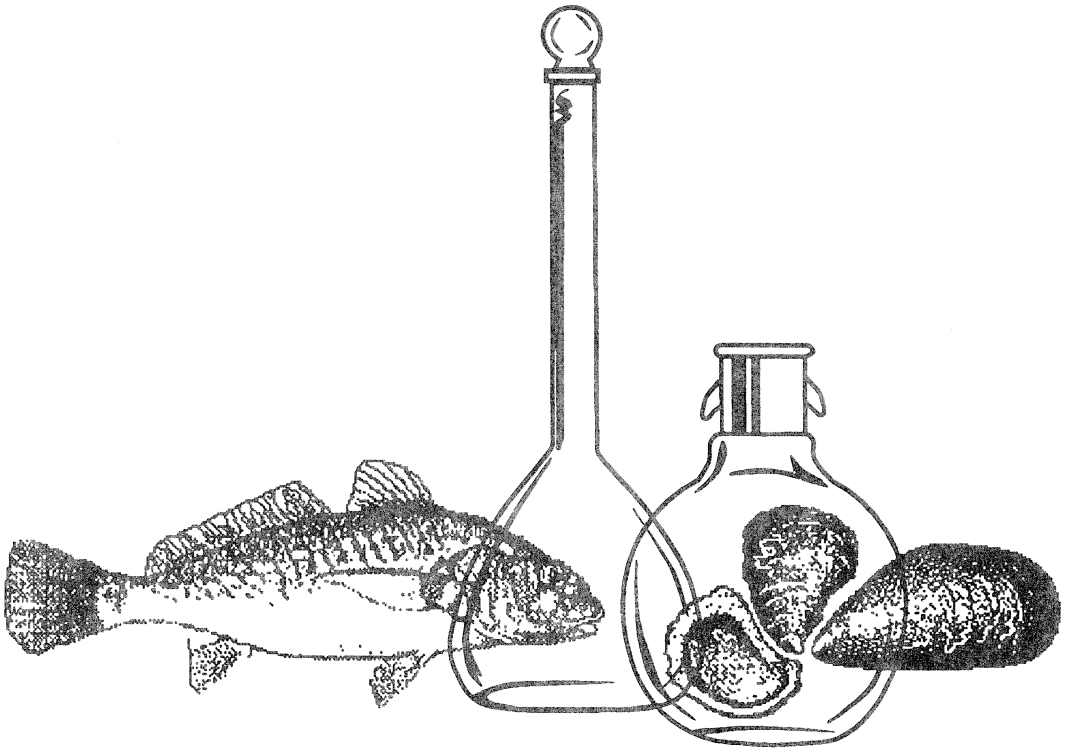
NOAA Technical Memorandum NOS ORCA 79

National Status and Trends Program
for Marine Environmental Quality

Quality Assurance Project Intercomparison Exercise Results 1991 - 1993



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Office of Ocean Resources Conservation and Assessment
Coastal Monitoring and Bioeffects Assessment Division

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NOAA Technical Memorandum NOS ORCA 79

Quality Assurance Project Intercomparison Exercise Results 1991 - 1993

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Silver Spring, Maryland
August, 1995

United States Department of Commerce	National Oceanic and Atmospheric Administration	National Ocean Service
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LIST OF ACRONYMS

CRM	Certified reference material
DDTs	Dichlorophenyltrichloroethane and metabolites
GERG	Geochemical and Environmental Research Group/TAMU
NIST	National Institute of Standards and Technology (formerly National Bureau of Standards)
NMFS	National Marine Fisheries Service, NOAA
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council of Canada
NS&T	NOAA National Status and Trends Program
NWFSC	NOAA/NMFS/Northwest Fisheries Science Center, Seattle, WA
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
QA	Quality assurance
SEFSC	NOAA/NMFS/Southeast Fisheries Science Center, Beaufort, NC
SRM	Standard Reference Material
TAMU	Texas A&M University

Quality Assurance Project Intercomparison Exercise Results 1991 - 1993

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ABSTRACT

The NOAA National Status and Trends (NS&T) Program determines the current status and any changes over time of the environmental health of the estuarine and coastal waters of the United States. Concentrations of organic and inorganic contaminants are determined in mollusks, bottom-dwelling fish and sediments collected along the coast of the United States. The quality of the analytical data generated by the NS&T Program is overseen by its QA Project component, which is designed to document sampling protocols, analytical procedures, and laboratory performance, and to reduce intralaboratory and interlaboratory variation. NS&T does not specify analytical methodology. Laboratories can use any analytical procedure as long as the results of the intercomparison exercises are within certain specified limits. All NS&T laboratories are required to participate in yearly intercomparison exercises. The results of the trace organic and trace metals 1991 through 1993 intercomparison exercises are described and discussed.

1. INTRODUCTION

The National Oceanic and Atmospheric Administration's (NOAA) National Status and Trends (NS&T) Program determines the current status of, and any changes over time in the environmental health of the estuarine and coastal waters of the United States, including Alaska and Hawaii. The NS&T Program consists of seven major components, two of which generate monitoring data: the National Benthic Surveillance Project, and the Mussel Watch Project.

Concentrations of organic and inorganic contaminants in sediments and bottom-dwelling fish taken in the same area are determined as part of the National Benthic Surveillance Project at sites located around the nation. The analytes include 24 polycyclic aromatic hydrocarbons, 18 polychlorinated biphenyl congeners, DDT and its metabolites, 9 other chlorinated pesticides, organotins, 4 major elements and 12 trace elements (Table 1). Toxaphene, DNA adducts, and aryl hydrocarbon hydroxylase are measured at certain sites. The frequency of external disease conditions and internal lesions (liver tumors) in the bottomfish are also being documented. Currently, there are about 80 National Benthic Surveillance sites in estuaries and coastal waters, including both urban and rural areas. Samples are generally collected biennially at these sites. Sample collection and analyses for the National Benthic Surveillance Project are currently done by the NOAA National Marine Fisheries Service (NMFS) Northwest Fisheries Science Center (NWFSC), Seattle, WA, and the NMFS/Southeast Fisheries Science Center (SEFSC), Beaufort, NC.

Table 1. Chemicals determined as part of the NOAA National Status and Trends Program.

Polycyclic aromatic hydrocarbons

Biphenyl
Naphthalene
1-Methylnaphthalene
2-Methylnaphthalene
2,6-Dimethylnaphthalene
Acenaphthene
Acenaphthylene
1,6,7-Trimethylnaphthalene
Fluorene
Phenanthrene
1-Methylphenanthrene
Anthracene
Fluoranthene
Pyrene
Benz[*a*]anthracene
Chrysene
Benzo[*a*]pyrene
Benzo[*e*]pyrene
Perylene
Dibenz[*a,h*]anthracene
Benzo[*b*]fluoranthene
Benzo[*k*]fluoranthene
Indeno[1,2,3-*cd*]pyrene
Benzo[*ghi*]perylene

DDT and metabolites

2,4'-DDD	4,4'-DDD
2,4'-DDE	4,4'-DDE
2,4'-DDT	4,4'-DDT

Chlorinated pesticides other than DDT

Aldrin	Dieldrin
cis-Chlordane	*trans*-Nonachlor
Heptachlor	gamma-HCH
Heptachlor epoxide	Mirex
Hexachlorobenzene	

Polychlorinated biphenyl congeners (nomenclature of Ballschmiter and Zell, 1980)

PCB 8	PCB 18	PCB 28
PCB 44	PCB 52	PCB 66
PCB 101	PCB 105	PCB 118
PCB 128	PCB 138	PCB 153
PCB 170	PCB 180	PCB 187
PCB 195	PCB 206	PCB 209

Elements

Al	Si	Mn	Fe
Cr	Ni	Cu	Zn
As	Se	Ag	Cd
Sn	Sb	Pb	Hg

Tributyltin species

Tributyltin [bis(tri-n-butyltin)oxide]
Dibutyltin (degradation product)
Monobutyltin (degradation product)

The same contaminants are determined in sediments and mussels or oysters as part of the Mussel Watch Project. The bivalves are collected on a yearly basis from approximately 240 sites in the United States, while sediments are collected at the same sites on a less-than-yearly basis. Sample collection and analysis for the Mussel Watch Projects are currently done by the Texas A&M University (TAMU) Geochemical and Environmental Research Group (GERG), College Station, TX, and the Battelle Ocean Sciences (BATTELLE) laboratories at Duxbury, MA, and Sequim, WA.

2. OBJECTIVES OF THE QA PROJECT

The quality of the analytical data generated by the NS&T Program is overseen by the QA Project component, which has been in operation since 1985 and is designed to document sampling protocols and analytical procedures, and to reduce intralaboratory and interlaboratory variation. Details of the NS&T QA Program can be found in Cantillo and Lauenstein (1993). NS&T does not specify analytical methodology. Laboratories can use any analytical procedure as long as the results of the intercomparison exercises are within certain specified limits of the consensus values. This allows the use of new or improved analytical methodology or instrumentation without compromising the quality of the data sets. The analysis of reference materials, such as the National Research Council (NRC) of Canada Certified Reference Materials (CRMs) and National Institute of Standards and Technology (NIST) Standard Reference Materials (SRMs), and of control materials generated for use by NS&T labs as part of the sample stream, is required. To document laboratory expertise, the QA Project requires all NS&T cooperating laboratories to participate in a continuing series of intercomparison exercises utilizing a variety of materials. The organic analytical intercomparison exercises are coordinated by NIST, and the inorganic exercises by NRC Canada. Sampling and analytical protocols used in the NS&T Program since its inception are documented in Lauenstein and Cantillo (1993).

3. INTERCOMPARISON EXERCISES

All the NS&T laboratories are required to participate in the yearly intercomparison exercises which began in 1986. The results of the exercises previous to 1991 are described in Cantillo and Parris (1993) and Valette-Silver (1992). The exercise materials used in the 1991, 1992 and 1993 exercises are listed in Table 2. The exercise materials are usually sent early in the spring or summer, with complete handling instructions and data reporting format. The type and matrix of the samples change yearly.

The results of the intercomparison exercises are not intended to be a reflection of the absolute capability of a laboratory. Given time and budgetary constraints, the methodology used may not be the one resulting in the lowest detection limits or best precision, rather, it is the one that can be used to generate data of the quality specified by the NS&T Program.

In response to the needs of the NS&T Program, NOAA has partially funded the production of eight NIST SRMs and seven internal standard solutions (Table 3). The SRMs are two natural matrix materials and calibration solutions at two concentration levels of the three chemical classes of analytes. The latter are used to facilitate the preparation of multipoint calibration curves. The internal standard solutions were prepared at the request of the NS&T contract laboratories and are provided free of charge. These SRMs and control materials have been and continue to be used by NS&T contract laboratories.

Table 2. Materials used for the NS&T intercomparison exercises for 1991 through 1993.

Year	Materials		
Trace Metal Exercises			
1991	Sediment N		Freeze dried sediment from Baie des Chaleurs
	Mussel P		Tissue homogenate from the Pacific Northwest
	BCSS-1		Estuarine Sediment CRM
	SRM 1566a		Oyster Tissue CRM
1992	Fish Q		Spray-dried Nova Scotia flounder fillet
	Sediment R		Freeze dried sediment from Chesapeake Bay
	DORM-1		Dogfish (*Squalus acanthias*) Muscle CRM
	BCSS-1		Estuarine Sediment CRM
1993	Sediment T		Freeze dried sediment from Mississippi Delta
	Tissue S		Freeze-dried *Mytilus edulis* tissue from French coast
	BCSS-1		Estuarine Sediment CRM
	SRM 1566a		Oyster Tissue CRM
Trace Organic Exercises			
1991	Tissue Control material III	QA90TC	Frozen bivalve tissue homogenate
	Bivalve extract II	QA91BE2	Extract of frozen bivalve tissue homogenate*
1992	Marine sediment III	QA92SED3	Wetted marine sediment prepared using candidate SRM 1941a
	Mussel tissue IV	QA92TIS4	Frozen Mussel Homogenate from Dorchester Bay
1993	Mussel Tissue V	QA93TIS5	Frozen *Mytilus edulis* homogenate from Boston Harbor (candidate SRM 1974a)
	Fish Homogenate I	QA93FSH1	Carp homogenate from Saginaw Bay (candidate NRC CRM)

* Gravimetrically spiked with one analyte from each of the three chemical classes. The material was not spiked or enriched with the other 48 organic target analytes.

Table 3. NIST SRMs and internal standards funded by the NS&T Program.

SRM 1491	Aromatic Hydrocarbons in Hexane/Toluene
SRM 1492	Chlorinated Pesticides in Hexane
SRM 1493	Chlorinated Biphenyl Congeners in 2,2,4-Trimethylpentane
SRM 1941	Organics in Marine Sediment
SRM 1974	Organics in Mussel Tissue (*Mytilus edulis*)
SRM 2260	Aromatic Hydrocarbons in Toluene
SRM 2261	Chlorinated Pesticides in Hexane
SRM 2262	Chlorinated Biphenyl Congeners in 2,2,4-Trimethylpentane
AH	Naphthalene-d_8, acenaphthene-d_{10}, benzo[*a*]pyrene-d_{12}, perylene-d_{12}
PES	1,2,3-Trichlorobenzene, 4,4'-dibromooctafluorobiphenyl
TCMX	2,4,5,6-Tetrachloro-m-xylene

* SRMs 1491 and 2260; and SRM 1492 and 2261 have the same suite of analytes at different concentrations. SRM 1493 contains twenty PCB congeners, and SRM 2262 contains the same twenty congeners at different concentrations plus eight additional congeners.

4. TRACE METAL INTERCOMPARISON EXERCISE RESULTS

4.1. 1991 Exercise

The fifth NS&T trace metal intercomparison exercise, NOAA/5, took place in 1991 and was coordinated by NRC. The NS&T cooperating laboratories were SEFSC, BATTELLE, and TAMU. Materials were sent to the other 37 laboratories that participated on a voluntary basis. Results were received from the NS&T cooperating laboratories and 26 non-NS&T laboratories. The materials used were Sediment N, BCSS-1, Mussel P and SRM 1566a. The results of the analyses are listed in Appendix I. A detailed description of the exercise and the results of the other participating laboratories can be found in Willie and Berman (1991).

4.1.1. Description of materials and exercise

Sediment N is a siliceous material collected in Nova Scotia Harbor, Canada, and is moderately contaminated. Mussel P is a moderately contaminated tissue homogenate of *Mytilus edulis* specimens collected off the northwest coast of the US by Battelle Pacific Northwest. Sediment for BCSS-1 was collected in the Baie des Chaleurs, Gulf of St. Lawrence. The sediment was freeze-dried, screened to pass through a 125-µm screen, blended, bottled, and radiation-sterilized. BCSS-1 may contain sea salt. The certified values are listed in Table 4, and a more complete description of the preparation, analysis and composition of BCSS-1 can be found in NRC (1990). SRM 1566a was prepared using oysters obtained from a commercial source. The oysters were shucked, frozen, and packaged in sealed plastic bags. The oyster material was ground, freeze-dried, and powdered. At NIST, the material was jet-milled to pass a 355 µm screen, radiation sterilized and bottled. Certified and noncertified values are listed in Table 5, and a more detailed description of the preparation and analysis of SRM 1566a can be found in NIST (1989).

Each laboratory received 10-g samples of each "unknown" sample, and were asked to perform five replicate analysis of each of the two unknowns, BCSS-1 and SRM 1566a, for Al, Cr, Fe, Cu, Zn, As, Se, Cd, Sn, Hg, and Pb. Analyses of Si, Mn, Sb and Tl were optional. The analysis of

Ag was also requested for biological tissues. All results, including outliers, are shown graphically in Figures 1 - 13, and are listed in Appendix I. NRC provided benchmarks for accuracy by analyzing Sediment N and Mussel P by two different methods. Whenever possible, one of these methods was isotope dilution inductively coupled plasma mass spectrometry, which can produce very accurate results.

4.1.2. "Accepted" values

One purpose of the exercise was to arrive at an "accepted" value for each analyte concentration in the unknown materials. The overall mean concentration for each metal was calculated from the mean of laboratory replicates and the NRC data by Willie and Berman (1991). These means were assumed to be normally distributed which may not be a valid assumption at low concentrations. Obvious outliers were eliminated prior to statistical evaluation. A successively applied Student *t* test at the 95% confidence limit was used to identify other outliers. The "accepted" values and uncertainties as well as the certified values and uncertainties for BCSS-1 and SRM 1566a are listed in Tables I.1 - I.4 in Appendix I.

4.1.3. Results

4.1.3.1. Al, Si, Fe, and Mn

The results of the Al, Fe and Mn analyses are shown in Figures 1, 2 and 3 respectively. The results of the five replicate analyses are shown in the figures including any outliers. Only three laboratories and NRC reported Si results. No NS&T laboratory reported Si values for this exercise. The means of the five replicate analysis of Al for Sediment N and BCSS-1 reported by the NS&T cooperating laboratories were within the 95% confidence interval of each material. The precision was better for Sediment N although the Al levels of the two materials were similar. Aluminum analysis of tissues was not required. The Fe results of the Sediment N and

Table 4. Major and trace element certified concentrations and uncertainties available for BCSS-1, Estuarine Sediment (Uncertainties represent 95% tolerance limits.) (µg/g dry weight unless noted).

Element	Value	Uncertainty (±)	Element	Value	Uncertainty (±)	Element	Value	Uncertainty (±)
Be	1.3	0.3	K_2O (%)	2.17	0.04	Cu	18.5	2.7
C (%)	2.19	0.09	CaO (%)	0.76	0.074	Zn	119	12
Na_2O (%)	2.72	0.21	TiO_2 (%)	0.734	0.024	As	11.1	1.4
MgO (%)	2.44	0.23	V	93.4	4.9	Se	0.43	0.06
Al_2O_3 (%)	11.83	0.41	Cr	123	14	Cd	0.25	0.04
SiO_2 (%)	66.1	1	Mn	229	15	Sn	1.85	0.2
P_2O_5 (%)	0.154	0.016	Fe_2O_3 (%)	4.7	0.14	Sb	0.59	0.06
S (%)	0.36	0.05	Co	11.4	2.1	Pb	22.7	3.4
Cl (%)	1.12	0.05	Ni	55.3	3.6			

Table 5. Major and trace element certified and noncertified concentrations and uncertainties available for SRM 1566a, Oyster Tissue (µg/g dry weight unless noted).

Certified concentrations

Element	Value	Uncertainty (±) *	Element	Value	Uncertainty (±)	Element	Value	Uncertainty (±)
Na (%)	0.417	0.013	Cr	1.43	0.46	Sr	11.1	1.0
Mg (%)	0.118	0.017	Mn	12.3	1.5	Ag	1.68	0.15
Al	202.5	12.5	Fe	539	15	Cd	4.15	0.38
P (%)	0.623	0.018	Co	0.57	0.11	I	4.46	0.42
S (%)	0.862	0.019	Ni	2.25	0.44	Hg	0.0642	0.0067
Cl (%)	0.829	0.014	Cu	66.3	4.3	Pb	0.371	0.014
K (%)	0.790	0.047	Zn	830	57	U	0.132	0.012
Ca (%)	0.196	0.019	As	14.0	1.2			
V	4.68	0.15	Se	2.21	0.24			

Noncertified concentrations

Element	Value	Element	Value	Element	Value
N (%)	6.81	Cs	0.02	Hf	0.04
F	240	La	0.3	Ta	0.003
Sc	0.06	Ce	0.4	Au	0.01
Rb	3	Sm	0.06	Th	0.04
Sn	3	Eu	0.01		
Sb	0.01	Tb	0.007		

* Uncertainties represent 95% confidence limits.

Mussel P analyses by all three NS&T laboratories were within the confidence intervals of the accepted value. Although the concentrations of Fe in the sediment materials and tissue materials were similar, BCSS-1 and SRM 1566a have much smaller confidence intervals. BATTELLE and SEFSC results were within the confidence interval for BCSS-1, while TAMU reported slightly higher results. All three laboratories reported good results for SRM 1566a. The precision of the Fe analyses was good for all three NS&T cooperating laboratories. The results of the analyses of Mn in the sediment materials were within the confidence intervals and the precision was good. The determination of Mn in tissues was not required.

4.1.3.2. Cr, Cu, and Zn

The results of the Cr, Cu, and Zn analyses are shown in Figures 4, 5 and 6 respectively. No Cr results were reported by SEFSC for sediment or tissue materials. The means of the Cr analyses by BATTELLE and TAMU were within the confidence interval of all four materials. Willie and Berman (1991) found that, in general, intralaboratory precision for Cr was worse than for most analytes. The results of the Cu analyses by the three NS&T cooperating laboratories were good for both the sediment and tissue materials, although the Mussel P mean for SEFSC was slightly high. Similar results were obtained for Zn.

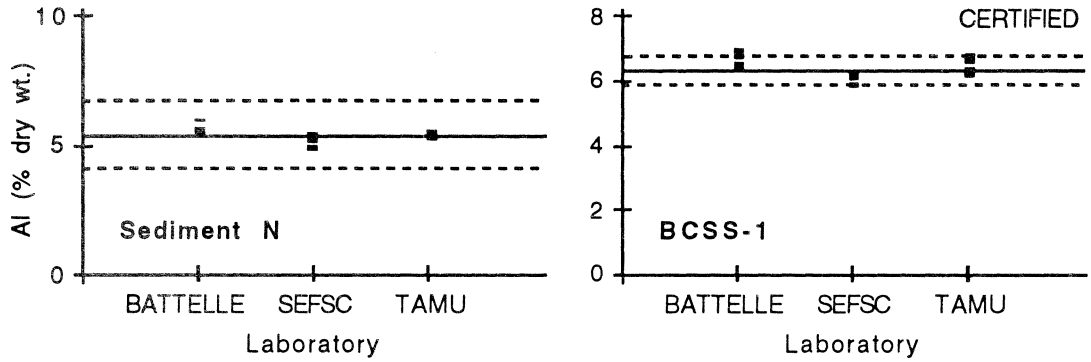


Figure 1. 1991 NOAA/5 Al intercomparison exercise results of five replicates for Sediment N and BCSS-1. (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (% dry wt.).

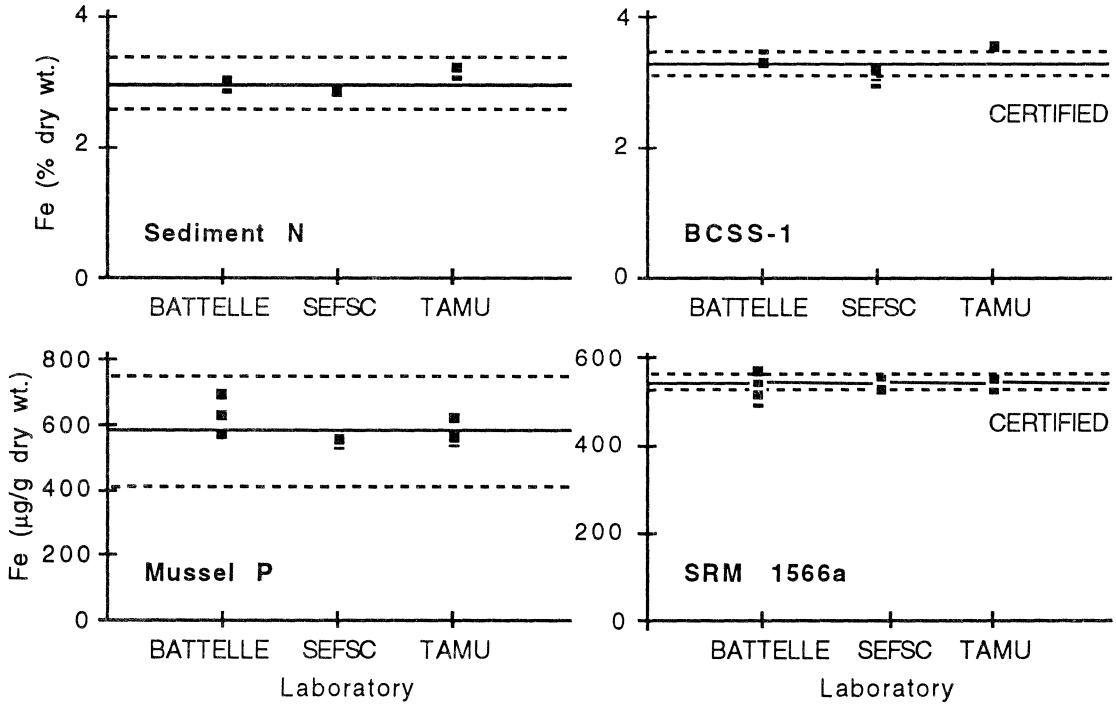


Figure 2. 1991 NOAA/5 Fe intercomparison exercise results of five replicates for Sediment N, BCSS-1, Mussel P, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (% or µg/g dry wt. as noted).

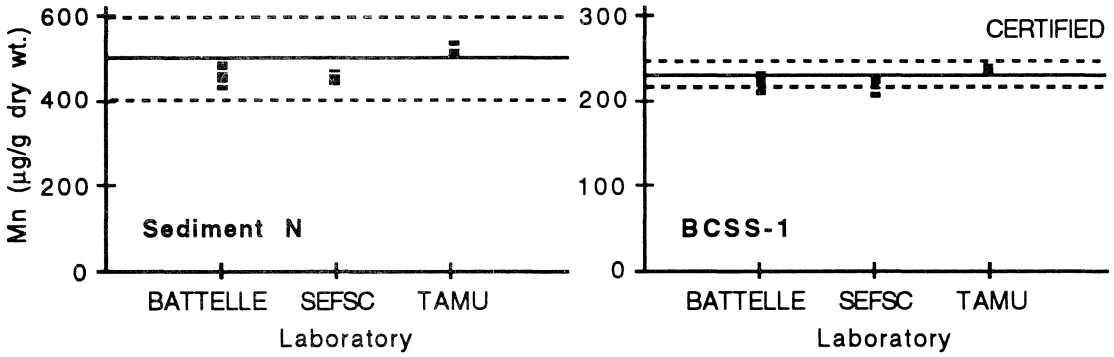


Figure 3. 1991 NOAA/5 Mn intercomparison exercise results of five replicates for Sediment N and BCSS-1 (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

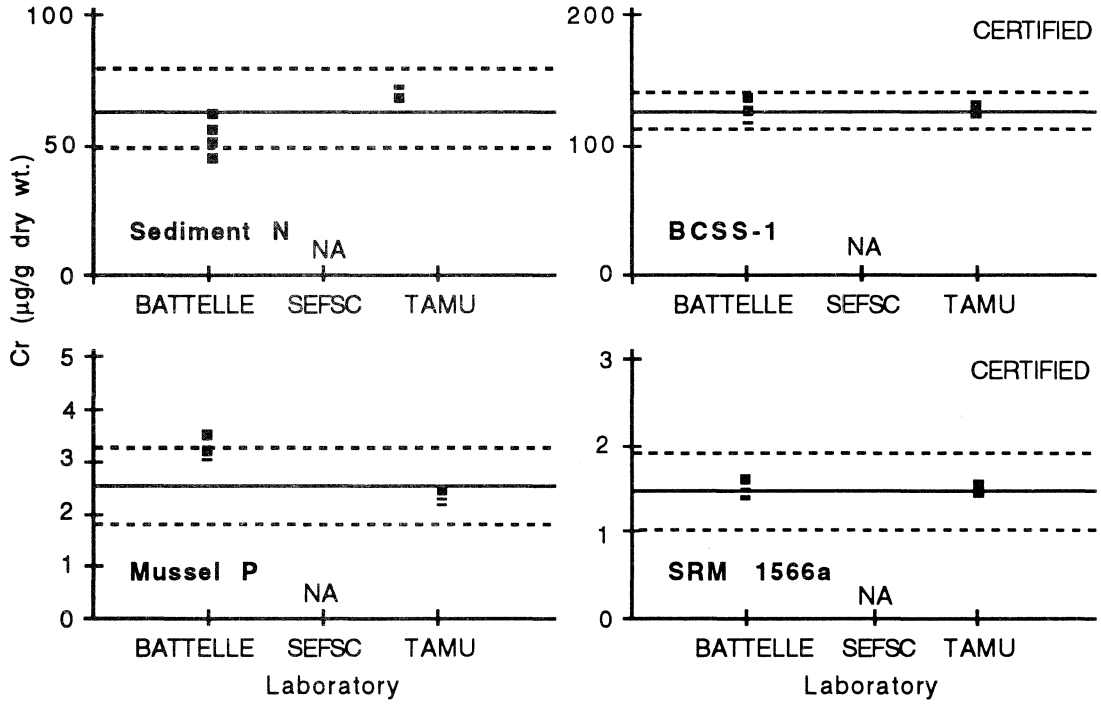


Figure 4. 1991 NOAA/5 Cr intercomparison exercise results of five replicates for Sediment N, BCSS-1, Mussel P, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ± uncertainty. NA - not analyzed.)(µg/g dry wt.).

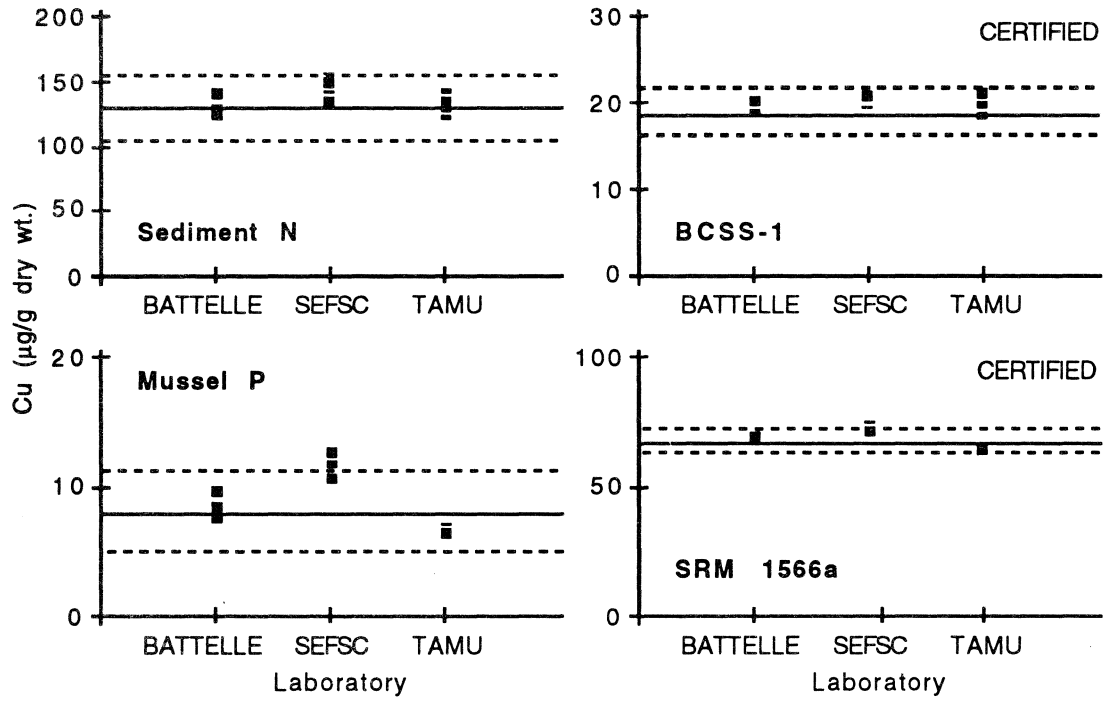


Figure 5. 1991 NOAA/5 Cu intercomparison exercise results of five replicates of Sediment N, BCSS-1, Mussel P, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

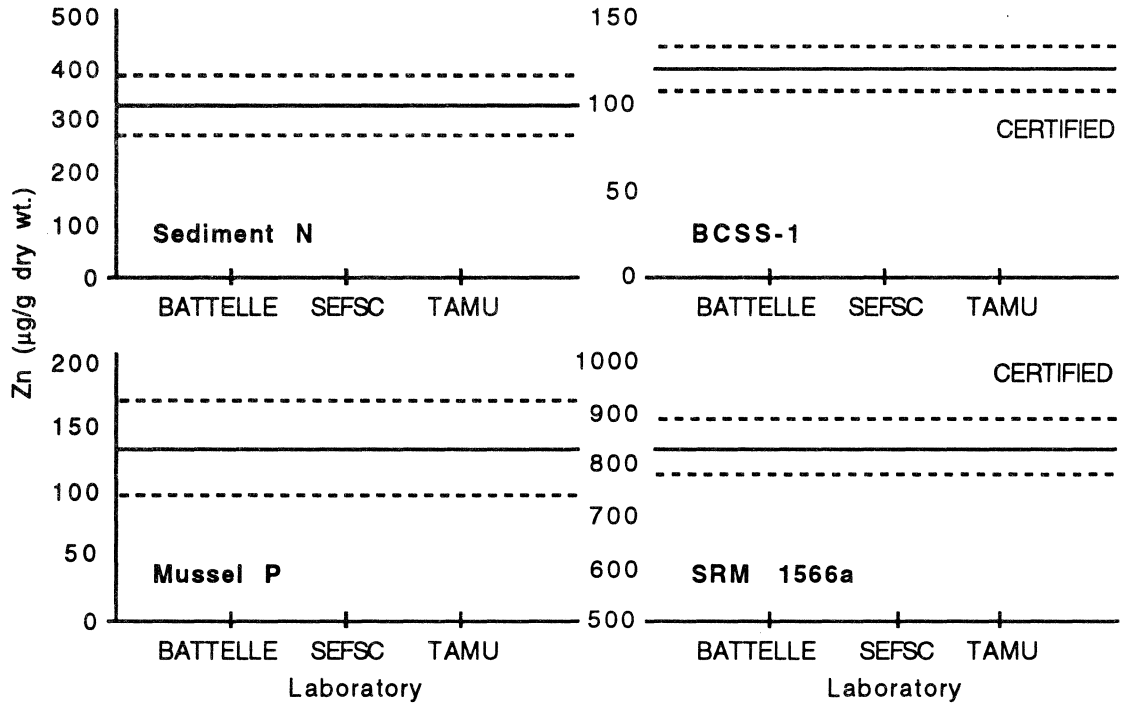


Figure 6. 1991 NOAA/5 Zn intercomparison exercise results of five replicates for Sediment N, BCSS-1, Mussel P, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

4.1.3.3. As, Cd, Ag, Hg, and Pb

The results of the As, Cd, Ag, Hg, and Pb analyses are shown in Figures 7, 8, 9, 10 and 11 respectively. The means of the As results reported by the three NS&T cooperating laboratories were within the confidence intervals of the four exercise materials. SEFSC and TAMU reported Cd means within the confidence interval of the two sediment materials, while the BATTELLE mean for BCSS-1 was high. The certified BCSS-1 Cd concentration, 0.25 ± 0.04 µg/g, is one order of magnitude lower than that of the "accepted" value for Cd for Sediment N, 2.03 ± 0.58 µg/g. The detection limit reported by BATTELLE for sediments is 0.12 µg/g, approximately half of the certified value of BCSS-1 (Tables 4 and 6). The Cd results of the analyses of the tissue materials by all three laboratories were good and within the confidence intervals. The determination of Ag in sediments was not required. The results of the Ag analyses of the tissue exercise materials by the three NS&T cooperating laboratories were within the confidence intervals. The results of the Hg analyses of the sediment and tissue materials were also within the confidence intervals.* The results of the Pb analyses of the four exercise materials were within the confidence intervals, except for those of SEFSC for SRM 1566a, which were slightly high, and those of BATTELLE for the same material, which were slightly low.

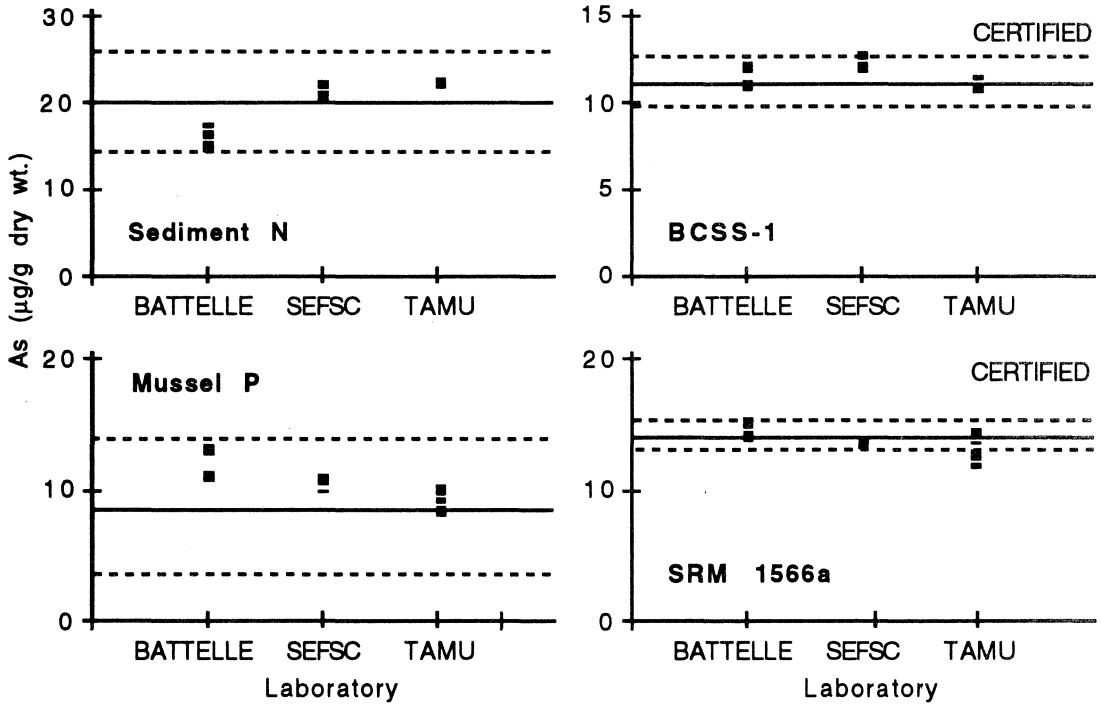


Figure 7. 1991 NOAA/5 As intercomparison exercise results of five replicates for Sediment N, BCSS-1, Mussel P, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.)(µg/g dry wt.).

