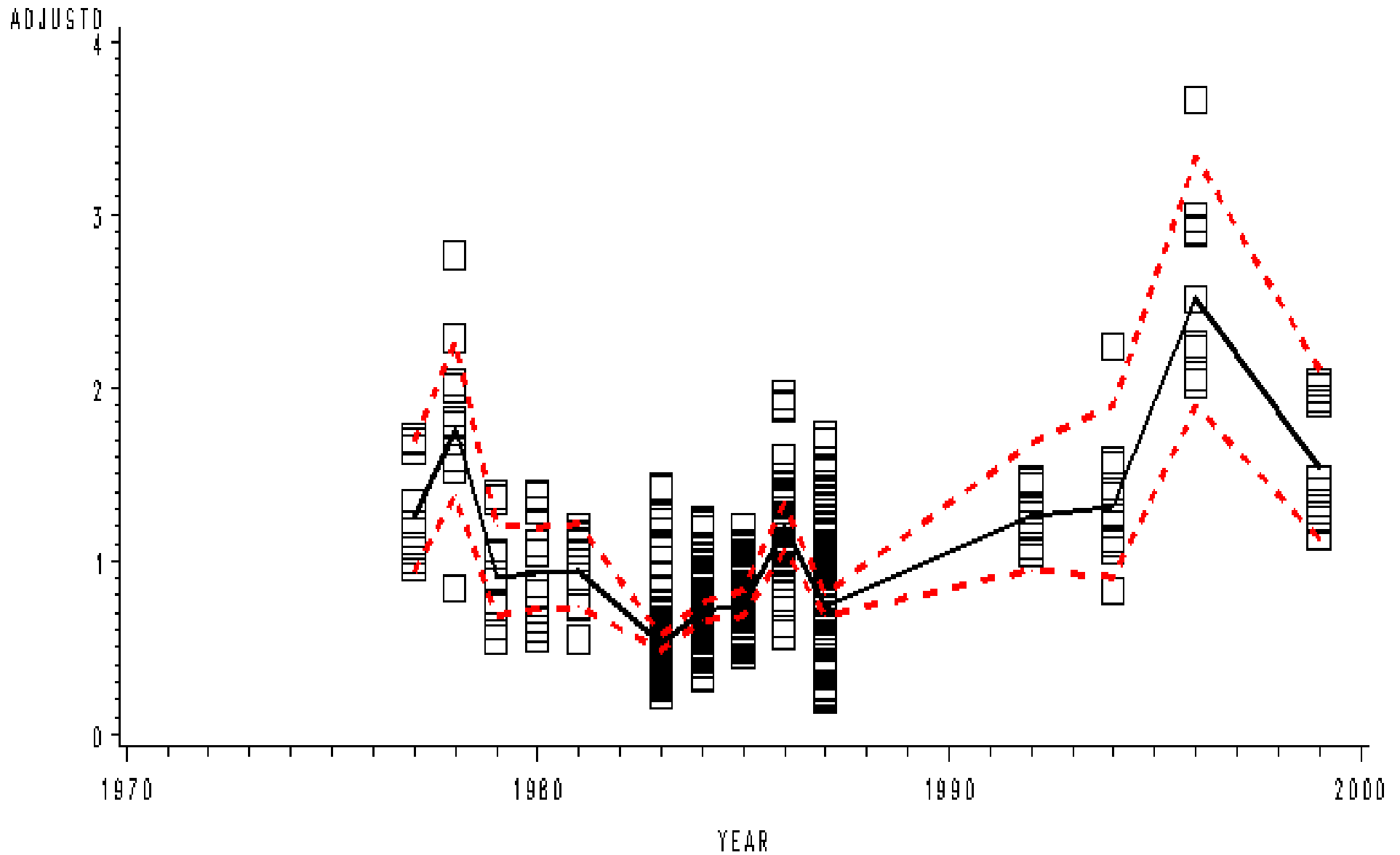
Adjusted and Predicted Total Hg in SUNFISH

MODEL: LOGTHG=STATION*YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=5 STAT_ID=1BSTH020.44



