PHASE 2 REPORT
FURTHER SITE CHARACTERIZATION AND ANALYSIS
VOLUME 2E - REVISED BASELINE ECOLOGICAL RISK ASSESSMENT
HUDSON RIVER PCBs REASSESSMENT

NOVEMBER 2000

For

U.S. Environmental Protection Agency
Region 2
and
U.S. Army Corps of Engineers
Kansas City District

Book 2 of 2
Tables, Figures and Plates

TAMS Consultants, Inc.
Menzie-Cura & Associates, Inc.

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FURTHER SITE CHARACTERIZATION AND ANALYSIS
VOLUME 2E- REVISED BASELINE ECOLOGICAL RISK ASSESSMENT
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LIST OF PLATES

CANADA
UNITED STATES

Lake Champlain

VERMONT

Champlain Canal
Glens Falls

MASSACHUSETTS

CONNECTICUT

NEW YORK CITY

River

Troy

Hudson

UPPER HUDSON

ALBANY

Hudson River

LOWER HUDSON

NEW JERSEY

Mohawk River

MOHAWK

NEW YORK

LAKE ONTARIO

Erie Canal

PENNSYLVANIA

LAKE ERIE

N

SOURCES:

1. NEW YORK STATE DEPARTMENT OF TRANSPORTATION, 1987.

2. NYSDEC, 1978.

----- DRAINAGE BASIN

40 20 0 40 MILES

HUDSON RIVER PCB REASSESSMENT RI/FS
PHASE 2: FURTHER SITE CHARACTERIZATION AND ANALYSIS
VOLUME 2E: BASELINE ECOLOGICAL RISK ASSESSMENT

HUDSON RIVER DRAINAGE
BASIN AND
SITE LOCATION MAP

TAMS/MCA   FIGURE 1-1

Figure 1-2
Baseline Ecological Risk Assessment
Upper Hudson River Sampling Stations

Figure 1-3
Baseline Ecological Risk Assessment
Lower Hudson River Sampling Stations

FEDERAL DAM (RM 153.0)

Troy

150

ALBANY

ECO-STATION 10 (RM 143.5)

ECO-STATION 11A (RM 137.2)
ECO-STATION 11B (RM 136.7)

125

ECO-STATION 12A (RM 122.7)
ECO-STATION 12B (RM 122.4)

ECO-STATION 13 (RM 113.8)

Catskill

Rip Van Winkle
Bridge

ECO-STATION 14 (RM 100.0)

100

Kingston-Rhinecliff
Bridge

Kingston

ECO-STATION 15A (RM 89.4)
ECO-STATION 15B (RM 88.9)

Mid-Hudson
Bridge

Poughkeepsie

75

Newburgh-
Beacon
Bridge

ECO-STATION 16 (RM 58.7)

LEGEND

50

ECO-STATION 17 (RM 47.3)

Bear Mountain
Bridge

190   RIVER MILE

ECOLOGICAL SAMPLING
LOCATION

Tappan Zee
Bridge

ECO-STATION 18 (RM 25.8)

25

Yonkers

N

George Washington
Bridge

Newark

NEW YORK
CITY

0

The Battery

7   3.5   0   7 MILES

TAMS / MCA

ECOLOGICAL DATA SOURCES

OTHER

PHASE2
(USEPA)

WATER
COLUMN
(USGS)

AVIAN
(USFWS)

FISH
(NOAA,
NYSDEC)

FISH
STOMACH
CONTENTS
(GE)

MACROINVER-
TEBRATES
(NYSDOH)

SEDIMENTS
(NYSDEC,
NYSDOH)

WATER
COLUMN

SEDIMENT
(High Resolution
Coring)

ECOLOGICAL
(Fish, Sediment &
Macroinvertebrates)

TAMS/MCA

Figure 1-4
Hudson River ERA Data Sources

Figure 1-5
Eight-Step Ecological Risk Assessment Process for Superfund
Hudson River PCB Reassessment
Ecological Risk Assessment

Compile Existing Information

STEP 1: SCREENING-LEVEL:
- Site Visit
- Problem Formulation
- Toxicity Evaluation

Risk Assessor and Risk Manager Agreement

STEP 2: SCREENING-LEVEL:
- Exposure Estimate
- Risk Calculation

SMDP

Data Collection

STEP 3: PROBLEM FORMULATION

Toxicity Evaluation

Assessment Endpoints

Conceptual Model Exposure Pathways

Questions/Hypotheses

SMDP

STEP 4: STUDY AND DESIGN DQO PROCESS
- Lines of Evidence
- Measurement Endpoints

Work Plan and Sampling and Analysis Plan

SMDP

STEP 5: VERIFICATION OF FIELD SAMPLING DESIGN

SMDP

STEP 6: SITE INVESTIGAITON AND DATA ANALYSIS

SMDP

STEP 7: RISK CHARACTERIZATION

STEP 8: RISK MANAGEMENT

SMDP

Figure 2-1
Hudson River PCB Reassessment
Conceptual Model Diagram Including Floodplain Soils

PCB SOURCES

GE FACILITIES

HUDSON RIVER SEDIMENTS

Exposure point for macroinvertebrates and fish living in the river

HUDSON RIVER WATER COLUMN

Direct exposure point for macroinvertebrates and fish living in the river and for birds and mammals drinking from the river

Floodplain Soils

Trophic Level 1-3 Receptors
- Terrestrial invertebrates
- Amphibians and reptiles
- Burrowing animals

Trophic Level 2-3 Receptors
- Terrestrial omnivores

Trophic Level 1 Receptors
- Aquatic invertebrates

Trophic Level 2 Receptors
- Forage fish

Trophic Level 2-3 Receptors
- Piscivorous Fish

Trophic Level 3-5 Receptors
- Consumption of a variety of invertebrate, fish, avian and mammalian prey

Trophic Level 2 Receptors
- Insectivorous birds and mammals

Trophic Level 3-5 Receptors
- Piscivorous birds
- Piscivorous mammals

Notes:
1. All receptors may be directly exposed to river water and sediments.
2. Trophic levels are provided as a general guide to bioaccumulation potential, but vary according to species and food availability.
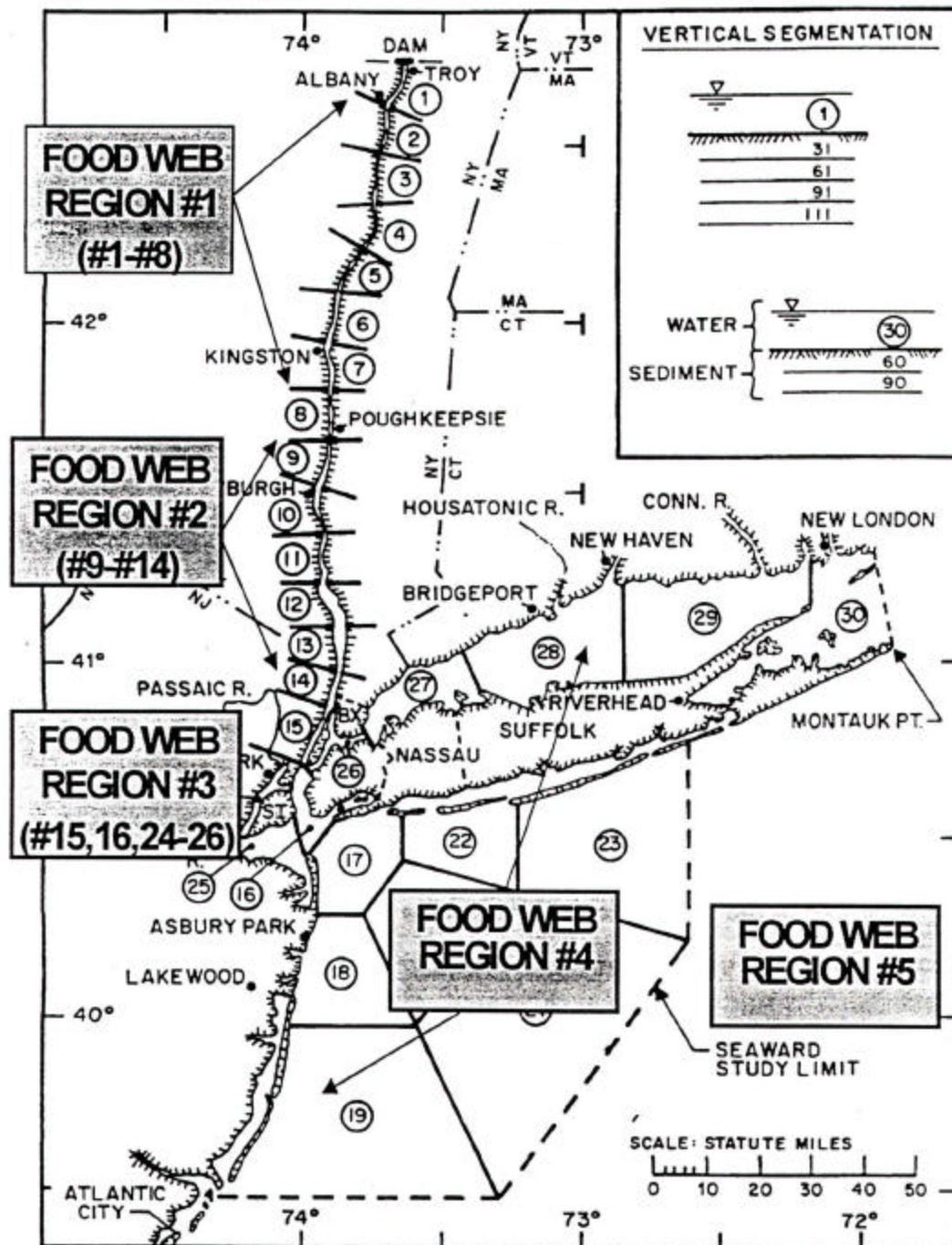
Source: Farley et al., 1999

Note: Model segment numbers 1-30 pertain to the Fate and transport model. Model segments are combined into five food web regions for the bioaccumulation model calculations

Figure 3-1
Revised Segments and Regions of the Farley Model for PCBs in Hudson River Estuary
and Surrounding Waters

FIGURE 3-2: AVERAGE WET WEIGHT PCB CONCENTRATIONS IN SELECTED FISH SPECIES BASED ON NYSDEC DATA

TAMS/MCA
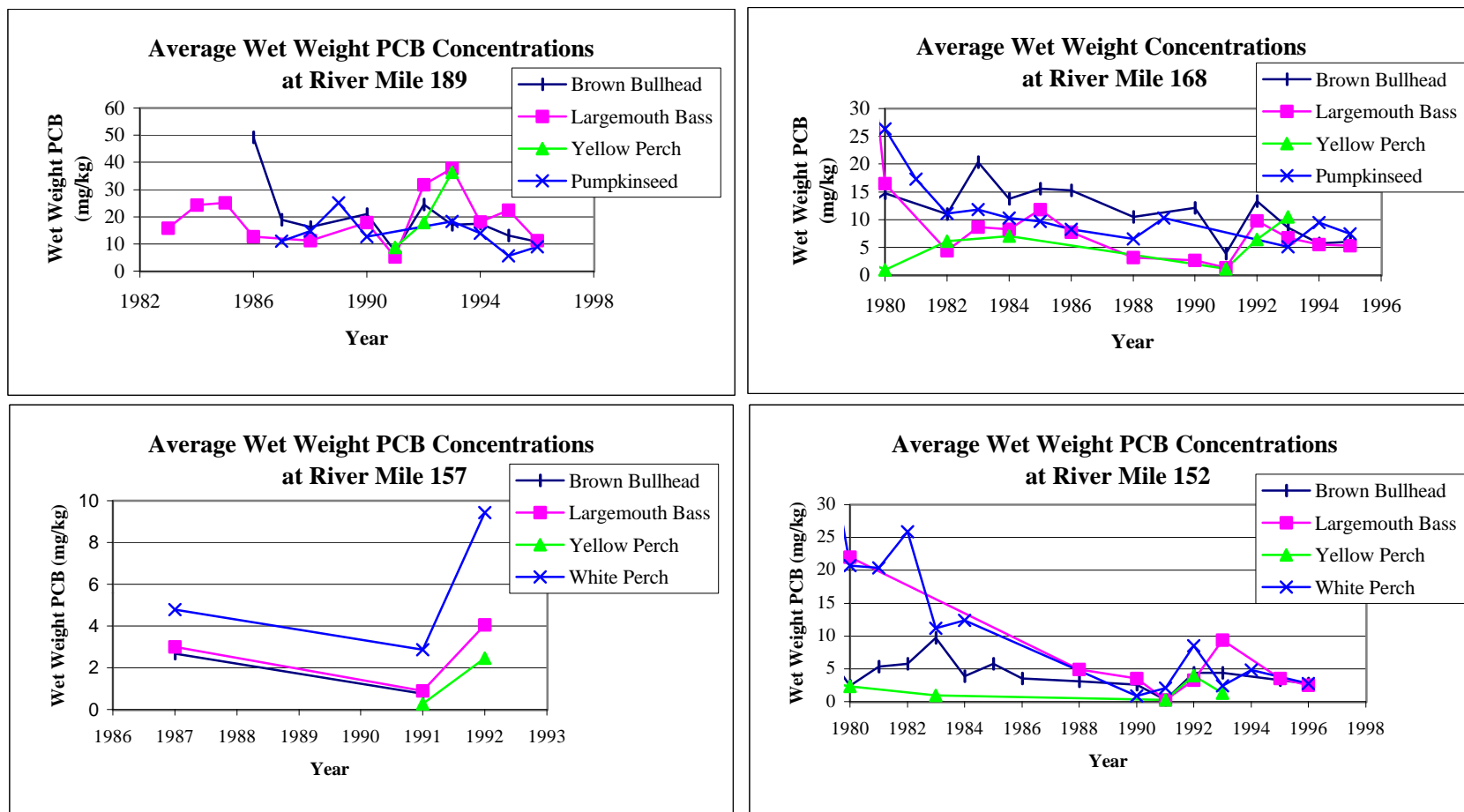
FIGURE 3-3: AVERAGE LIPID-NORMALIZED PCB CONCENTRATIONS IN SELECTED FISH SPECIES BASED ON NYSDEC DATA
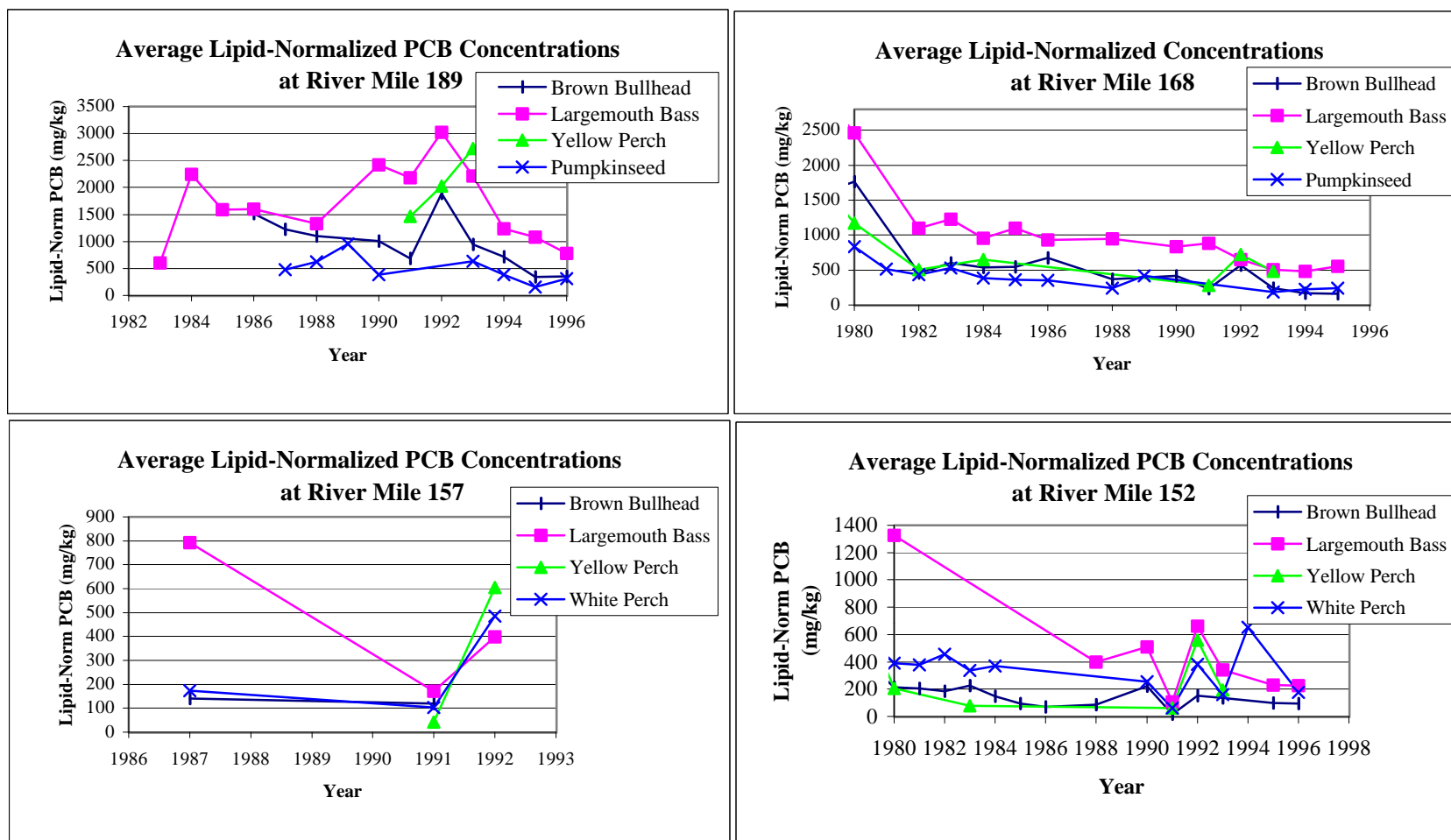
Figure 3-4: Cumulative Distribution Functions of Exposure for Kingfisher and Eagle