* BCSS-1 is no longer certified for Hg.

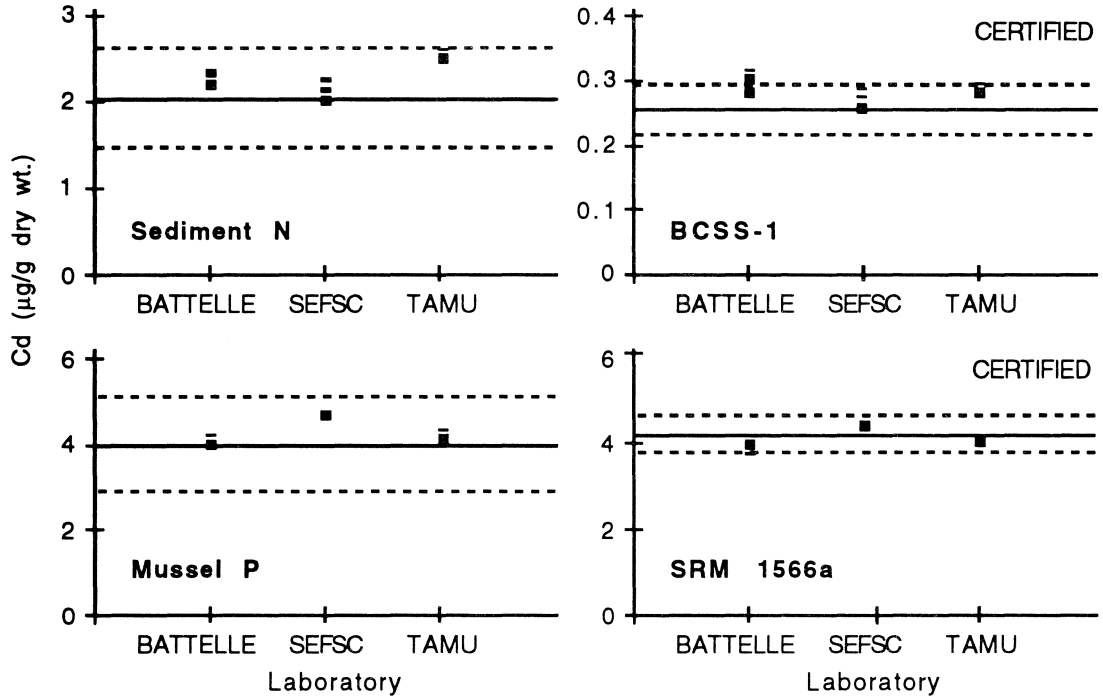


Figure 8. 1991 NOAA/5 Cd intercomparison exercise results of five replicates for Sediment N, BCSS-1, Mussel P, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.)(µg/g dry wt.).

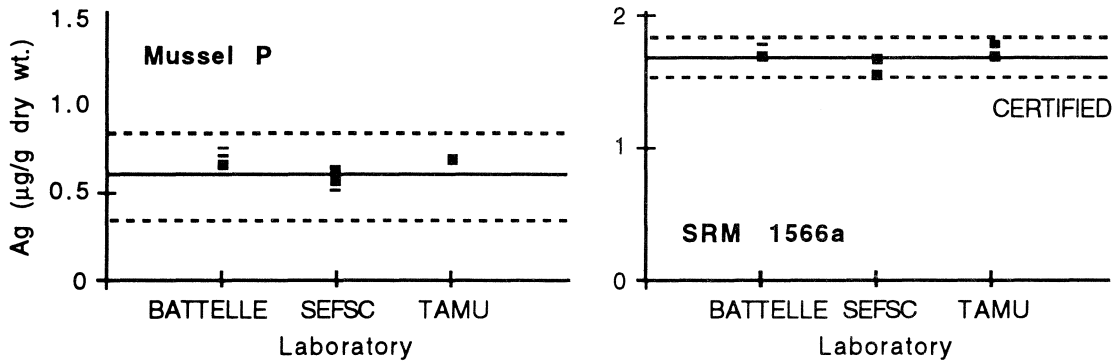


Figure 9. 1991 NOAA/5 Ag intercomparison exercise results of five replicates for Mussel P and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

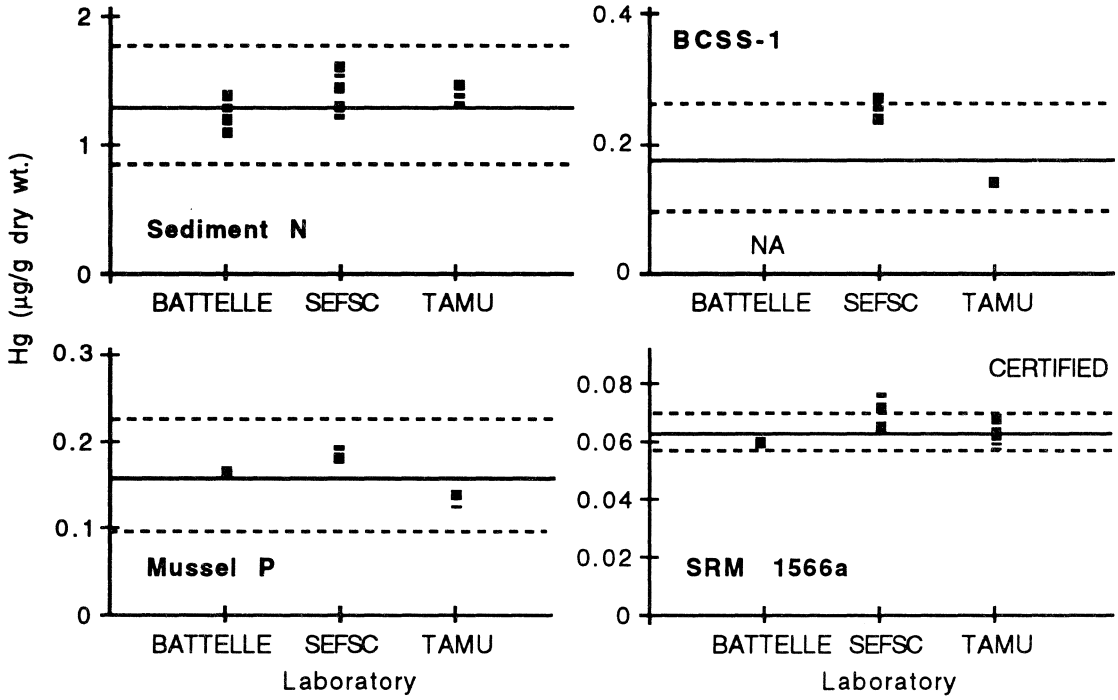


Figure 10. 1991 NOAA/5 Hg intercomparison exercise results of five replicates for Sediment N, BCSS-1, Mussel P, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ± uncertainty. NA - Not analyzed.) (µg/g dry wt.).

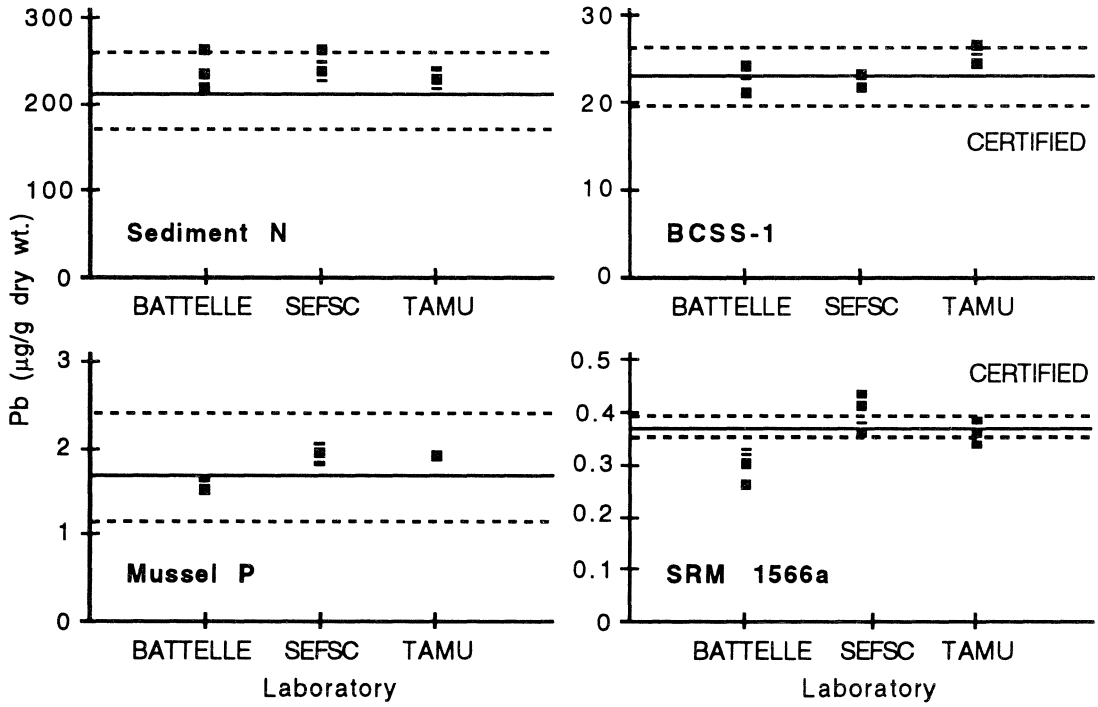


Figure 11. 1991 NOAA/5 Pb intercomparison exercise results of five replicates for Sediment N, BCSS-1, Mussel P, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

Table 6. 1991 Limits of detection for NS&T major and trace element analyses of sediments and tissues (µg/g unless noted).

	Sediments			Tissues		
	BATTELLE◊	SEFSC△	TAMU*	BATTELLE◊ (Mussels and oysters)	SEFSC△△ (Fish livers)	TAMU* (Oysters)
Al	1.3%	0.09	444	47	ND	ND
Si	2.2%	0.8	ND	500	ND	ND
Cr	16	2	0.11	0.37	0.05	0.12
Mn	220	ND	ND	0.28	1	ND
Fe	0.04%	0.05%	40.5	33	5	12.8
Ni	8.5	2	0.72	0.96	0.1	0.17
Cu	6.4	0.8	0.44	3.7	1	0.25
Zn	15	5	2.2	37	2	1.9
As	4.3	0.8	0.29	1.7	0.3	0.17
Se	1.3	0.05	0.17	0.77	0.4	0.49
Ag	0.05	0.02	0.026	0.09	0.02	0.035
Cd	0.12	0.02	0.008	0.21	0.01	0.008
Sn	0.37	0.3	0.11	0.55	0.2	0.19
Sb	0.3	0.8	ND	0.01	0.2	ND
Hg	0.035	0.06	0.0075	0.005	0.05	0.034
Pb	2.2	0.5	0.35	0.04	0.1	0.12

◊ Battelle (1992). △ Evans and Hanson (1993a). * GERG (1992). △△ Evans and Hanson (1993b). ND - Not determined.

4.1.3.4. Se, Sn, and Sb

The results of the Se analyses are shown in Figure 12. The calculated confidence interval for Sediment N was large, ±45%. All three NS&T cooperating laboratories reported mean values within the confidence interval for this material. The certified value and confidence interval for Se for BCSS-1 are 0.43 ± 0.06 µg/g dry wt. The certified value was below the MDL for BATTELLE, < 0.8 µg/g. Some of the Se values for BCSS-1 reported by SEFSC were slightly above the upper limit of the confidence interval. The values reported by TAMU were within the confidence interval. The Se analyses of the two tissue materials were within the confidence intervals except for some of the replicates reported by BATTELLE for SRM 1566a.

The results of the Sn analyses are shown in Figure 13. The three NS&T cooperating laboratories reported mean values within the confidence interval of Sediment N, Mussel P and SRM 1566a, except for SEFSC, which reported values below the confidence intervals for SRM 1566a and values below the MDL for the Mussel P material. The Sb concentration found in BCSS-1 were much lower than those of Sediment N. Two of the NS&T laboratories reported values above the confidence interval, and the other reported values below. The mean values of each of the three laboratories, however, were not far outside the confidence intervals.

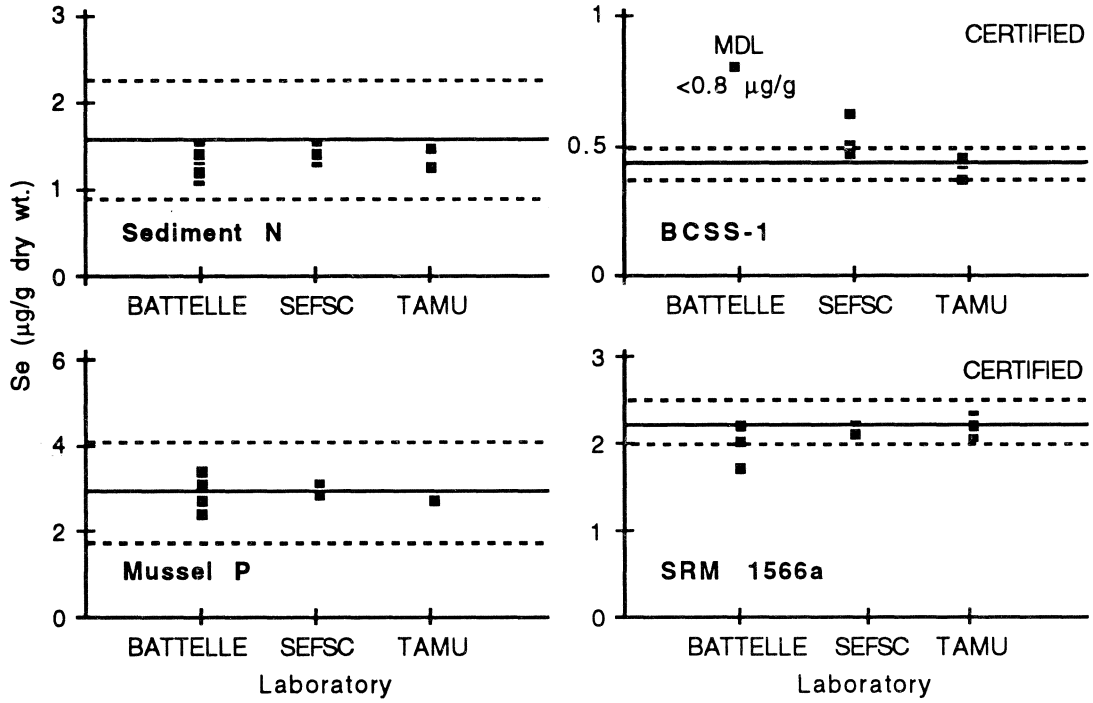


Figure 12. 1991 NOAA/5 Se intercomparison exercise results of five replicates for Sediment N, BCSS-1, Mussel P, and SRM 1566a. (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ± uncertainty. MDL is the method detection limit.) (µg/g dry wt.).

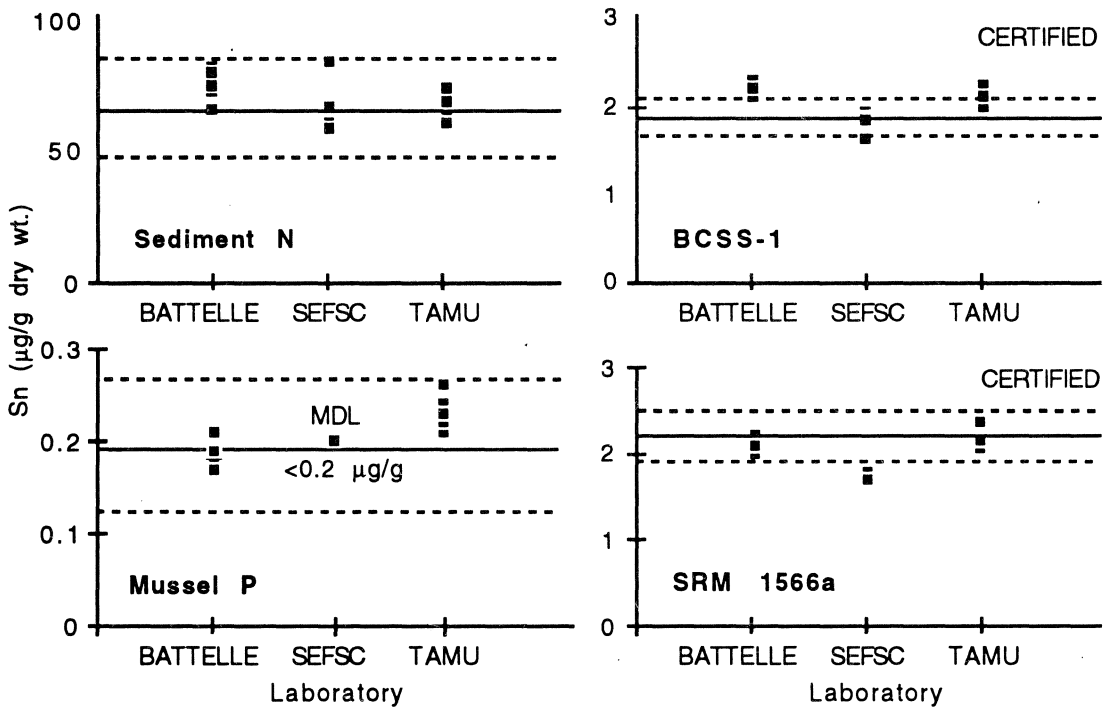


Figure 13. 1991 NOAA/5 Sn intercomparison exercise results of five replicates for Sediment N, BCSS-1, Mussel P, and SRM 1566a. (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

The analysis of Sb was optional, and BATTELLE was the only NS&T laboratory that reported Sb results. Only six laboratories reported results for the analysis of Sb in Sediment N, and no accepted value was calculated. Four laboratories reported results for BCSS-1. The results reported by BATTELLE were within the confidence interval for the CRM.

4.1.4. Performance evaluation of NS&T laboratories

Willie and Berman (1991) summarized the results of the 1991 NOAA/5 exercise using an accuracy and precision scale (Table 7). The same information is shown graphically in Figures 14 and 15. Accuracy was judged to be excellent if all the replicates were within the established confidence interval, or good if the mean of the replicates was within the established confidence interval but one or more of the replicates was outside the interval. Low or high results, being lower or higher than the confidence intervals, were also evaluated. The intralaboratory precision was judged to be good if the percent relative standard deviation (%RSD) of the five replicates met the following criteria for various analyte concentrations: for concentrations greater than 10 µg/g, the expected RSD was ±10%; for concentrations between 1 and 10 µg/g, the expected RSD was ±15%; and for concentrations lower than 1 µg/g, the expected RSD was ±20%. The expected %RSD for Al and Fe in sediments was ±5%. Precision was judged to be poor if the %RSD requirements described above were not met. The accuracy and precision achieved by three NS&T cooperating laboratories was rated good to superior in the NOAA/5 exercise.

4.1.5. Performance evaluation of "core" and "new" laboratories

There is an apparent correlation between level of performance and previous experience in intercomparison exercises. Willie and Berman (1991) compared the results of "core" laboratories that participated in one or more of the four previous NOAA intercomparison exercises with the results of those of laboratories participating for the first time. The means and standard deviations of the two laboratory groups are listed in Tables 8 and 9 for sediment and tissue analyses respectively. Conspicuous outliers were not included in the calculation of the means. The new participants produced lower means and worse precision for both sets of analyses than those produced by the core laboratories. The results of the sediment analysis may be the results of incomplete dissolution of the sample. It is essential to incorporate HF in the dissolution procedure. The reason for lower means for the tissue analysis was not apparent.

Table 7. Laboratory performance evaluation for NOAA/5 (First letter is the evaluation of the accuracy and the other of the precision.).

Accuracy:

- E - Excellent accuracy. All replicates were within the established confidence interval.
- G - Good accuracy. The mean of the replicates was within the established confidence interval but one or more of the replicates was outside.
- L - Low results. The mean of the replicates was less than the lower confidence interval.
- H - High results. The mean of the replicates was greater than the higher confidence interval.
- ? - Accuracy could not be established.

Precision:

- G - Good precision. The intralaboratory precision was within the following criteria for various analyte concentrations: concentration ≥10 µg/g, expected RSD ±10% (±5% for Al and Fe in sediments); concentration ≥1 - <10 µg/g, expected RSD ±15%; and concentration <1 µg/g, expected RSD ±20%
- X - The intralaboratory precision was not within the criteria described above.
- - - No results or a "less than" value submitted.

	Mussel P		SRM 1566a		Sed. N		BCSS-1			Mussel P		SRM 1566a		Sed. N		BCSS-1	
BATTELLE																	
Al	?	G	L	G	E	G	G	G	Se	E	G	G	G	E	G	-	-
Si	-	-	-	-	E	G	G	G	Ag	E	G	E	G	-	-	-	-
Cr	G	G	E	G	G	G	E	G	Cd	E	G	E	G	E	G	H	G
Mn	-	-	-	-	E	G	E	G	Sn	E	G	E	G	G	G	H	G
Fe	E	G	G	G	E	G	E	G	Sb	-	-	-	-	-	-	G	G
Cu	E	G	E	G	E	G	E	G	Hg	E	G	E	G	E	G	-	-
Zn	E	G	E	G	H	G	L	G	Pb	E	G	L	G	G	G	E	G
As	E	G	E	G	E	G	E	G									
SEFSC																	
Al	-	-	-	-	E	G	E	G	Se	E	G	E	G	E	G	H	G
Si	-	-	-	-	-	-	-	-	Ag	E	G	E	G	-	-	-	-
Cr	-	-	-	-	-	-	-	-	Cd	E	G	E	G	E	G	E	G
Mn	-	-	-	-	E	G	G	G	Sn	-	-	L	G	G	X	E	G
Fe	E	G	E	G	E	G	L	G	Sb	-	-	-	-	-	-	-	-
Cu	H	G	H	G	E	G	E	G	Hg	E	G	G	G	E	G	G	G
Zn	E	G	E	G	G	G	E	G	Pb	E	G	H	G	G	G	E	G
As	E	G	E	G	E	G	G	G									
TAMU																	
Al	?	G	G	G	E	G	E	G	Se	E	G	E	G	E	G	E	G
Si	-	-	-	-	-	-	-	-	Ag	E	G	E	G	-	-	-	-
Cr	E	G	E	G	E	G	E	G	Cd	E	G	E	G	E	G	E	G
Mn					E	G	E	G	Sn	E	G	E	G	E	G	H	G
Fe	E	G	E	G	E	G	H	G	Sb	-	-	-	-	-	-	-	-
Cu	E	G	E	G	E	G	E	G	Hg	E	G	E	G	E	G	E	G
Zn	E	G	E	G	E	G	E	G	Pb	E	G	G	G	E	G	G	G
As	E	G	G	G	E	G	E	G									

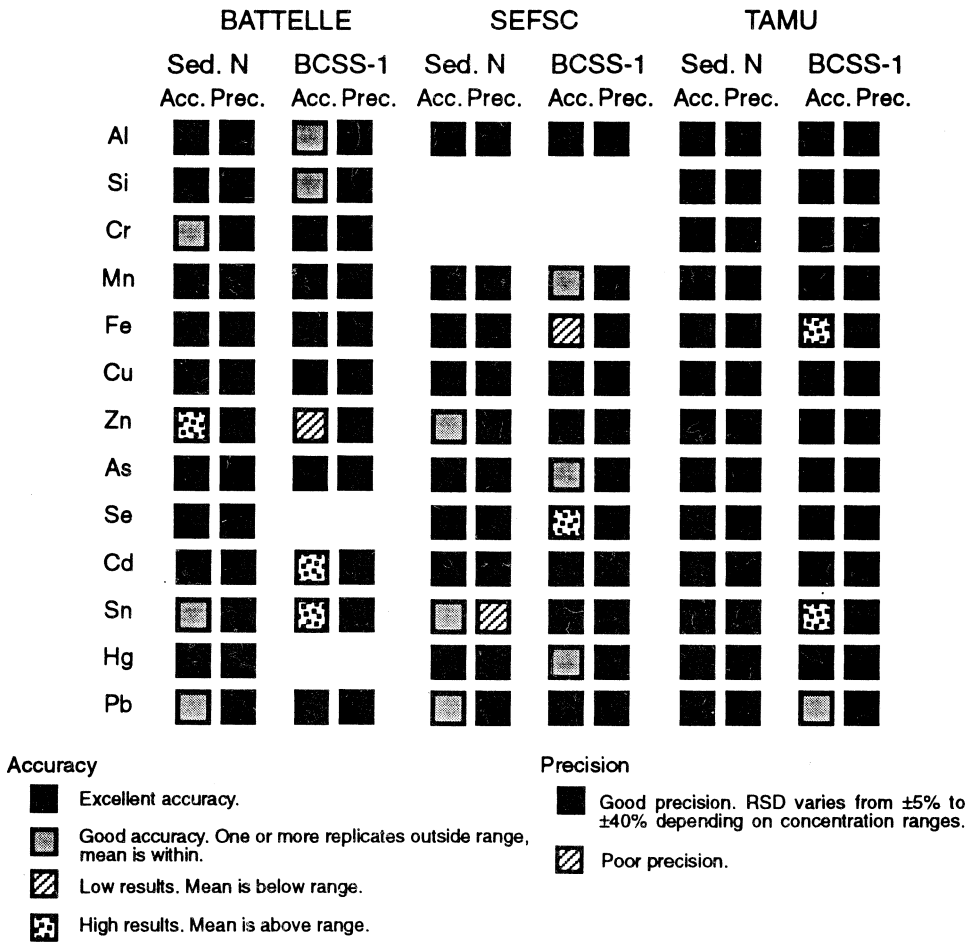


Figure 14. 1991 major and trace element sediment determination performance evaluation.

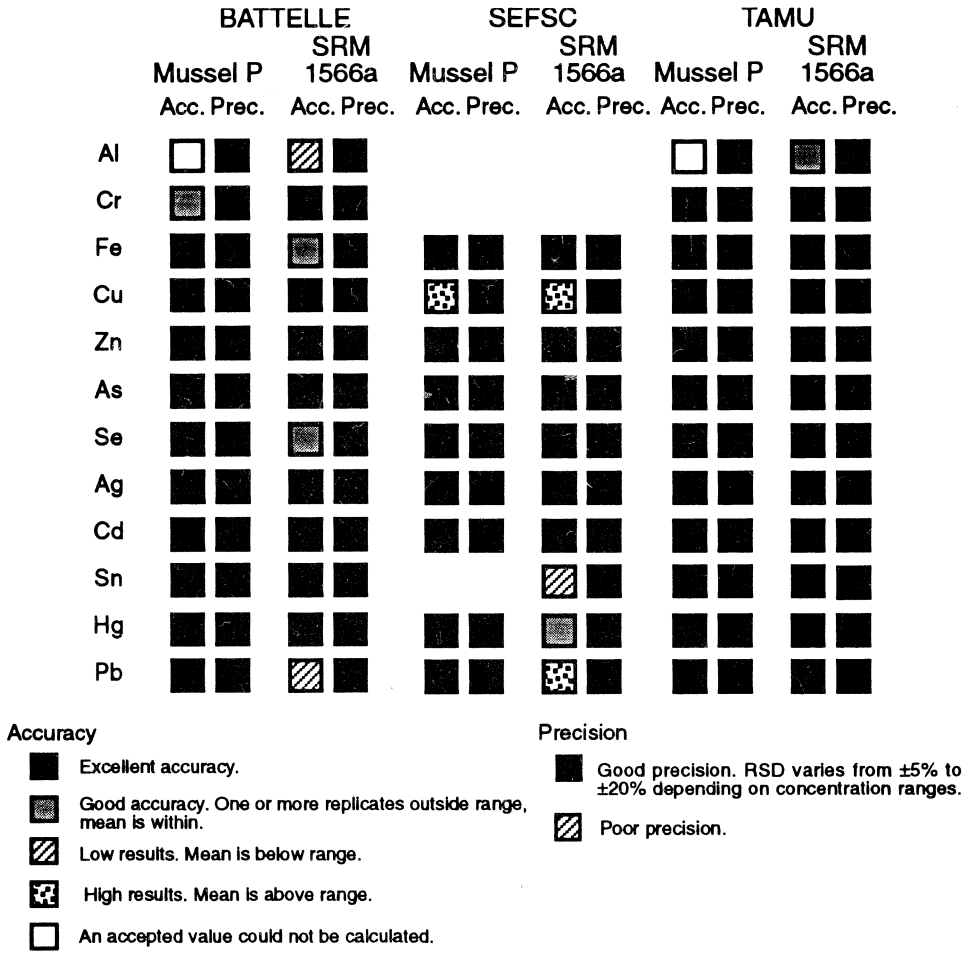


Figure 15. 1991 major and trace element tissue determination performance evaluation.

Table 8. Comparison of 1991 sediment analysis results of previous participants and new participants (µg/g unless noted) (number of means used in the calculation are in parenthesis) (from Willie and Berman, 1991).

Element	Sample	Core* laboratories	New laboratories	Accepted or certified value
Al (%)	Sediment N	5.37 ± 0.56 (9)	2.72 ± 2.19 (12)	5.27 ± 1.30
	BCSS-1	6.28 ± 0.41 (7)	3.12 ± 2.41 (11)	6.26 ± 0.41
Cr	Sediment N	62.1 ± 7.2 (11)	41.9 ± 16.7 (13)	63.1 ± 15.7
	BCSS-1	115 ± 17 (8)	59 ± 29 (13)	123 ± 14
Mn	Sediment N	491 ± 43 (11)	369 ± 139 (9)	495 ± 103
	BCSS-1	228 ± 10 (8)	201 ± 31 (9)	229 ± 15
Fe (%)	Sediment N	2.95 ± 0.21 (10)	2.67 ± 0.37 (12)	2.97 ± 0.40
	BCSS-1	3.04 ± 0.44 (9)	2.74 ± 0.47 (10)	3.28 ± 0.14
Cu	Sediment N	132 ± 11 (11)	115 ± 28 (15)	129 ± 26
	BCSS-1	18.8 ± 2.3 (9)	16.8 ± 5.4 (14)	18.5 ± 2.7
Zn	Sediment N	336 ± 16 (11)	311 ± 35 (12)	325 ± 55
	BCSS-1	131 ± 60 (9)	105 ± 19 (13)	119 ± 12
As	Sediment N	21.2 ± 4.4 (9)	18.5 ± 3.1 (11)	19.8 ± 5.8
	BCSS-1	10.4 ± 1.5 (7)	9.02 ± 3.57 (10)	11.1 ± 1.4
Se	Sediment N	1.47 ± 0.23 (6)	1.10 ± 0.61 (9)	1.54 ± 0.70
	BCSS-1	0.48 ± 0.06 (4)	0.45 ± 0.13 (4)	0.43 ± 0.06
Cd	Sediment N	2.31 ± 0.44 (10)	2.16 ± 0.67 (14)	2.03 ± 0.58
	BCSS-1	0.279 ± 0.128 (8)	0.269 ± 0.129 (11)	0.25 ± 0.04
Sn	Sediment N	63 ± 14 (9)	54 ± 15 (4)	65.4 ± 19.1
	BCSS-1	1.93 ± 0.44 (7)	1.41 ± 0.67 (7)	1.85 ± 0.20
Hg	Sediment N	1.47 ± 1.32 (8)	1.24 ± 0.26 (14)	1.34 ± 0.47
	BCSS-1	0.163 ± 0.044 (7)	0.179 ± 0.057 (13)	0.174 ± 0.081
Pb	Sediment N	193 ± 69 (9)	196 ± 55 (14)	211 ± 46
	BCSS-1	22.9 ± 2.1 (9)	22.8 ± 6.4 (14)	22.7 ± 3.4

* Laboratories that have participated in one or more of the former four NOAA intercomparison exercises.

Table 9. Comparison of 1991 tissue analysis results of previous participants and new participants (µg/g) (number of means used in the calculation are in parenthesis) (from Willie and Berman, 1991).

Element	Sample	Core * laboratories	New laboratories	Accepted or certified value
Al	Mussel P	645 ± 276 (8)	307 ± 125 (8)	-
	SRM 1566a	95 ± 62 (6)	62 ± 30 (6)	202.5 ± 12.5
Cr	Mussel P	2.55 ± 0.79 (9)	1.20 ± 0.33 (7)	2.52 ± 0.75
	SRM 1566a	2.24 ± 0.47 (9)	1.58 ± 0.75 (13)	1.43 ± 0.46
Fe	Mussel P	567 ± 109 (8)	460 ± 127 (11)	575 ± 172
	SRM 1566a	511 ± 64 (7)	464 ± 96 (7)	539 ± 15
Cu	Mussel P	6.93 ± 2.24(10)	8.02 ± 1.91 (11)	7.81 ± 3.07
	SRM 1566a	65.5 ± 6.1 (8)	61.5 ± 2.0 (9)	66.3 ± 4.3
Zn	Mussel P	151 ± 17.5 (10)	140 ± 16 (14)	146 ± 19
	SRM 1566a	807 ± 72 (7)	787 ± 81 (9)	830 ± 55.7
As	Mussel P	9.33 ± 2.45 (8)	8.79 ± 3.06 (13)	8.56 ± 5.0
	SRM 1566a	12.6 ± 2.3 (8)	11.4 ± 2.2 (8)	14 ± 1.2
Se	Mussel P	3.21 ± 0.78 (8)	2.79 ± 0.74 (10)	2.86 ± 1.20
	SRM 1566a	2.16 ± 0.10 (6)	1.93 ± 0.48 (6)	2.21 ± 0.24
Ag	Mussel P	0.621 ± 0.093 (9)	0.535 0.15 (6)	0.587 ± 0.257
	SRM 1566a	1.64 ± 0.11 (7)	1.38 ± 0.62 (6)	1.68 ± 0.15
Cd	Mussel P	4.30 ± 0.44 (9)	3.73 ± 0.53 (14)	3.96 ± 1.14
	SRM 1566a	4.10 ± 0.34 (8)	4.01 ± 0.40 (10)	4.15 ± 0.38
Sn	SRM 1566a	1.82 ± 0.74 (7)	2.72 1.12 (3)	2.18 0.27
Hg	Mussel P	0.165 ± 0.075 (8)	0.222 ± 0.182 (14)	0.159 ± 0.065
	SRM 1566a	0.0616 ± 0.0115 (7)	0.0634 ± 0.0238 (9)	0.0642 ± .0067
Pb	Mussel P	1.77 ± 0.29 (10)	1.87 ± 0.54 (11)	1.75 ± 0.67
	SRM 1566a	0.335 ± 0.049 (8)	0.318 ± 0.041 (5)	0.371 ± 0.014

* Laboratories that have participated in one or more of the former four NOAA intercomparison exercises.

4.2. 1992 Exercise

The sixth NS&T trace metals intercomparison exercise, NOAA/6, took place in 1992 and was coordinated by NRC. The NS&T cooperating laboratories were SEFSC, BATTELLE, and TAMU. Materials were sent to 39 other laboratories, some of which participated on a voluntary basis. Results were received from the NS&T cooperating laboratories and 32 non-NS&T laboratories. The materials used were Sediment R, BCSS-1, Fish Q and DORM-1. The results of the analyses are listed in Appendix II. A detailed description of the exercise and the results of the other participating laboratories can be found in Willie and Berman (1992).

4.2.1. Description of materials and exercise

Sediment R is a freeze dried sediment from Chesapeake Bay donated by the NIST. Fish Q is a spray-dried sample of filleted flounder collected off the east coast of Nova Scotia, Canada, and prepared for NRC by the Technical University of Nova Scotia. DORM-1, Dogfish Liver, is composed of dogfish (*Squalus acanthias*) liver containing 5% fat. The livers were cleaned and frozen for storage, thawed, homogenized and extracted with acetone to produce a partially defatted protein powder. This powder was screened through a 24-mesh nylon screen, mixed, bottled, and radiation sterilized. The certified values are listed in Table 10, and a more complete description of the preparation and analysis of DORM-1 can be found in NRC (1986).

As for the NOAA/5 exercise, each laboratory received 10-g samples of each "unknown" sample, and were asked to perform five replicate analyses of each of the two unknowns, BCSS-1, and DORM-1, for Al, Cr, Fe, Ni, Cu, Zn, As, Se, Ag, Cd, Sn, Hg and Pb. Analyses of Si, Mn, Sb and Tl were also required for Sediment R and BCSS-1. The results are shown graphically in Figures 16 - 30, and are listed in Appendix II. NRC provided benchmarks for accuracy by analyzing Sediment R and Fish Q by two different methods, including IDICPMS when possible.

4.2.2. "Accepted" values

"Accepted" values were calculated from the mean of laboratory replicates and the NRC data as described in Section 4.1.2. The "accepted" values and uncertainties as well as the certified values and uncertainties for BCSS-1 and DORM-1 are listed in Tables II.1 - II.4 in Appendix II.

Table 10. Major and trace element certified concentrations and uncertainties available for DORM-1, Dogfish Muscle (Uncertainties represent 95% tolerance limits.) (µg/g dry weight unless noted).