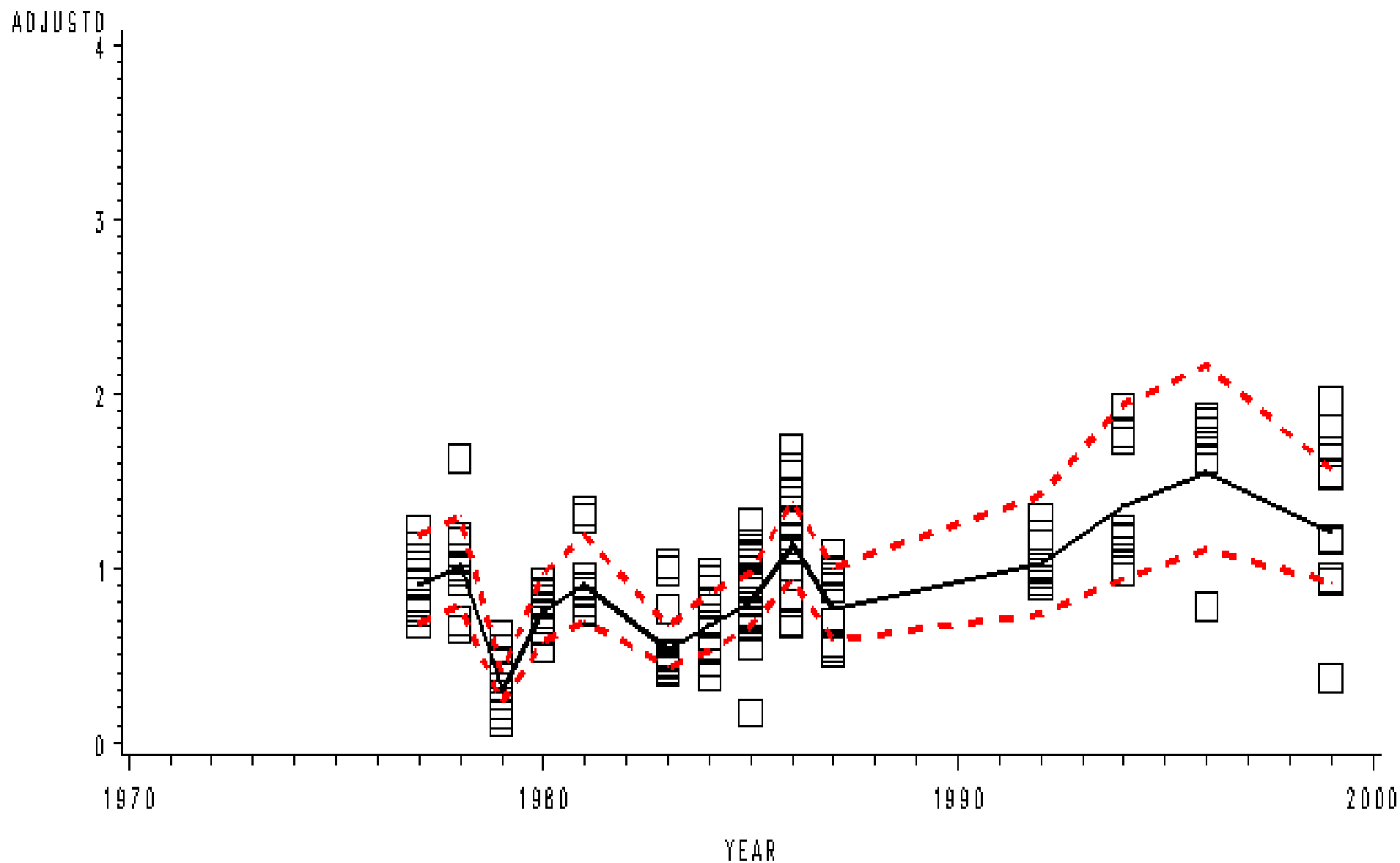
Adjusted and Predicted Total Hg in SUNFISH

MODEL: LOGTHG=STATION*YEAR LOGLEN STATION*LOGLEN YEAR*LOGLEN
FULL DATA SET
STATION=6 STAT_ID=1BSTHD14.60



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



Redbreast/Sunfish Summary

- Strong trends at stations 5, 6, 7
- Peak in 1996 at most stations, falling in '99
- Other statistically declared trends due mostly to 1996 effect

**Is there evidence that a plume
of high Hg concentration is
working its way down river?**

NO.