Cumulative Distribution Function for Female Kingfisher Exposed to Total PCBs

Cumulative Distribution Function for Female Eagle Exposed to Total PCBs
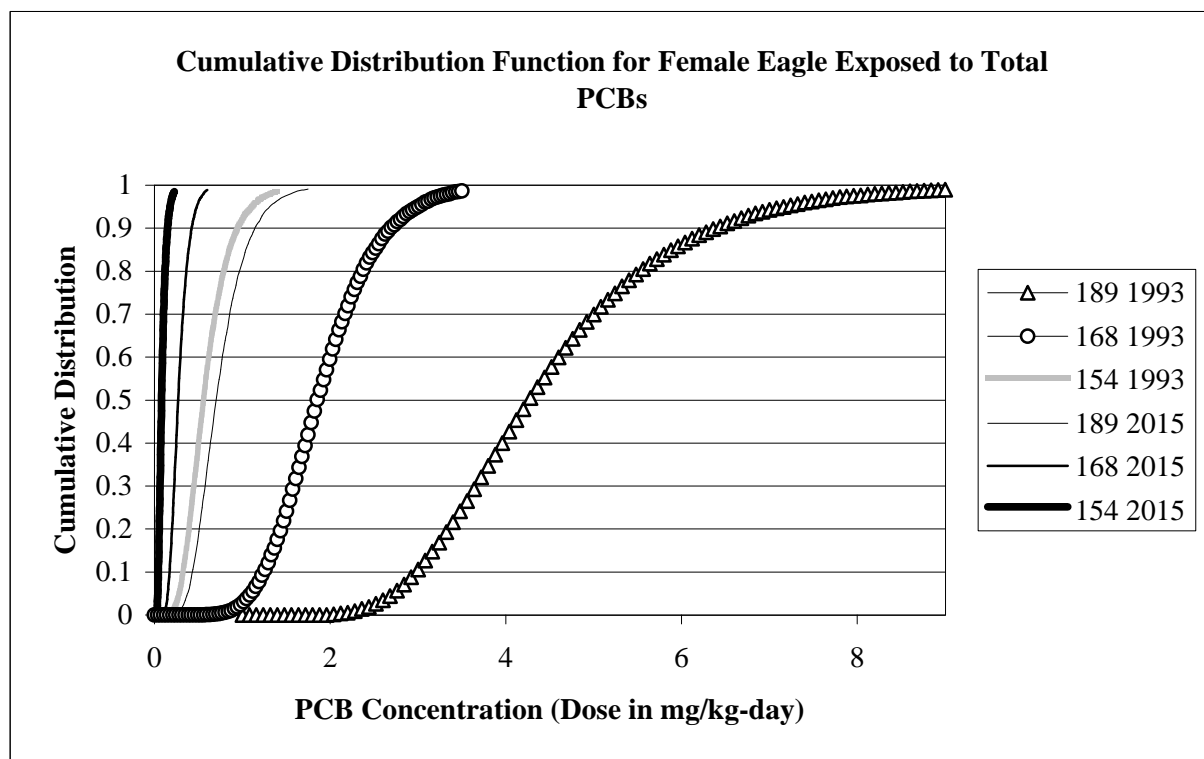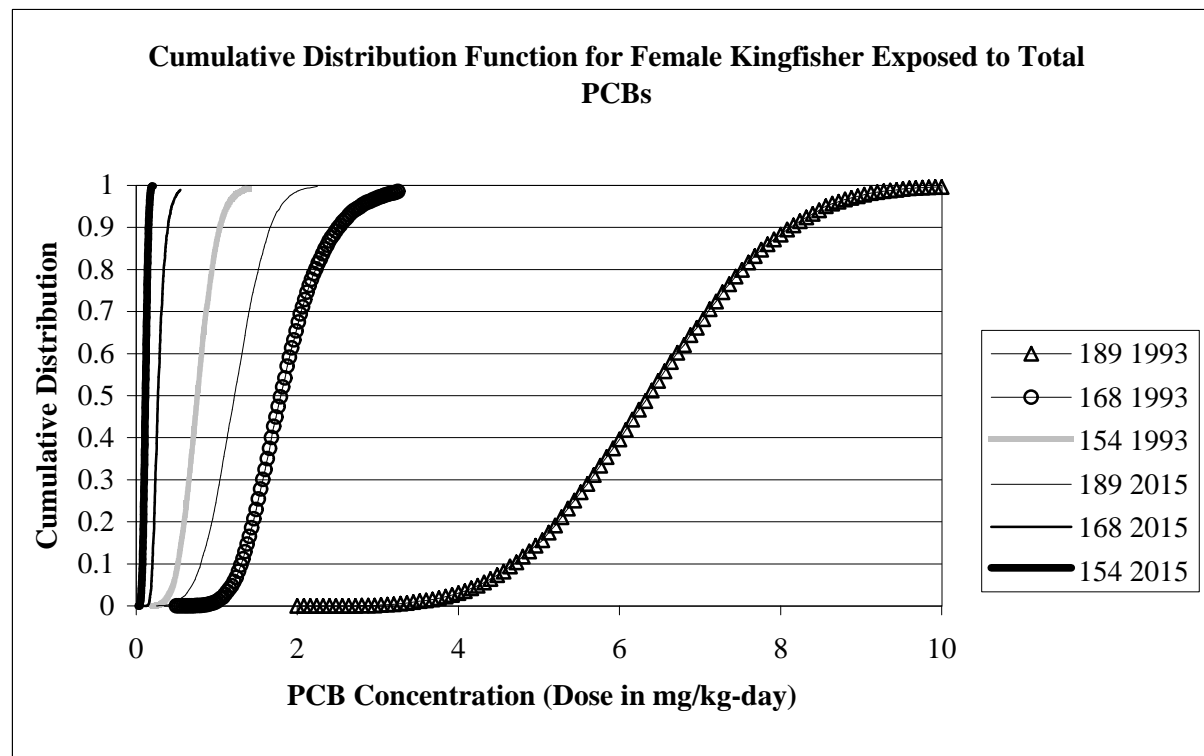
Figure 3-5: Cumulative Distribution Functions of Exposure for Mink and Otter
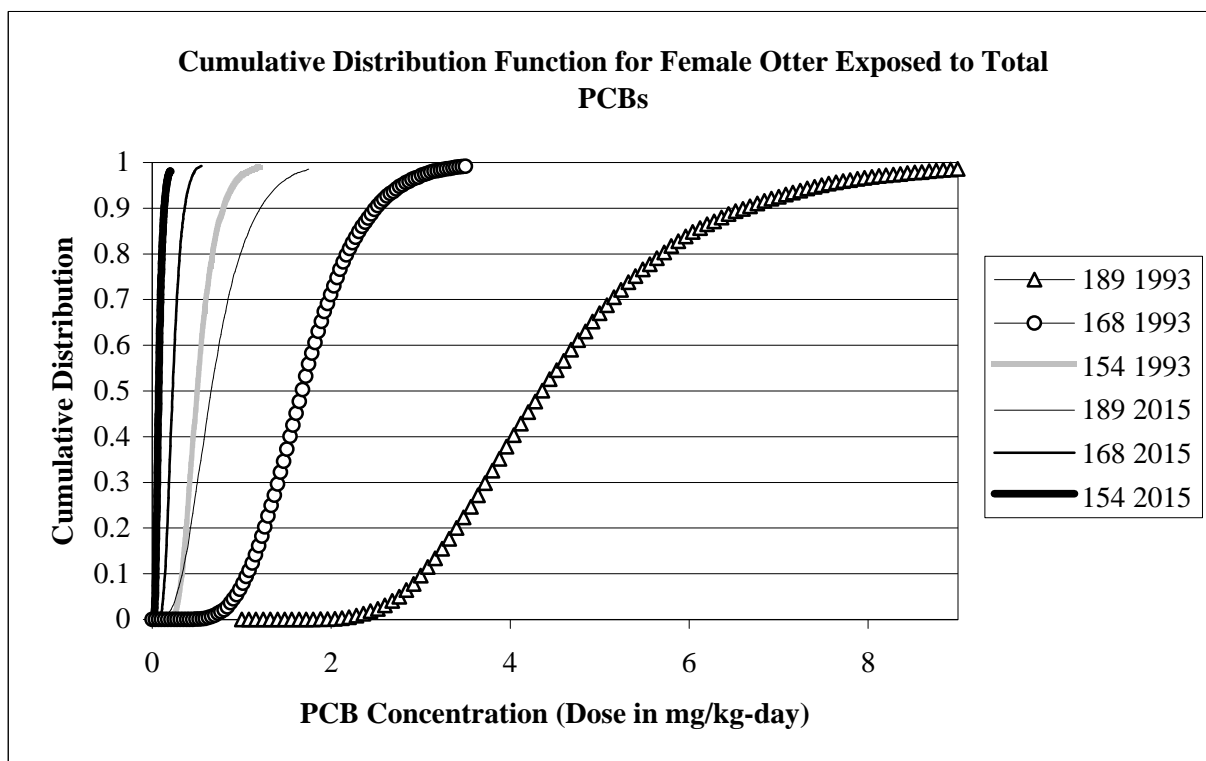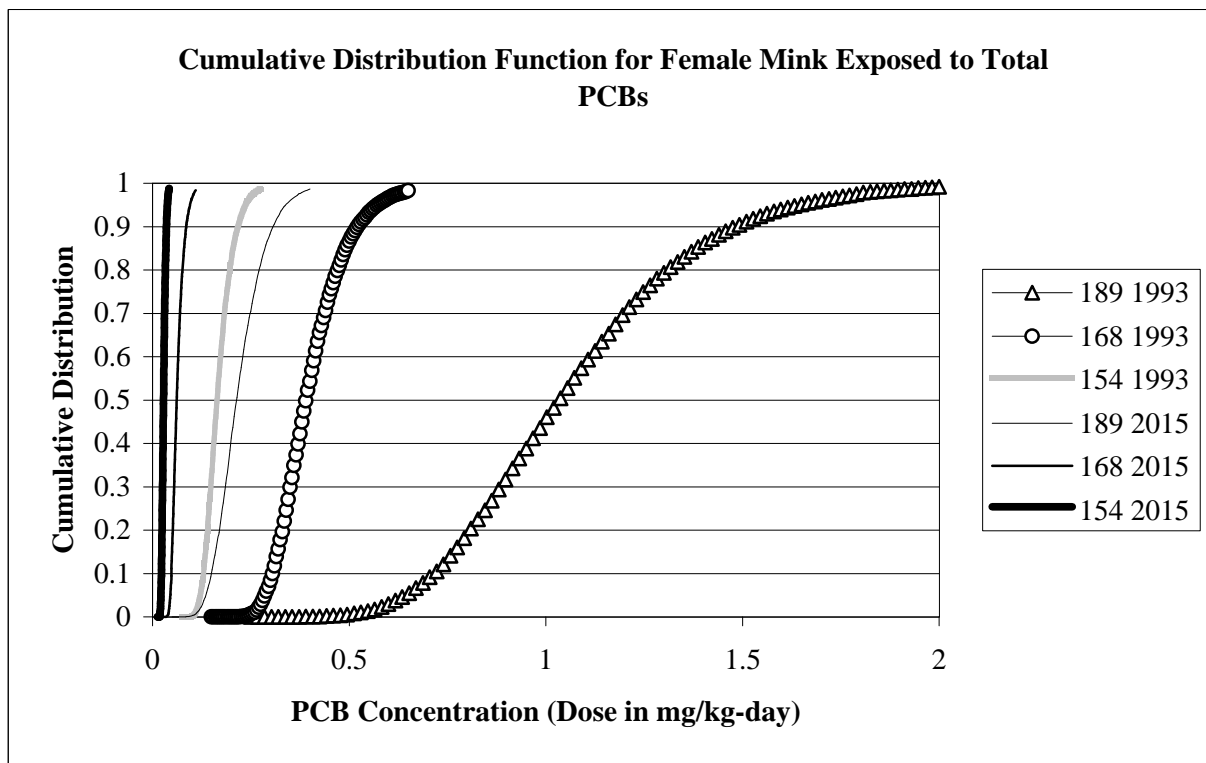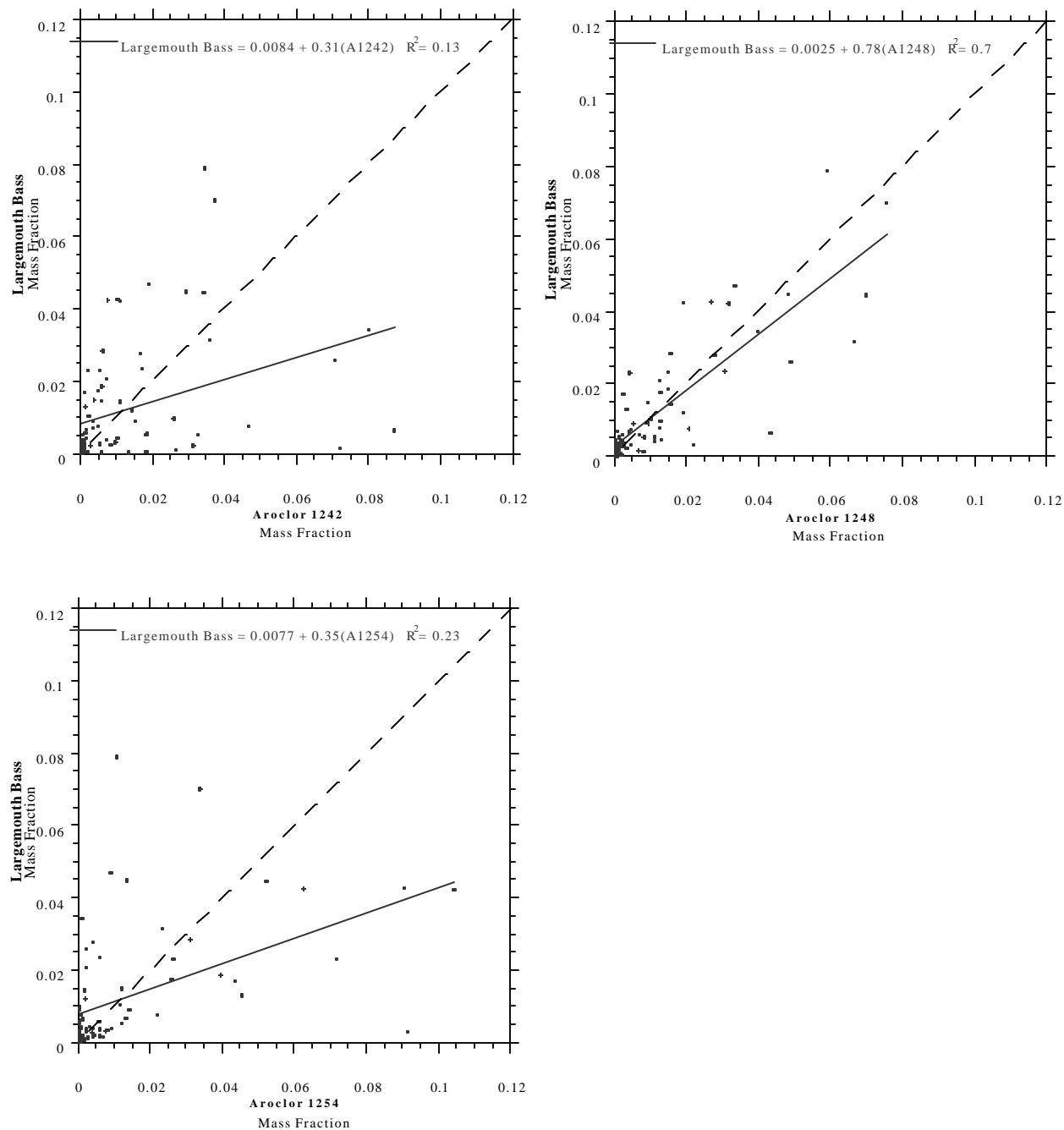
Cumulative Distribution Function for Female Mink Exposed to Total PCBs