Element	Value	Uncertainty (±)	Element	Value	Uncertainty (±)
Na (%)	0.800	0.060	Cu	5.22	0.33
Mg (%)	0.121	0.013	Zn	21.3	1.0
Cl (%)	1.13	0.03	As	17.7	2.1
K (%)	1.59	0.10	Se	1.62	0.12
Cr	3.60	0.40	Cd	0.086	0.012
Mn	1.32	0.26	Hg	0.798	0.074
Fe	63.6	5.3	Pb	0.40	0.12
Co	0.049	0.014			
Ni	1.20	0.30	Methyl Hg	0.731	0.060

4.2.3. Results

4.2.3.1. Al, Si, Fe, and Mn

The results of the Al, Fe and Mn analyses are shown in Figures 16, 17 and 18, respectively. The means of the three NS&T cooperating laboratories for Al were within the 95% confidence interval of Sediment R and BCSS-1, although the mean reported by BATTELLE for BCSS-1 was slightly high (Figure 16). Aluminum analysis of tissues was not required. The analysis of Si in tissues was not required and only one of the three laboratories reported Si values in sediments. The Si results for BCSS-1 were within the certified range for the CRM. Although there were insufficient data to determine an accepted value for Sediment R, the results of the three reporting laboratories were comparable. The Fe results are shown in Figure 17. BATTELLE and TAMU reported means within the confidence interval of Sediment R and BCSS-1. SEFSC reported a mean value of 2.22 ± 0.03% for Sediment R, higher than the accepted value of 1.88 ± 0.25%, and outside the confidence interval. The confidence interval for Fish Q was large, approximately ± 47%, and the three NS&T laboratories reported values within the confidence interval. The confidence interval of DORM-1 was ± 8%. BATTELLE and TAMU reported mean values within the confidence interval. The mean value reported by SEFSC was 70 ± 3 µg/g, slightly above the certified value and confidence interval of DORM-1, 63.6 ± 5.3 µg/g. The Mn results are shown in Figure 18. The determination of Mn in tissues was not required. The mean values reported by BATTELLE and SEFSC were within the confidence intervals for Sediment R and BCSS-1. No Mn results were reported by TAMU.

4.2.3.2. Cr, Ni, Cu, and Zn

The results of the Cr, Ni, Cu, and Zn analyses are shown in Figures 19, 20, 21, and 22, respectively. The mean Cr values reported by the three NS&T cooperating laboratories were within the confidence intervals of each of the exercise materials, except for the SEFSC result for BCCS-1 which was low, 92 µg/g, compared to the certified value of 123 µg/g, and the BATTELLE result for DORM-1 which was high, 4.2 µg/g, compared with the certified value of 3.6 µg/g. Low Cr values for sediment samples may be indicative of incomplete dissolution. The BATTELLE mean value for DORM-1, 4.2 µg/g, was slightly higher than the upper limit of the confidence interval, 4.0 µg/g. Nickel was not a target analyte for previous exercises. The results of the Ni analyses of the four exercise materials by BATTELLE and TAMU

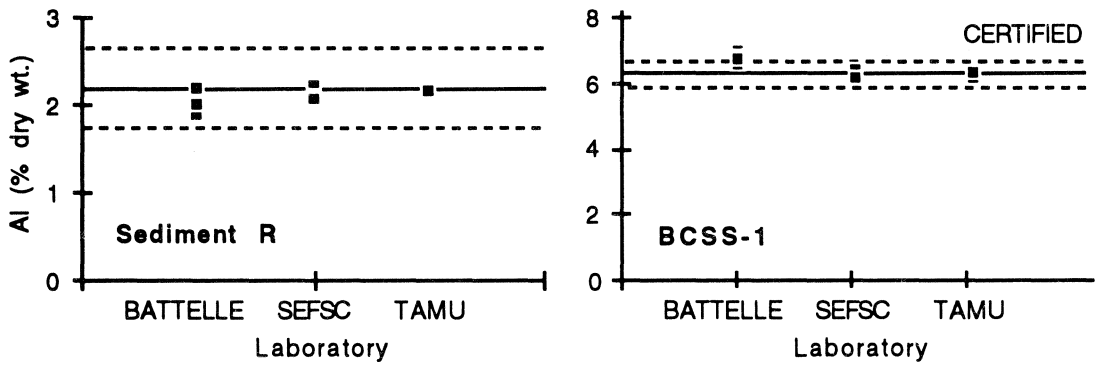


Figure 16. 1992 NOAA/6 Al intercomparison exercise results of five replicates for Sediment R and BCSS-1 (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ± uncertainty.) (% dry wt.).

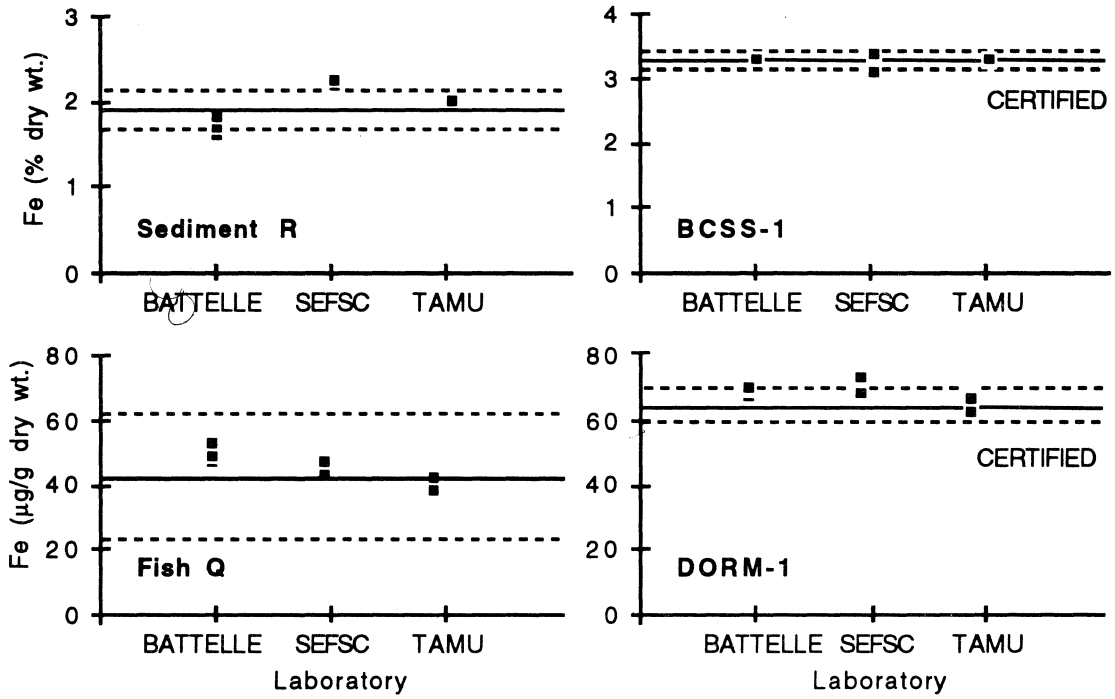


Figure 17. 1992 NOAA/6 Fe intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (percent or µg/g dry wt. as noted).

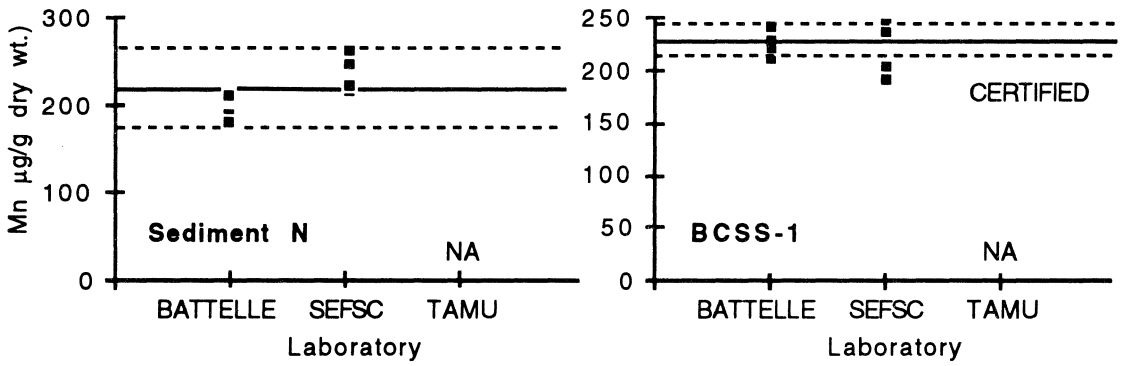


Figure 18. 1992 NOAA/6 Mn intercomparison exercise results of five replicates for Sediment R and BCSS1 (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ± uncertainty. NA - Not available.) (µg/g dry wt.).

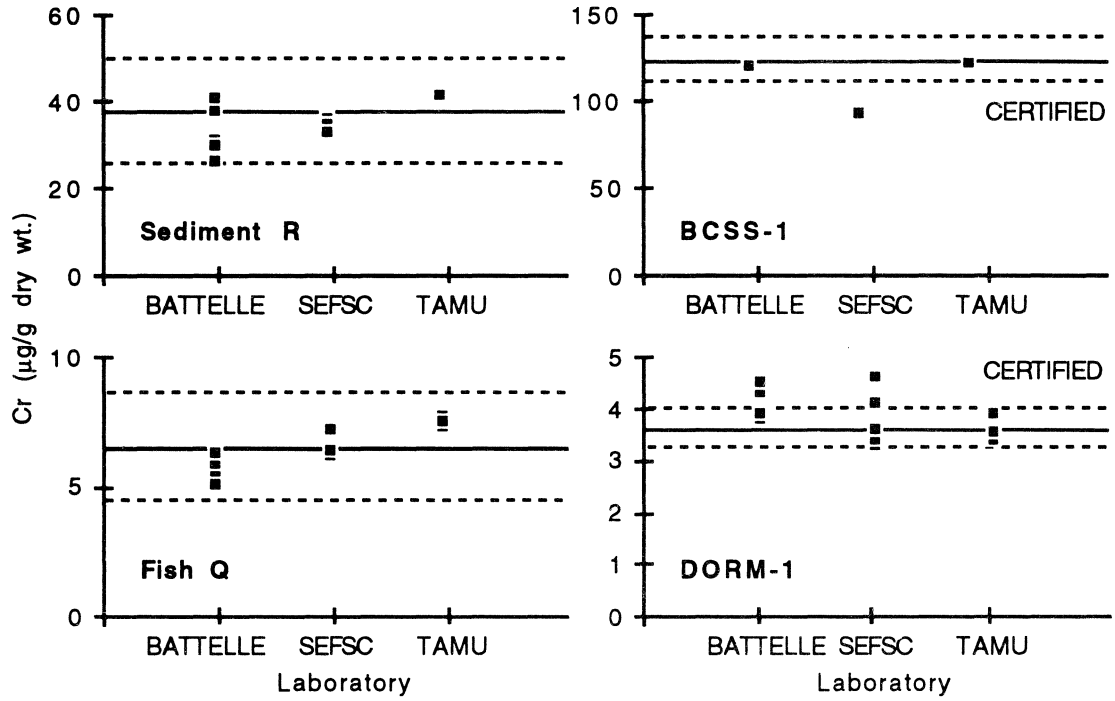


Figure 19. 1992 NOAA/6 Cr intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

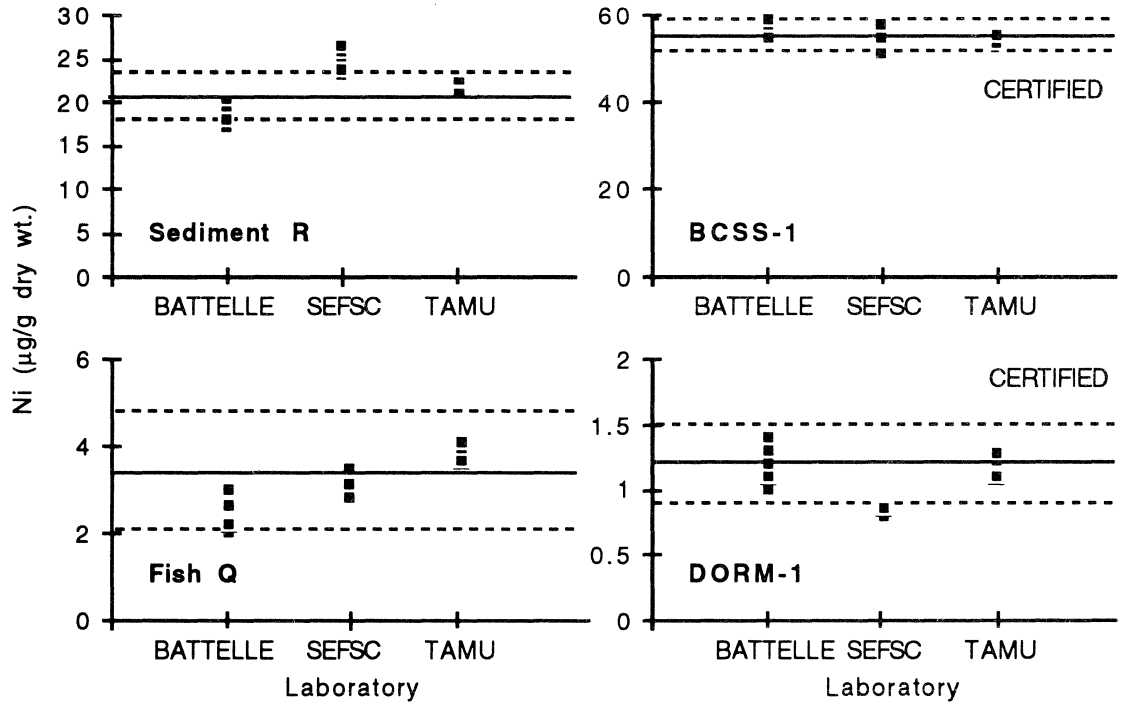


Figure 20. 1992 NOAA/6 Ni intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.). (µg/g dry wt.).

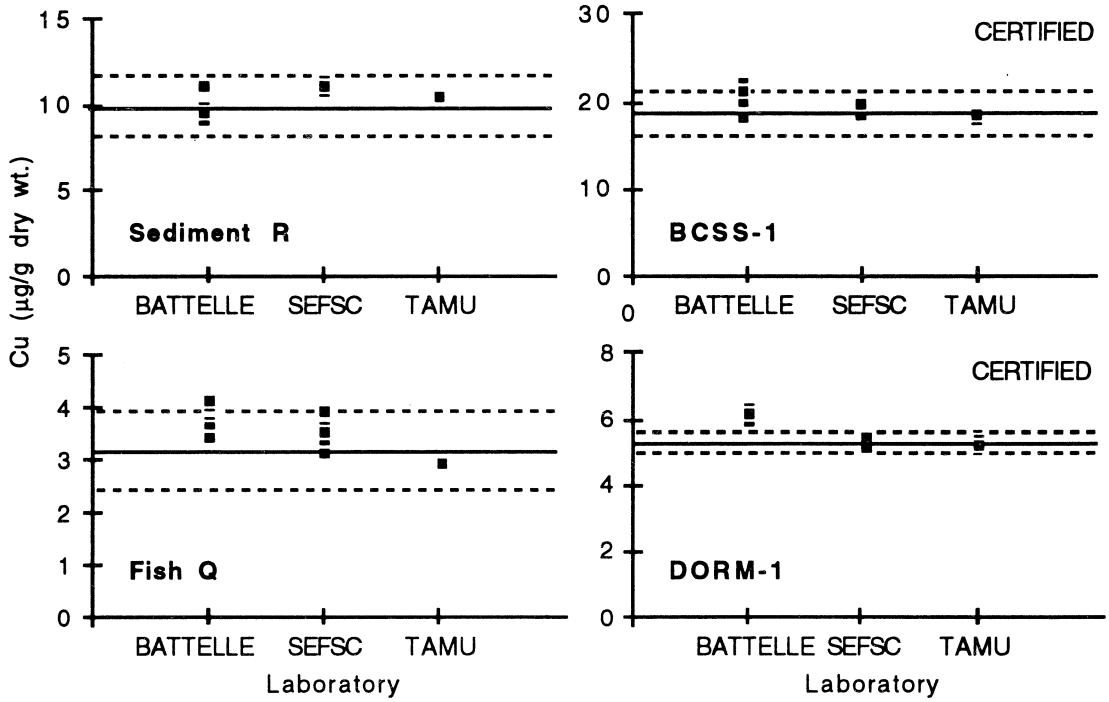


Figure 21. 1992 NOAA/6 Cu intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

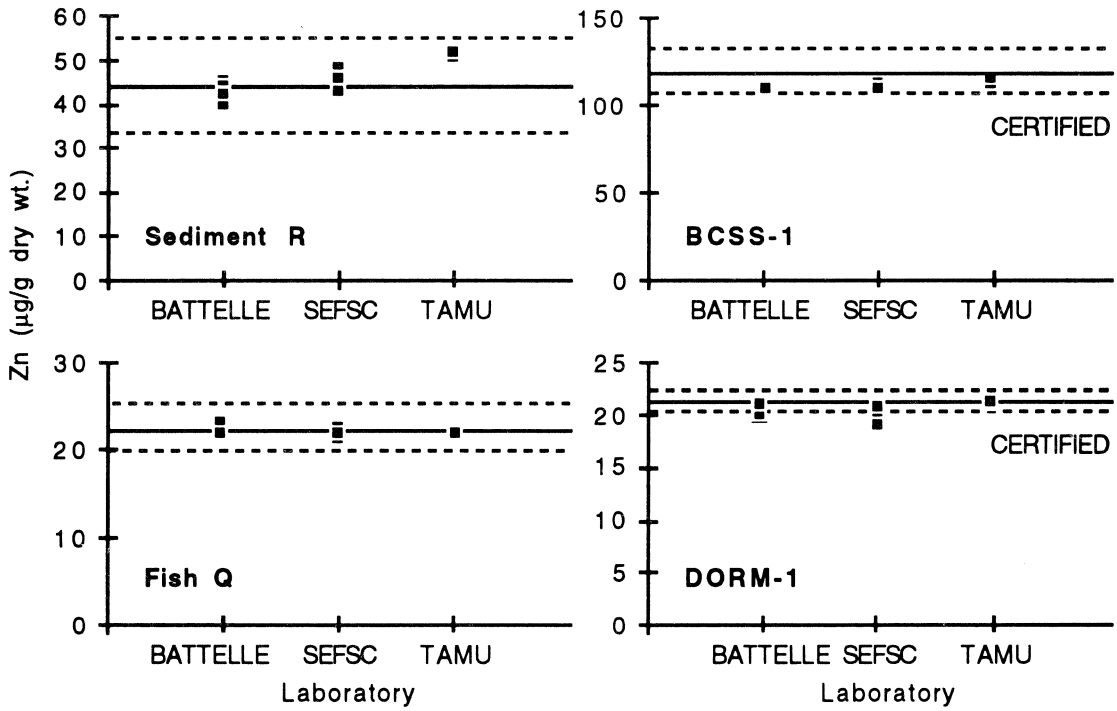


Figure 22 1992 NOAA/6 Zn intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

were within the confidence intervals. The mean Ni value reported by SEFSC for DORM-1, 0.084 µg/g, was slightly lower than the lower limit of the confidence interval, 0.9 µg/g. The mean Ni reported by SEFSC for Sediment R, 24.7 µg/g, was slightly above the higher limit of the confidence interval, 23.5 µg/g. The SEFSC results for the other materials were within the confidence intervals. The mean Cu values reported by the three NS&T cooperating laboratories were within the confidence intervals of each of the exercise materials except for the BATTELLE results for DORM-1, 6.2 µg/g, compared to the upper limit of the confidence interval, 5.55 µg/g (Figure 21). The mean Zn values were within the confidence intervals except for the SEFSC mean for DORM-1, 19.7 µg/g, which was just below the lower limit of the confidence interval, 20.3 µg/g (Figure 22). The confidence interval for DORM-1 was only ± 10%, which is very narrow.

4.2.3.3. As, Cd, Ag, Hg, and Pb

The results of the As, Cd, Ag, Hg, and Pb analyses are shown in Figures 23, 24, 25, 26, and 27, respectively. The means of the As results reported by the three NS&T cooperating laboratories were within the confidence intervals of the four exercise materials (Figure 23). The means of the Cd results for Sediment R and BCSS-1 were within the confidence intervals of the exercise materials (Figure 24). Similar results were reported for Fish Q and DORM-1 by SEFSC and TAMU. The Cd results reported by BATTELLE for Fish Q and DORM-1 have %RSDs of 43% and 42% respectively, and the mean values are outside the confidence intervals. The reported MDL for BATTELLE for tissues is 0.21 µg/g (Table 6), which is higher than the accepted value for Fish Q and the certified value for DORM-1. The results of the Ag analyses are shown in Figure 25. The Ag concentration of Sediment R was quite low, 0.40 ± 0.022 µg/g.

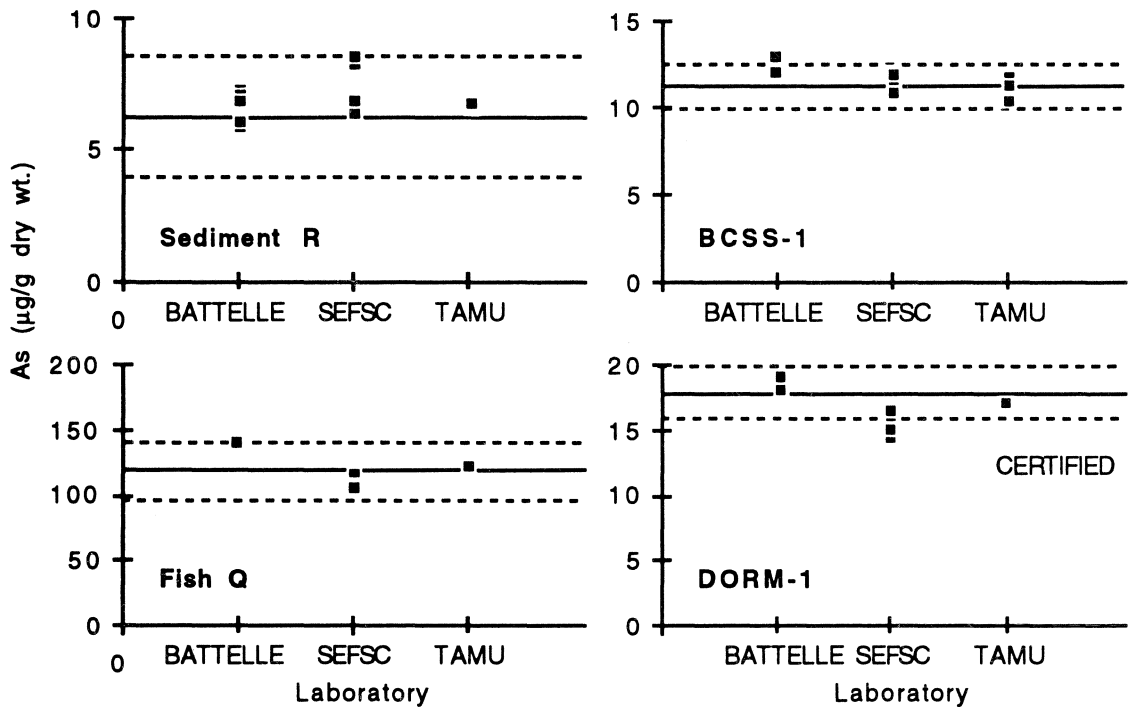


Figure 23. 1992 NOAA/6 As intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (µg/g dry wt.) (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.).

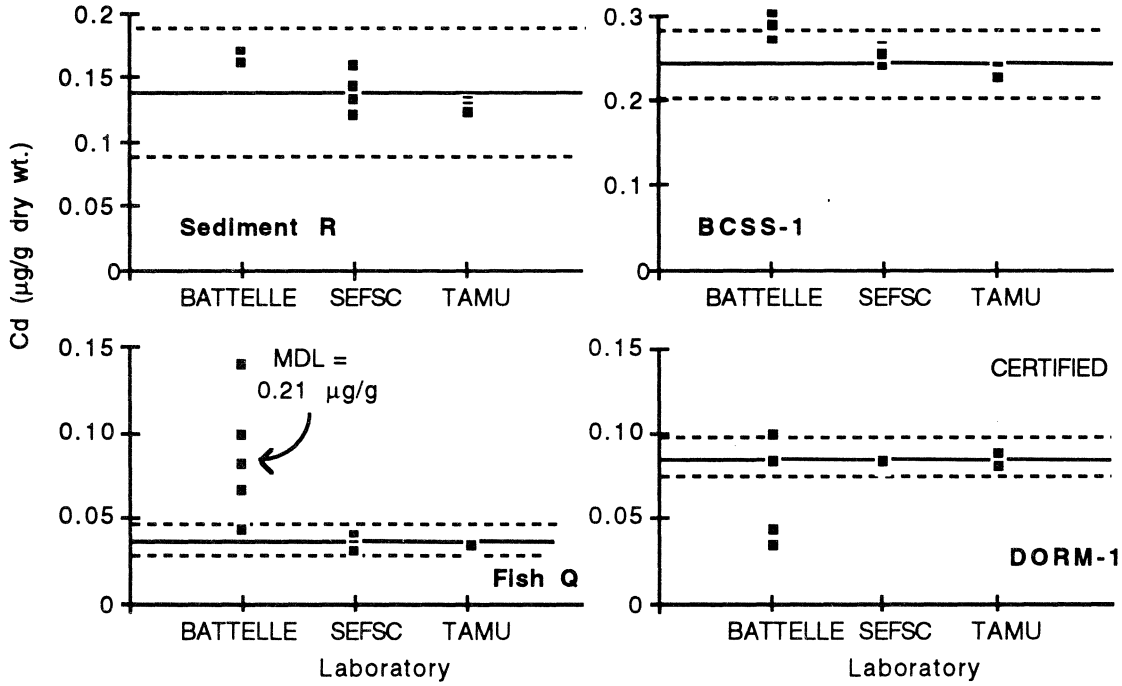


Figure 24. 1992 NOAA/6 Cd intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (µg/g dry wt.) (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.).

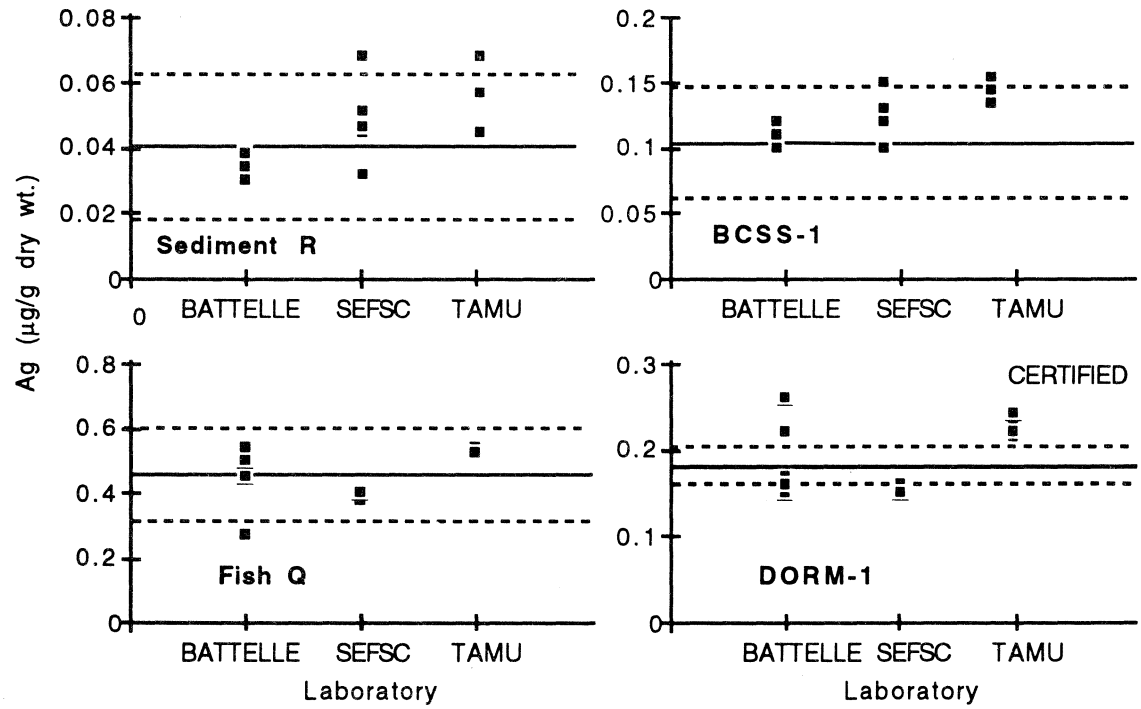


Figure 25. 1992 NOAA/6 Ag intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (µg/g dry wt.) (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.).

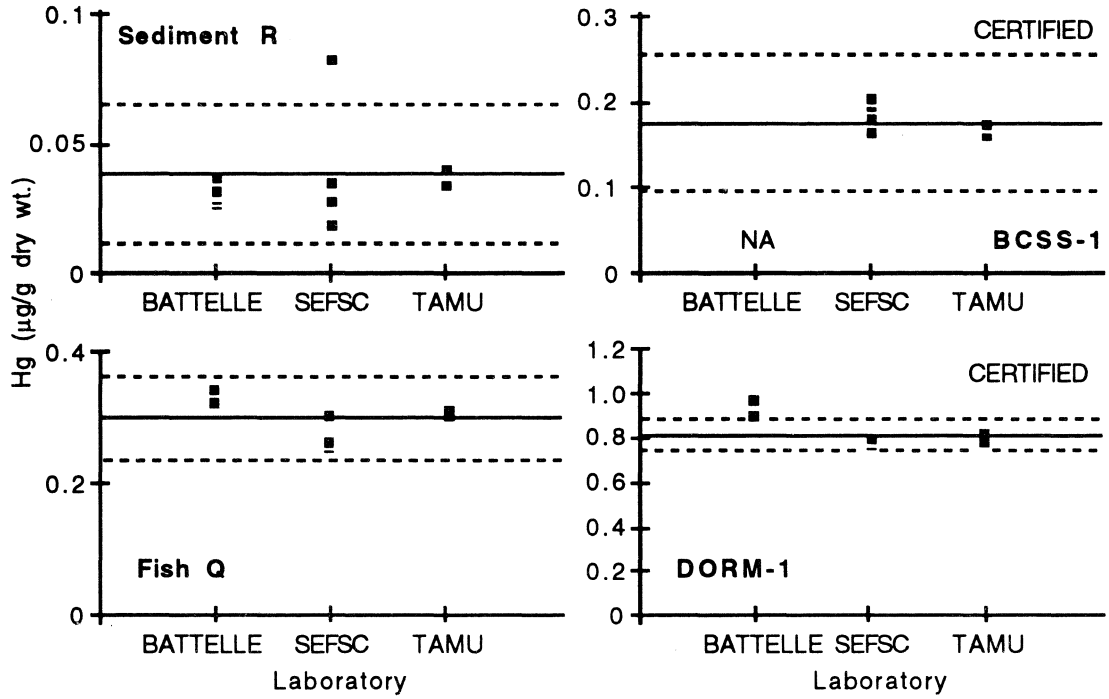


Figure 26. 1992 NOAA/6 Hg intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (µg/g dry wt.) (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ± uncertainty. NA - Not available.).

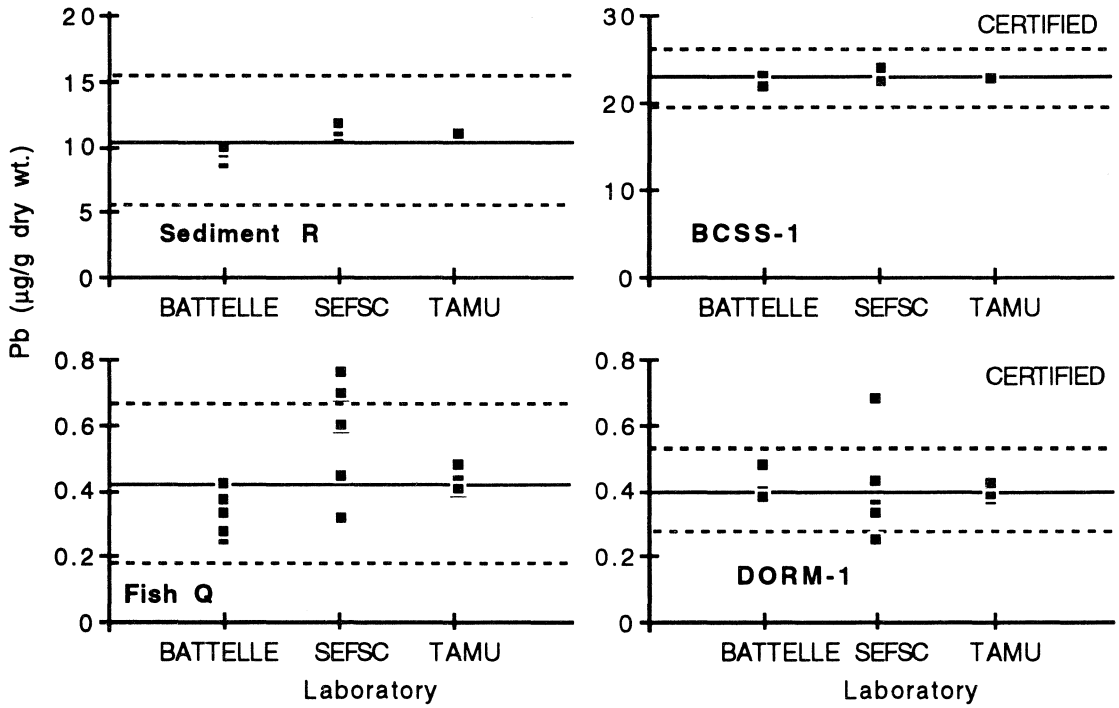


Figure 27. 1992 NOAA/6 Pb intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (µg/g dry wt.) (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.).

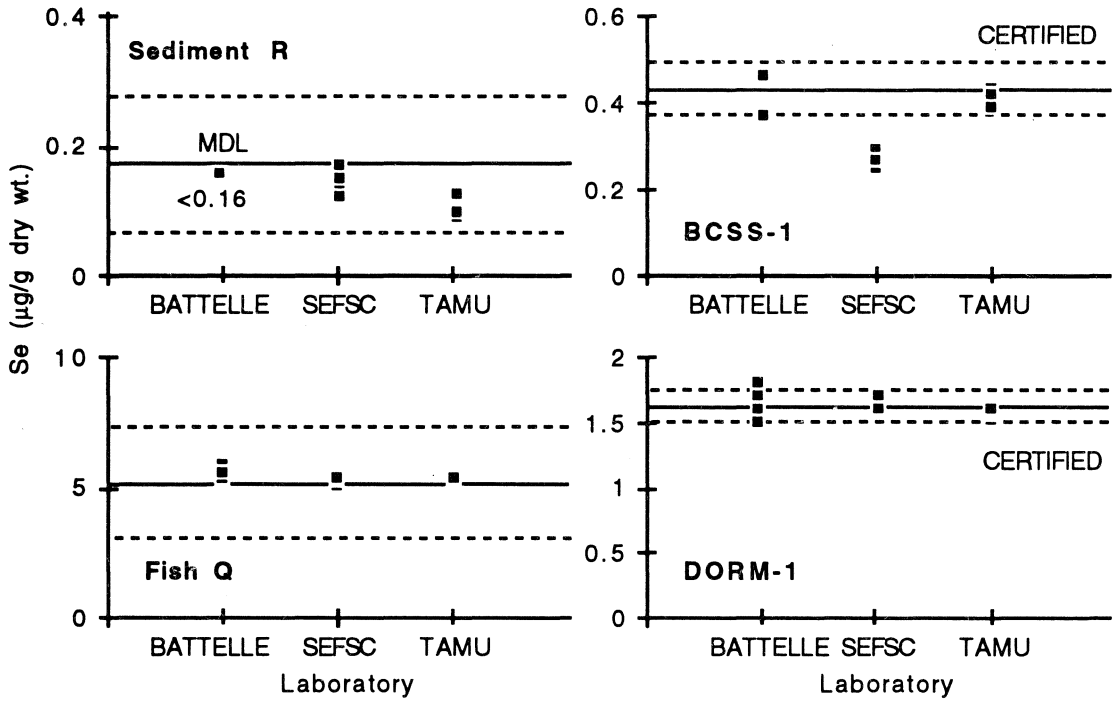


Figure 28. 1992 NOAA/6 Se intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (µg/g dry wt.) (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.).

There is no certified value for BCSS-1. The results of the three NS&T laboratories, however, were within the confidence interval of both materials. The mean values reported for the Fish Q were also within the confidence intervals. The accepted Ag value for Fish Q is 0.18 ± 0.022 µg/g. BATTELLE reported a slightly high mean value of 0.19 µg/g for DORM-1, and TAMU a slightly high one of 0.23 ± 0.02 µg/g. The Hg content of Sediment R was quite low, only 0.038 ± 0.027 µg/g. The results of the three NS&T cooperating laboratories were within the confidence interval of this material. Similar results were reported for BCSS-1, although no Hg data were submitted by BATTELLE. The results for the tissue materials were also good. The BATTELLE Hg mean, 0.092 µg/g, was slightly high compared to the upper limit of the confidence interval, 0.872 µg/g. The performance of the three NS&T cooperating laboratories was very good for all four exercise materials for Pb. The Pb level in Fish Q, 0.42 ± 0.24 µg/g, was very low so the precision of the results was lower than for the other three sets of analyses. Overall, the best results for all the laboratories participating in NOAA/6 were for Pb.