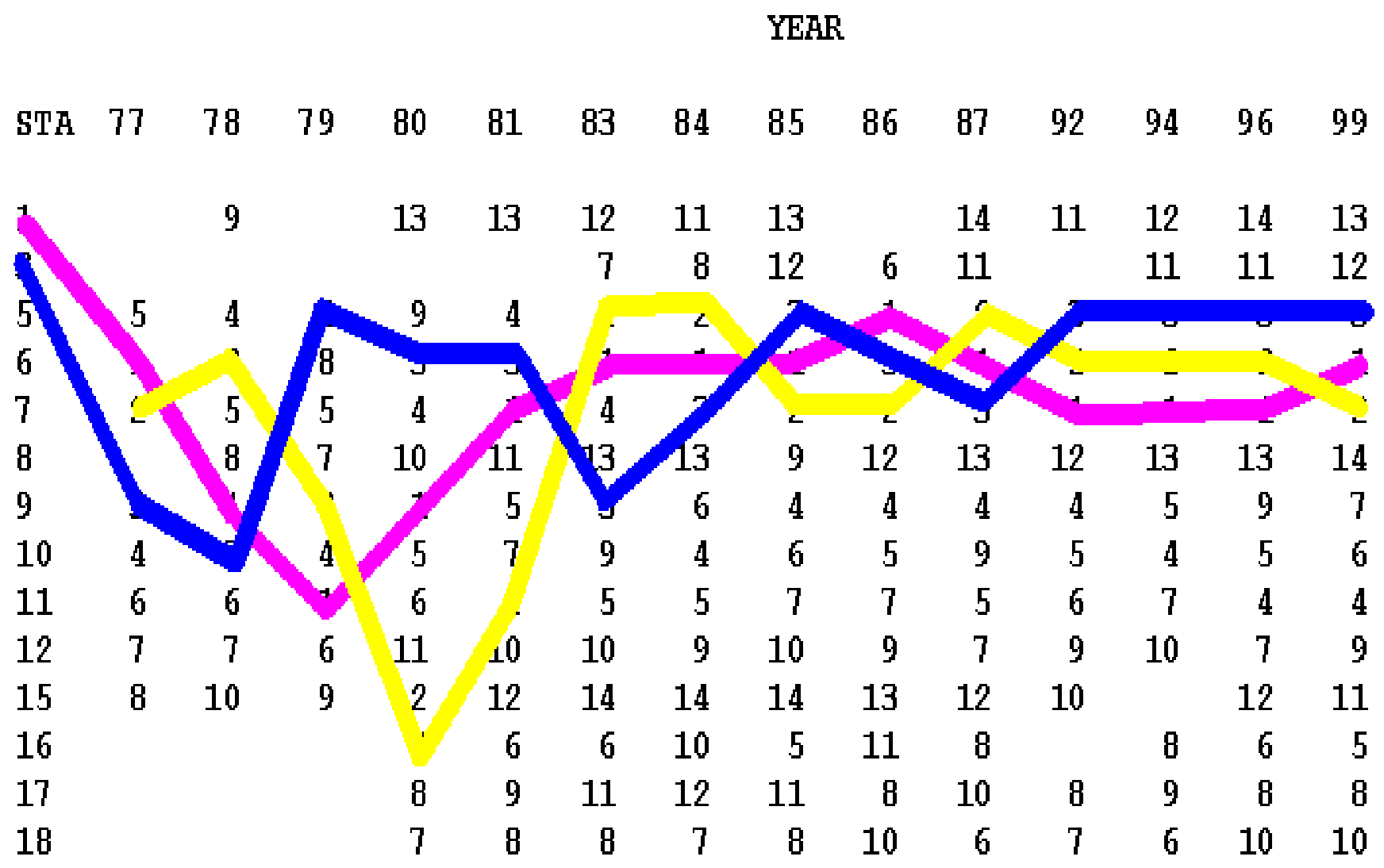
**For each year, the station means were ranked, with 1 being the highest mean Hg level, 2 next highest, etc.
NOTE: Formal statistical tests verified what is apparent in these simple displays.**

In pink is the station with the highest level of Hg in a given year.

Yellow is for the second highest mean Hg level.

Blue is for the third highest.

Rank of Adjusted Mean Total Hg in BASS by Station and Year
 1=Highest, 2=Second Highest, etc