Cumulative Distribution Function for Female Otter Exposed to Total PCBs

Figure 3-6

**Comparison of Congener Mass Fraction Between a Large
Mouth Bass Sample from RM 190 and Several Aroclor Standards**
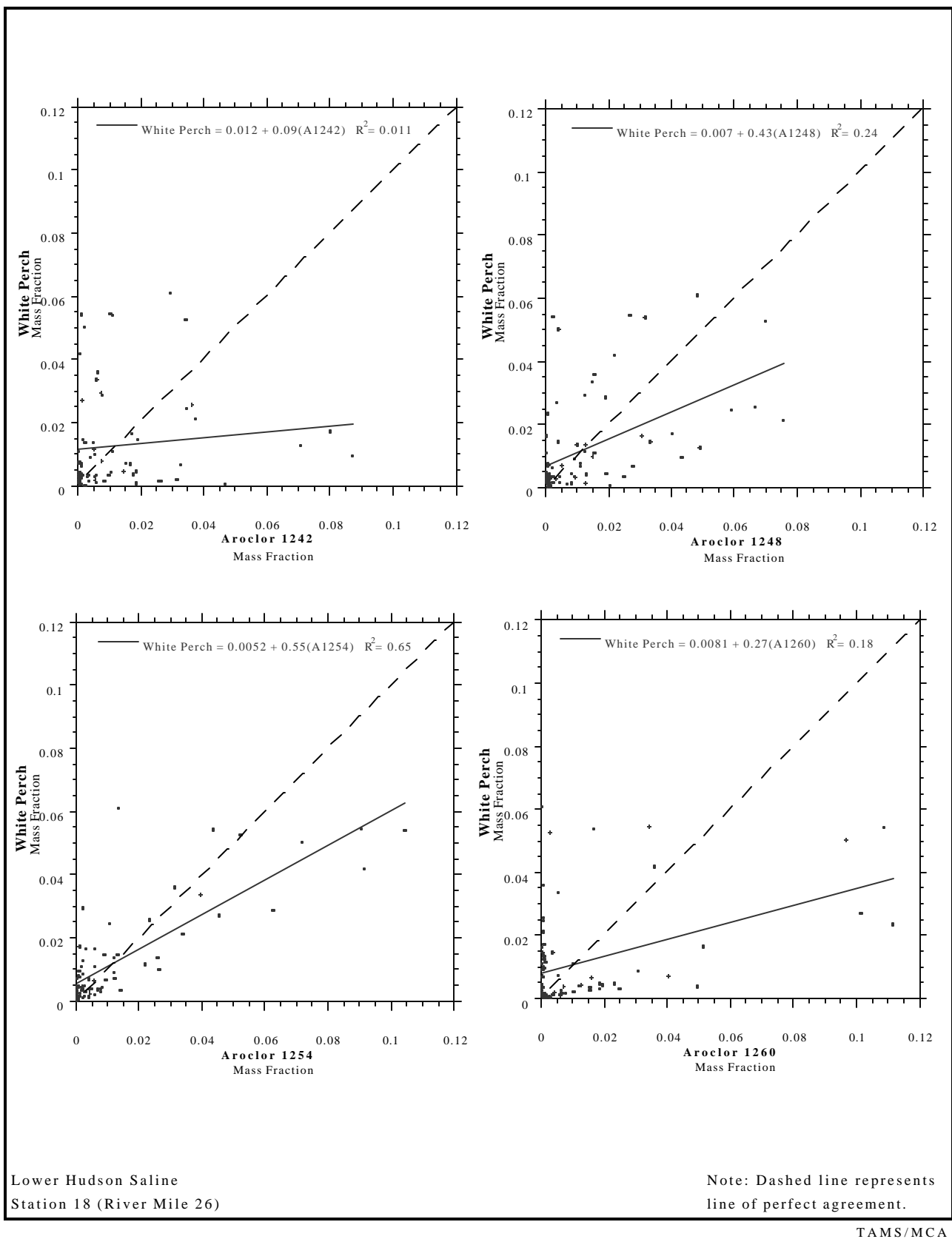
Figure 3-7