4.2.3.4. Se, Sn, and Sb

The results of the Se, Sn and Sb analyses are shown in Figures 28, 29, and 30, respectively. The Se concentration of Sediment R was quite low, 0.17 µg/g, and this was close to the MDL for BATTELLE, 0.16 µg/g. The results reported by SEFSC and TAMU were within the confidence intervals for this material. The mean of the results reported by SEFSC for BCSS-1, 0.28 µg/g, was below the lower limit of the confidence interval, 0.37 µg/g. The results reported by BATTELLE and TAMU were within the confidence interval for BCSS-1. The results of the Se

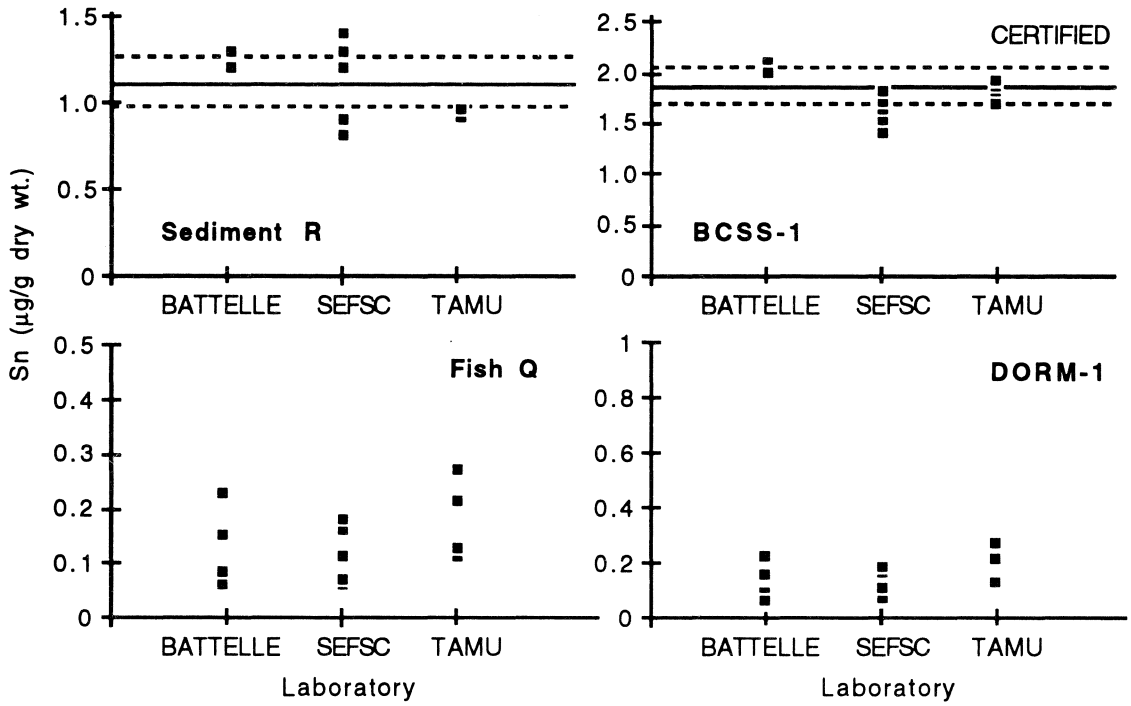


Figure 29. 1992 NOAA/6 Sn intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (µg/g dry wt.) (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit. No certified or accepted value were available for Fish Q and DORM-1.).

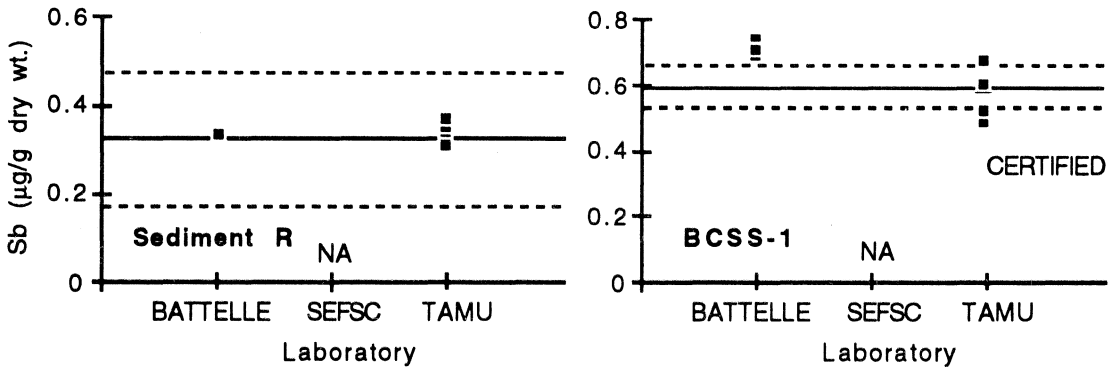


Figure 30. 1992 NOAA/6 Sb intercomparison exercise results of five replicates for Sediment R, BCSS-1, Fish Q, and DORM-1 (µg/g dry wt.) (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ± uncertainty. NA - Not available.).

tissue analyses were within the confidence intervals of Fish Q and DORM-1. The results for Sediment R for Sn reported by BATTELLE and SEFSC were within the confidence interval. The mean Sn reported by TAMU for Sediment R, 0.94 µg/g, was slightly lower than the lower limit of the confidence interval, 0.97 µg/g. The Sn means reported by BATTELLE and TAMU for BCSS-1 were within the confidence interval. The mean Sn reported by SEFSC, 1.6 µg/g, was lower than the lower limit of the confidence interval, 1.85 µg/g. The concentrations of Sn in Fish Q and DORM-1 were very low and close to the tissue MDLs of the three laboratories (Table 6). Few laboratories reported results for these materials so no accepted value was calculated for Fish Q. DORM-1 is not certified for Sn. SEFSC did not submit results for Sb. The means reported by TAMU for Sediment R and BCSS-1 for Sb were within the confidence interval. Those reported by BATTELLE were within the confidence interval for Sediment R but slightly high for BCSS-1. The BATTELLE mean for BCSS-1 was 0.71 µg/g, and the upper limit of the confidence interval was 0.65 µg/g. The determination of Sb in tissues was not required.

4.2.4. Performance evaluation of NS&T laboratories

Willie and Berman (1992) summarized the results of the 1992 NOAA/6 exercise using the accuracy and precision scale previously described in Section 4.1.4 (Table 11). The same information is shown graphically in Figures 31 and 32. The performance of the NS&T laboratories was rated good to superior, although the precision of the BATTELLE results could be improved.

4.2.5. Performance evaluation of "core" and "new" laboratories

As for NOAA/5, the performance of the "core" laboratories that had previously participated in intercomparison exercises was better in most cases than that of laboratories participating for the first time. For example, the results submitted for NOAA/5 and NOAA/6 by a non-NS&T laboratory that participated in the intercomparison exercises for the first time in 1991 show improvement in analytical performance over a year's time. The mean absolute percent errors (absolute percent difference from the consensus mean) for Al, Cr, Fe, Cu, Zn, As, Se, Cd, Sn, Hg and Pb for each of the four exercise materials in each intercomparison exercise are shown in Figure 33. It is apparent that, overall, the mean absolute percent errors are smaller for the 1992 exercise than for the 1991 exercise, although there is still room for improvement. Only one material was common to both NOAA/5 and NOAA/6, BCSS-1, and with some exceptions, the mean absolute percent errors were also smaller for the CRM. This type of evaluation should be interpreted with caution since errors magnify as values decrease. Analytical errors also increase as analyte values approach MDLs.

4.3. 1993 Exercise

The seventh NS&T trace metal intercomparison exercise, NOAA/7, took place in 1993 and was coordinated by NRC. The NS&T laboratories were SEFSC, BATTELLE, and TAMU. Materials were sent to 56 other laboratories including 16 Canadian laboratories participating for the first time. The materials used were Sediment T, BCSS-1, Tissue S, and SRM 1566a. The results of the analyses are listed in Appendix III. A detailed description of the exercise and the results of the other participating laboratories can be found in Willie and Berman (1993).

Table 11. Laboratory performance evaluation for NOAA/6 (The first letter is the evaluation of the accuracy and the second of the precision.).

Accuracy:

- E - Excellent accuracy. All replicates were within the established confidence interval.
- G - Good accuracy. The mean of the replicates was within the established confidence interval, but one or more of the replicates was outside.
- L - Low results. The mean of the replicates was less than the lower confidence interval.
- H - High results. The mean of the replicates was greater than the higher confidence interval.
- ? - Accuracy could not be established.

Precision:

- G - Good precision. The intralaboratory precision was within the following criteria for various analyte concentrations: concentration ≥10 µg/g, expected RSD ±10% (±5% for Al and Fe in sediments); concentration ≥1 - <10 µg/g, expected RSD ±15%; and concentration <1 µg/g, expected RSD ±20%.
- X - The intralaboratory precision was not within the criteria described above.
- - - No results or a "less than" value submitted.

	Fish Q	DORM-1	Sed. R	BCSS-1		Fish Q	DORM-1	Sed. R	BCSS-1
BATTELLE									
Al	G X	E G	E X	H G	As	E G	E G	E G	G G
Si			? G	E G	Se	E G	G G	- -	E G
Cr	E G	H G	E G	E G	Ag	E X	E X	E G	E G
Mn	- -	- -	E X	G G	Cd	H X	L X	E G	G G
Fe	E G	G G	G G	E G	Sn	? X	? X	E G	E G
Ni	E X	E G	G G	E G	Sb	- -	- -	E G	H G
Cu	G G	H G	E G	G G	Hg	E G	H G	E G	- -
Zn	E G	G G	E G	E G	Pb	E G	E G	E G	E G
SEFSC									
Al	- -	- -	E G	E G	Se	E G	G G	E X	L G
Cr	E G	G G	E G	L G	Ag	E G	L G	G X	G G
Mn	- -	- -	E G	G X	Cd	E G	E G	E G	E G
Fe	E G	H G	H G	E G	Sn	? X	? X	G G	L G
Ni	E G	L G	H G	E G	Sb	- -	- -	- -	- -
Cu	E G	E G	E G	E G	Hg	E G	E G	E G	E G
Zn	E G	L G	E G	E G	Pb	G G	E X	E X	E G
As	E G	G G	E G	E G					
TAMU									
Al	- -	- -	E G	E G	Se	E G	E G	E G	E G
Cr	E G	E G	E G	E G	Ag	E G	H G	G G	G G
Fe	E G	E G	E G	E G	Cd	E G	E G	H G	E G
Ni	E G	E G	E G	E G	Sn	? X	? G	L G	E G
Cu	E G	E G	E G	E G	Sb	- -	- -	E G	G G
Zn	E G	E G	E G	E G	Hg	E G	E G	E G	E G
As	E G	E G	E G	E G	Pb	E G	E G	E G	E G

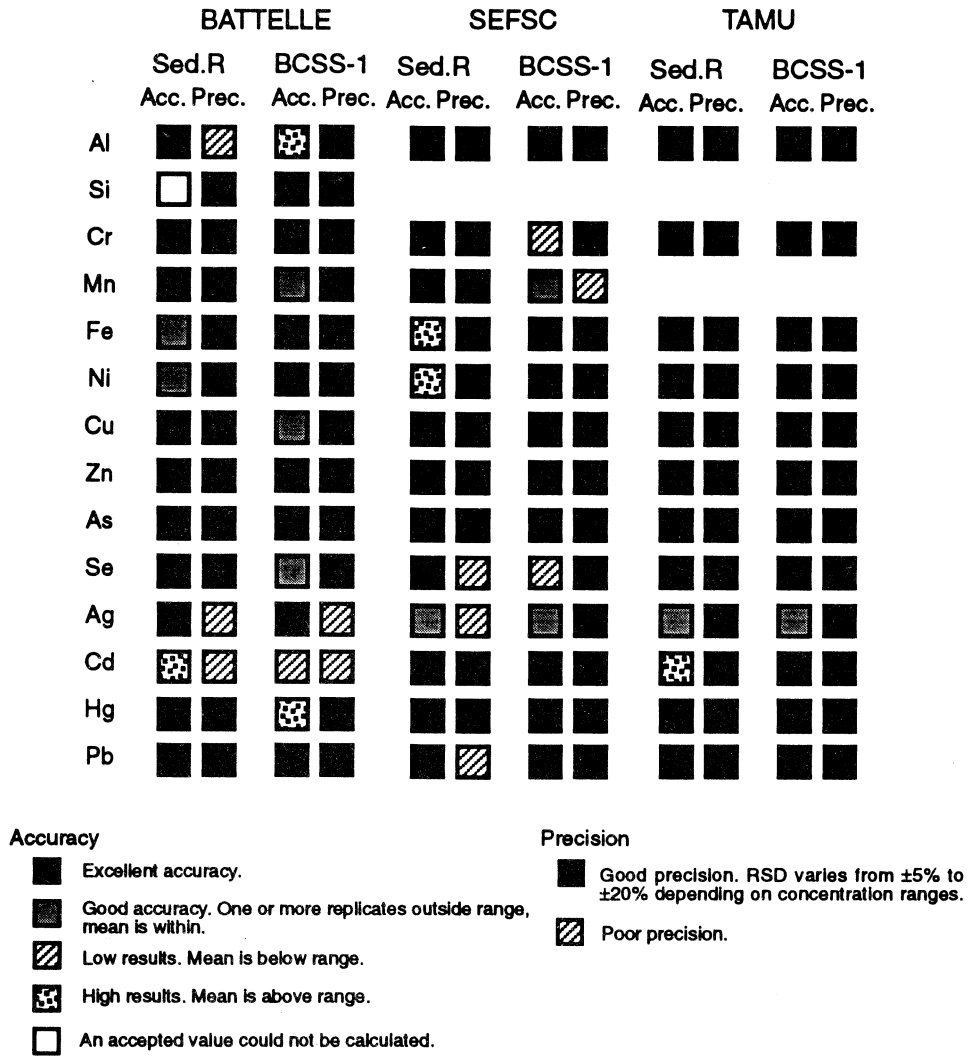


Figure 31. 1992 major and trace element sediment determination performance evaluation.

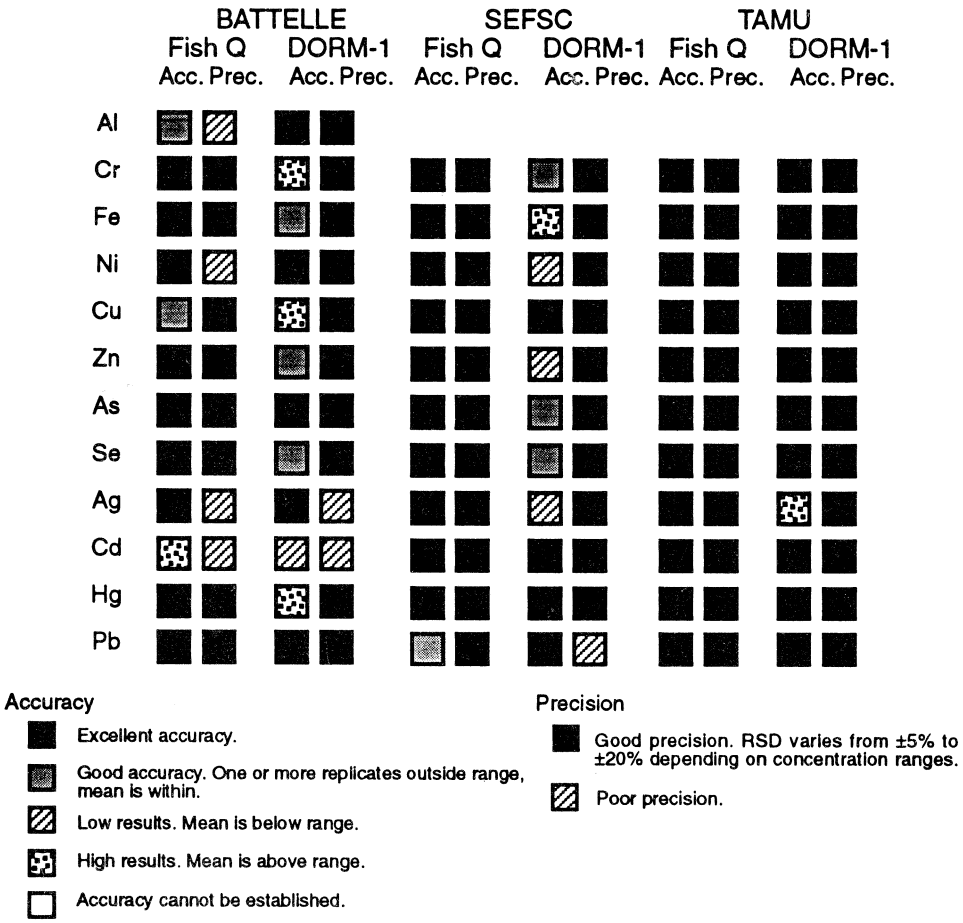


Figure 32. 1992 major and trace element tissue determination performance evaluation.

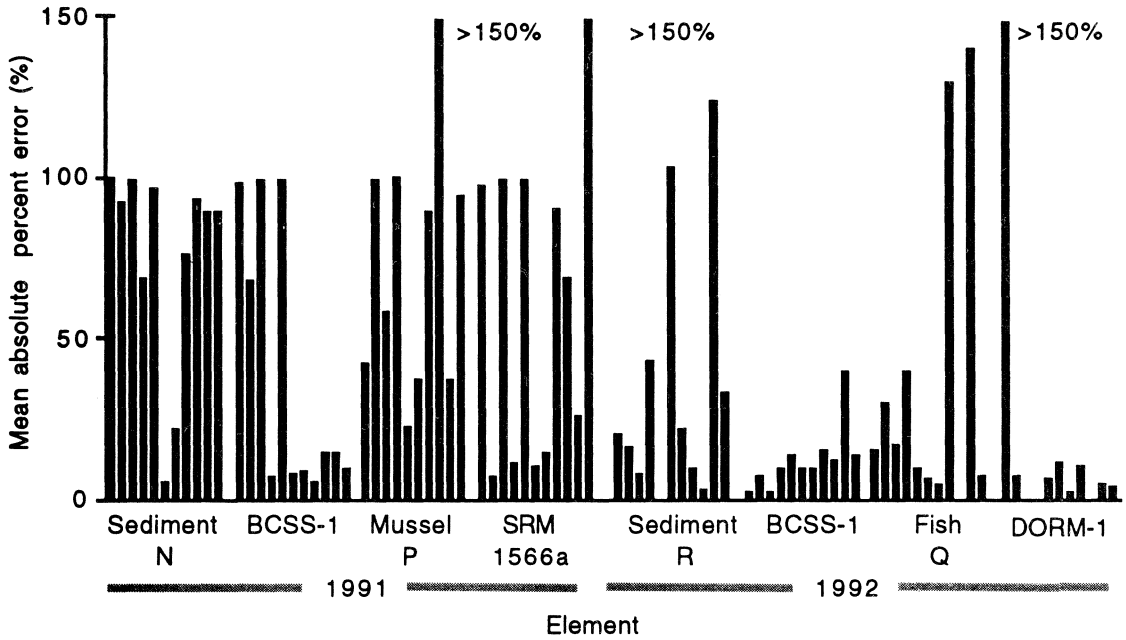


Figure 33. Absolute mean percent errors of the results of 1991 and 1992 intercomparison exercises of a laboratory participating in the exercises for the first time in 1991 (Order of elements: Al, Cr, Fe, Cu, Zn, As, Se, Cd, Sn, Hg, and Pb.).

4.3.1. Description of materials and exercise

Sediment T is a freeze-dried Mississippi Delta sediment donated by TAMU. Tissue S is a freeze-dried *Mytilus edulis* tissue homogenate collected by the International Atomic Energy Agency in the Mediterranean off the coast of France and further processed and bottled by the SRM program at NIST. Since the flounder tissue used for the NOAA/6 exercise contained low levels of contaminants, the Tissue S material was selected since it was expected to have higher levels. The control materials, BCSS-1 and SRM 1566a, were described previously.

Each laboratory received 10-g samples of each "unknown" sample and were asked to perform five replicate analysis of each of the unknowns, BCSS-1 and SRM 1566a for Al, Cr, Fe, Ni, Cu, Zn, As, Se, Ag, Cd, Sn, Hg, and Pb. The sediment materials were also to be analyzed for Be, Si, Mn, Sb and Tl. All results, including outliers, are shown graphically in Figures 34 - 47 and are listed in Appendix III. As in previous exercises, NRC provided benchmarks for accuracy.

4.3.2. "Accepted" values

Accepted values were determined as in previous exercises (Section 4.1.2).

4.3.3. Results

4.3.3.1. Al, Si, Fe, and Mn

The results of the Al, Fe and Mn analyses are shown in Figures 34, 35 and 36 respectively. The means of the Al results of the three NS&T cooperating laboratories were within the 95% confidence interval of Sediment T, BCSS-1 and Tissue S. The results of the SRM 1566a

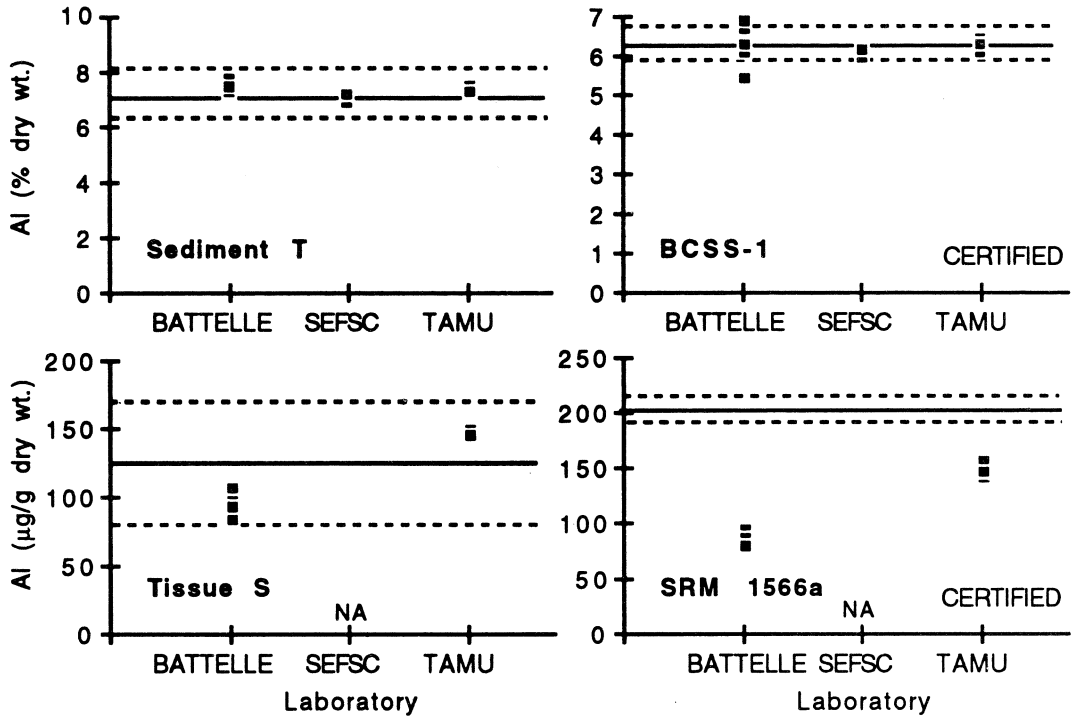


Figure 34. 1993 NOAA/7 Al intercomparison exercise results of five replicates for Sediment T, BCSS-1, Tissue S, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.)(% dry wt.).

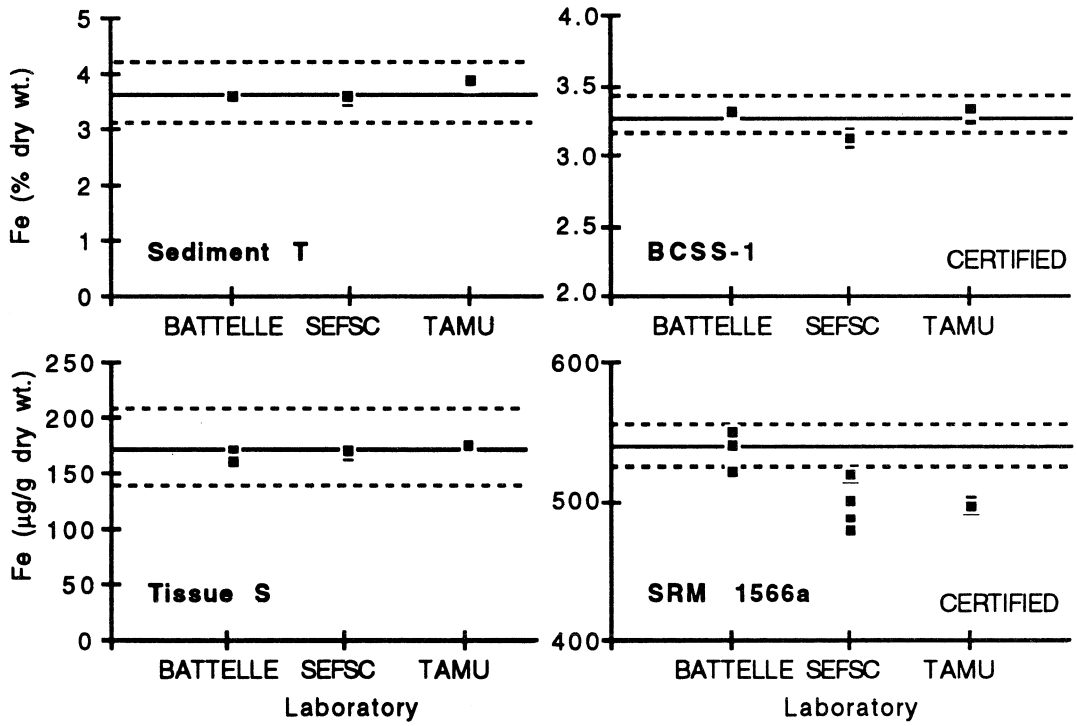


Figure 35. 1993 NOAA/7 Fe intercomparison exercise results of five replicates for Sediment T, BCSS-1, Tissue S, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (% or µg/g dry wt. as noted).

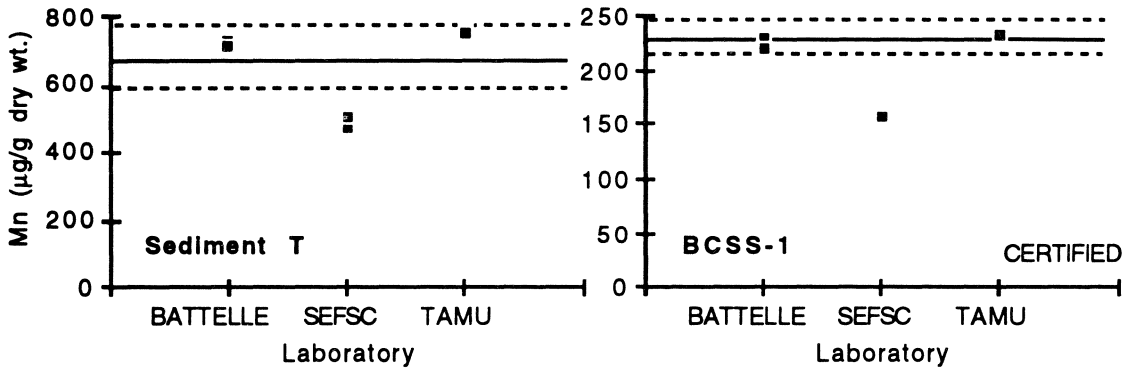


Figure 36. 1993 NOAA/7 Mn intercomparison exercise results of five replicates for Sediment T and BCSS-1 (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt. as noted).

analyses were low for BATTELLE and TAMU. SEFSC did not report results for Al in tissues. The results of the Fe analyses are shown in Figure 35. All the mean values were within the confidence interval except for those of SEFSC and TAMU for SRM 1566a. The Mn results are shown in Figure 36. The SEFSC results were low and outside the confidence interval. No Mn analysis of the tissue materials was required. Only BATTELLE reported Si values for the sediment materials and the results were within the confidence intervals. Analysis of Si in the tissue materials was not required.

4.3.3.2. Cr, Ni, Cu, and Zn

The results of the Cr, Ni, Cu, and Zn analyses are shown in Figures 37, 38, 39, and 40, respectively. The Cr results for the sediment materials were within the confidence intervals, except for the SEFSC results for BCSS-1. The calculated concentration for Cr in Tissue S was low, 0.5 µg/g, and the confidence interval was high, ± 60%. The results of SEFSC and TAMU were within the confidence interval, and those of BATTELLE were high. For SRM 1566a, which has a comparable concentration to that of Tissue S, the BATTELLE and TAMU results were within the confidence interval and those of SEFSC were slightly low. The Ni analyses results were within the confidence intervals except for the SEFSC values for BCSS-1 and SRM 1566a (Figure 38). The mean results of the Cu analyses of all the exercise materials were within the confidence intervals, except for the mean of TAMU for Tissue S which was low. The Zn results are shown in Figure 40. The means were within the confidence intervals except for the TAMU results for Sediment T and Tissue S which were high.

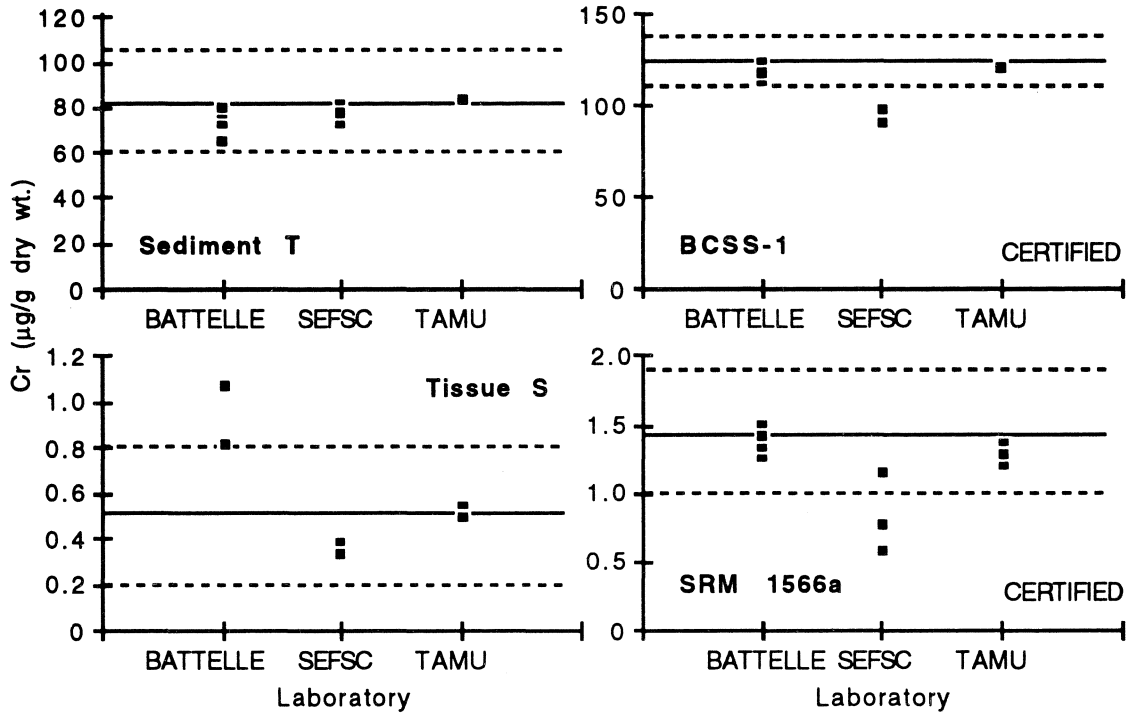


Figure 37. 1993 NOAA/7 Cr intercomparison exercise results of five replicates for Sediment T, BCSS-1, Tissue S, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.)(µg/g dry wt.).

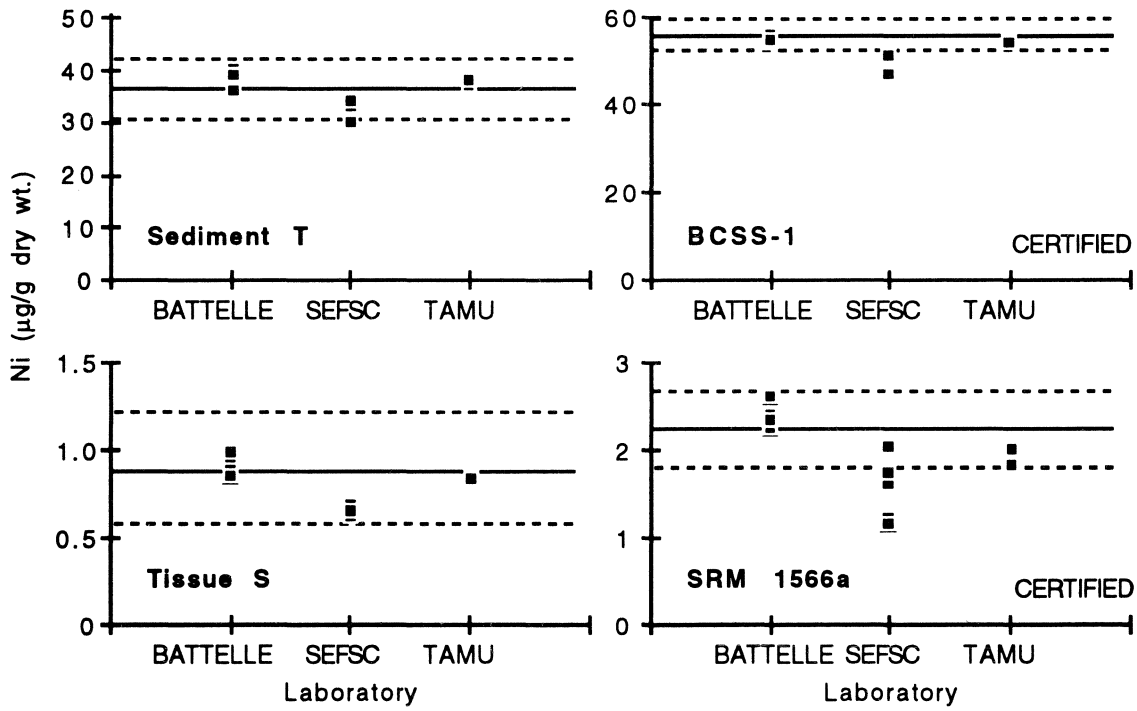


Figure 38. 1993 NOAA/7 Ni intercomparison exercise results of five replicates for Sediment T, BCSS-1, Tissue S, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.)(µg/g dry wt.).

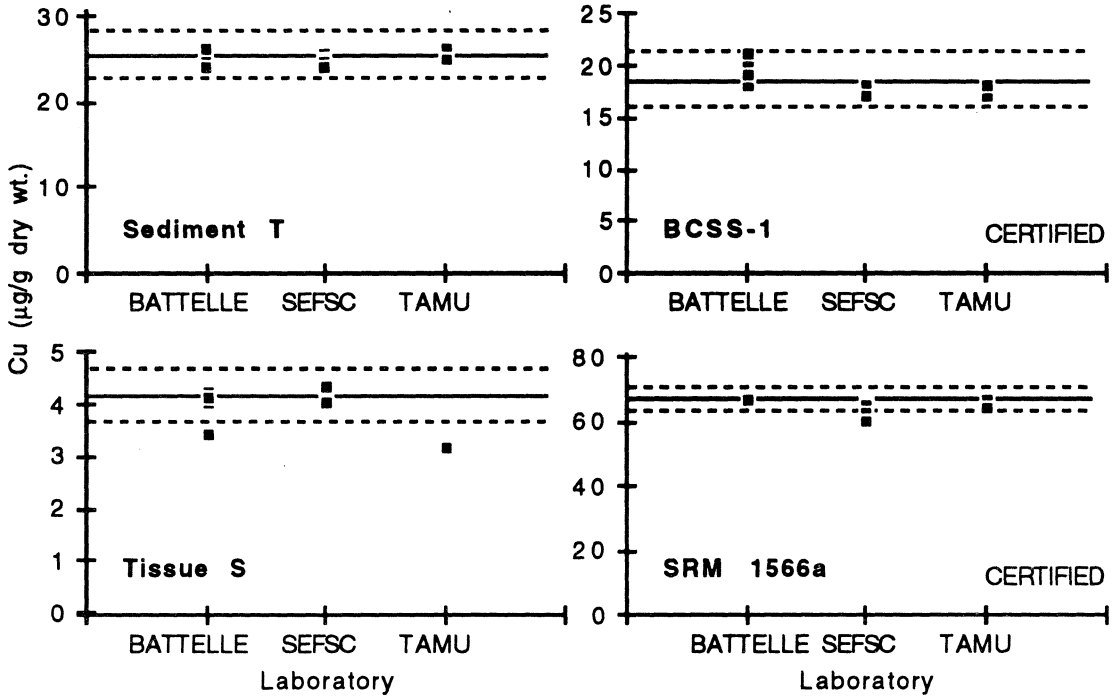


Figure 39. 1993 NOAA/7 Cu intercomparison exercise results of five replicates of Sediment T, BCSS-1, Tissue S, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

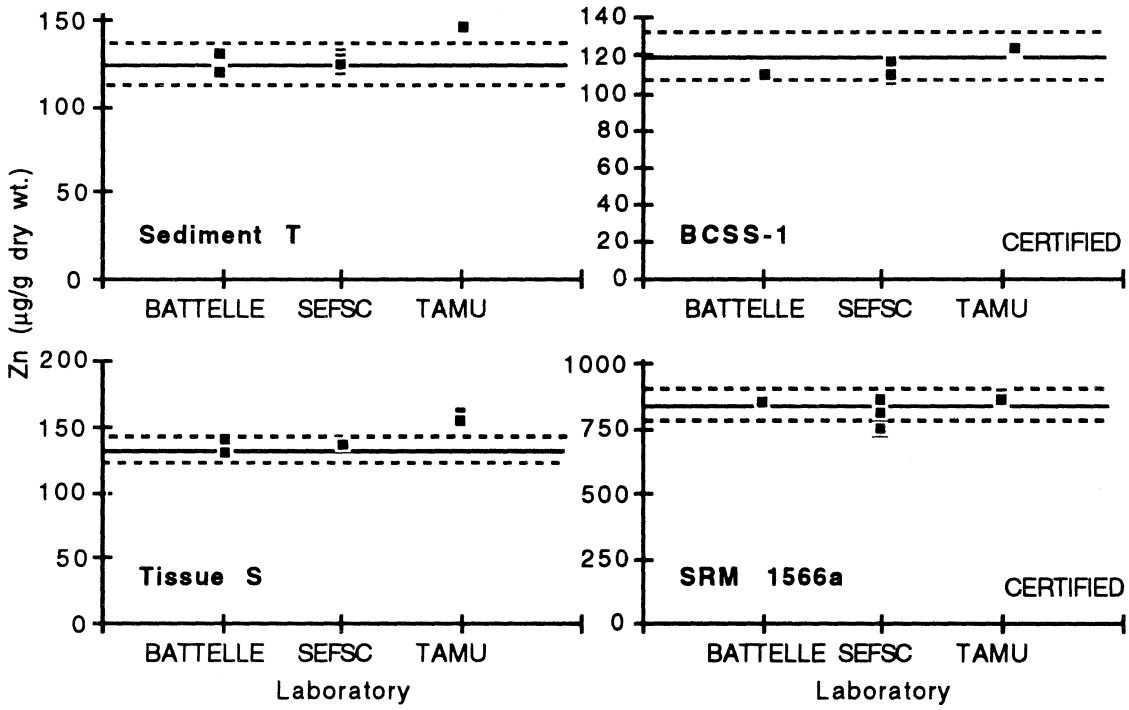


Figure 40. 1993 NOAA/7 Zn intercomparison exercise results of five replicates for Sediment T, BCSS-1, Tissue S, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

4.3.3.3. As, Cd, Ag, Hg, and Pb

The results of the As, Cd, Ag, Hg, and Pb analyses are shown in Figures 41, 42, 43, 44, and 45, respectively. The means of the As results reported by BATTELLE and TAMU were within the confidence intervals of the four exercise materials (Figure 41). The SEFSC results were within the confidence interval for Sediment T, but low for the other three materials. The results of the Cd analyses are shown in Figure 42. All the BATTELLE means were within the confidence intervals. The SEFSC results for Sediment T and BCSS-1 were within the confidence limits, but outside the confidence limits for the tissue materials. Two of the TAMU means were just outside the confidence intervals. That for Sediment T was high, and that of SRM 1566a was low. The Ag results are shown in Figure 43. BATTELLE and SEFSC reported some values below the limit of detection. The mean of the SRM 1566a analyses by BATTELLE was slightly high. The precision of the SEFSC Ag analyses was low. The Hg analyses results for BATTELLE and TAMU were within the confidence intervals (Figure 44). The mean reported by SEFSC was high and outside the confidence interval for Sediment T, and low and outside the interval for SRM 1566a. The precision of the SEFSC results was low. The means of the Pb analyses were within the confidence intervals (Figure 45). The precision for SEFSC for SRM 1566a was again low.