Summary: Fish Data

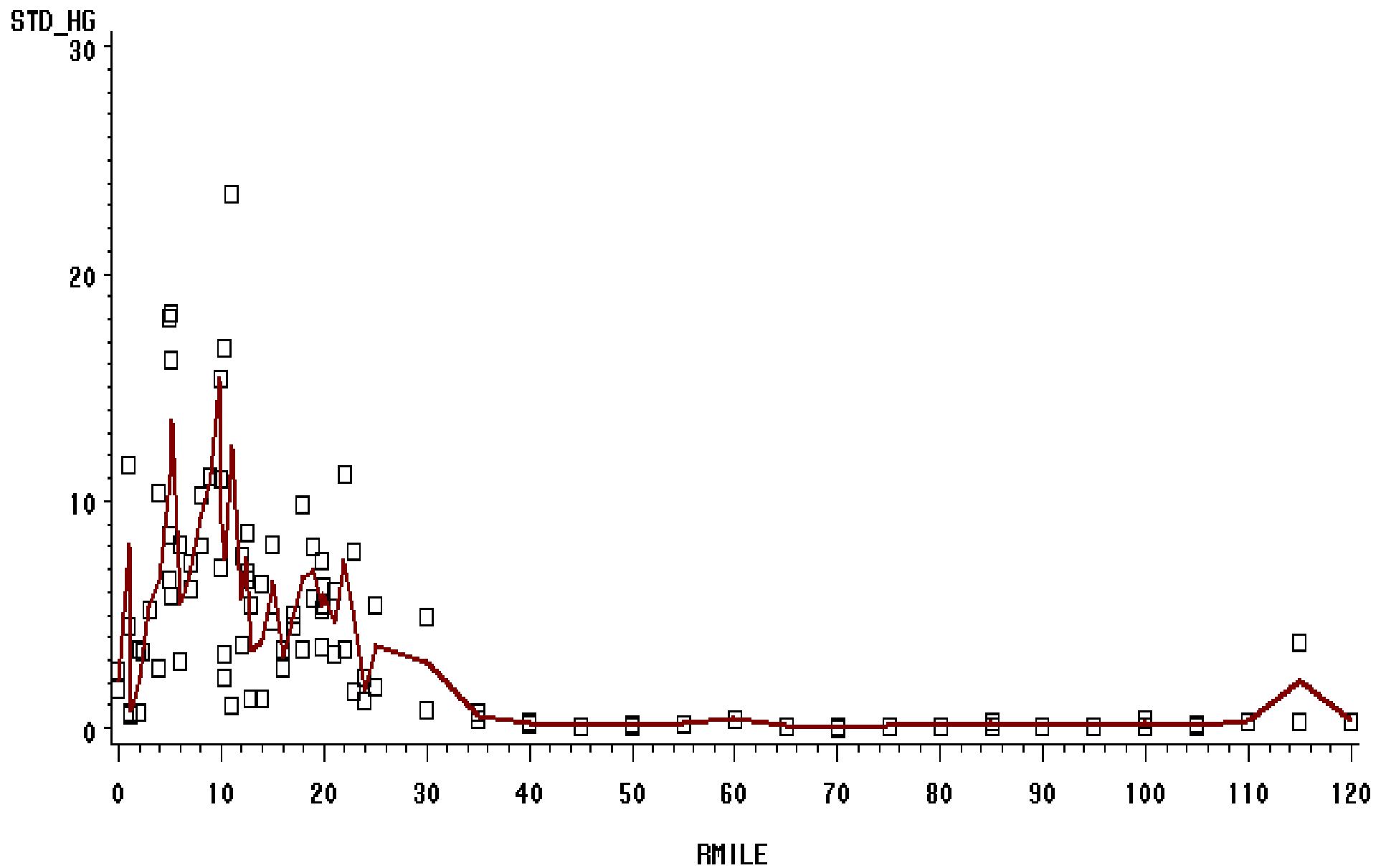
- **With few exceptions, highest level of Hg is found at stations 5, 6 and 7 from late 70's or early 80's to mid or late 90's**
- **Most evident in small+largemouth, Redbreast+sunfish and rockfish.**
- **Little evidence in fish data to support a claim that the Hg is moving downstream.**

SEDIMENT DATA

- **Sediment samples collected in 1997**
- **Identified by rivermile**
 - **miles from DuPont site**
- **2 samples per rivermile**

STANDARDIZED Hg vs RIVERMILE

TWO LARGE VALUES REPRESSED



Sediment Summary

- **Hg levels in sediment samples**
- **Peak around rivermile 5**
 - around station 5
- **Fall steadily thereafter**
- **Reduce to mile 0 level around rivermile 25**
 - just below station 7
- **Near zero after rivermile 35**
 - except for small spike around mile 110

Collection of Future Samples

- **Recommendation:**
- **At least 10 fish of each type at each station, each year (based on power analysis)**
- **Uniform range of fish sizes for each species**
 - range will be species dependent
 - cover the range of sizes for cohort of interest

Future Sampling

- **Recommendation:**
- **Sample every station every year for every species**
- **Fewer sampling stations with complete information preferred to many stations with gaps, unless gaps are well designed**
 - **planned experiments are better than convenience samples**