Comparisons of Congener Mass Fraction Between a White Perch Sample from RM 26 and Several Aroclor Standards
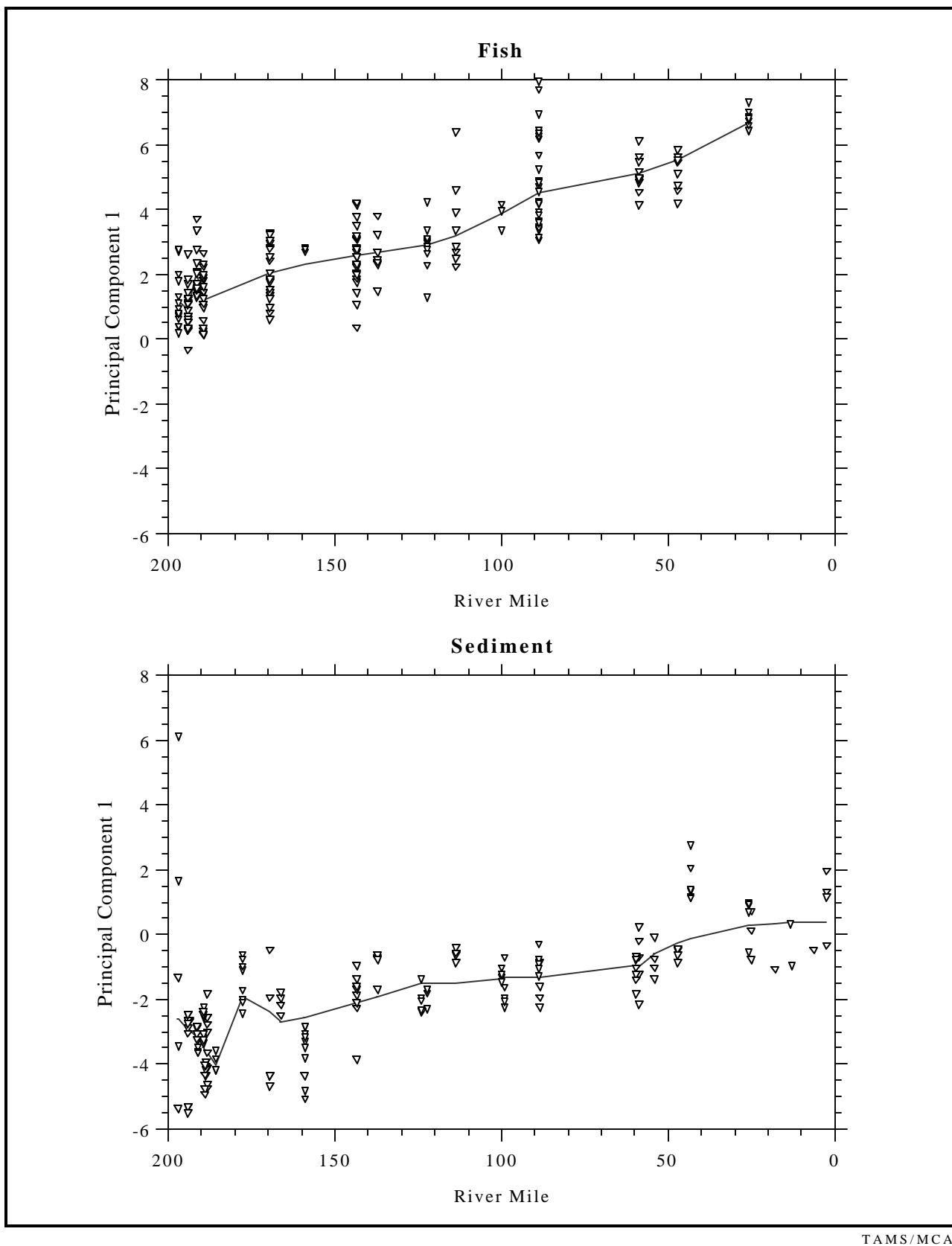
Figure 3-8
Variation of Principal Component 1 with River Mile in Fish and Sediment
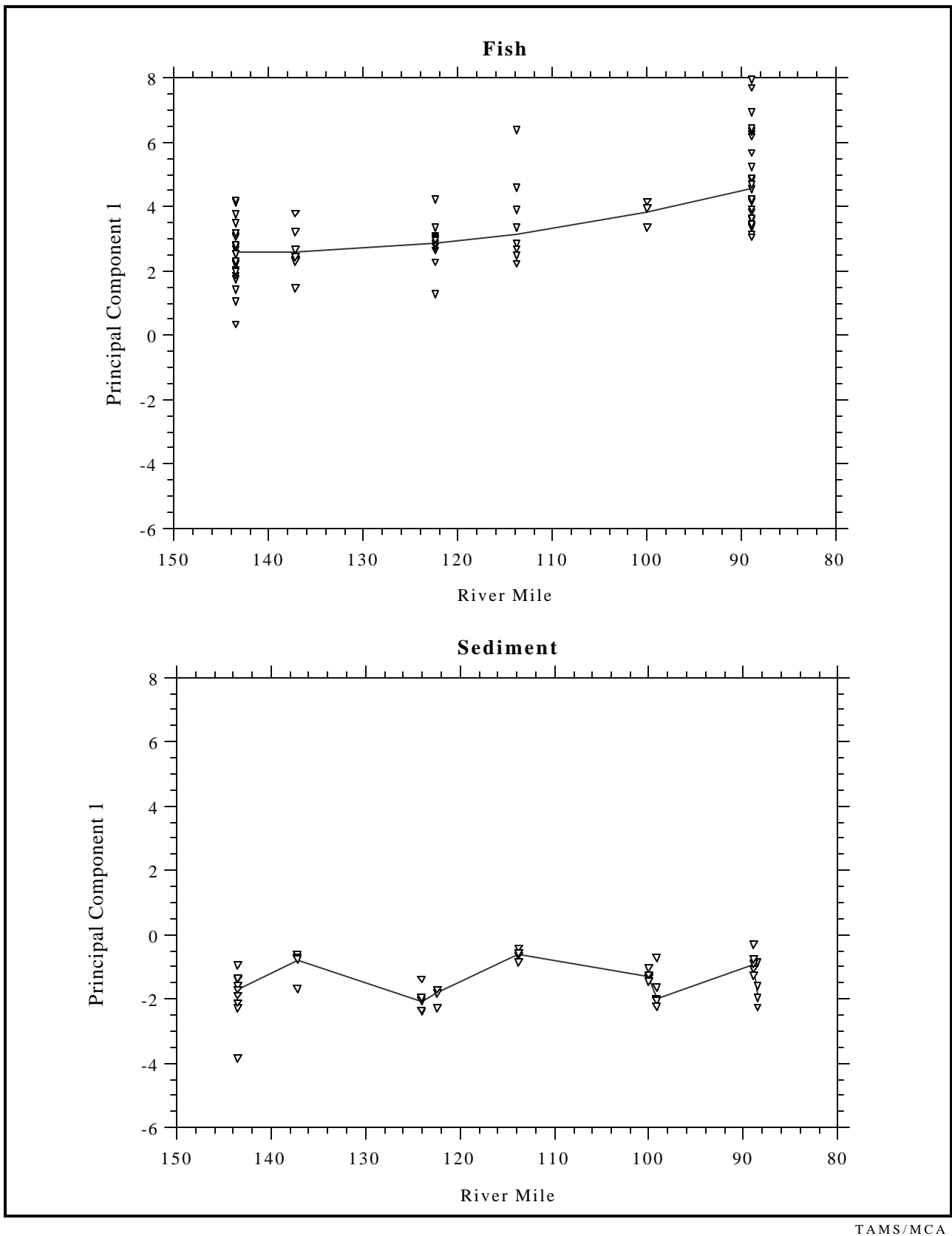
Figure 3-9
Variation of Principal Component 1 with River Mile in Fish and
Sediment River Miles 150 to 80
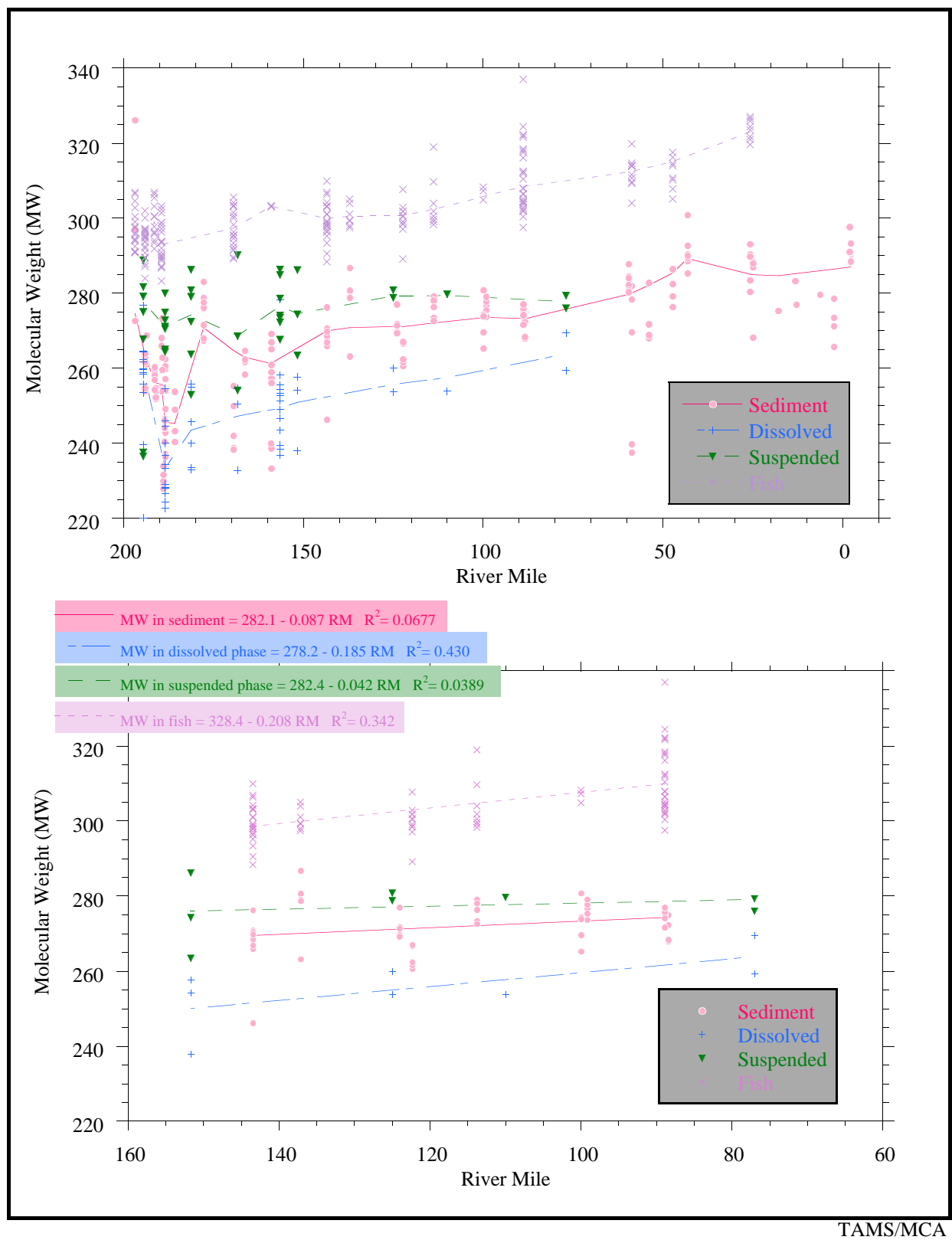
TAMS/MCA

Figure 3-10
Comparison Between Molecular Weight and River Mile
for 1993 Hudson River Samples
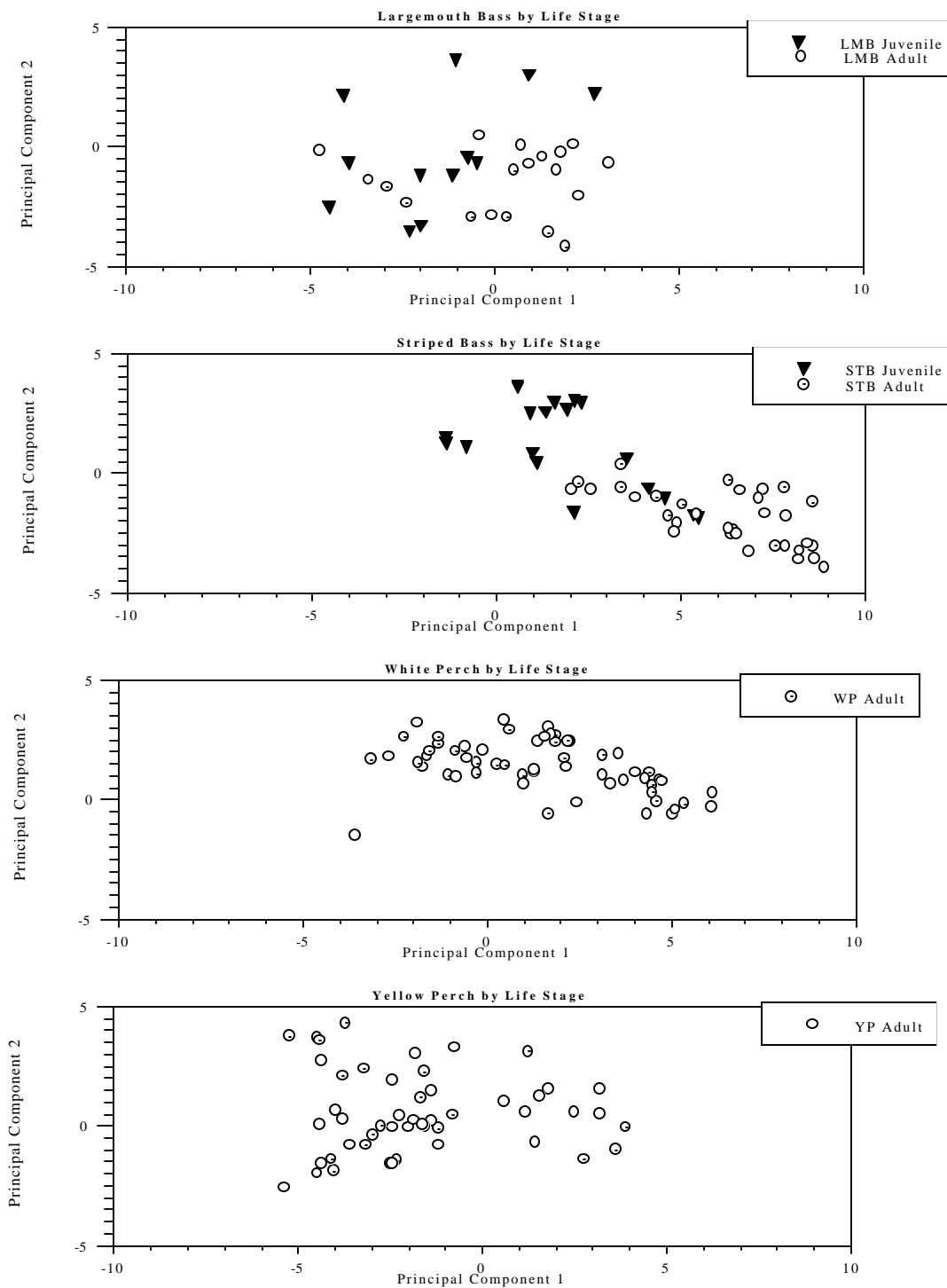
TAMS/MCA

Note: 1993 USEPA and NOAA Fish Data and 1995 NOAA Fish Data
316 Samples (Eleven 1995 Samples Omitted, NOAA, 1997)