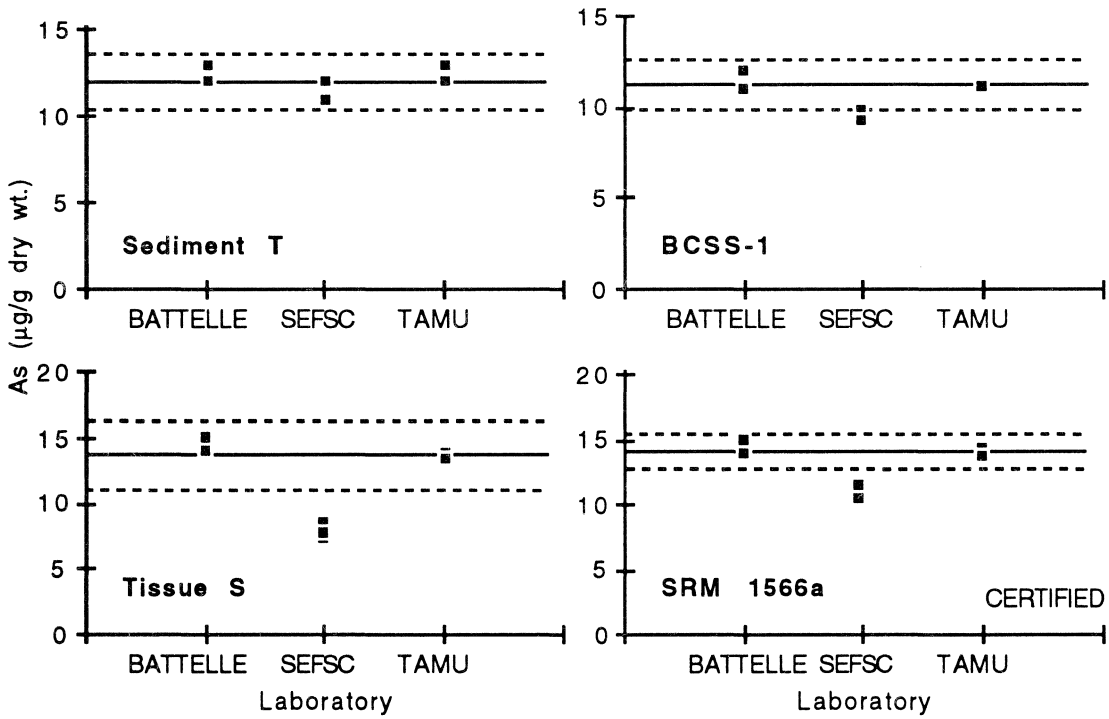


Figure 41. 1993 NOAA/7 As intercomparison exercise results of five replicates for Sediment T, BCSS-1, Tissue S, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

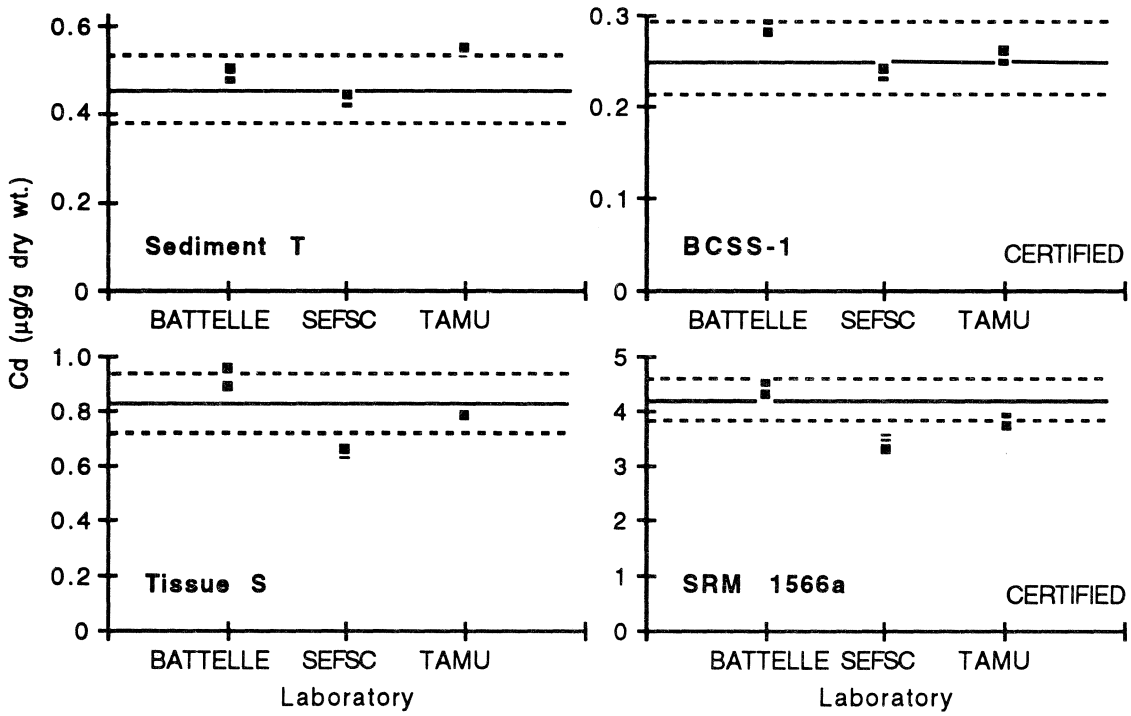


Figure 42. 1993 NOAA/7 Cd intercomparison exercise results of five replicates for Sediment T, BCSS-1, Tissue S, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

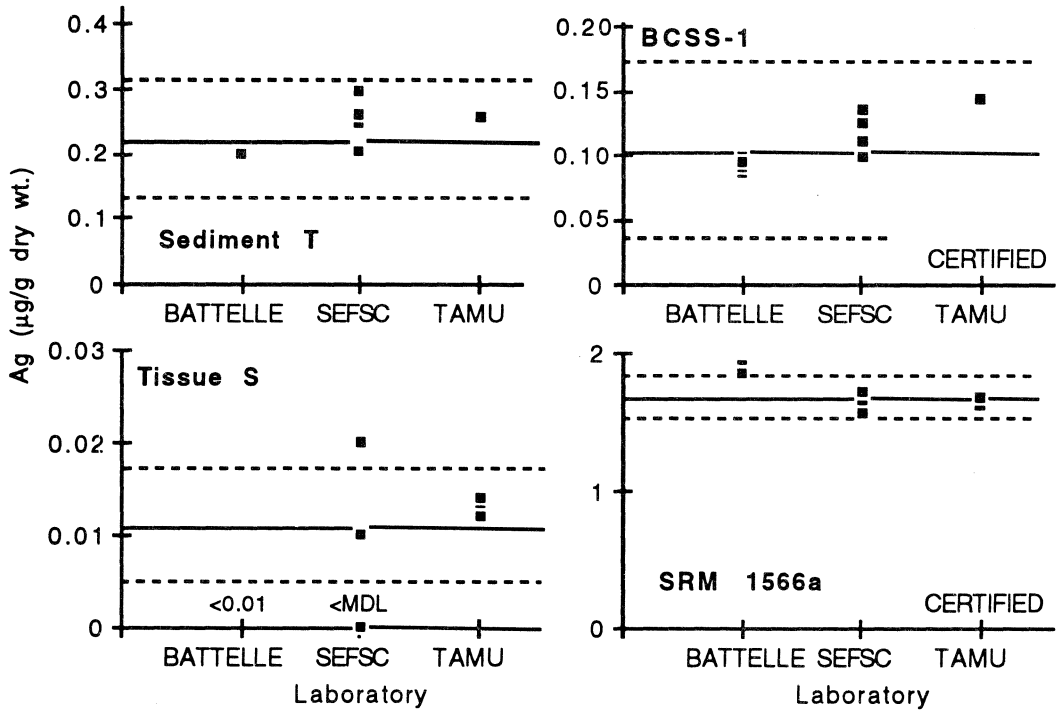


Figure 43. 1993 NOAA/7 Ag intercomparison exercise results of five replicates for Tissue S and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

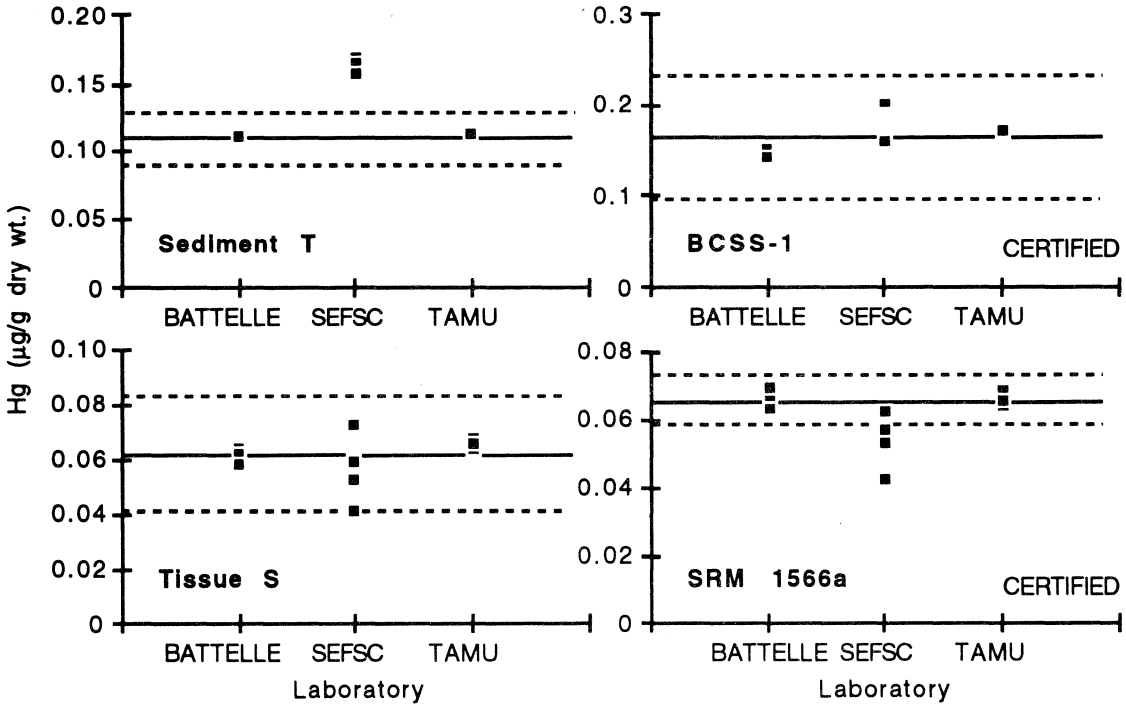


Figure 44. 1993 NOAA/7 Hg intercomparison exercise results of five replicates for Sediment T, BCSS-1, Tissue S, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

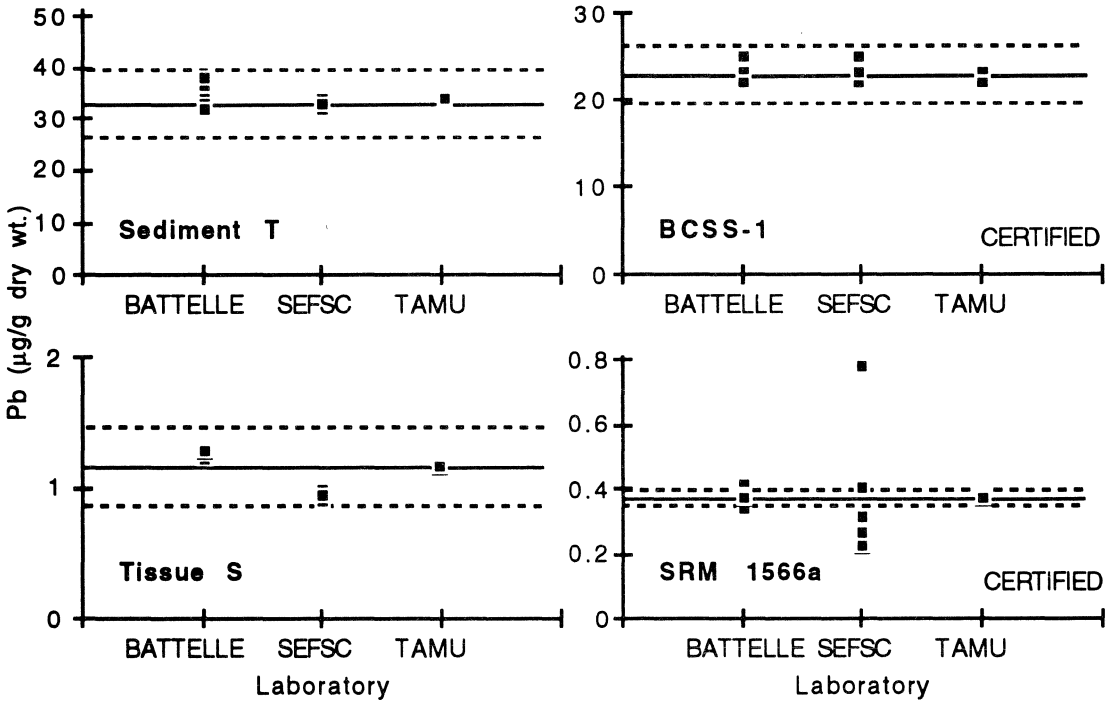


Figure 45. 1993 NOAA/7 Pb intercomparison exercise results of five replicates for Sediment T, BCSS-1, Tissue S, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

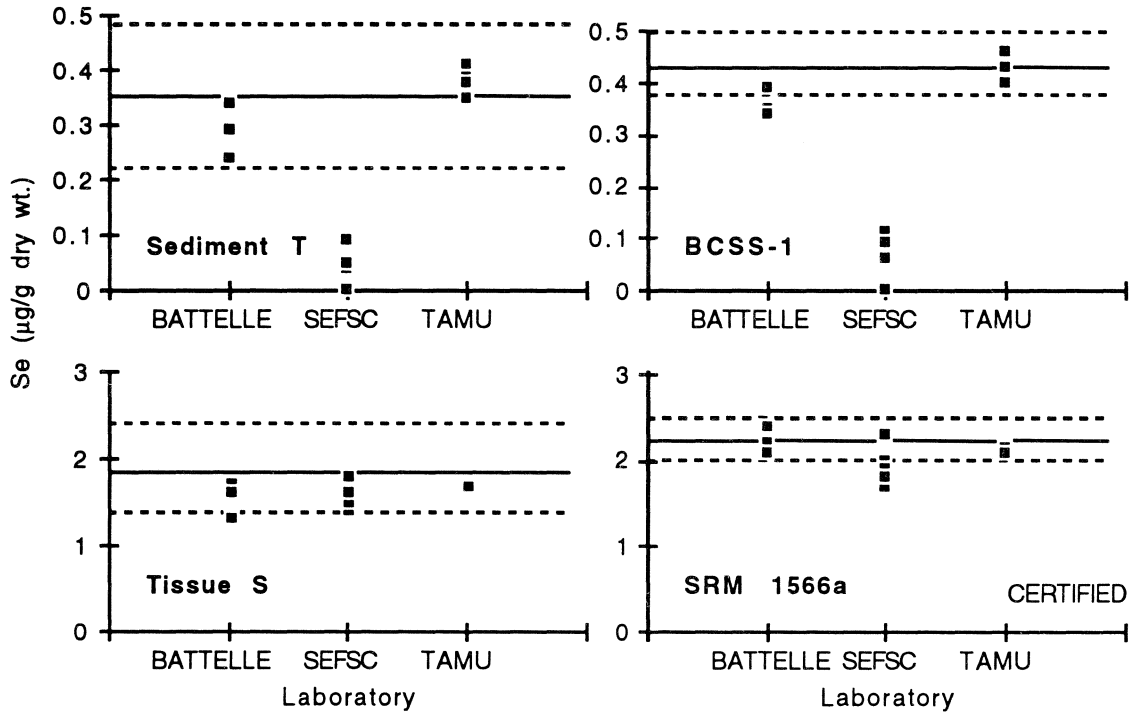


Figure 46. 1993 NOAA/7 Se intercomparison exercise results of five replicates for Sediment T, BCSS-1, Tissue S, and SRM 1566a (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

4.3.3.4. Se, Sn, and Sb

The Se results are shown in Figures 46. The means of the five replicates were within the confidence intervals, except for the BCSS-1 mean by BATTELLE which was slightly low and the SEFSC means, which were low and outside the confidence intervals for the Sediment T and BCSS-1. The Sn means for Sediment T, BCSS-1, and SRM 1566a were within the confidence intervals, except for the means of SEFSC, which were slightly low (Figure 47). The level of Sn in Tissue S was very low, 0.08 ± 0.053 µg/g. The TAMU results were low and SEFSC reported values below the limit of detection. Of the NS&T cooperating laboratories, only BATTELLE and TAMU reported results for Sb, and the results were within the confidence intervals (Figure 48).

4.3.3.5. Be

Beryllium was analyzed for the first time as part of an NS&T exercise during NOAA/7. Analysis of Be in the tissue materials was not requested. Only BATTELLE reported Be analyses results and these were within the confidence intervals of Sediment T and BCSS-1.

4.3.4. Performance evaluation of NS&T laboratories

Willie and Berman (1993) summarized the results of the 1993 NOAA/7 exercise using the accuracy and precision scale previously described in Section 4.1.4 and listed in Table 12. The same information is shown graphically in Figures 49 and 50. The performance of the NS&T laboratories was rated good to superior in most cases, although that of SEFSC could be improved.

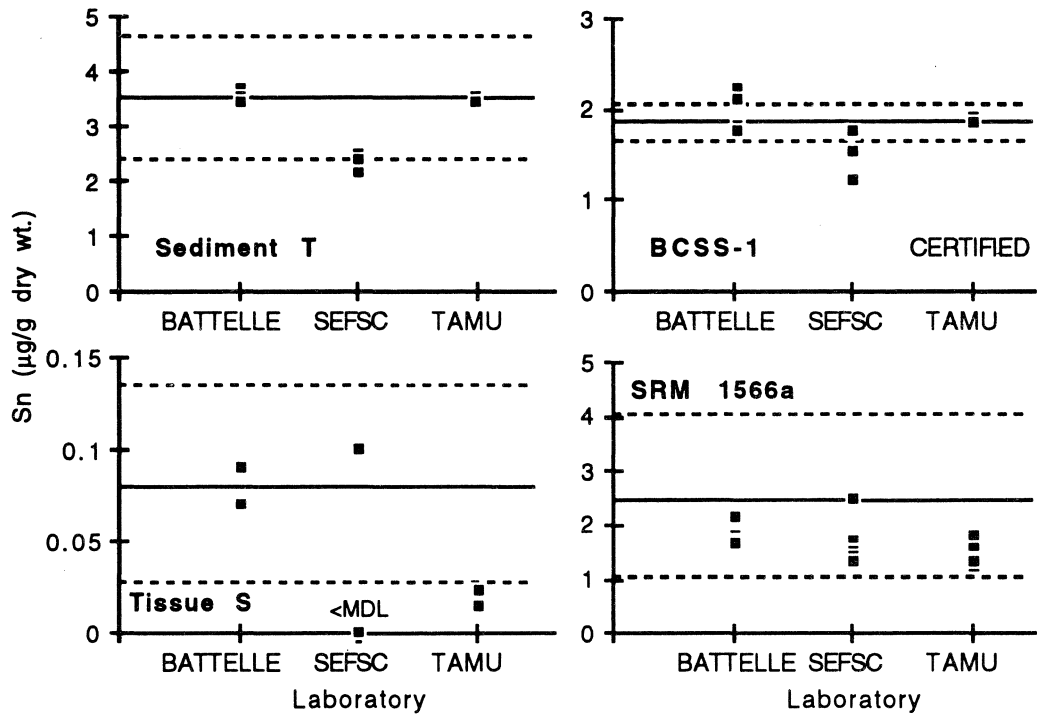


Figure 47. 1993 NOAA/7 Sn intercomparison exercise results of five replicates for Sediment T and BCSS-1 (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ±95% confidence limit.) (µg/g dry wt.).

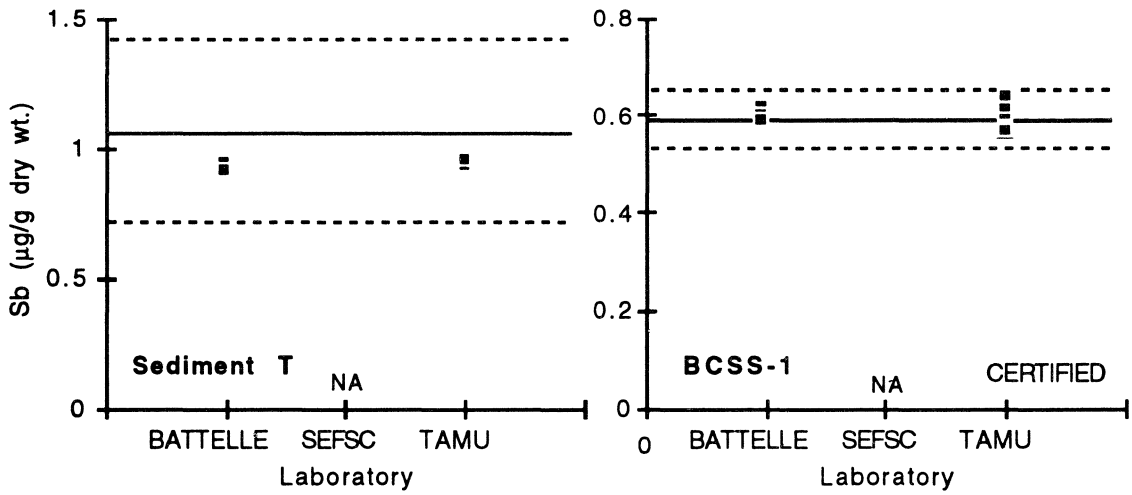


Figure 48. 1993 NOAA/7 Sb intercomparison exercise results of five replicates for Sediment T and BCSS-1 (Solid line is the certified value, if available, or the accepted value determined by NRC using exercise results. Dashed line is ± uncertainty. NA - Not analyzed.) (µg/g dry wt.).

4.3.5. Performance evaluation of "core" and "new" laboratories

As for the previous exercises, the performance of the "core" laboratories that had previously participated in intercomparison exercises was better in most cases than that of laboratories participating for the first time.

5. TRACE ORGANIC INTERCOMPARISON EXERCISE RESULTS

5.1. 1991 Exercise

The 1991 trace organic intercomparison exercise was organized by NIST. The materials used were prepared by NIST and were Tissue Control Material III (QC90TC) and Bivalve Tissue Extract II (QA91BE2). The NS&T cooperating laboratories were NWFSC, BATTELLE, and TAMU. Tissue Control Material III was sent to 27 other laboratories, and Bivalve Tissue Extract II to 21 other laboratories. These laboratories participated in the exercise on a voluntary basis. Results were received from 9 and 10 laboratories respectively, in addition to the NS&T cooperating laboratories. The results of the NS&T cooperating laboratories are listed in Appendix IV.

5.1.1. Description of materials and exercise

The Tissue Control Material III (QC90TC) was prepared by NIST in 1990 but not used by the NS&T cooperating laboratories until 1991. This material was a frozen bivalve tissue homogenate still containing its endogenous water. Bivalve Tissue Extract II (QA91BE2) was an accuracy-based material prepared by NIST, and was a concentrated extract of SRM 1974, Organics in Mussel Tissue. Each ampoule contained approximately 4 mL of the dichloromethane extract, equivalent to 2.36 g dry weight (19.2 g wet weight) of SRM 1974. Gravimetric amounts of one analyte of each of the three chemical classes were added to the extract to yield the following: 300 ng/ampoule of 1-methylphenanthrene (consensus value 284 ng/ampoule); 41.5 ng/ampoule of mirex (consensus value 40 ng/ampoule); and 86.6 ng/ampoule of PCB 209 (consensus value 89 ng/ampoule). The entire contents of each ampoule was used for each analysis. The results were based on the total contents of each ampoule. The weight of material in each ampoule was determined by NIST.

Each laboratory received three ampoules or jars of each unknown, and was asked to extract the materials and perform triplicate injections of the extract of a sample from one of the ampoules or jars, and single injections of the other two. Two ampoules each of concentrated PCBs (SRM 2262) and pesticides (SRM 2261), and PAHs (SRM 2260) calibration solutions were also sent to each participant. A computer diskette accompanied the samples to facilitate data reporting. The analytes determined were the organic compounds listed in Table 1. The participants were unaware of the identity of the material extracted to prepare the Bivalve Tissue Extract II.

5.1.2. Consensus values

For each analyte, the laboratory analyte means were evaluated for outliers, using the Dixon Test, and by the use of NIST expert chemical judgement after viewing both normal and log plots of the data (R. Parris, NIST, personal communication, 1994). This judgement utilized knowledge of potential coeluters based on reported analytical methods. The consensus mean was calculated as the mean of the individual laboratory analyte means with the identified outliers excluded. In a few instances in which the analyte concentration was below the detection limit of most participating laboratories, no consensus value was calculated. The exercise coordinators

Table 12. Laboratory performance evaluation for NOAA/7 (First letter is the evaluation of the accuracy and the second of the precision.).

Accuracy:

- E - Excellent accuracy. All replicates were within the established confidence interval.
- G - Good accuracy. The mean of the replicates was within the established confidence interval, but one or more of the replicates was outside.
- L - Low results. The mean of the replicates was less than the lower confidence interval.
- H - High results. The mean of the replicates was greater than the higher confidence interval.
- ? - Accuracy could not be established.

Precision:

- G - Good precision. The intralaboratory precision was within the following criteria for various analyte concentrations: concentration ≥10 µg/g, expected RSD ±10% (±5% for Al and Fe in sediments); concentration ≥1 - <10 µg/g, expected RSD ±15%; and concentration <1 µg/g, expected RSD ±20%.
- X - The intralaboratory precision was not within the criteria described above.
- - - No results or a "less than" value submitted.

	Sed. T	BCSS-1	Tissue S	SRM 1566a		Sed. T	BCSS-1	Tissue S	SRM 1566a
BATTELLE									
Al	E G	G X	L G	E G	As	E G	E G	E G	E G
Si	E G	G G	- -	- -	Se	E X	L G	E G	G X
Cr	E G	E G	E G	H X	Ag	E G	E G	H G	G -
Mn	E G	E G	- -	- -	Cd	E G	E G	E G	E G
Fe	E G	E G	G G	E G	Sn	E G	G X	E X	E X
Ni	E G	E G	E G	E G	Sb	E G	E G	- -	- -
Cu	E G	E G	E G	G X	Hg	E G	E G	E G	E G
Zn	E G	E G	E G	E G	Pb	E G	E G	G G	E G
SEFSC									
Al	E G	E G	- -	- -	As	E G	G G	- -	- -
Si	- -	- -	- -	- -	Se	L X	L X	- -	- -
Cr	E G	L G	- -	- -	Ag	E X	E X	L G	G -
Mn	L G	L G	- -	- -	Cd	E G	E G	- -	- -
Fe	E G	G G	E G	G G	Sn	L G	L X	- -	- -
Ni	E G	L G	- -	- -	Sb	- -	- -	- -	- -
Cu	E G	E G	E G	L G	Hg	H G	E G	E G	E G
Zn	E G	E G	E G	E G	Pb	E G	E G	G -	H G
TAMU									
Al	E G	E G	L G	E G	As	E G	E G	E G	E G
Si	- -	- -	- -	- -	Se	E G	E G	E G	E G
Cr	E G	E G	E G	E G	Ag	E G	E G	E G	E G
Mn	E G	E G	- -	- -	Cd	H G	E G	E G	E G
Fe	E G	E G	L G	E G	Sn	E G	E G	E X	L X
Ni	E G	E G	E G	E G	Sb	E G	E G	- -	- -
Cu	E G	E G	E G	L G	Hg	E G	E G	E G	E G
Zn	H G	E G	E G	H G	Pb	E G	E G	E G	E G

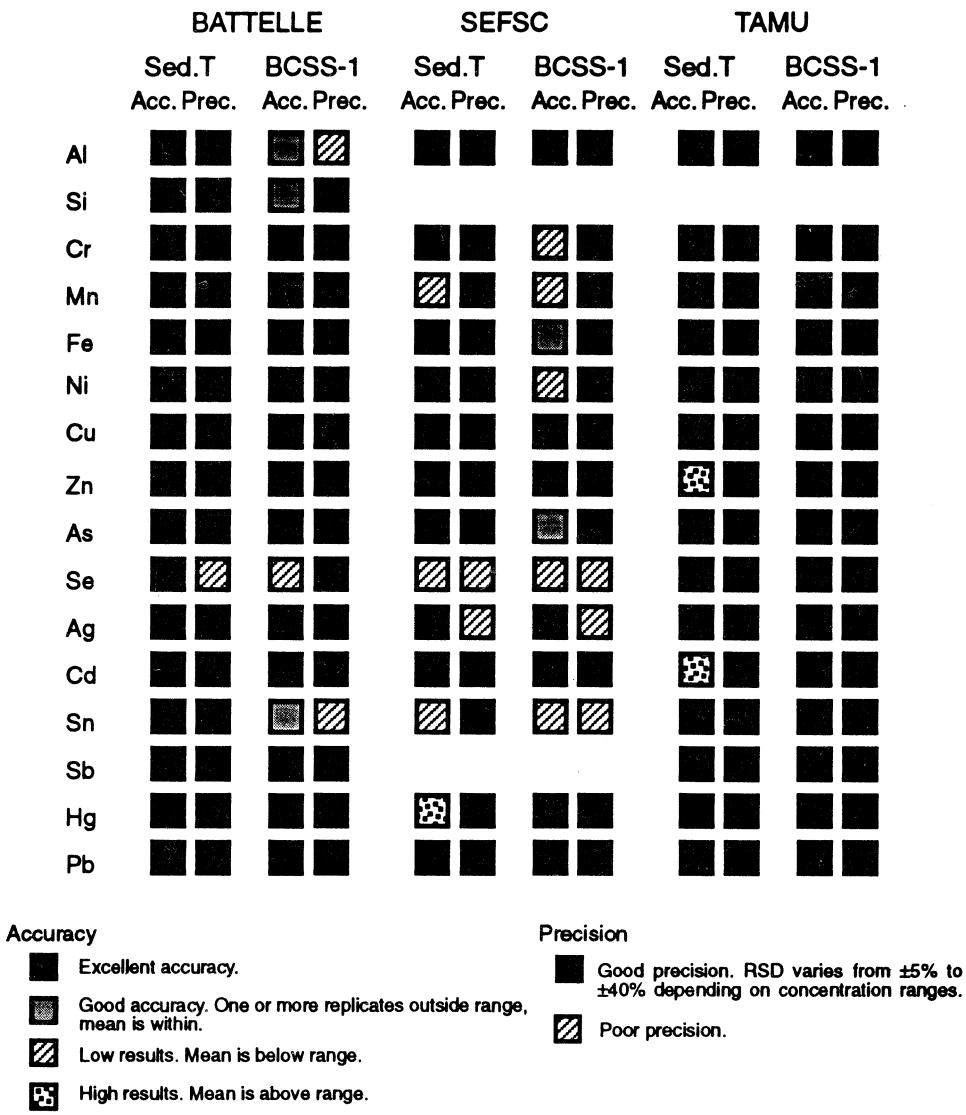


Figure 49. 1993 major and trace element sediment determination performance evaluation.

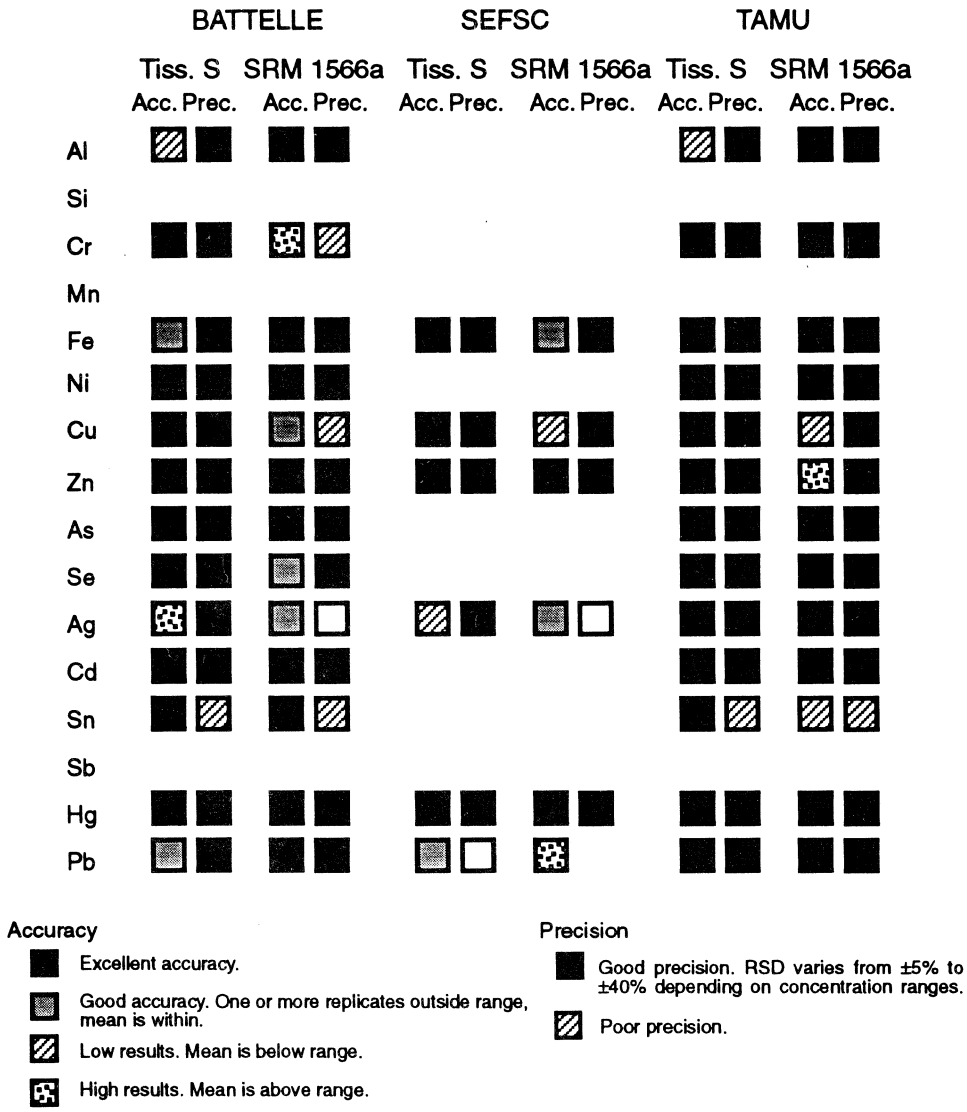


Figure 50. 1993 major and trace element tissue determination performance evaluation.

recognize the limitations of using a consensus mean as the "assigned value" for evaluation of exercise results. Concurrent reference material analyses have been required for a number of years in the trace metals exercise program and have proved to be quite useful in the assessment of results. The lack of availability of appropriate CRMs or SRMs has precluded their use in this manner in the trace organic exercises, but this approach will be utilized in future exercises. The materials used in the Marine Sediment III (1992), Mussel V (1993), and Fish I (1993) exercises were candidate CRMs, and certified concentrations will be available for comparison with the consensus values for the majority of the analytes of interest.

5.1.3. Results

5.1.3.1. Tissue Control Material III (QC90TC)

The results of the intercomparison exercise reported by the NS&T cooperating laboratories are shown graphically in Figures 51 - 56.

The results of determinations of the 2- and 3-ring PAHs (low molecular weight) and the 4- and 5-ring (high molecular weight) PAHs are shown graphically in Figures 51 and 52. The compounds in each of these classes of PAHs are listed in Table 13. In these two figures and others in this section, the solid line is the consensus value calculated by NIST using the exercise results, not including outliers. The dotted line is the range defined by plus or minus one standard deviation of the consensus value, and the dashed line is ±35% of the high and low limits of the consensus value range. This is the limit of acceptability defined by the NS&T Program for organic compounds when the concentrations in the samples are 10 times higher than the MDL of the laboratory. The results of the laboratories were within the NS&T specified range, and most were within the smaller range defined as plus or minus one standard deviation of the consensus value. It is also important to note that the concentrations of most analytes were at low ng/g dry weight range, which makes it especially difficult to produce precise and accurate data.

The results of the PCB congener determinations are shown in Figure 53. Similar results to those of the PAHs were obtained. Except in a few instances, the results were within the NS&T

Table 13. Polycyclic aromatic hydrocarbons molecular weight categories used in the NS&T Program.

Low molecular weight PAHs (2- and 3-ring structures)	High molecular weight PAHs (4- and 5-rings)
1-Methylnaphthalene	Benzo[*a*]pyrene
1-Methylphenanthrene	Benzo[*b*]fluoranthene
1,6,7-Trimethylnaphthalene	Benzo[*e*]pyrene
2,6-Dimethylnaphthalene	Benzo[*ghi*]perylene
2-Methylnaphthalene	Benzo[*k*]fluoranthene
Acenaphthene	Benz[*a*]anthracene
Acenaphthylene	Chrysene
Anthracene	Dibenzo[*a,h*]anthracene
Biphenyl	Fluoranthene
Fluorene	Indeno[1,2,3-*cd*]pyrene
Naphthalene	Perylene
Phenanthrene	Pyrene

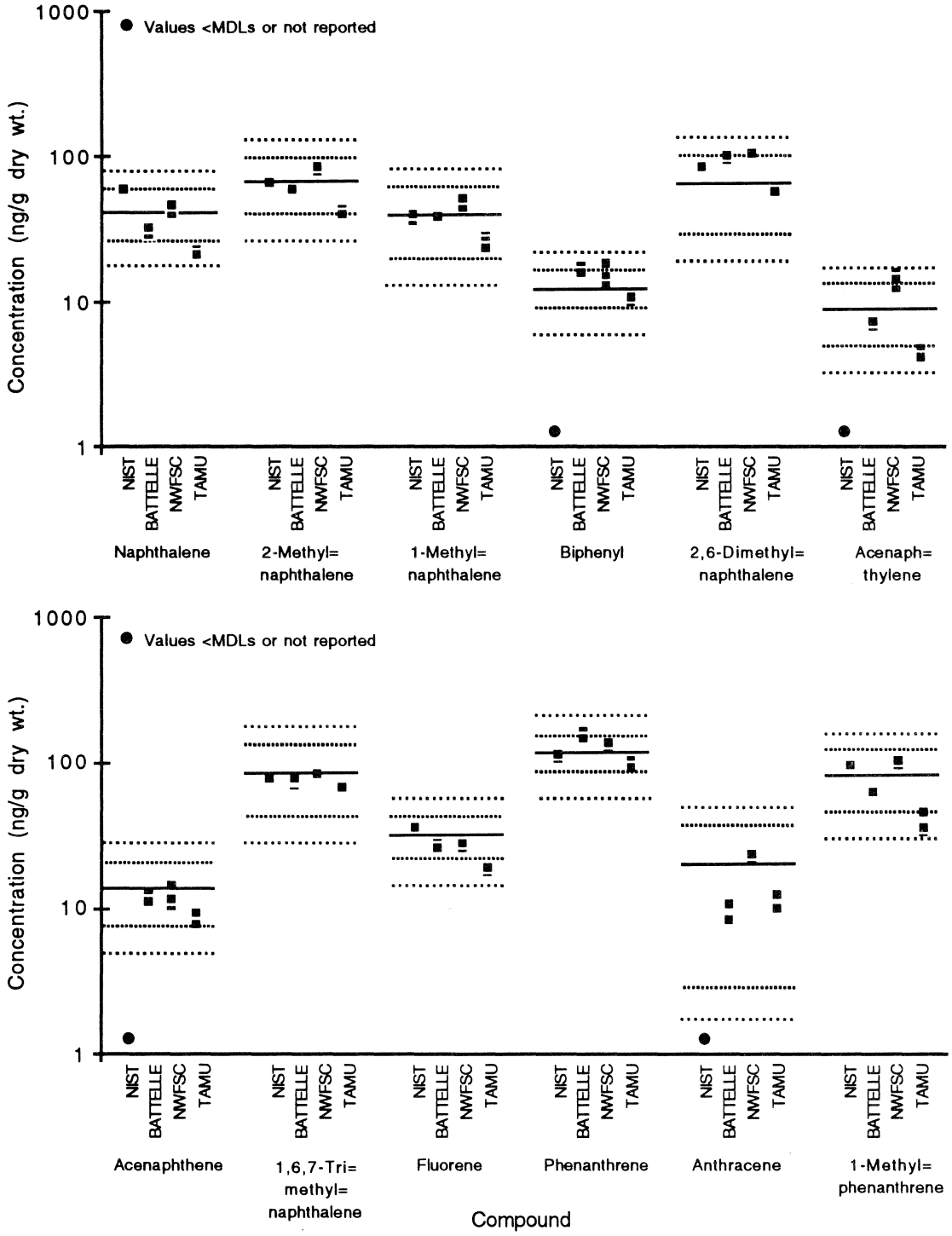


Figure 51. 1991 Tissue Control material (QA90TC) intercomparison exercise results of low molecular weight PAHs (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

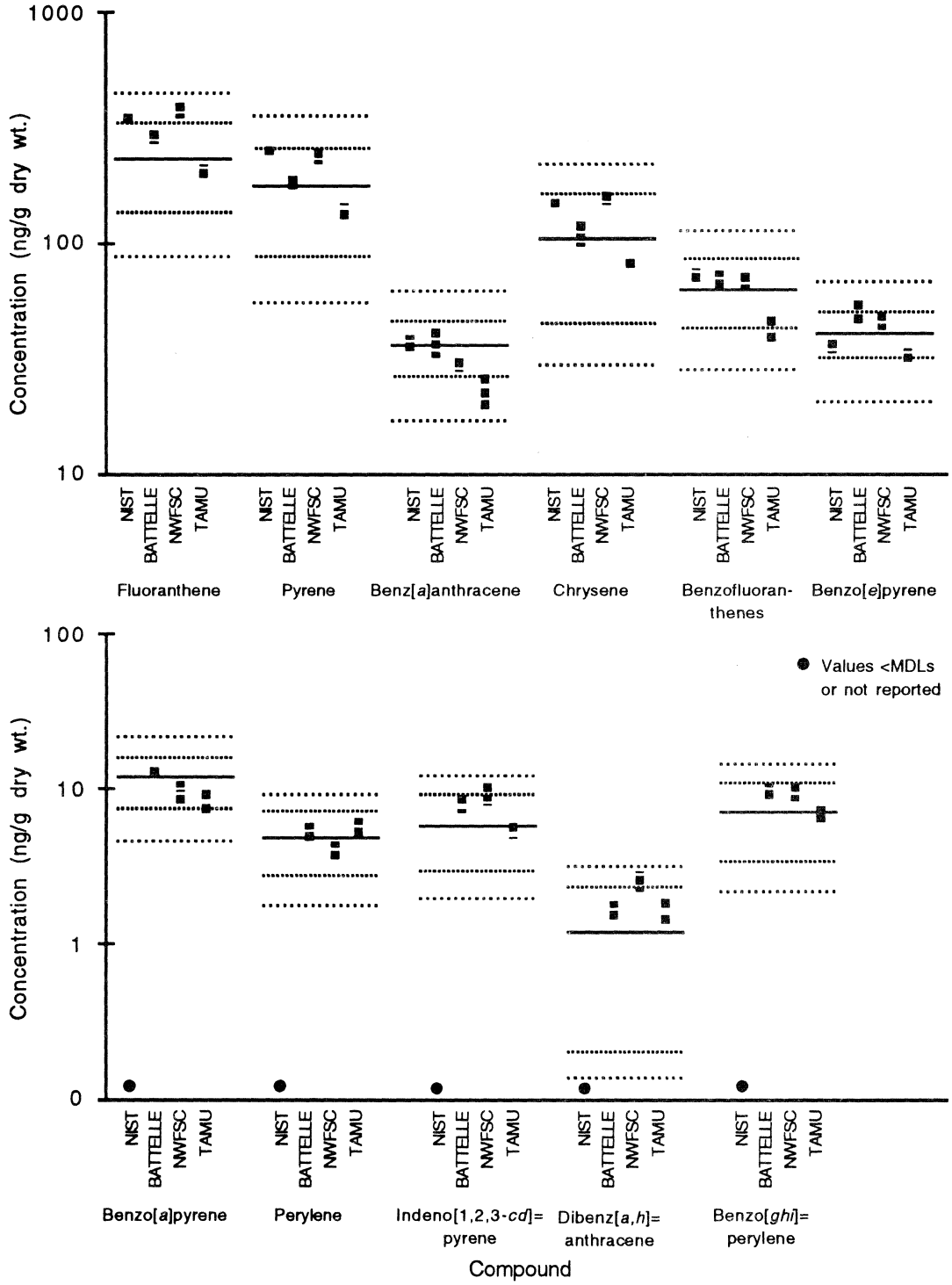


Figure 52. 1991 Tissue Control material (QA90TC) intercomparison exercise results of high molecular weight PAHs (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

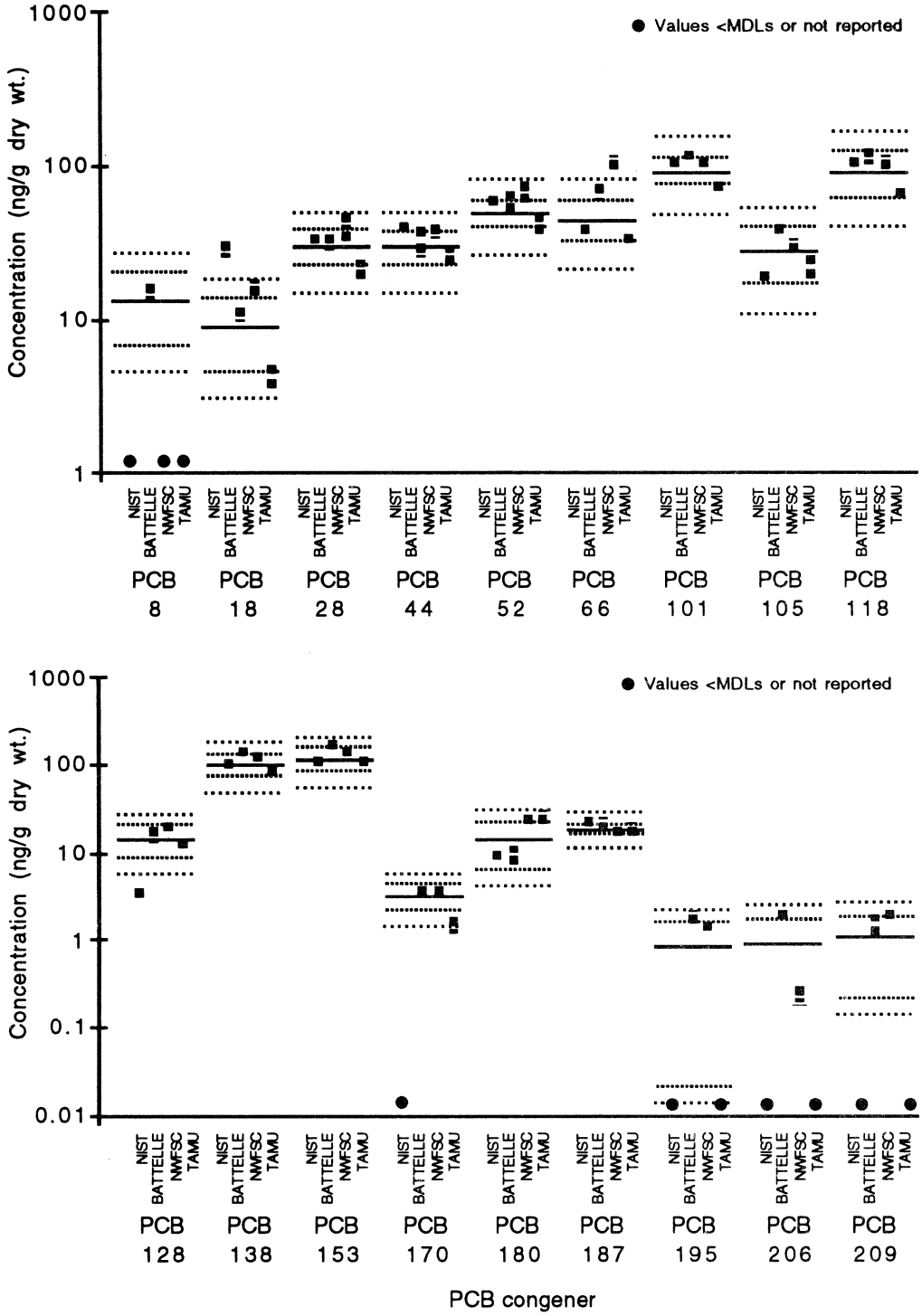


Figure 53. 1991 Tissue Control material (QA90TC) intercomparison exercise results of PCB congener analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

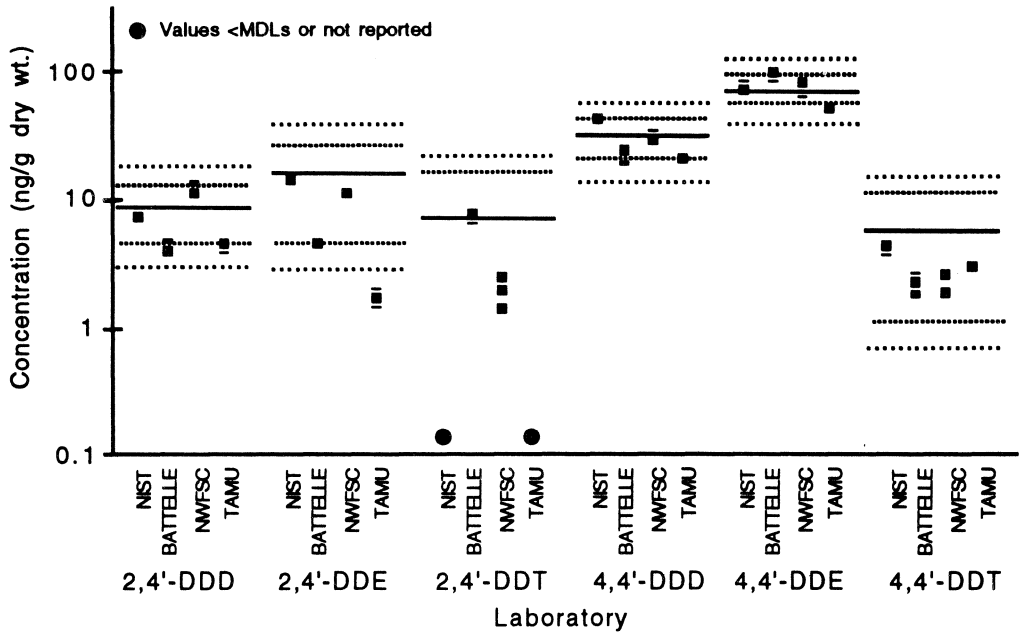


Figure 54. 1991 Tissue Control material (QA90TC) intercomparison exercise results of DDT and metabolite analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

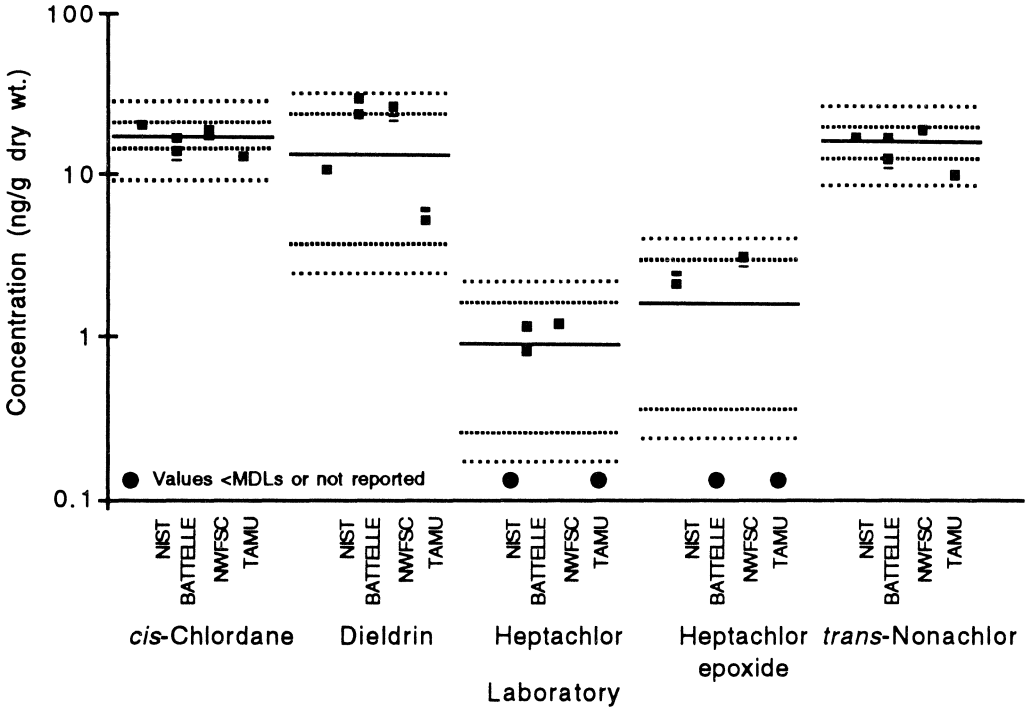


Figure 55. 1991 Tissue Control material (QA90TC) intercomparison exercise results of cyclopentadiene pesticide analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

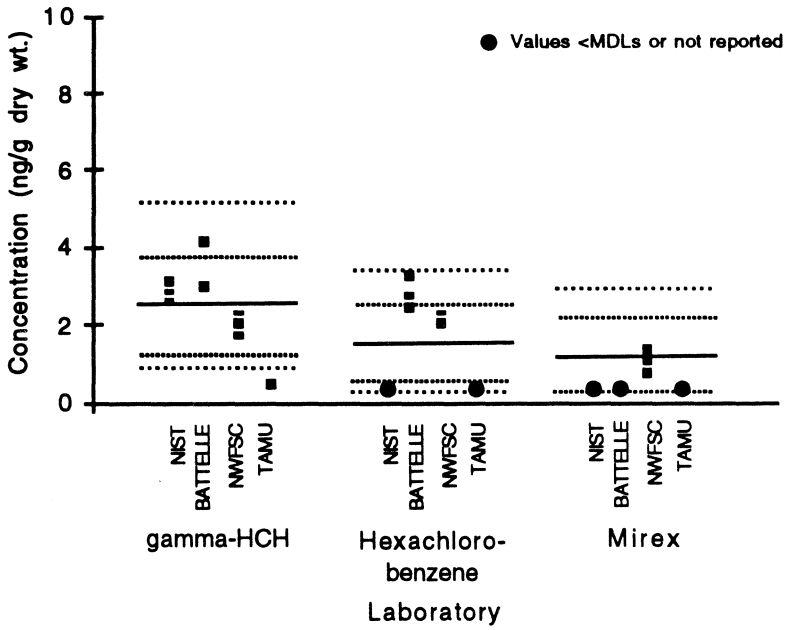


Figure 56. 1991 Tissue Control material (QA90TC) intercomparison exercise results of gamma-HCH, hexachlorobenzene and mirex analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

specified range and most were within the smaller range defined by the consensus value, plus or minus one standard deviation. The results of DDT and metabolites are shown in Figure 54. All results were within the NS&T specified range except for those of 2,4'-DDE for TAMU. The 2,4'-DDT levels in the tissue control material were very low, and NIST and TAMU reported values below the MDL. The results for *cis*-chlordane, dieldrin, heptachlor, heptachlor epoxide and *trans*-nonachlor are shown in Figure 55. These cyclopentadiene compounds have similar structures and thus are shown together. All results were within the NS&T specified range. The results of analyses of the other pesticides in the NS&T analyte list, gamma-HCH, hexachlorobenzene and mirex, are shown in Figure 56. The levels of these pesticides in the tissue control material were low and several laboratories reported values below the MDL. The results were within the specified range expect for those reported by TAMU for gamma-HCH. To determine if there is any bias in the analyses, the ratios of the analytically determined mean values to those of the consensus values are shown in Figures 57 - 59. The order of the analytes is the same as those in Appendix IV. TAMU results are biased low for PAHs, PCBs, and chlorinated pesticides. BATTELLE and NWFSC results are biased high for PCBs.

5.1.3.2. Bivalve Tissue Extract II (QA91BE2)

The Bivalve Tissue Extract II (QA91BE2) sample had a large number of potential interfering compounds so the participating laboratories had to remove the interferences and perform a class separation prior to measurement. This exercise follows the 1990 Enriched Bivalve Tissue Extract (QA90E1) which was intended as an intermediate step of difficulty between a gravimetric solution and a "real" sample (Cantillo and Parris, 1993). Concentrations were reported on a per ampoule basis, and can be converted to ng/g dry weight by dividing the per ampoule value by 2.36.

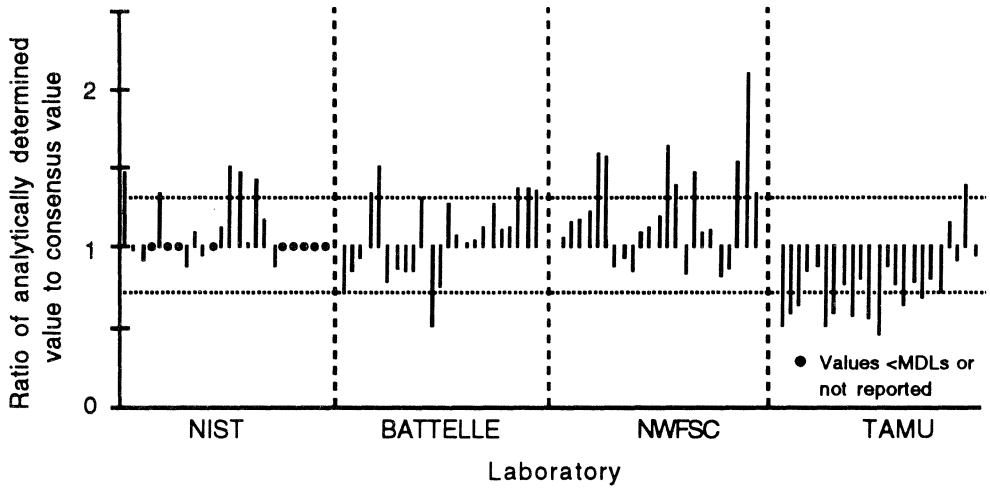


Figure 57. 1991 Tissue Control material (QA90TC) intercomparison exercise PAHs ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table IV.1, Appendix IV. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

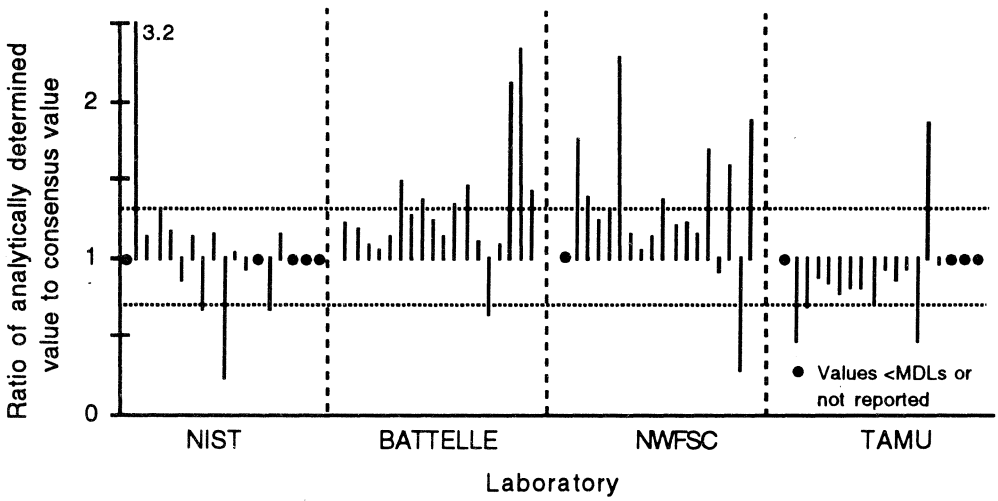


Figure 58. 1991 Tissue Control material (QA90TC) intercomparison exercise PCB congener ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table IV.1, Appendix IV. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

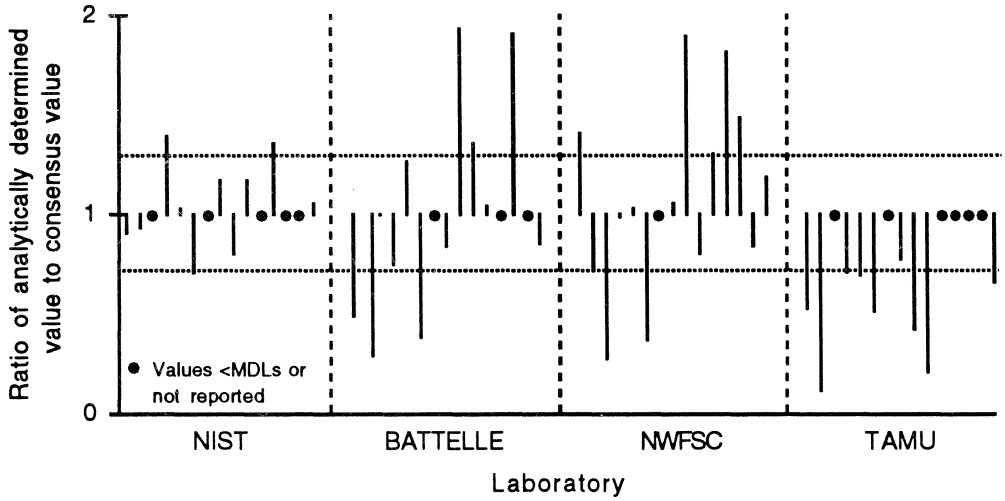


Figure 59. 1991 Tissue Control material (QA90TC) intercomparison exercise pesticides ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table IV.1, Appendix IV. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

The results of the low and high molecular weight PAH analysis are shown in Figures 60 and 61, respectively. Most of the results submitted by NWFSC were slightly high, with the mean of the replicates above the consensus value range defined as the consensus value plus or minus one standard deviation. The mean value reported by NWFSC for naphthalene, however, was considerably higher than the consensus value. Slightly high values were also reported by BATTELLE for phenanthrene. Slightly low means were reported by BATTELLE for 1,6,7-trimethylnaphthalene; and by TAMU for phenanthrene and anthracene. These values were above the MDLs listed in Table 14.

The results of the PCB congener analyses are shown in Figure 62. Relatively higher values were submitted by BATTELLE for PCB congeners 44, 52, 66, 101, 153, and 170. Apparent mean absolute percent errors ranged from 12 to 42%, except for the PCB 170 results which had a percent error of 73%. The concentration of this congener in the bivalve extract was very low in comparison with the levels of the other congeners. The consensus value for PCB 170 was 7.8 ng/ampoule. Only PCB 195 and PCB 206 were present at lower levels, below the limit of detection of BATTELLE and NMFSC (Table 15). The mean submitted by TAMU for PCB 206 was slightly high. The consensus value for this analyte was low and close to the MDL. The absolute percent errors of these results were less than 27%.

The results of the DDT and metabolite analyses are shown in Figure 63. Typical MDLs for the participating laboratories are listed in Table 16. Only four means were below the consensus value range. The means submitted by TAMU for 2,4'-DDT and 4,4'-DDD were low, and the mean submitted by TAMU for 2,4'-DDD was below the NS&T limit of acceptability. The mean submitted by NWFSC for 4,4'-DDE was low. The concentration of 2,4'-DDE in the extract was below the MDLs of BATTELLE and TAMU. The results of the cyclopentadiene (aldrin, *cis*-chlordane, dieldrin, heptachlor, heptachlor epoxide, and *trans*-nonachlor) pesticides are shown in Figures 64. The concentration of of aldrin and heptachlor were below detection for BATTELLE

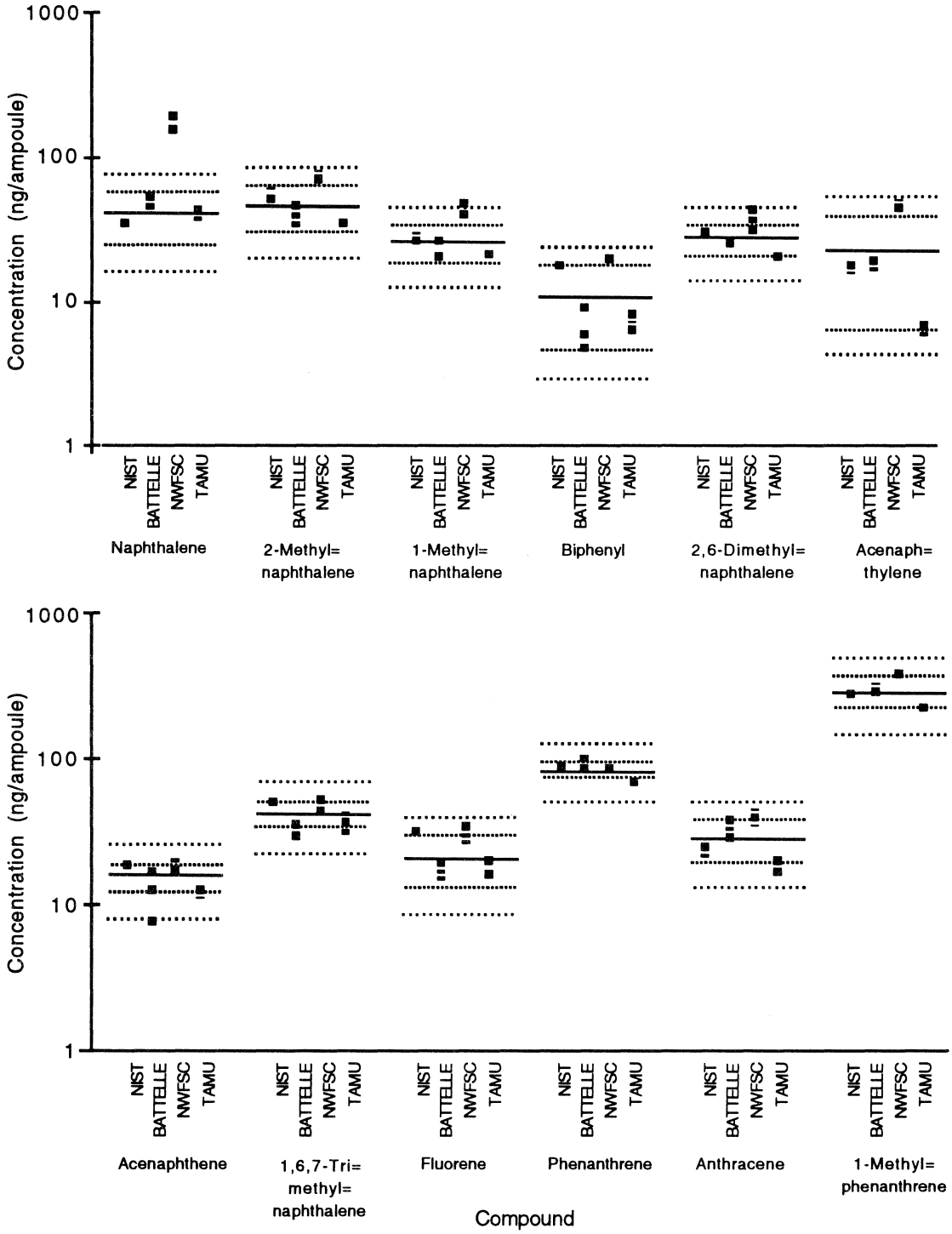


Figure 60. 1991 Bivalve Extract II (QA91BE2) intercomparison exercise results of low molecular weight PAHs (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range.) (ng/ampoule.).

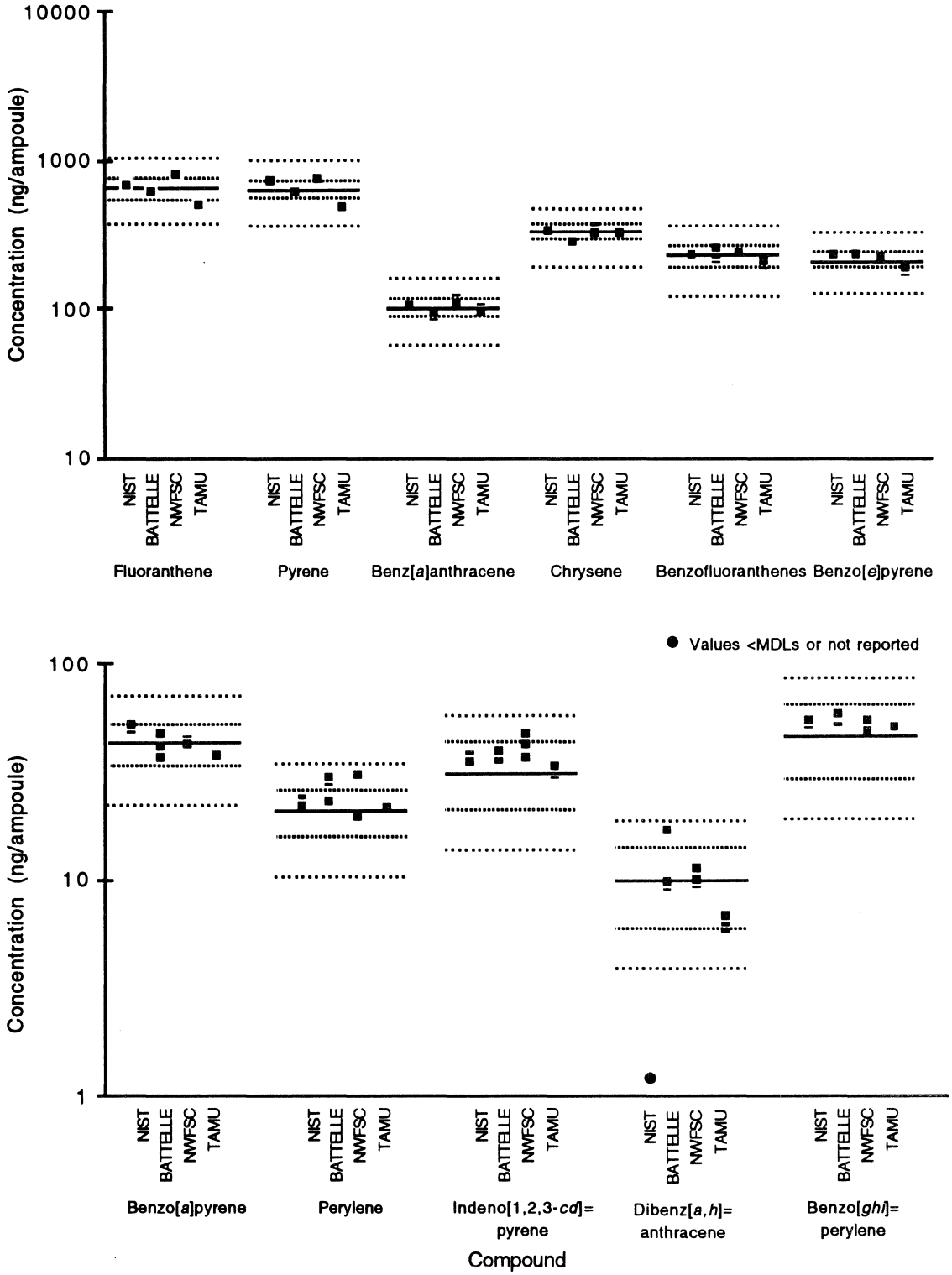


Figure 61. 1991 Bivalve Extract II (QA91BE2) intercomparison exercise results of high molecular weight PAHs (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/ampoule).

Table 14. 1991 limits of detection for NS&T polycyclic aromatic hydrocarbon analyses of sediments and tissues (ng/g dry weight).