TAMS/MCA

**Figure 3-11
Principal Component Results for 1993 and 1995
Fish Samples by Life Stage
(Based on 29 Congeners)**

Mass Fraction

Congener Number

Largemouth Bass
Upper Hudson

Water Column
Rogers Island
Spring Flood April 1993

White Perch
Saline Lower Hudson

Aroclor
1242

Aroclor
1248

Aroclor
1254
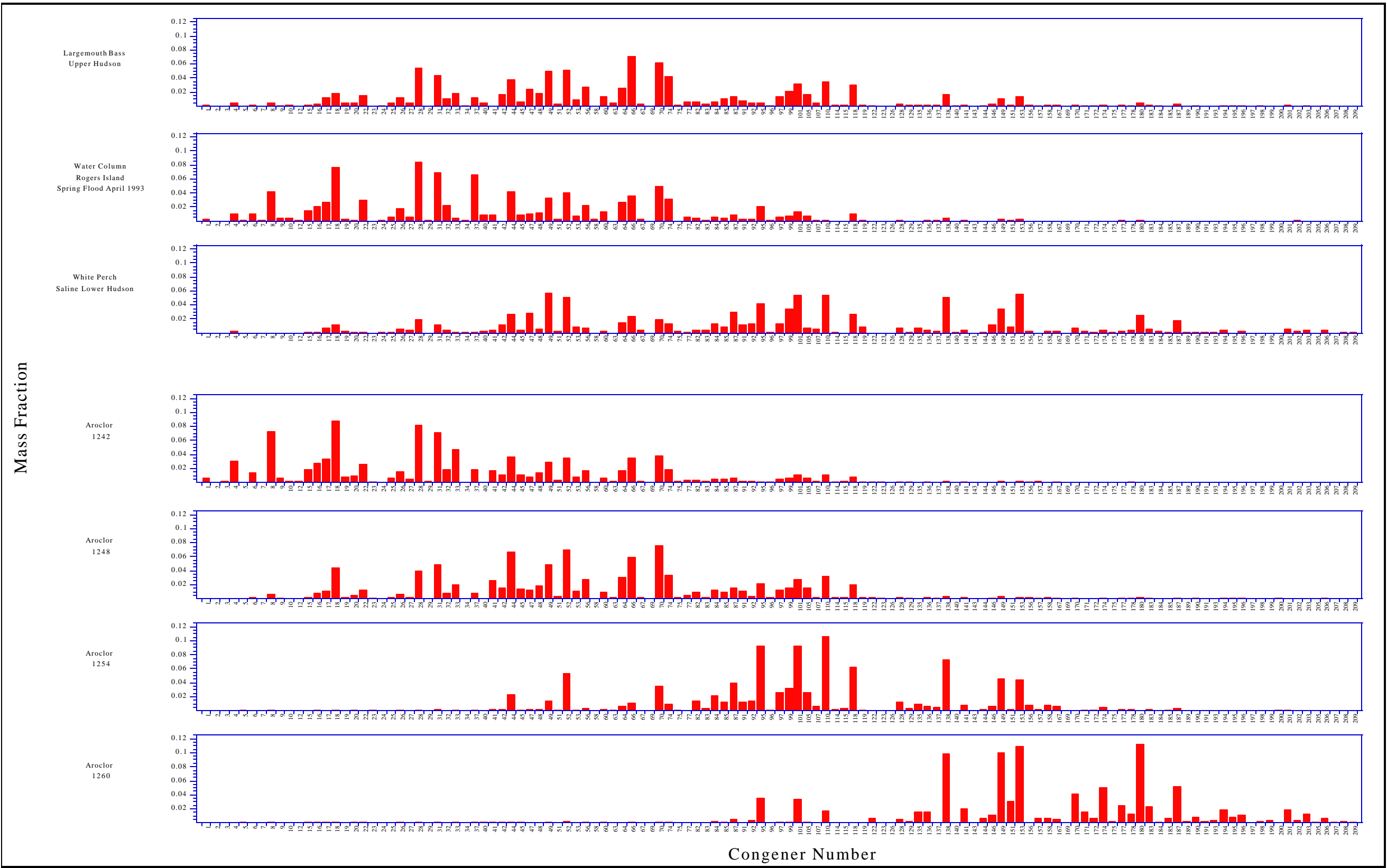
Aroclor
1260

TAMS/MCA

Figure 3-12
Comparison of Congener Mass Fraction in Hudson River Fish and Several Aroclor Standards: Linear Scale
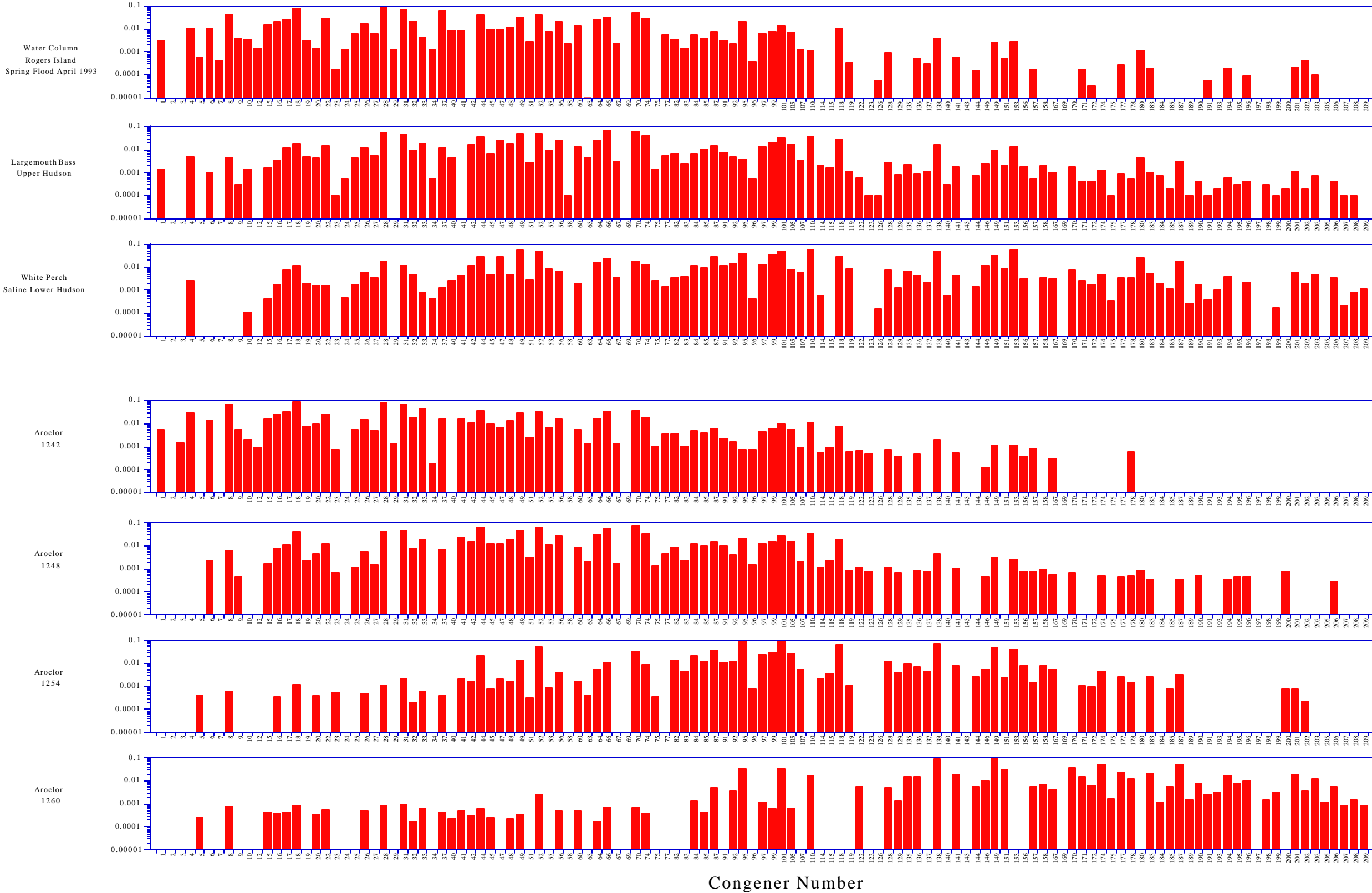
Figure 3-13
Comparison of Congener Mass Fraction in Hudson River Fish and Several Aroclor Standards: Semilogarithmic Scale

TAMS/MCA

2 (ortho)   6' (ortho)

3 (meta)   5' (meta)

4 (para)   4' (para)

5 (meta)   3' (meta)

6 (ortho)   2' (ortho)
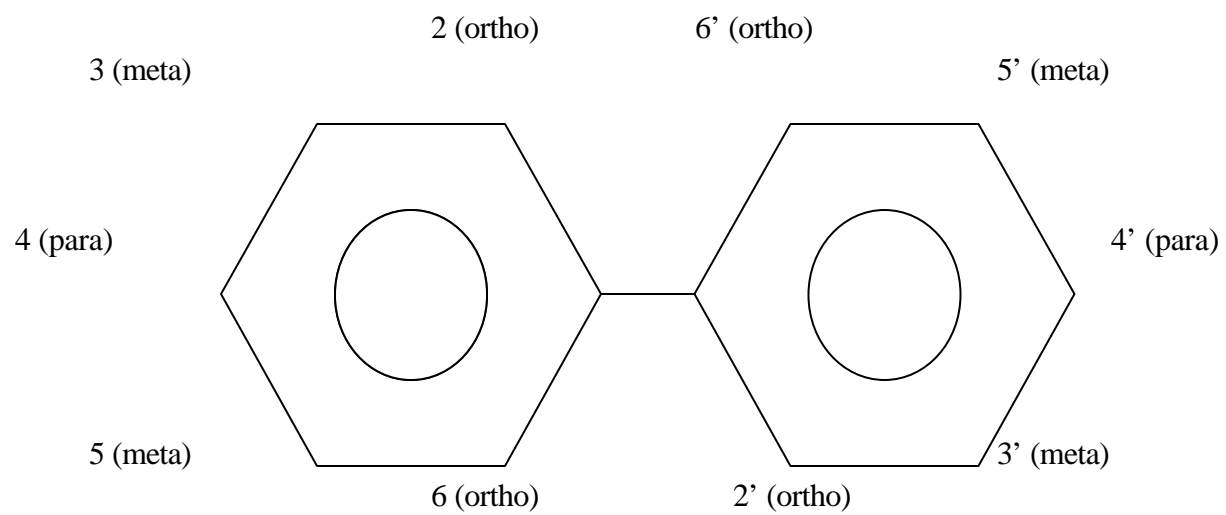
Figure 4-1: Shape of Biphenyl and Substitution Sites

FIGURE 4-2: Dose Response Functions for Pheasant and Mink
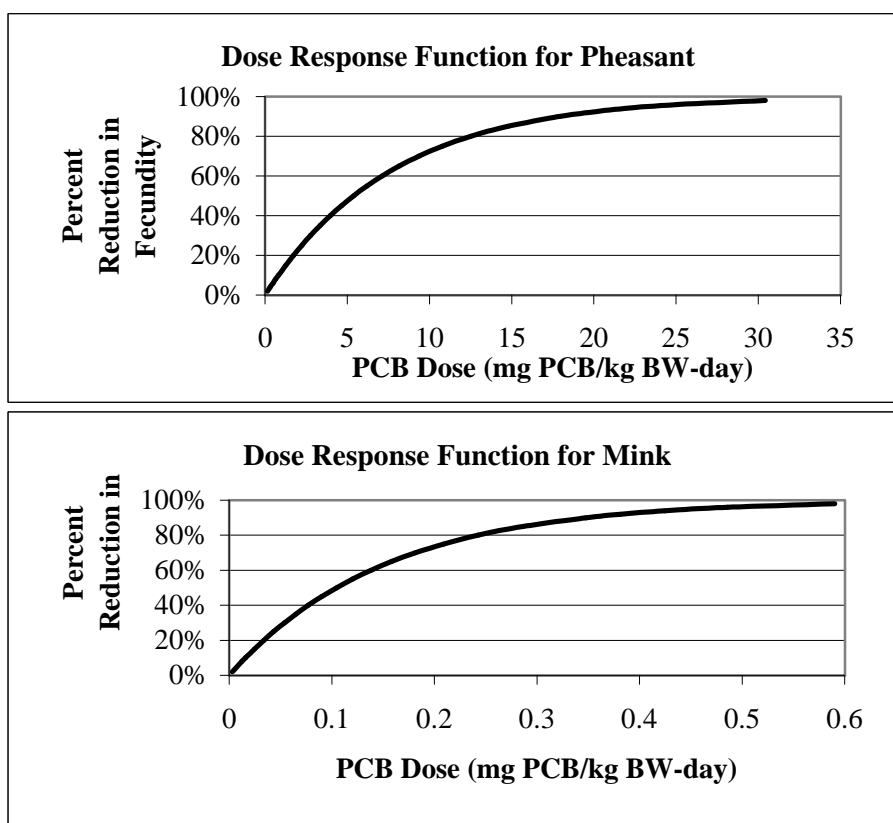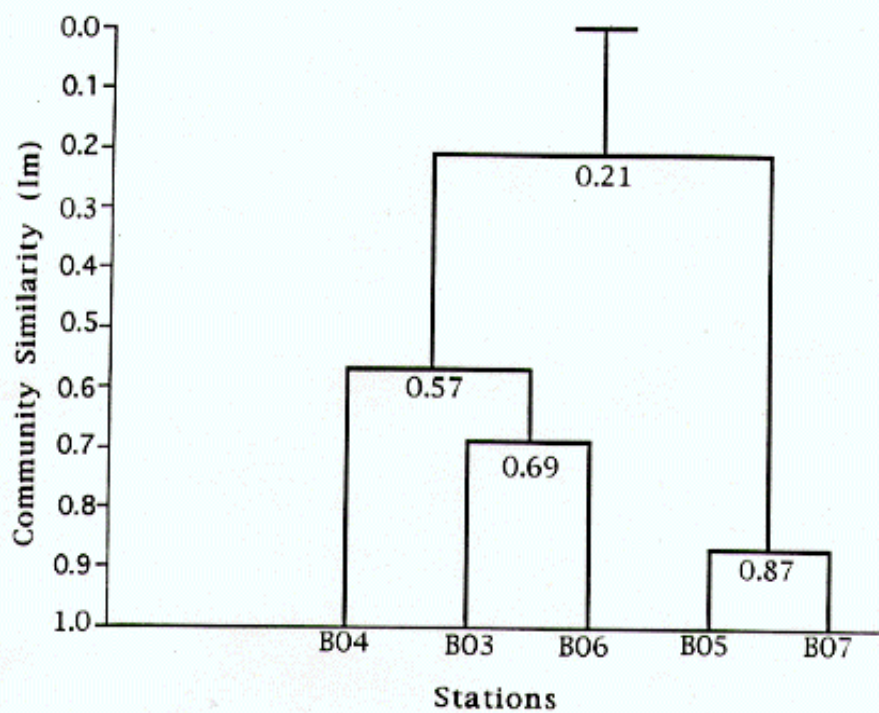
Dose Response Function for Pheasant

Dose Response Function for Mink

Figure 5-1
Complete Linkage Clustering - TI Pool
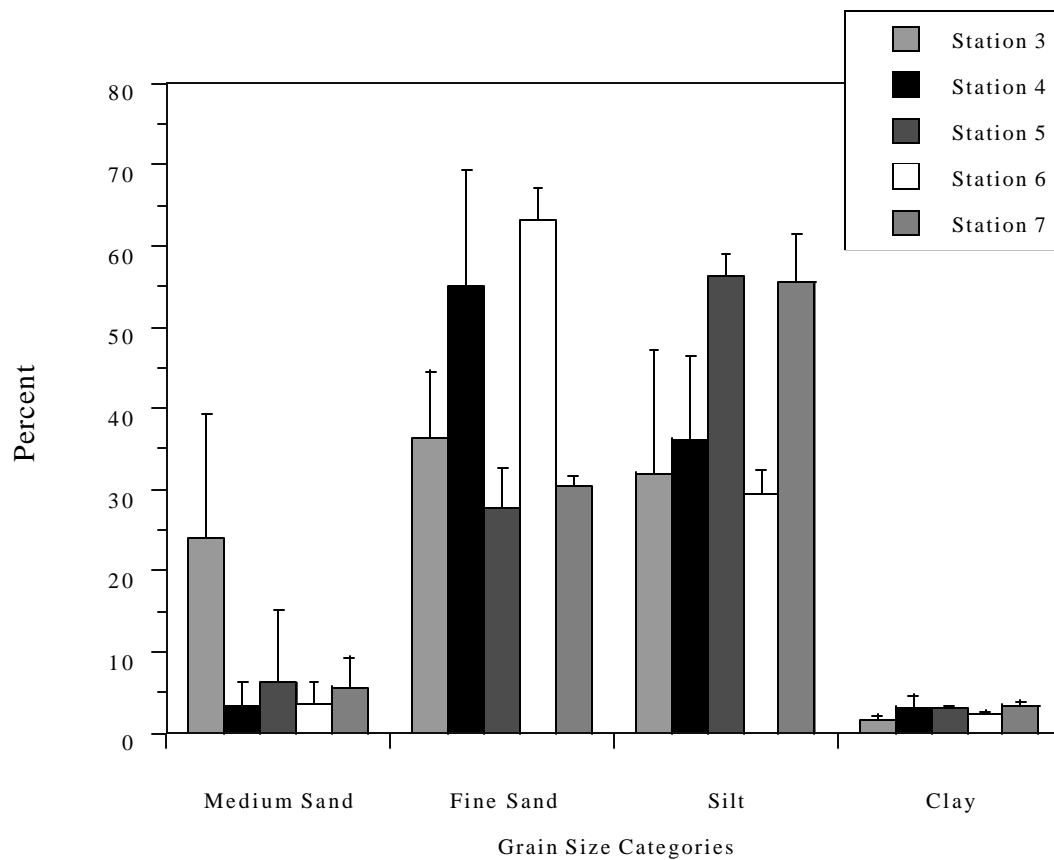
Note: Error bars represent one standard deviation.

Figure 5-2
Relative Percent Grain Size Classes - TI Pool

TOC (% DW)

Station
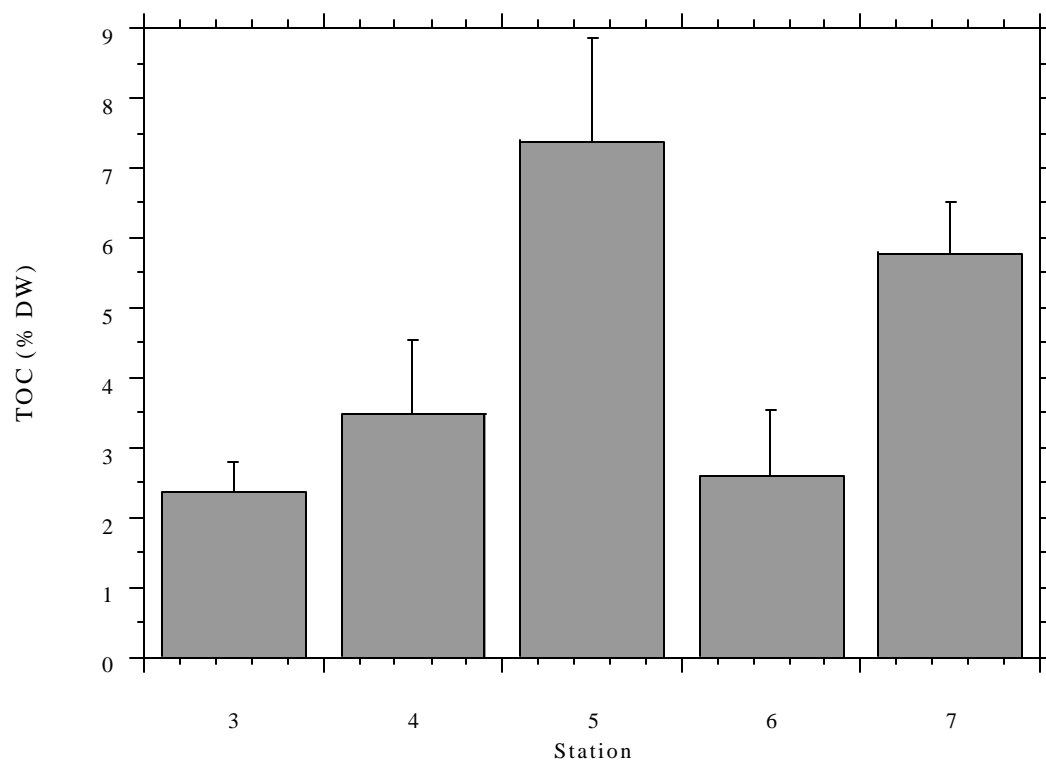
Note: Error bars represent one standard deviation.

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Figure 5-3
Mean Sediment TOC - TI Pool

40,000

30,000

Total PCBs (ug/kg)

20,000

10,000

0

3   4   5   6   7

Station
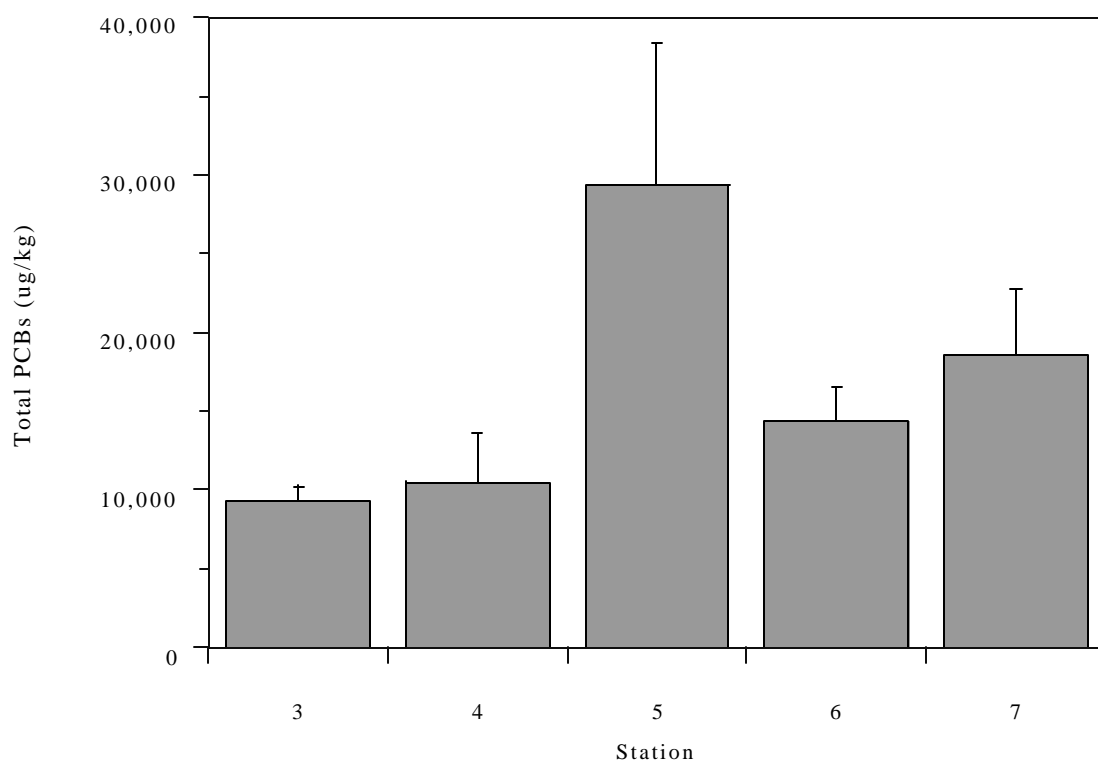
Note: Error bars represent one standard deviation.

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Figure 5-4
Mean Total PCB Concentration in Sediment - TI Pool

Average Biomass of All Benthic Invertebrates

Note: Error bars represent one standard deviation.
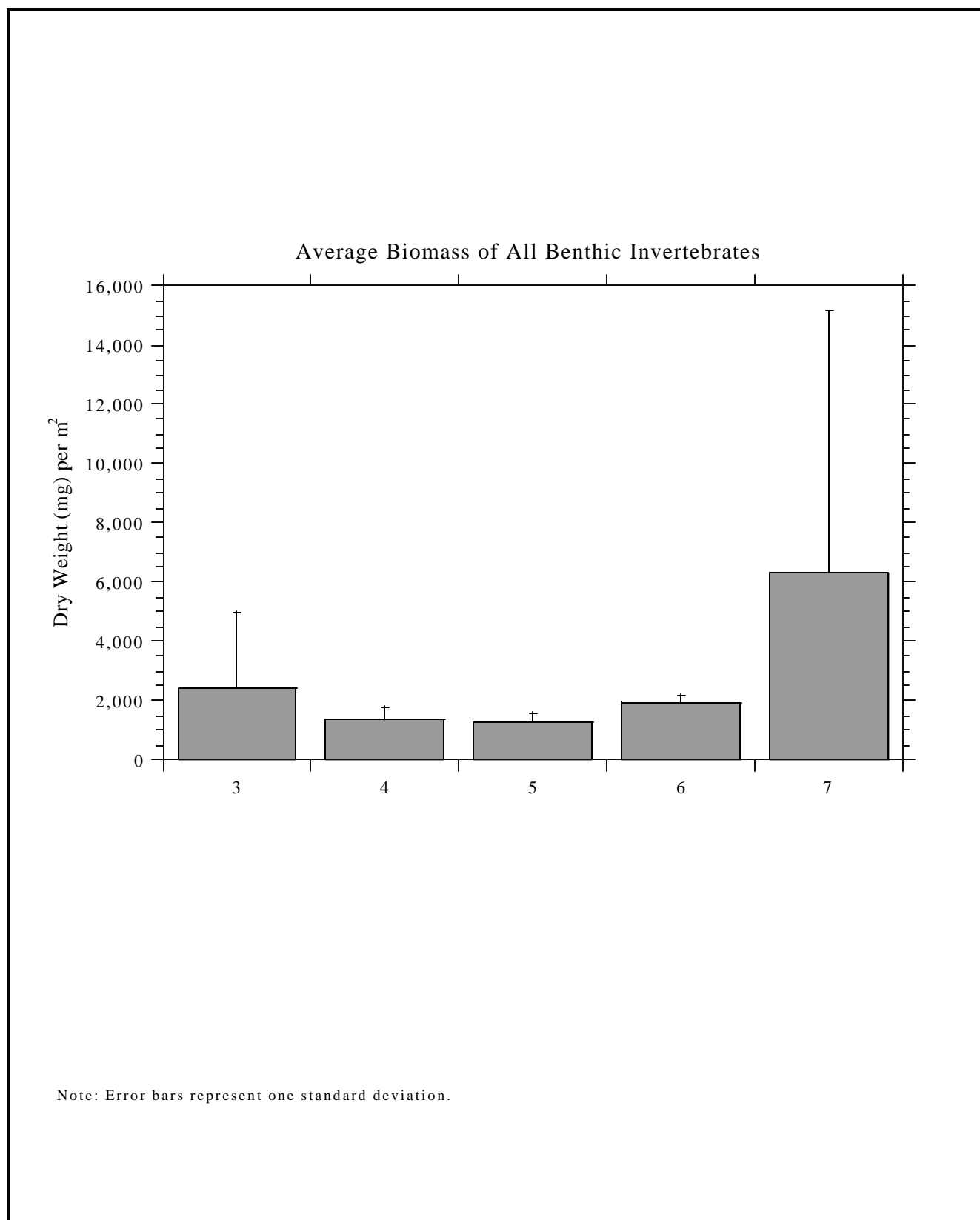
TAMS/MCA

Figure 5-5
Biomass of Benthic Invertebrates - TI Pool
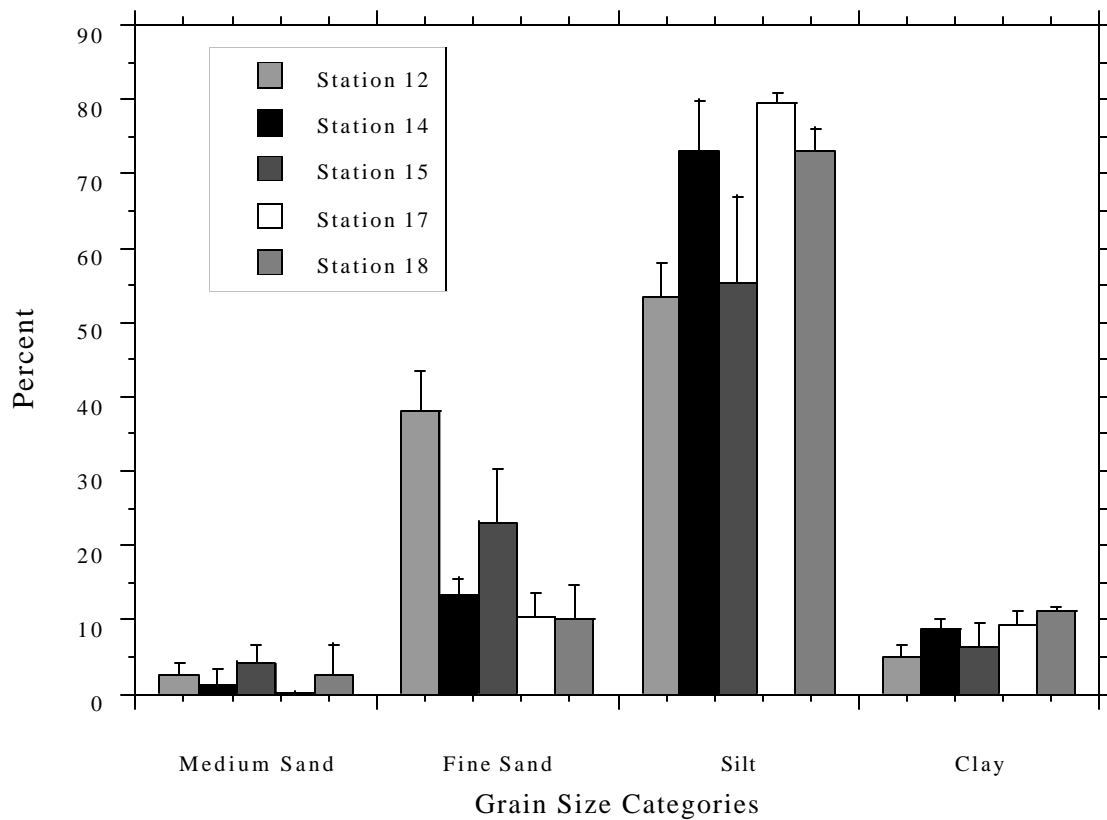
Figure 5-6
Relative Percent Grain Size Classes - Lower Hudson River
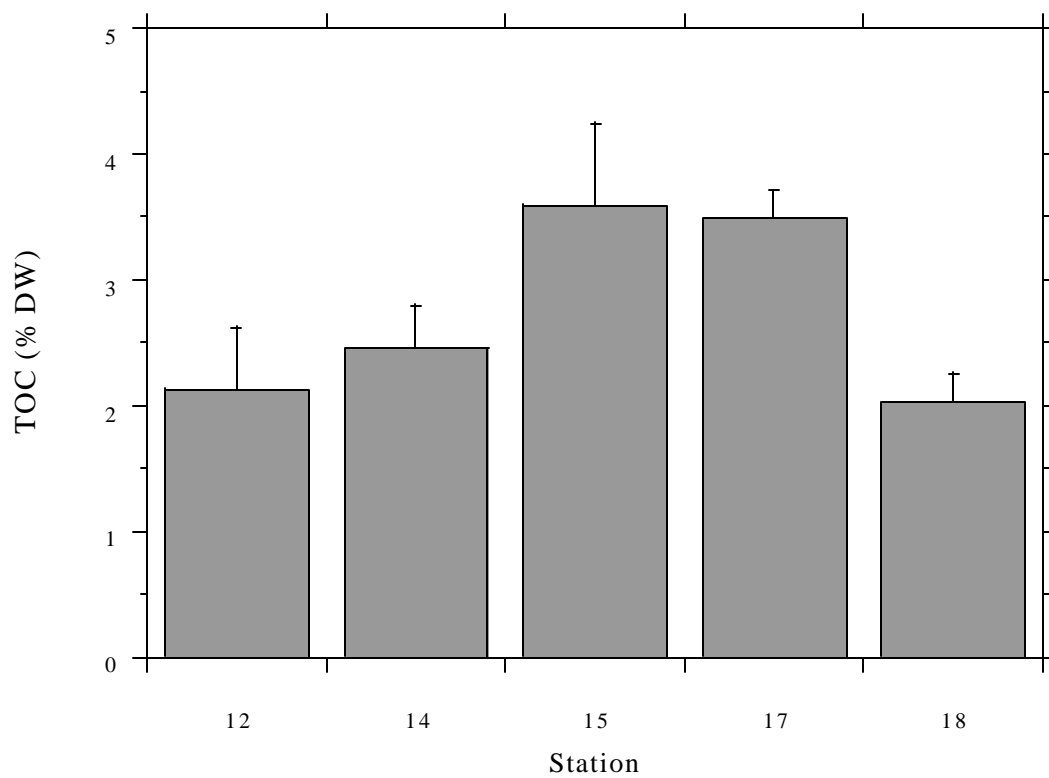
TAMS/MCA