Compound	Sediments			Tissues		
	BATTELLE 1991-1992 †	NWFSC 1993 *	TAMU 1989-1992 ◊	BATTELLE 1992 +	NWFSC 1993 *	TAMU 1991-1992 s
1-Methylnaphthalene	0.86	2 to <8	0.8	5.7	0.3 - <2	0.71
1-Methylphenanthrene	1.7	|	0.6	9.3	|	0.64
2-Methylnaphthalene	0.87	|	0.8	5.5	|	0.63
2,6-Dimethylnaphthalene	1.2	|	2.4	8.6	|	0.46
1,6,7-Trimethylnaphthalene	1.4	|	2.4	5.0	|	0.54
Acenaphthene	1.1	|	4.5	3.8	|	0.66
Acenaphthylene	1.4	|	3.7	10	|	0.55
Anthracene	1.3	|	4.1	5.5	|	0.92
Benz[*a*]anthracene	1.5	|	1.4	8.6	|	0.37
Benzo[*a*]pyrene	2.6	|	1.2	6.7	|	0.70
Benzo[*b*]fluoranthene	1.4	|	1.8	7.2	|	0.59
Benzo[*e*]pyrene	0.99	|	2.4	3.6	|	0.57
Benzo[*ghi*]perylene	1.7	|	0.3	4.6	|	0.61
Benzo[*k*]fluoranthene	1.4	|	1.9	9.8	|	0.69
Biphenyl	1.5	|	2.0	4.3	|	1.6
Chrysene	1.2	|	0.5	8.8	|	0.68
Dibenz[*a,h*]anthracene	12	|	2.6	9.9	|	0.39
Fluoranthene	2.7	|	0.4	9.5	|	0.53
Fluorene	0.83	|	2.5	6.4	|	0.87
Indeno[1,2,3-*cd*]pyrene	2.4	|	1.6	7.9	|	0.61
Naphthalene	0.48	|	0.5	11	|	1.4
Perylene	4.6	|	3.3	5.1	|	3.2
Phenanthrene	1.4	|	0.5	7.1	|	0.61
Pyrene	2.4	V	3.1	6.8	V	0.66

◊ Brooks *et al.* (1990). † Battelle, 1992. s GERG , 1992b. + SIM detector, mussel samples. Battelle (in press).

* The actual detection limit for an individual analyte in a sample depends on factors such as the procedure used to analyze the sample, the sample weight, the percent dry weight, the smallest GC peak area of any detected analyte in the appropriate GC calibration solution with the lowest concentration analyzed with the sample, and the GC detector response to the individual analyte relative to the GC internal standard. Approximate 1993 detection limits for sediments based on a 10 g sample size and a 60% dry weight are 2 to <8 ng/g for PAHs. Stomach contents detection limits for a sample of 3 g and 20% dry weight were 0.3 to <2 ng/g for aromatic hydrocarbons (C. Sloan, NOAA/NMFS/NWFSC, Seattle, WA, personal communication, 1993.).

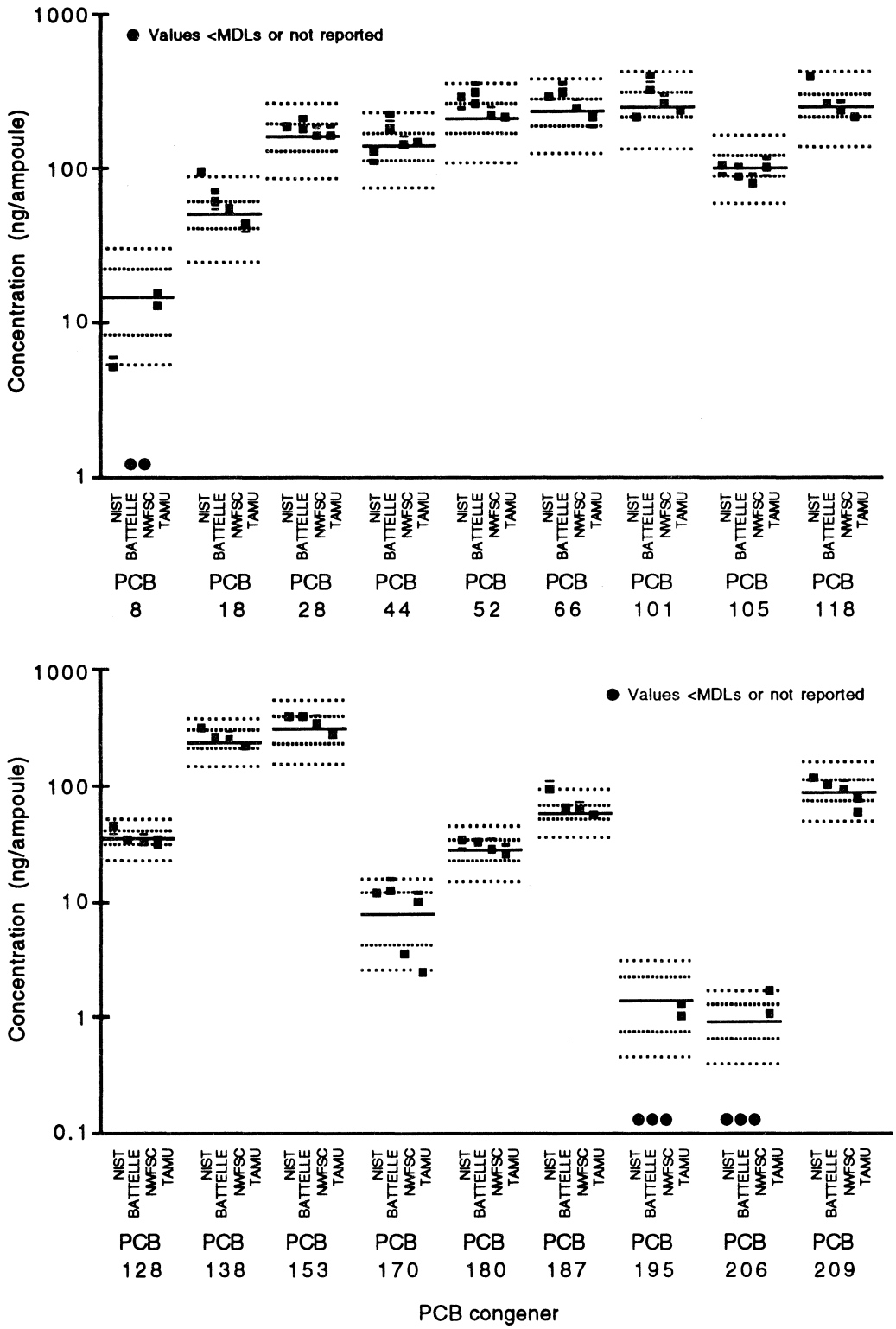


Figure 62. 1991 Bivalve Extract II (QA91BE2) intercomparison exercise results of PCB congener analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/ampoule).

Table 15. 1991 Limits of detection for NS&T PCB congener analyses of sediments and tissues (ng/g dry wt.).

Compound	Sediments			Tissues		
	BATTELLE 1991-1992†	NWFSC 1993 *	TAMU s 1989-1992 ◊	BATTELLE 1990 +	NWFSC 1993 *	TAMU 1991-1992 s
PCB 8	0.87	0.2 - <2	0.08	0.99	0.5 - <5	0.84
PCB 18	0.48	|	0.25	1.1	|	0.52
PCB 28	0.23	|	0.09	0.92	|	0.35
PCB 44	0.67	|	0.09	2.0	|	0.24
PCB 52	0.26	|	0.09	1.4	|	0.92
PCB 66	0.43	|	0.14	1.7	|	0.39
PCB 77*	0.60	|			|	1.1
PCB 101	0.49	|	0.13	2.6	|	0.51
PCB 105	0.60	|	0.10	2.0	|	1.1
PCB 118	0 45	|	0.12	2.4	|	0.47
PCB 126*	0.60	|			|	0.72
PCB 128	0.34	|	0.13	1.0	|	0.40
PCB 138	0.45	|	0.18	3.7	|	5.9
PCB 153	0.82	|	0.12	5.8	|	1.6
PCB 170	0.67	|	0.81	0.66	|	Δ
PCB 180	0.49	|	0.16	1.6	|	0.36
PCB 187	0.58	|	0.14	1.1	|	0.71
PCB 195	0.61	|	0.25	0.44	|	0.89
PCB 206	0.96	|	0.09	0.88	|	0.59
PCB 209	0.63	V	0.78	0.88	V	0.59

† Battelle, 1992. s GERG, 1992a. ◊ Brooks *et al.*, 1990. + Battelle, 1991.

Δ Not reported due to interference, of phthalates.

* The actual detection limit for an individual analyte in a sample depends on factors such as the procedure used to analyze the sample, the sample weight, the percent dry weight, the smallest GC peak area of any detected analyte in the appropriate GC calibration solution with the lowest concentration analyzed with the sample, and the GC detector response to the individual analyte relative to the GC internal standard. Approximate 1993 detection limits for sediments based on a 10 g sample size and a 60% dry weight are 0.2 to <2 ng/g for chlorinated hydrocarbons. The approximate 1993 detection limits for livers based on a 3 g sample size and a 30% dry weight are 0.5 to <5 ng/g for chlorinated hydrocarbons. Stomach contents detection limits for a sample of 3 g and 20% dry weight were 0.5 to <5 µg/g for chlorinated hydrocarbons (C. Sloan, NOAA/NMFS/NWFSC, Seattle, WA, personal communication, 1993.).

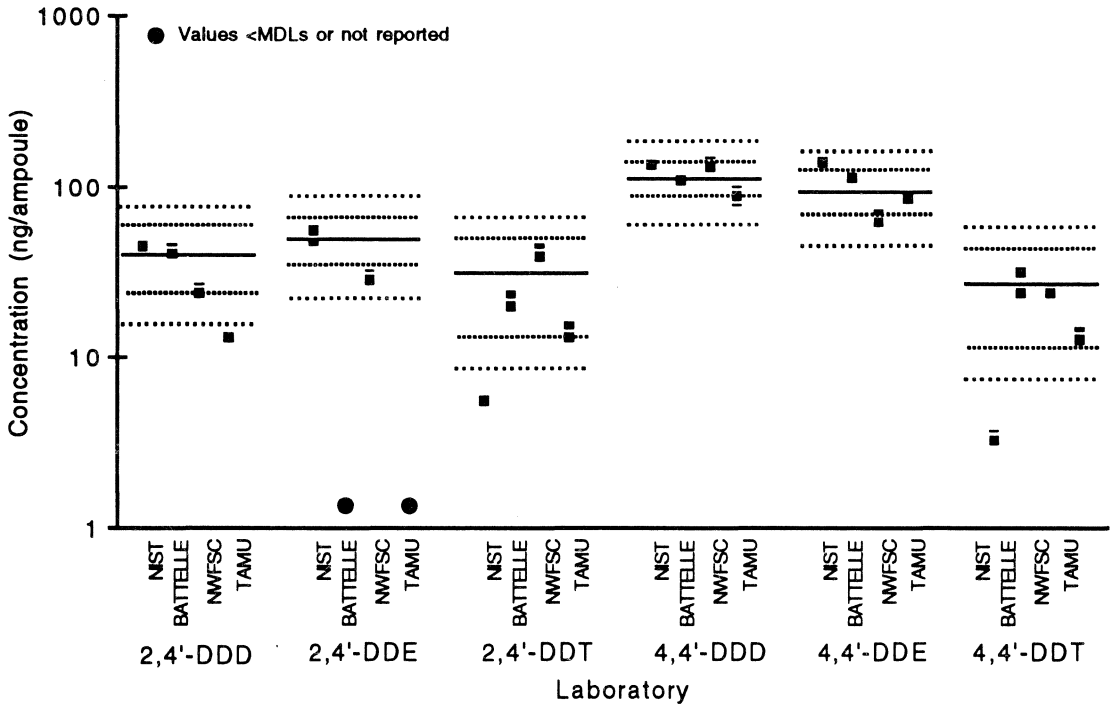


Figure 63. 1991 Bivalve Extract II (QA91BE2) intercomparison exercise results of DDT and metabolite analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/ampoule).

and NWFSC; and of heptachlor epoxide for BATTELLE. The BATTELLE means for *cis*-chlordane, dieldrin, and *trans*-nonachlor were higher than the consensus values. Slightly high means were also submitted by NWFSC for heptachlor epoxide, and *trans*-nonachlor. The level of heptachlor epoxide in the Bivalve Tissue Extract II was low and was not detected by one of the participating laboratories. The results of the mirex and hexachlorobenzene analyses are shown in Figure 65. High means were reported by NWFSC for mirex and by BATTELLE for hexachlorobenzene. The concentration of aldrin in the Bivalve Tissue Extract II was below the limit of detection of the three NS&T cooperating laboratories.

To determine if there is any bias in the analyses of this material, the ratios of the analytically determined mean values to those of the consensus values are shown in Figure 66 - 68. The order of the analytes is the same as those in Appendix IV. TAMU results are biased low for PAHs, but most of the results are within ±30% of the consensus values. NWFSC PAH results are biased high and about a third of the results are above 30% of the consensus value. The low concentration range of PAHs, however, presented analytical difficulties and the bias observed in the analytical results of one set of samples is not representative of the bias of the laboratory results overall. The PAH results for BATTELLE were within the ±30% range with only one exception. The BATTELLE results for PCB congener analysis were biased high with some results higher than 30% of the consensus value (Figure 67). The results for NWFSC and TAMU were within the 30% range with only a few exceptions. The concentrations of chlorinated pesticides in the Bivalve Tissue Extract were very low and many of the laboratories reported values below the MDLs. All three cooperating laboratories reported some values outside the ±30% range of the consensus value (Figure 68), and the results reported by TAMU seems to be biased low.

Table 16. 1991 Limits of detection for NS&T pesticide analyses of sediments and tissues (ng/g dry wt.).

Compound	Sediments			Tissues		
	BATTELLE 1991-1992†	NWFSC 1993 *	TAMU 1989-1992 ◊	BATTELLE 1991 +	NWFSC 1993 *	TAMU 1991-1992ˢ
2,4'-DDD	0.49	0.2 - <0.2	0.13	0.69	0.5 - <0.5	0.64
2,4'-DDE	0.32	|	0.28	1.1	|	0.30
2,4'-DDT	0.37	|	0.25	1.1	|	0.47
4,4'-DDD	0.58	|	-	7.1	|	0.38
4,4'-DDE	0.25	|	0.85	6.4	|	0.76
4,4'-DDT	0.62	|	0.24	1.7	|	0.38
Aldrin	0.42	|	0.25	0.39	|	0.49
cis-Chlordane	0.39	|	0.23	1.3	|	0.75
Dieldrin	0.40	|	0.16	2.9	|	0.66
gamma-HCH	0.20	|	0.22	1.9	|	0.33
Heptachlor	0.54	|	0.20	1.3	|	0.52
Heptachlor epoxide	0.46	|	0.16	1.4	|	0.57
Hexachlorobenzene	0.28	|	0.37	0.74	|	0.54
Mirex	0.49	|	0.17	0.86	|	0.54
trans-Nonachlor	0.42	V	0.10	0.99	V	1.9

† Battelle 1992. ˢ GERG , 1992b. + Battelle, 1991. * Brooks *et al.*, 1990.

* Approximate 1993 detection limits for sediments based on a 10 g sample size and a 60% dry weight are 0.2 to <2 ng/g for chlorinated hydrocarbons. The approximate 1993 detection limits for livers based on a 3 g sample size and a 30% dry weight are 0.5 to <5 ng/g for chlorinated hydrocarbons. Stomach contents detection limits for a sample of 3 g and 20% dry weight were 0.5 to <5 µg/g for chlorinated hydrocarbons. (C. Sloan, NOAA/NMFS/NWFSC, Seattle, WA, personal communication, 1993.).

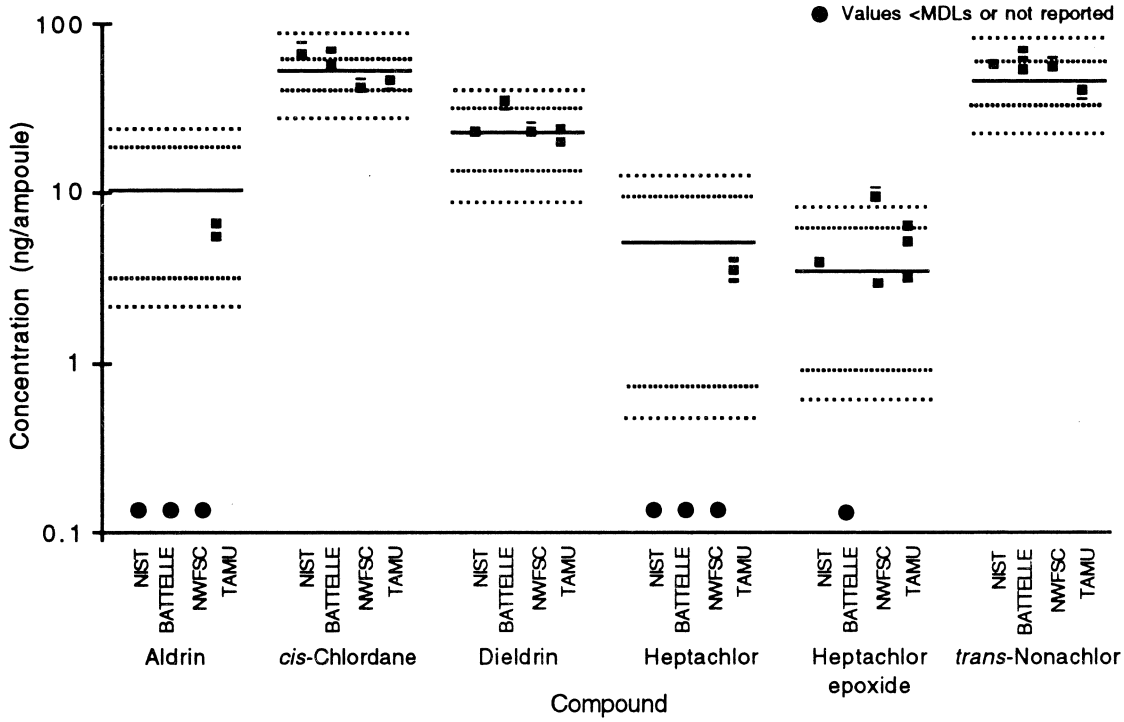


Figure 64. 1991 Bivalve Extract II (QA91BE2) intercomparison exercise results of cyclopentadiene pesticide analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/ampoule).

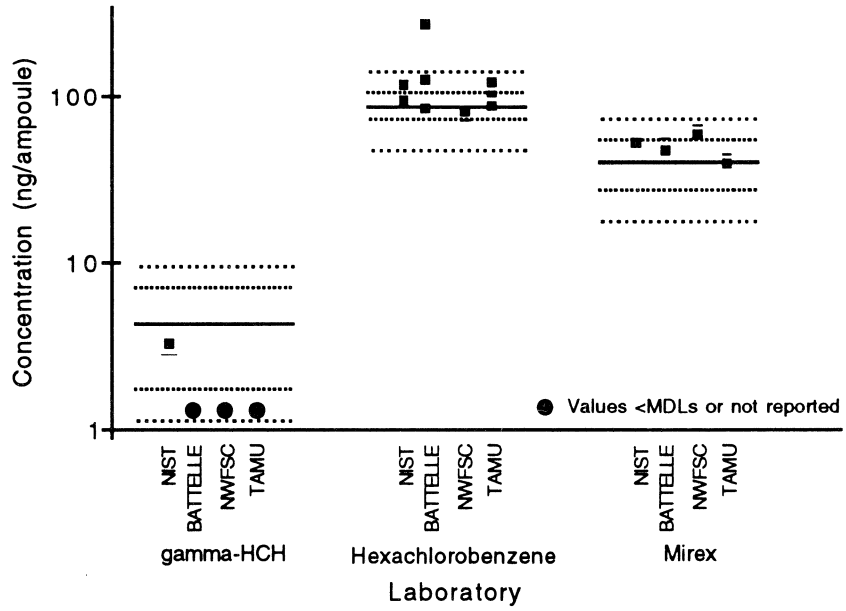


Figure 65. 1991 Bivalve Extract II (QA91BE2) intercomparison exercise results of gamma-HCH, hexachlorobenzene, and mirex analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/ampoule).

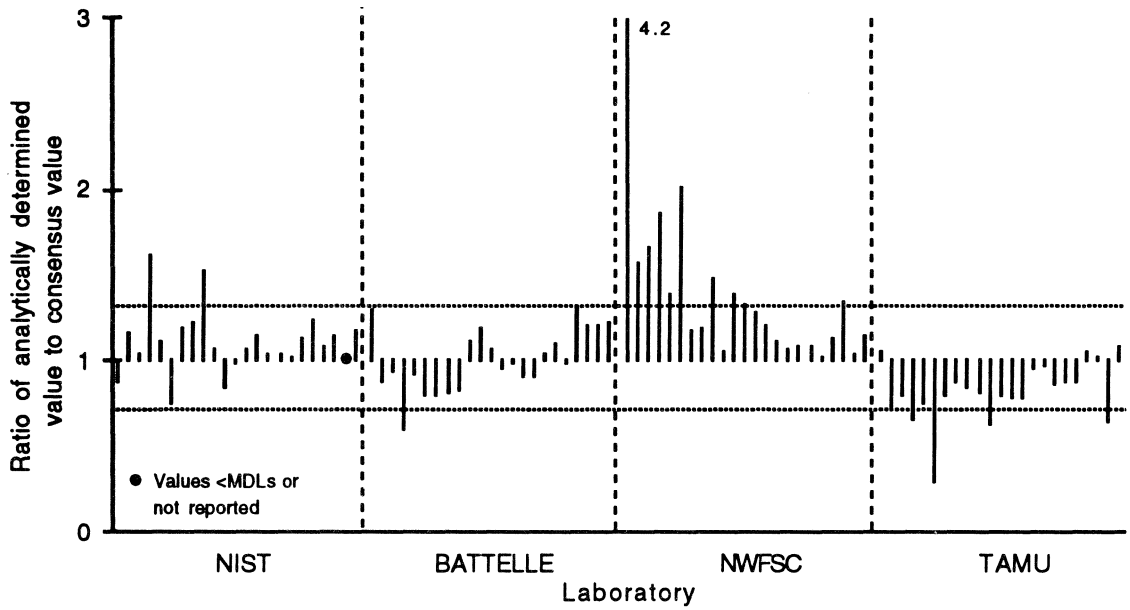


Figure 66. 1991 Bivalve Extract II (QA91BE2) intercomparison exercise PAHs ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table IV.2, Appendix IV Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

5.1.4. Performance evaluation of NS&T laboratories

An accuracy and precision scale similar to the one devised by Willie and Berman (1991, 1992, and 1993) in Sections 4.1.4, 4.2.4 and 4.3.4 was used to evaluate the performance of the NS&T cooperating laboratories. Accuracy was considered excellent if all replicates were within the range defined by the consensus value calculated by NIST using exercise results plus or minus one standard deviation, and good if the mean of the replicates was within the defined range but one or more of the replicates was outside. Further, results above or below the NS&T limits of acceptability are noted. Results were considered low or high if the mean of the replicates was lower or higher than the defined range. Precision was evaluated using the following criteria for various analyte concentrations: for concentrations ≥50 ng/g, the expected %RSD was ±10%; for concentrations ≥20 - <50 ng/g, the expected %RSD was ±20%; and for concentrations <20 ng/g, the expected %RSD was ±40%. The results of this evaluation are shown in Table 17. The same results are shown graphically in Figure 69 - 71. This graphical presentation does not take into account the concentration of the analyte in the exercise materials when compared to the MDLs of the participating laboratories. Typically, as the analyte concentration approaches the MDL of a method, the error increases.

The PAH analyses results reported by NWFSC for the Bivalve Extract II (QA91BE2) were biased high (Figure 66) and this is again shown in Figure 69. Some of the PAH analyses results reported by TAMU for the Tissue Control Material III (QC90TC) were low, and this was also shown in Figure 57. NIST was unable to quantitate many of the PAHs in the Tissue Control Material III since the concentrations of many of these compounds were below the detection

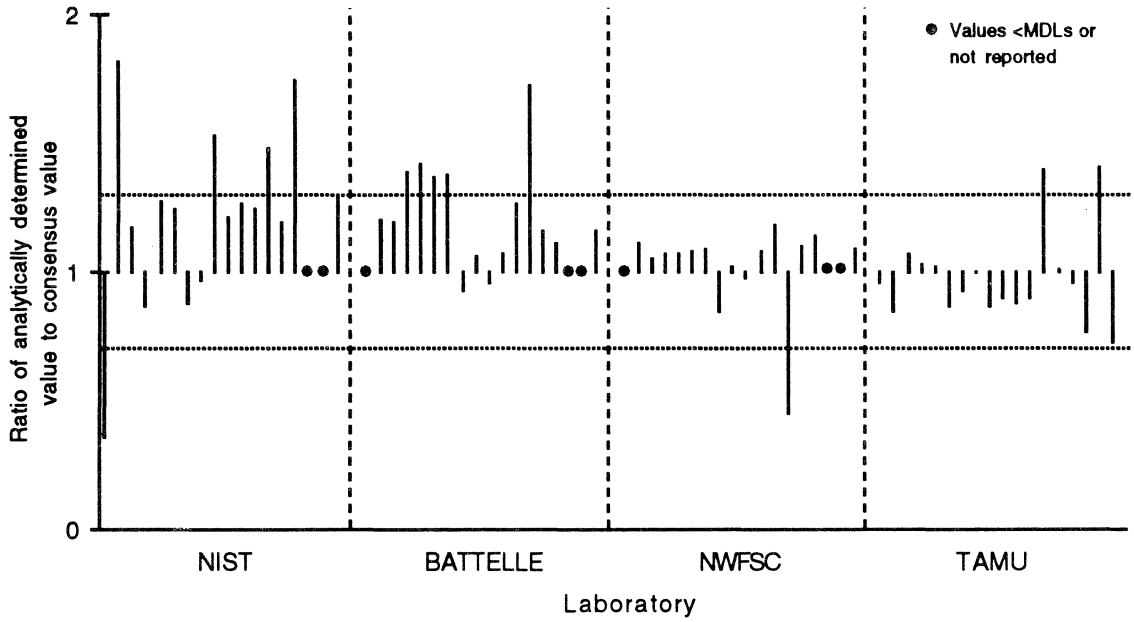


Figure 67. 1991 Bivalve Extract II (QA91BE2) intercomparison exercise PCB congener ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table IV.2, Appendix IV Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

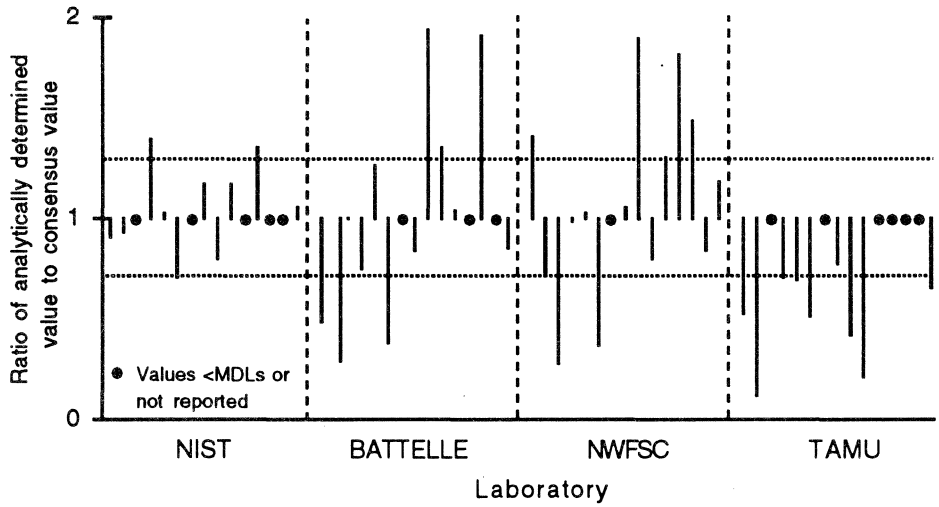


Figure 68. 1991 Bivalve Extract II (QA91BE2) intercomparison exercise pesticides ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table IV.2, Appendix IV Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

Table 17. Laboratory performance evaluation for 1991 trace organic intercomparison exercise (First letter is the evaluation of the accuracy and the second of the precision.).

Accuracy:	E	-	Excellent accuracy. All replicates are within the range defined by the consensus value calculated by NIST using exercise results plus or minus one standard deviation.
	G	-	Good accuracy. The mean of the replicates is within the range defined by the consensus value plus or minus one standard deviation, but one or more of the replicates is outside.
	L	-	Low results. The mean of the replicates is lower than the defined range.
	L-	-	Results lower than -30% of the lower limit of the defined range.
	H	-	High results. The mean of the replicates is larger than the defined range.
	H+	-	Results higher than +30% of the higher limit of the defined range.
Precision:	G	-	Good precision. The intralaboratory precision is within the following criteria for various analyte concentrations: Concentration ≥50 ng/g, expected RSD ±10%; concentration ≥20 - <50 ng/g, expected RSD ±20%; and concentration <20 ng/g, expected RSD ±40%
	X	-	The intralaboratory precision is not within the criteria described above.
	-	-	No results or a "less than" value submitted.

	Tissue Control Material (QA90TC)						Bivalve Extract II (QA91BE2)					
Compound	BATTELLE		NWFSC		TAMU		BATTELLE		NWFSC		TAMU	
PAHs												
Naphthalene	E	G	E	G	L	G	E	G	H+	G	E	G
2-Methylnaphthalene	E	G	E	G	G	G	E	G	H	G	E	G
1-Methylnaphthalene	E	G	E	G	E	G	E	G	H	G	E	G
Biphenyl	H	G	H	G	E	G	E	G	H	G	E	G
2,6-Dimethylnaphthalene	E	G	H	G	E	G	E	G	H	G	E	G
Acenaphthylene	E	G	H	G	L	G	E	G	H	G	G	G
Acenaphthene	E	G	E	G	E	G	G	G	G	G	G	G
1,6,7-Trimethylnaphthalene	E	G	E	G	E	G	L	G	H	G	G	G
Fluorene	E	G	E	G	L	G	E	G	H	G	E	G
Phenanthrene	G	G	E	G	E	G	H	G	E	G	L	G
Anthracene	E	G	E	G	E	G	G	G	H	G	L	G
1-Methylphenanthrene	E	G	E	G	L	G	E	G	H	G	E	G
Fluoranthene	E	G	H	G	E	G	E	G	H	G	L	G
Pyrene	E	G	E	G	E	G	E	G	H	G	L	G
Benz[*a*]anthracene	E	G	E	G	L	G	E	G	E	G	E	G
Chrysene	E	G	E	G	E	G	G	G	G	G	E	G
Benzofluoranthenes	E	G	E	G	G	G	E	G	E	G	E	G
Benzo[*e*]pyrene	H	G	E	G	E	G	G	G	E	G	L	G
Benzo[*a*]pyrene	E	G	E	G	E	G	E	G	E	G	E	G
Perylene	E	G	E	G	E	G	H	G	G	X	E	G
Indeno[1,2,3-*cd*]pyrene	E	G	H	G	E	G	E	G	H	G	E	G
Dibenz[*a,h*]anthracene	E	G	H	G	E	G	G	G	E	G	E	G
Benzo[*ghi*]perylene	E	G	E	G	E	G	E	G	E	G	E	G

Table 17. Laboratory performance evaluation for 1991 trace organic intercomparison exercise (First letter is the evaluation of the accuracy and the second of the precision.) (cont).

	Tissue Control Material (QA90TC)			Bivalve Extract II (QA91BE2)		
Compound	BATTELLE	NWFSC	TAMU	BATTELLE	NWFSC	TAMU
PCBs						
PCB 8	E G	- -	- -	- -	- -	E G
PCB 18	E G	H G	L G	G G	E G	E G
PCB 28	E G	H G	L G	G G	E G	E G
PCB 44	G G	H G	E G	H G	E G	E G
PCB 52	G G	H G	L G	H G	E G	E G
PCB 66	H G	H+ G	E G	H G	E G	E G
PCB 101	H G	E G	G G	H G	E G	E G
PCB 105	E G	E G	E G	E G	E G	E G
PCB 118	E G	E G	E G	E G	E G	E G
PCB 128	E G	E G	E G	E G	E G	E G
PCB 138	H G	E G	E G	E G	G G	E G
PCB 153	H G	E G	E G	H G	E G	E G
PCB 170	E G	E G	L G	H G	L G	H G
PCB 180	E G	H G	H G	H G	E G	E G
PCB 187	G G	E G	E G	H G	H G	E G
PCB 195	H G	E G	- -	- -	- -	E G
PCB 206	H G	E G	- -	- -	- -	H G
PCB 209	E G	H G	- -	E G	E G	L G
Chlorinated pesticides						
2,4'-DDD	L G	G G	G G	E G	E G	L- G
2,4'-DDE	E G	E G	L- G	- -	L G	- -
2,4'-DDT	E G	E G	- -	E G	E G	E G
4,4'-DDD	L G	E G	E G	E G	G G	G G
4,4'-DDE	H G	E G	L G	E G	L G	E G
4,4'-DDT	E G	E G	E G	E G	E G	E G
Aldrin	- -	- -	- -	- -	- -	E G
cis-Chlordane	E G	E G	L G	H G	E G	E G
Dieldrin	H G	H G	E G	H G	E G	E G
gamma-HCH	G G	E G	L+ G	- -	- -	- -
Heptachlor	E G	E G	- -	- -	- -	E G
Heptachlor epoxide	- -	H G	- -	- -	- -	G G
Hexachlorobenzene	H G	E G	- -	H X	E G	E G
Mirex	- -	E G	- -	G G	H G	E G
trans-Nonachlor	G G	E G	L G	E G	E G	E G

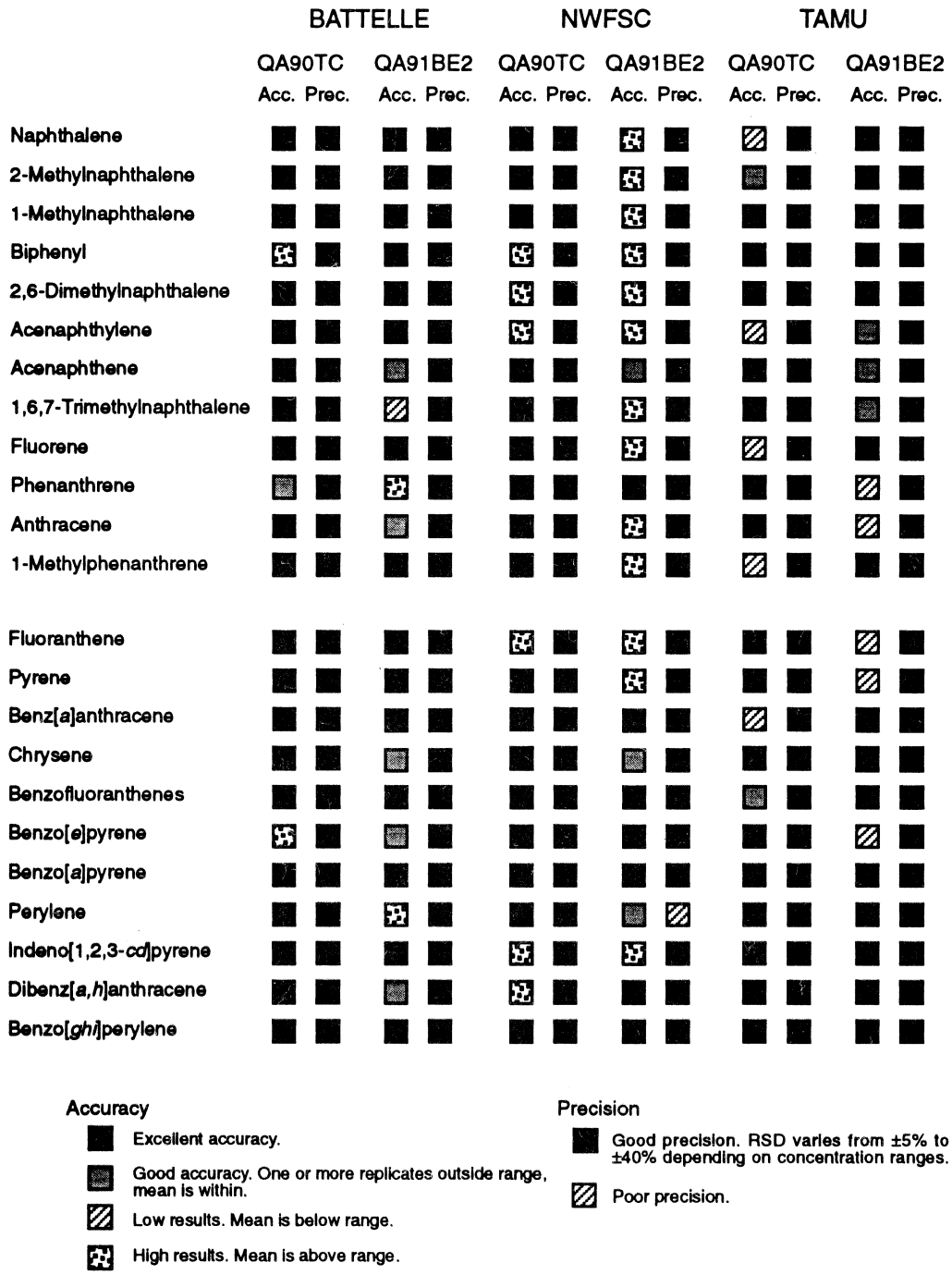


Figure 69. 1991 PAH determination performance evaluation.