Figure 5-7
Mean Sediment TOC - Lower Hudson River
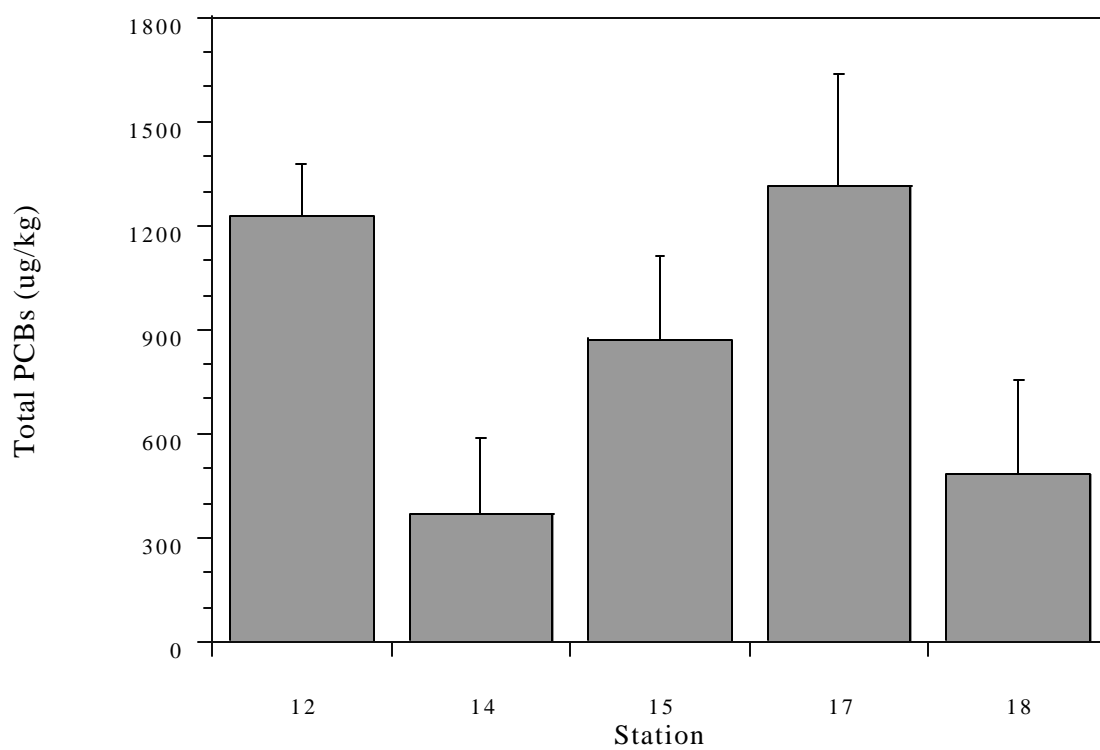
Note: Error bars represent one standard deviation.

Figure 5-8
Mean Total PCB Concentration in Sediment - Lower Hudson River

Figure 5-9: Cumulative Risk Functions for the Belted Kingfisher and Bald Eagle

Risk Function for Female Kingfisher
Exposed to Total PCBs

Risk Function for Female Eagle Exposed to Total PCBs
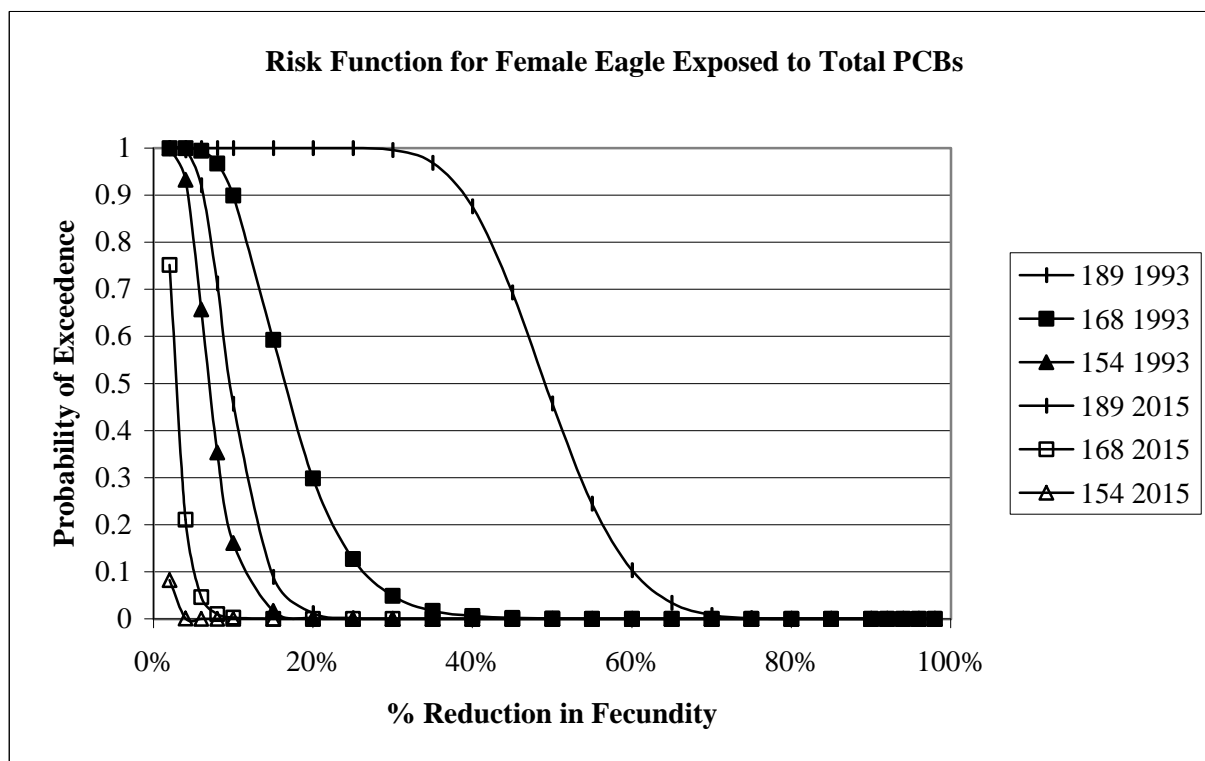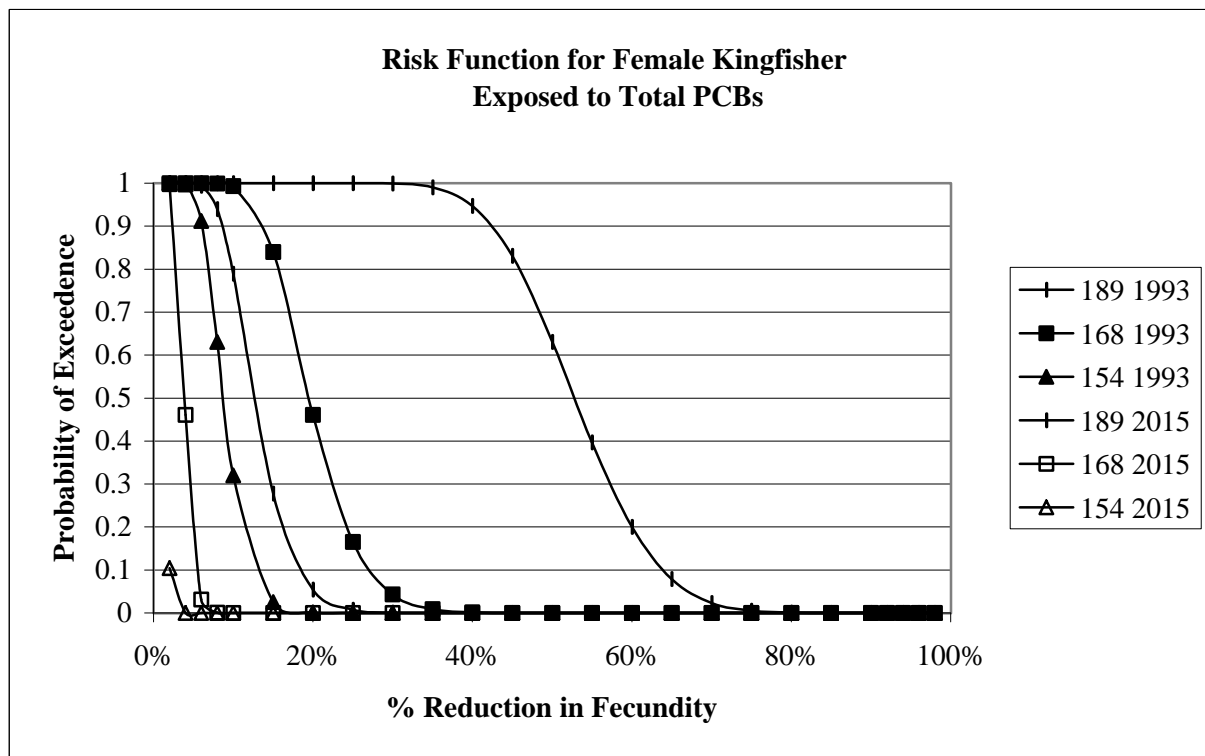
Figure 5-10: Cumulative Risk Functions for Mink and River Otter

Risk Function for Female Mink Exposed to Total PCBs

Probability of Exceedence vs % Reduction in Fecundity

Legend: 189 1993, 168 1993, 154 1993, 189 2015, 168 2015, 154 2015

Risk Function for Female Otter Exposed to Total PCBs

Probability of Exceedence vs % Reduction in Fecundity

Legend: 189 1993, 168 1993, 154 1993, 189 2015, 168 2015, 154 2015
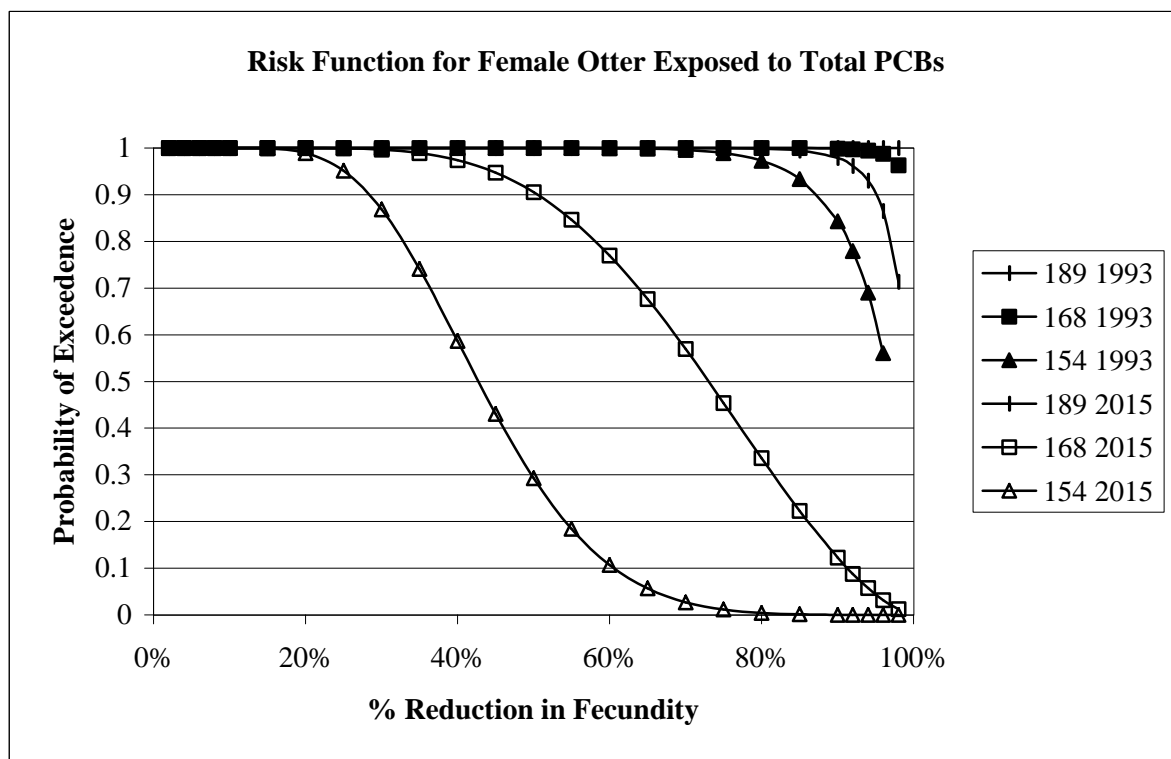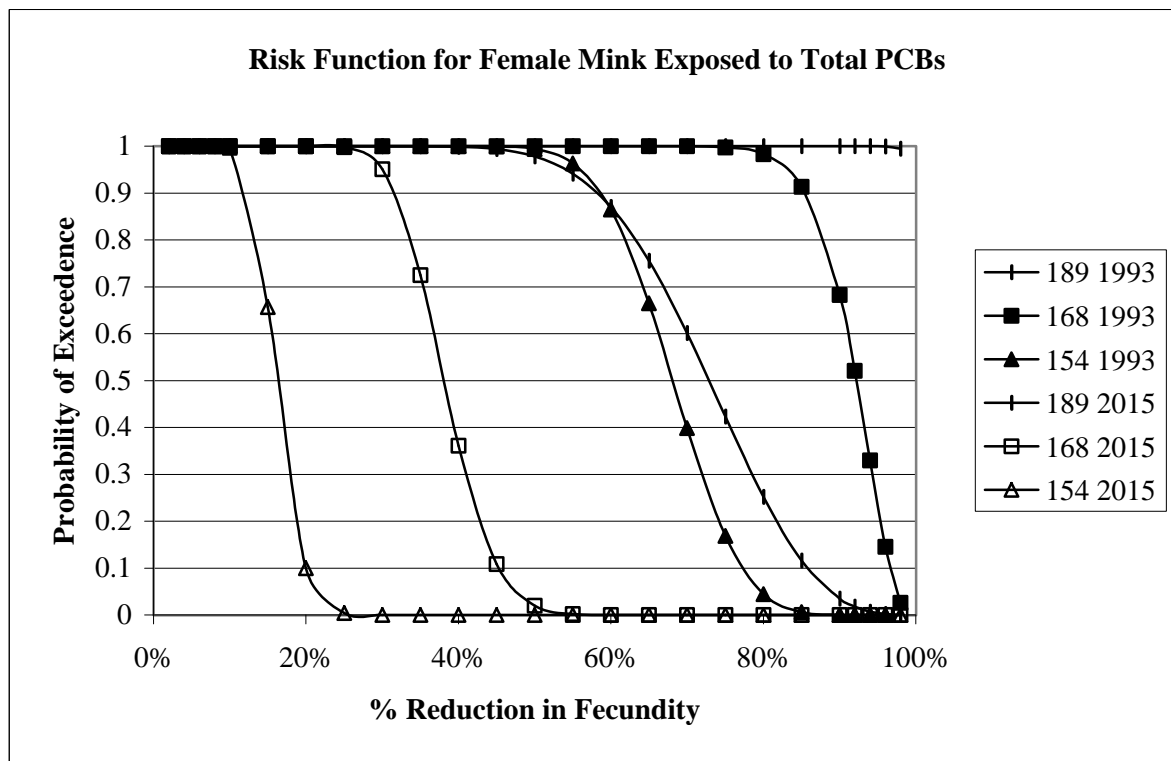
FIGURE 6-1: Predicted Toxicity Quotients from Uncertainty Analysis for Kingfisher and Kingfisher Egg
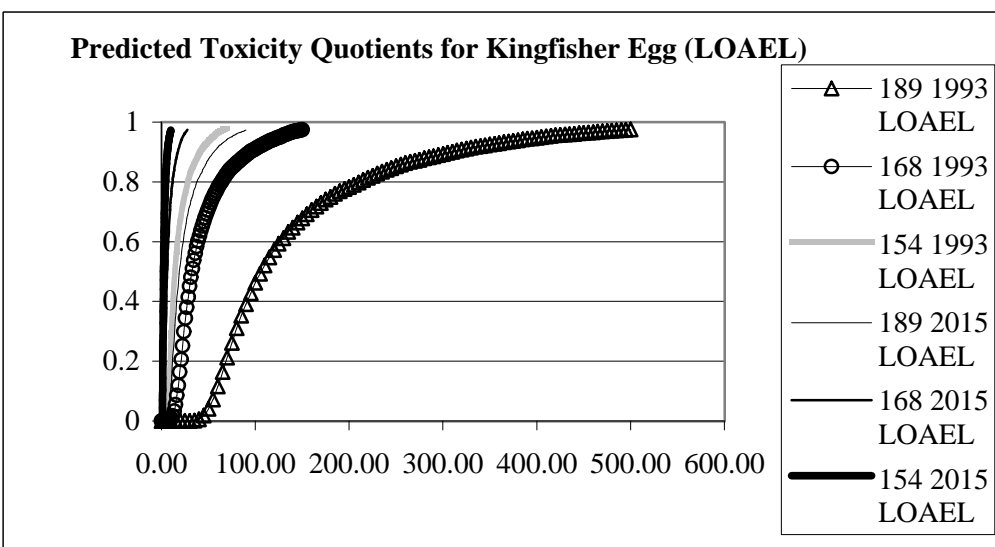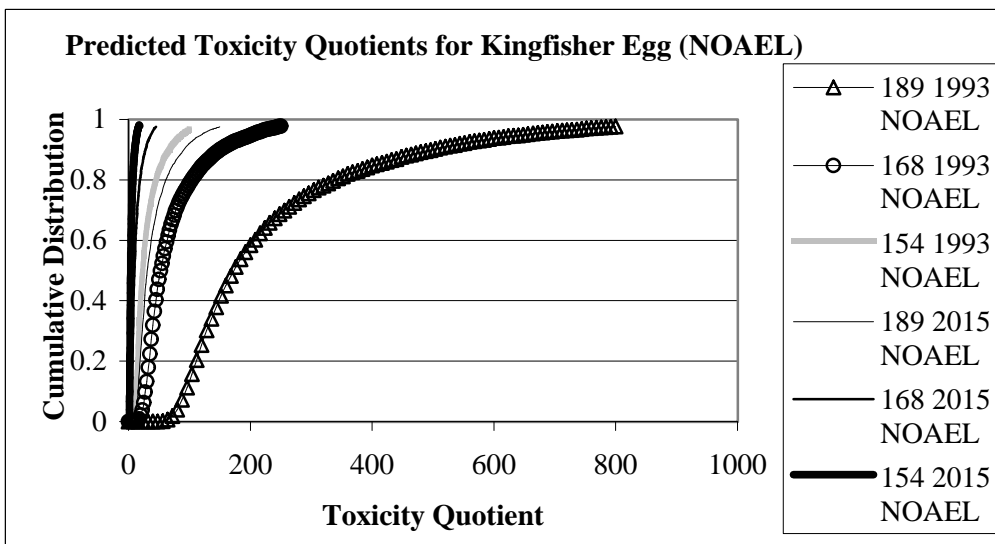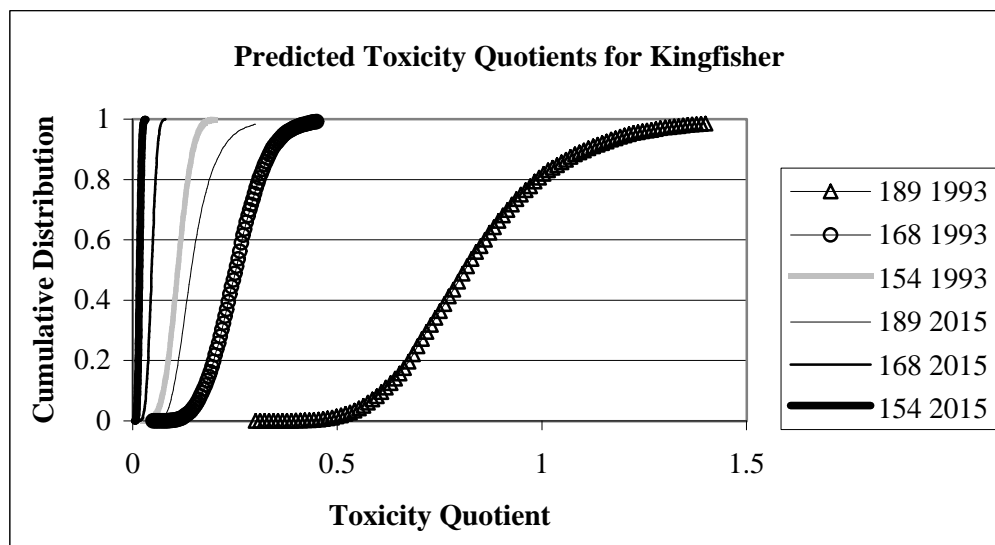
FIGURE 6-2: Predicted Toxicity Quotients from Uncertainty Analysis for Eagle and Eagle Egg

Predicted Toxicity Quotients for Eagle

Predicted Toxicity Quotients for Eagle Egg
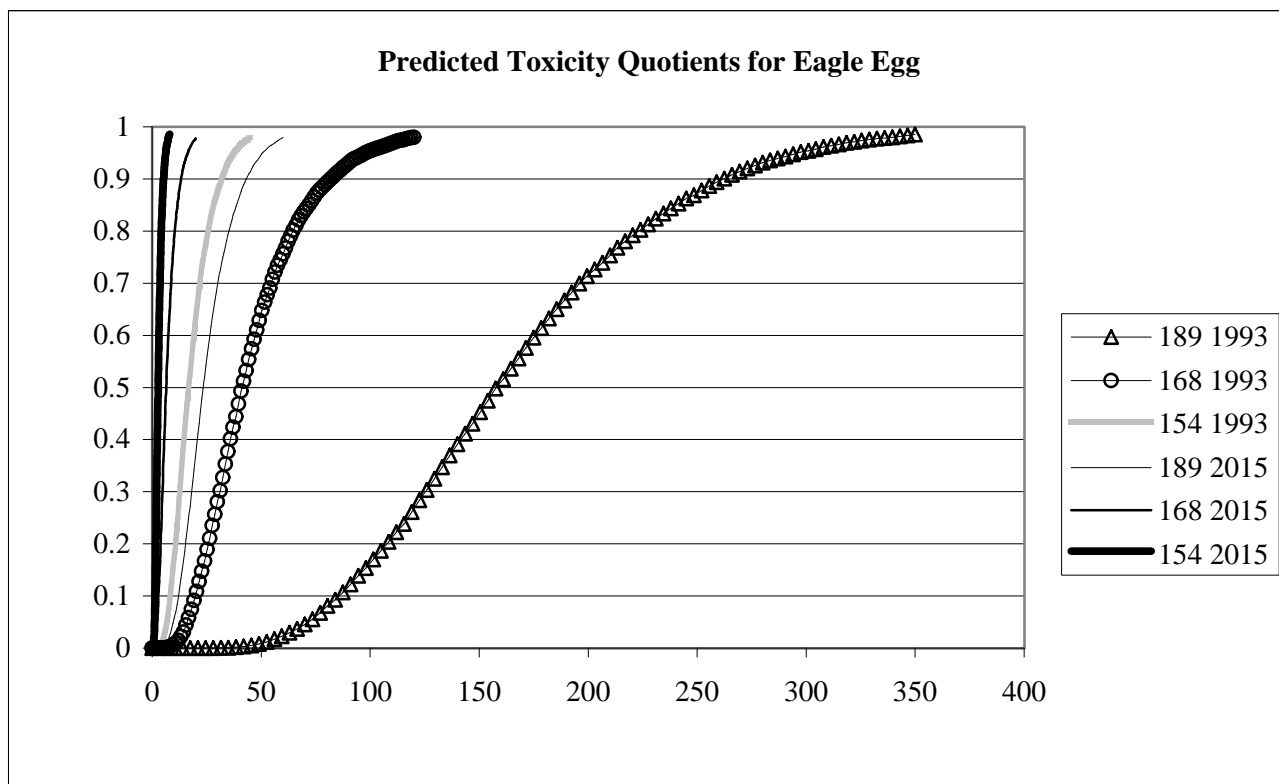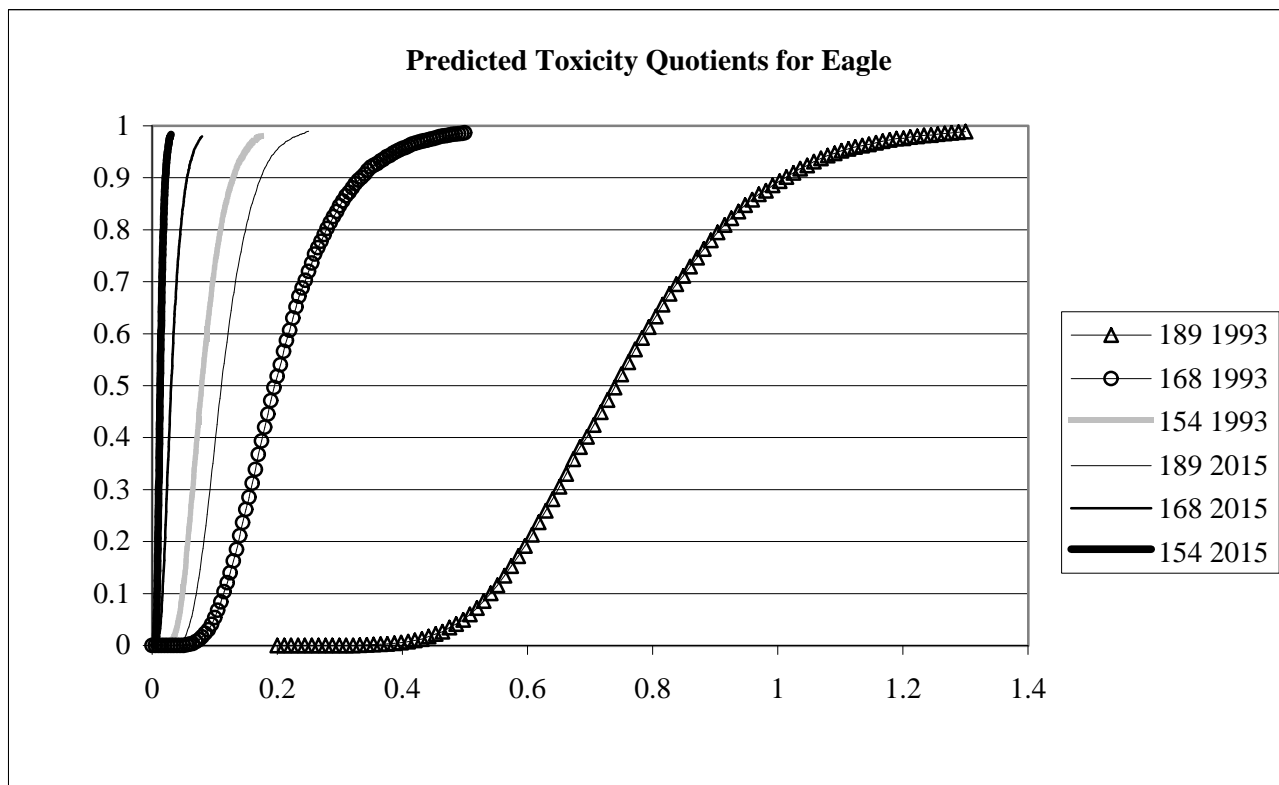
FIGURE 6-3: Predicted Toxicity Quotients from Uncertainty Analysis for Mink and Otter