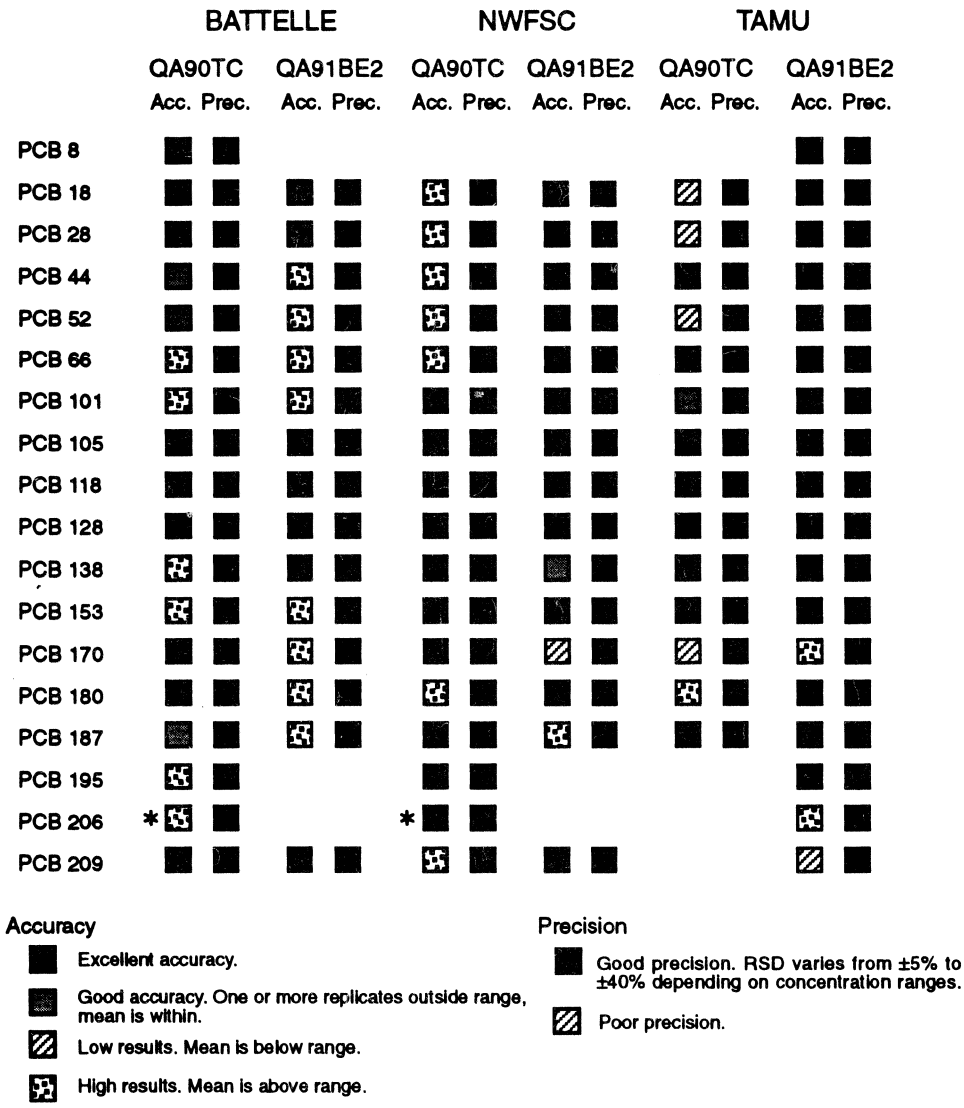


Figure 70. 1991 PCB determination performance evaluation (* - Consensus value low and standard deviation high, so lower limit of accepted concentration range is negative.).

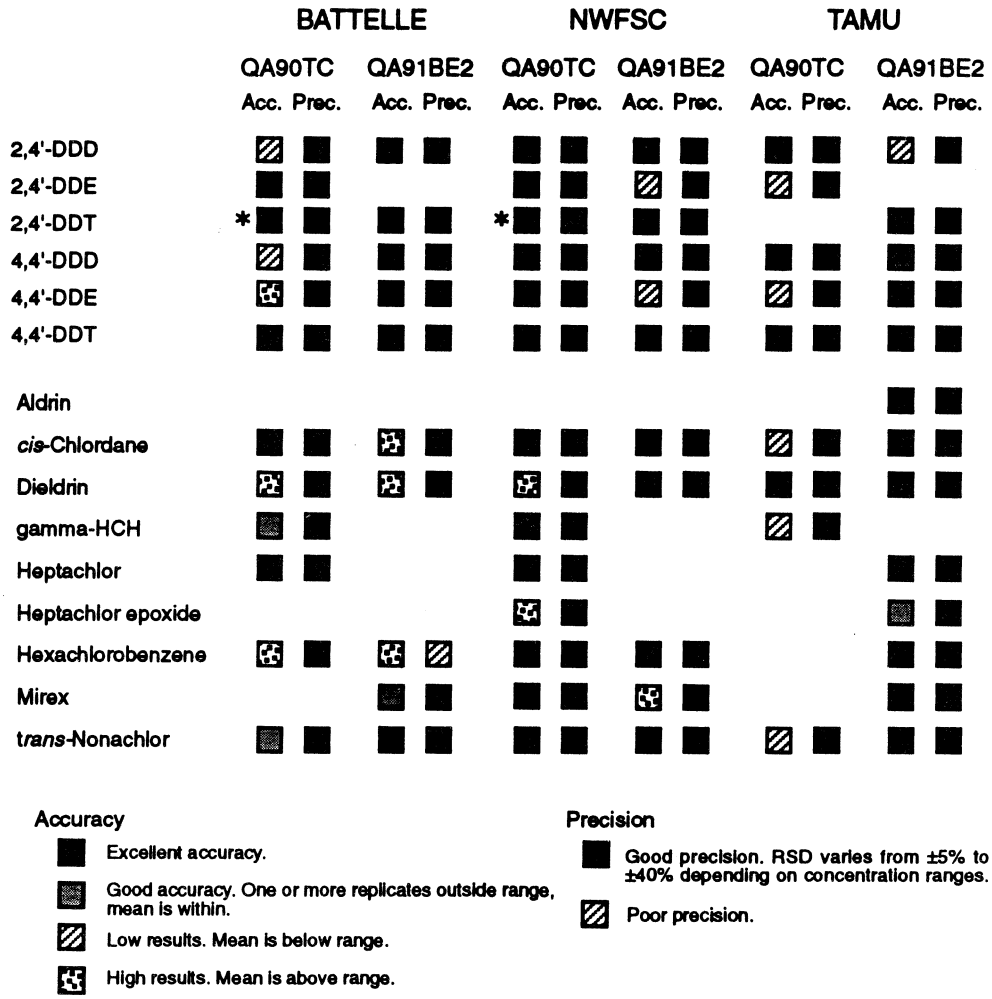


Figure 71. 1991 Chlorinated pesticides determination performance evaluation (* - Consensus value low and standard deviation high so lower limit of accepted concentration range is negative.).

limits of the analytical method used by that laboratory. Overall, the PAH analyses results were good. All results were within ±35% of the concentration range defined by plus or minus one standard deviation of the consensus value, except for the naphthalene results reported by NWFSC for the Bivalve Extract II (QA91BE2).

The results of the PCB congener analyses are shown in Figure 70. The consensus value calculated for PCB 206 for the Tissue Control Material III (QC90TC) was low and standard deviation high, so the lower limit of the accepted concentration range was negative. Several laboratories reported no values or values below the MDLs for several congeners. Many BATTELLE results were high for both materials in the 1991 exercise. The results reported by NWFSC were high for the Tissue Control Material III. Those reported by TAMU for the same material were low. All results were within ±35% of the NS&T concentration range defined by plus or minus one standard deviation of the consensus value, except for the PCB 66 results reported by NWFSC for the Tissue Control Material III (QC90TC).

The results of the chlorinated pesticide analyses are shown in Figure 71. The concentrations of these compounds in the exercise materials were low, and the lower limit of the concentration range defined by plus or minus one standard deviation was negative. The results reported by TAMU for 2,4'-DDD and gamma-HCH for the Tissue Control Material III, and for 2,4'-DDD for the Bivalve Extract II were outside the NS&T ±35% of the concentration range.

The overall precisions of the triplicate extraction analyses were very good.

5.2. 1992 Exercise

The 1992 trace organic intercomparison exercise was also organized by NIST. The materials used were prepared by NIST and were Marine Sediment III (QA92SED3) and Mussel Tissue IV Homogenate (QA92TIS4). The NS&T cooperating laboratories again were NWFSC, BATTELLE, and TAMU. Marine Sediment III was sent to 30 other laboratories and Mussel Tissue IV Homogenate to 29.

Results were received from 16 laboratories, in addition to the NS&T cooperating laboratories. A sediment was chosen for the exercise since none had been used since 1987. The results of the NS&T cooperating laboratories are listed in Appendix V.

5.2.1. Description of materials and exercise

Marine Sediment III was a wetted marine sediment prepared using candidate SRM 1941a and water (NIST, 1992 and 1993a). The material was issued wet to more closely match the matrix analyzed by the laboratories. This material was uncharacterized prior to its use for the 1992 exercise. NIST certified and noncertified values became available about a year later (NIST, 1994a). The sediment for candidate SRM 1941a was collected in the Chesapeake Bay near the Francis Scott Key Bridge using a modified Van Veen-type grab sampler with the assistance of NOAA. The sediment was stored in Teflon-lined containers at approximately 5°C until the material was freeze dried. The material was then sieved and the -60 to +100 (250 - 149 µm) mesh fraction was collected, blended, and radiation sterilized. The resulting material was homogenized and bottled, with the exception of the material needed for Marine Sediment III, which was stored in bulk in a Teflon-lined container. Exactly 8.00 g of the marine sediment were weighed into each glass bottle, and approximately 4 days before shipment of the sample to the various laboratories, 9.02 ± 0.02 g of water were added to each tared bottle. The masses of sediment and of the water in each bottle were accurately recorded. Trials showed that 9 g of water could moisten 8 g of sediment and only a very small amount of water was

observed on top of the sediment sample. Each bottle of material was stored at -80°C until shipped in dry ice to participants.

The mussels used for the Mussel Tissue IV Homogenate (QA92TIS4) were collected at Dorchester Bay, MA, by NOAA personnel in conjunction with Battelle New England (NIST, 1993b and 1993c). The mussels were shucked and cryogenically homogenized and stored in a teflon bag in a liquid nitrogen freezer at NIST. Approximately 15-20 g (wet wt.) portions of the mussel homogenate were aliquoted into precooled bottles. All subsequent manipulations of the bottles were performed in the liquid nitrogen freezer to avoid warming of the samples. The bottles were stored at -80°C until shipment on dry ice via overnight delivery to the participating laboratories. As for the 1991 exercise, each laboratory received three ampoules or jars of each unknown, and were asked to extract the materials and perform triplicate injections from a sample from one of the ampoules or jars, and single injections from the other two. Two ampoules each of concentrated PCBs (SRM 2262), pesticides (SRM 2261), and PAHs (SRM 2260) calibration solutions were also sent to each participant analyzing the Marine Sediment III, and only of SRM 2262 to those analyzing the Mussel Tissue IV Homogenate. A computer diskette with appropriate files accompanied the samples to facilitate data reporting.

Several sets of coeluting or unresolved PAHs and PCBs were noted by NIST. These were: chrysene and triphenylene; benzo[*b*]fluoranthene, benzo[*j*]fluoranthene, and benzo[*k*]fluor=-anthene; dibenz[*a,h*]anthracene and dibenz[*a,c*]anthracene; PCB 66 and PCB 95; PCB 101 and PCB 90; PCB 138, PCB 163, and PCB 164; PCB 170 and PCB 190; and PCB 187 and PCB 182. Coelution and lack of resolution in chromatography are functions of gas chromatographic analytical conditions, such as column type and size, and oven temperatures. Some of these coeluting or unresolved analytes may also have occurred during analyses by the cooperating laboratories. Some matrix interferences were noted during the exercises.

5.2.2. Consensus values

Consensus values were calculated as described in Section 5.1.2.

5.2.3. Results

5.2.3.1. Marine Sediment III (QA92SED3)

The results of the Marine Sediment III (QA92SED3) intercomparison exercise are shown graphically in Figures 72 - 77. The results of analyses of the 2- and 3-ring PAHs (low molecular weight) and the 4- and 5-ring (high molecular weight) PAHs are shown graphically in Figures 72 and 73. The compounds in each of these classes of PAHs are listed in Table 13. As before, the dotted line is the range defined by plus or minus one standard deviation of the consensus value, and the dashed line is ±35% of the high and low limits of the consensus value range. With few exceptions, the results of all NS&T laboratories were within the specified range, and most were within the smaller range of plus or minus one standard deviation of the consensus value.

The results of the NS&T cooperating laboratories PCB congener determinations are shown in Figure 74. Several laboratories reported values below their MDLs. The results reported by BATTELLE for PCBs 8 and 118, by TAMU for PCB 128 and by NWFSC for PCB 170/190, were higher than the NS&T limit of acceptability. The rest of the results were mostly within plus or minus one standard deviation of the consensus value.

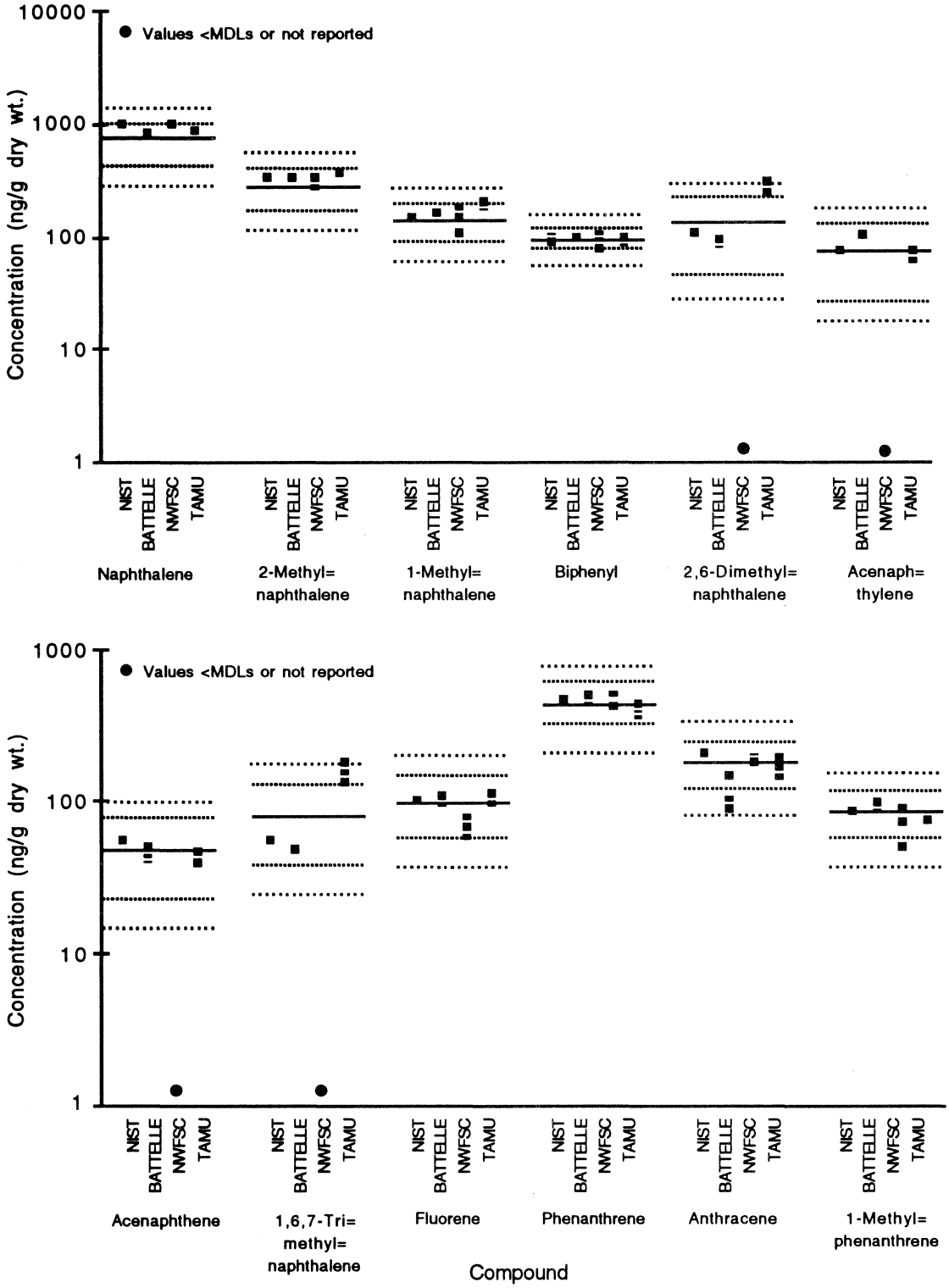


Figure 72. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results of low molecular weight PAHs (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

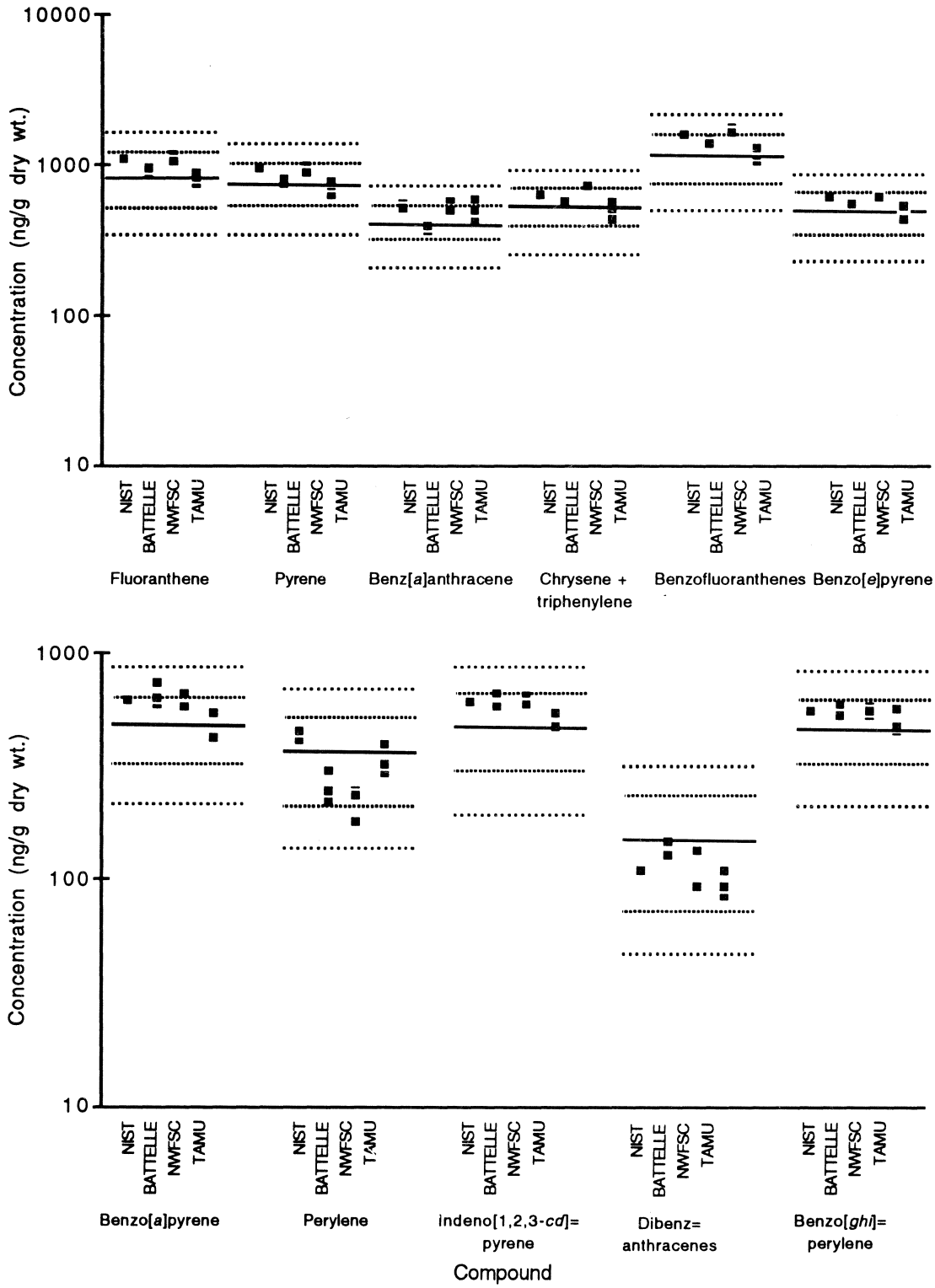


Figure 73. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results of high molecular weight PAHs (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

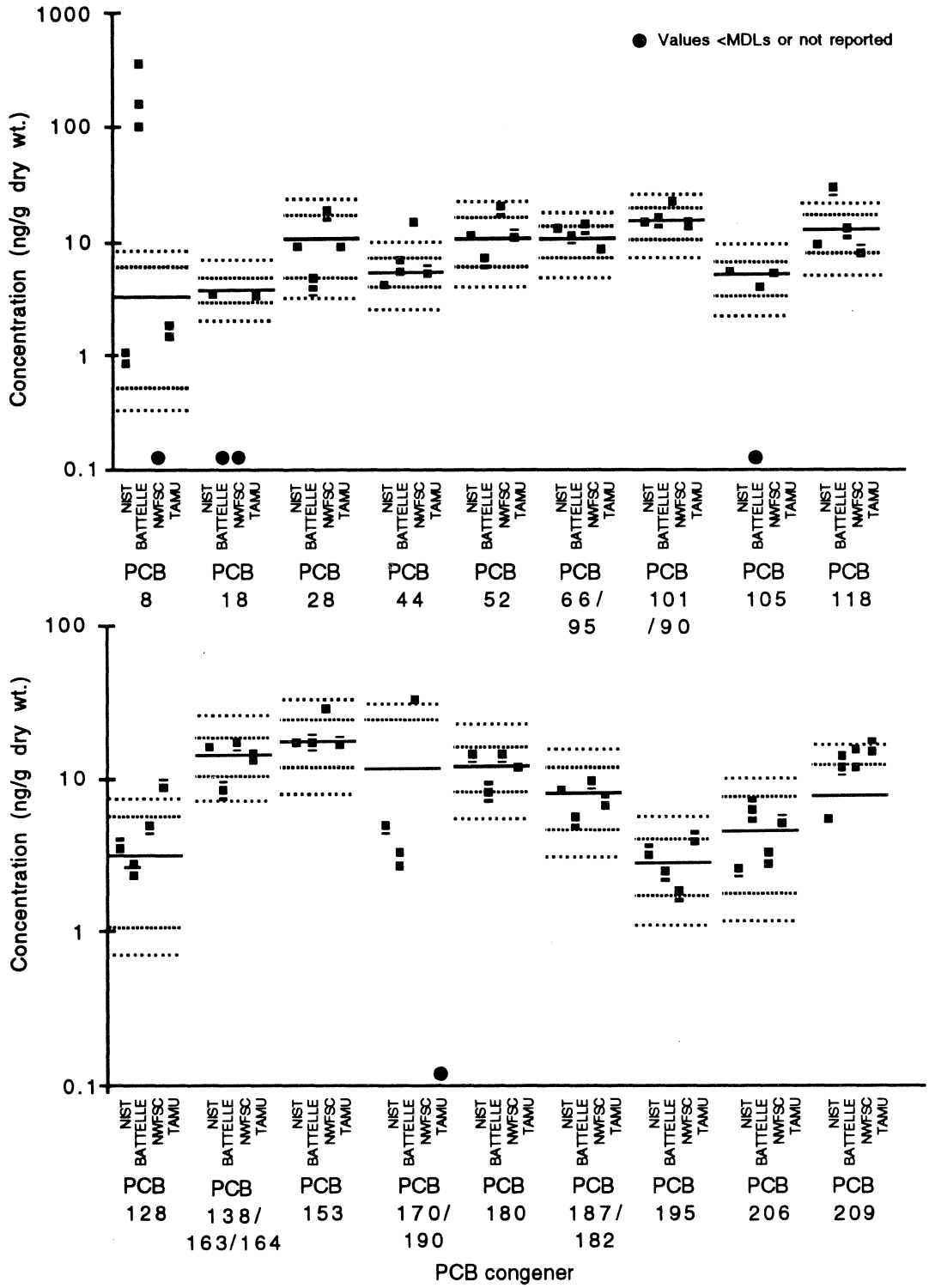


Figure 74. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results of PCB congener analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted. Consensus values for PCB s170/90 and 209 were low and the standard deviation high so lower limit of acceptability ranges are negative.) (ng/g dry wt.).

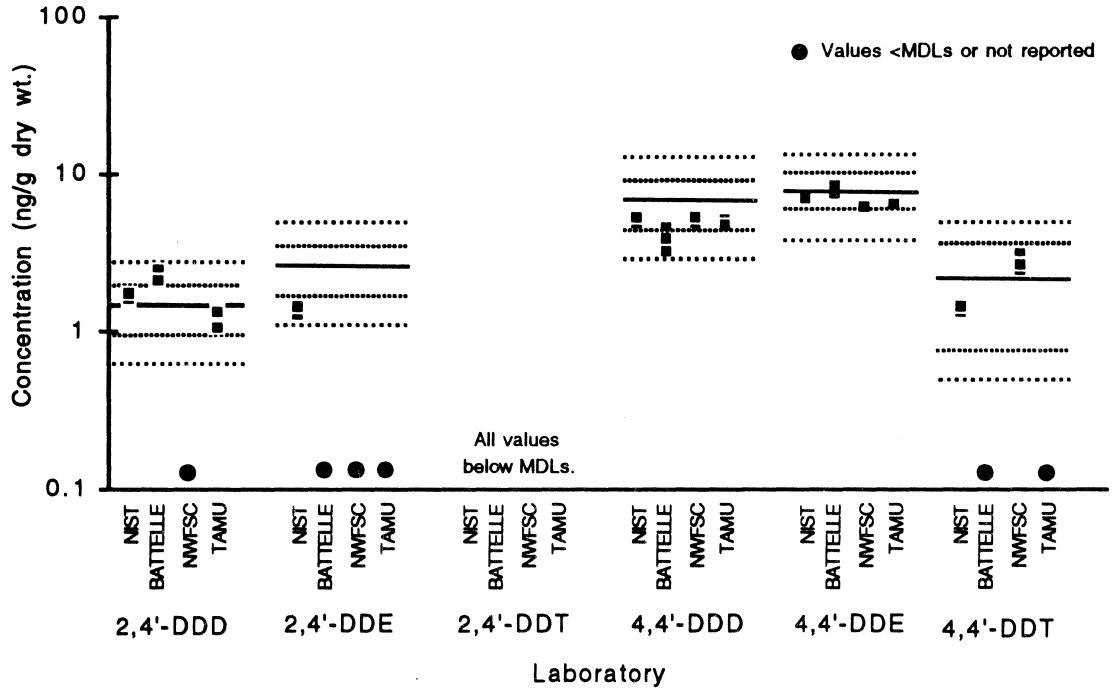


Figure 75. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results of DDT and metabolite analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

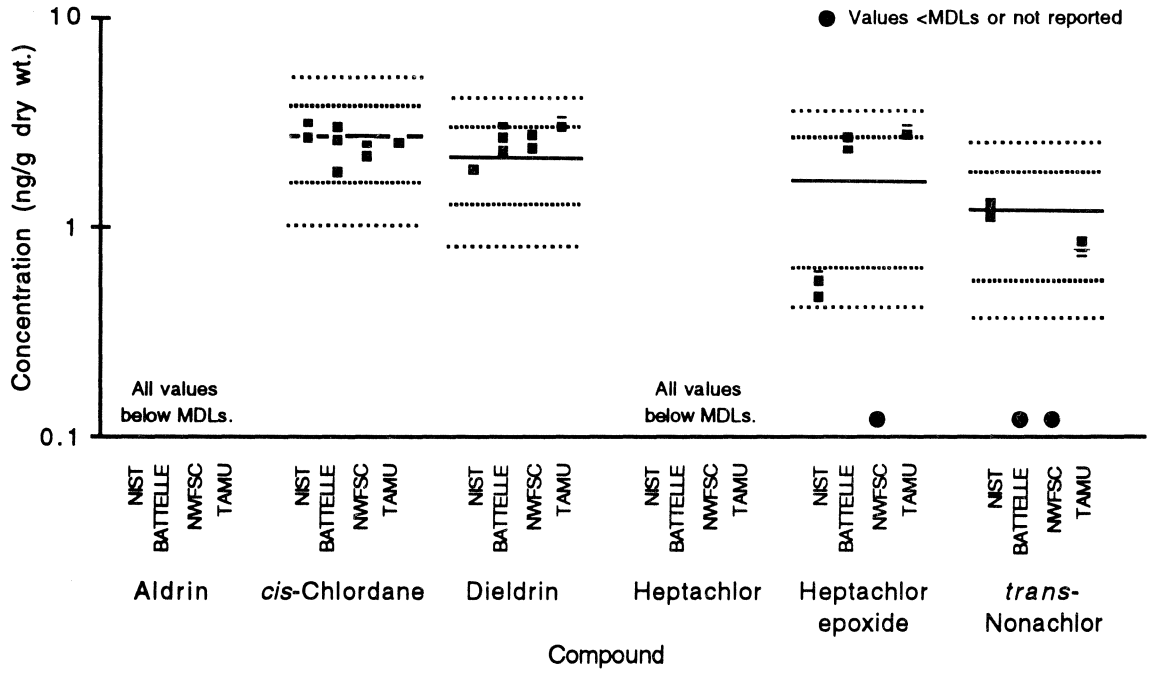


Figure 76. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results of cyclopentadiene pesticide analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

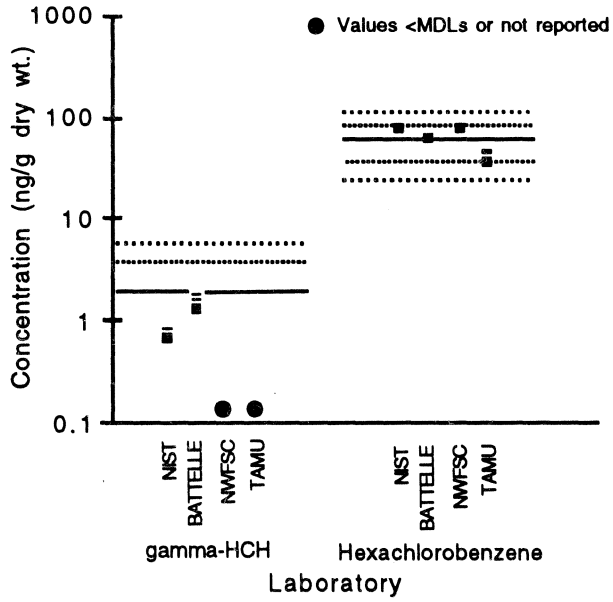


Figure 77. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results of gamma-HCH and hexachlorobenzene analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

The results for DDT and metabolites are shown in Figure 75. The levels of these compounds in the Marine Sediment III material were low and several laboratories reported values below their MDLs. Good results were obtained for 4,4'-DDD and 4,4'-DDE, except for a low mean reported by BATTELLE for 4,4'-DDD. The results reported by TAMU for 2,4'-DDD were within plus or minus one standard deviation of the consensus value. The mean reported by BATTELLE was high, and that reported for NWFSC below the MDL. The results of the analyses of the cyclopentadiene pesticides are shown in Figure 76. The results reported for *cis*-chlordane and dieldrin were good. All laboratories reported values below the MDLs for aldrin and heptachlor, and some also reported non-detectable concentrations for heptachlor epoxide and *trans*-nonachlor. Values below the MDLs were reported for gamma-HCH and no conclusions could be made (Figure 77). The values reported for hexachlorobenzene were good, although the TAMU results were slightly low. The results of the analyses of the DDT and metabolites and the chlorinated pesticides were difficult to judge since the levels of these compounds in the exercise material were low.

The ratios of the analytically determined mean values to those of the consensus values are shown in Figures 78 - 80 and these are indicative of bias. The order of the analytes is the same as that in Appendix V. The results for BATTELLE and NWFSC for the PAHs are mostly biased high (Figure 78). TAMU had little bias or error for the PAHs except for the results of 2,6-dimethylnaphthalene and 1,6,7-trimethylnaphthalene analyses. The ratios of the PCB analyses are shown in Figure 79. Most of the NWFSC results are biased high. The levels of chlorinated pesticides in the Marine Sediment III were very low and the participating laboratories reported values below the MDLs for many analytes (Figure 80). BATTELLE results appear to be biased high.

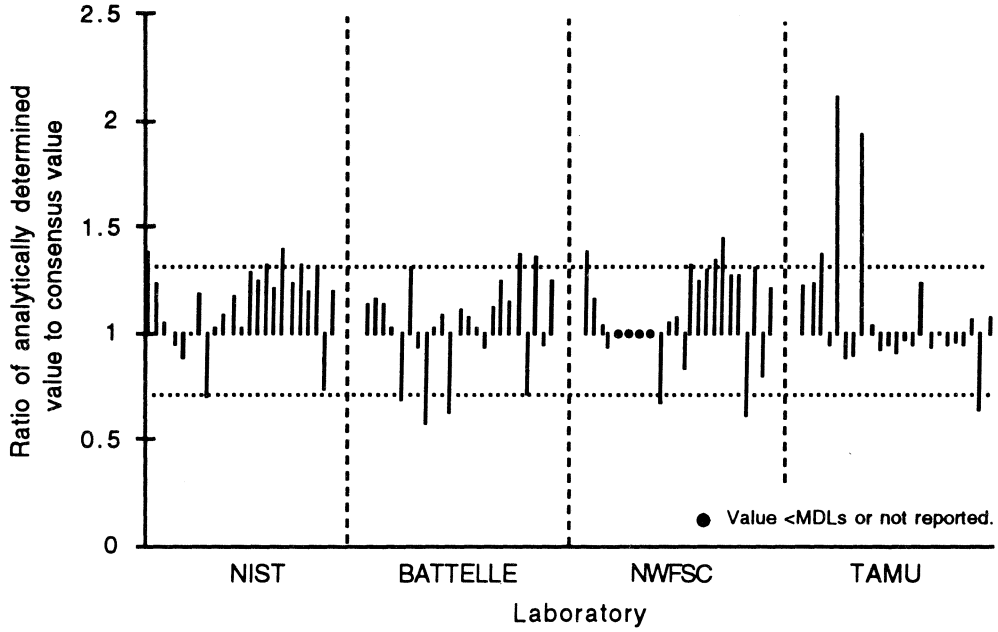


Figure 78. 1992 Marine Sediment III (QA92SED3) intercomparison exercise PAHs ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table V.1, Appendix V. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

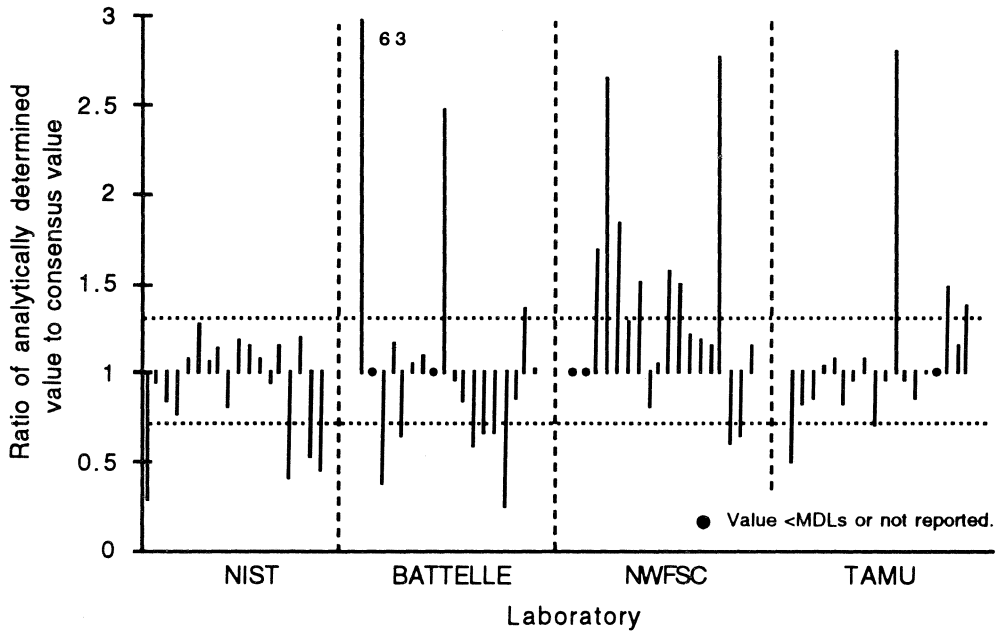


Figure 79. 1992 Marine Sediment III (QA92SED3) intercomparison exercise PCB congener ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table V.1, Appendix V. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

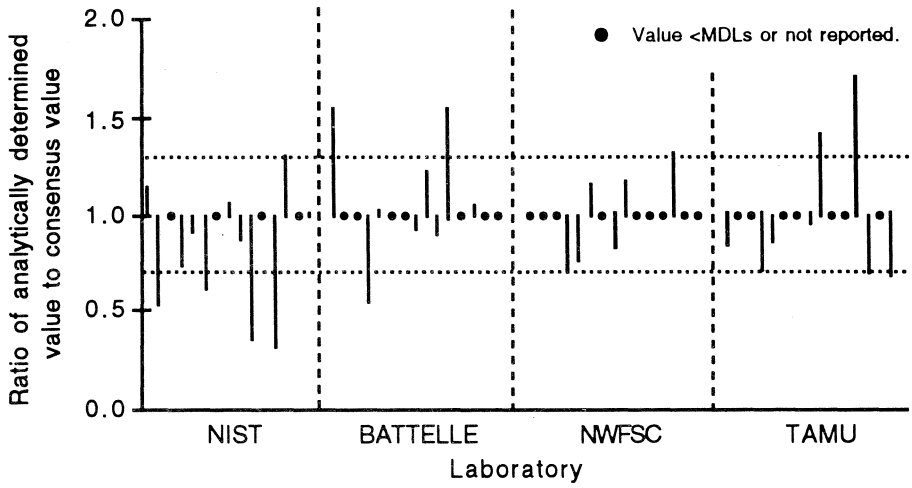


Figure 80. 1992 Marine Sediment III (QA92SED3) intercomparison exercise pesticides ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table V.1, Appendix V. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

5.2.3.2. Mussel Tissue IV Homogenate (QA92TIS4)

The results of the Mussel Tissue IV Homogenate (QA92TIS4) are shown in Figures 81 to 86. The results of analyses of the 2- and 3-ring PAHs (low molecular weight) and the 4- and 5-ring (high molecular weight) PAHs are shown graphically in Figures 81 and 82. As for previous exercises, the PAH results are mostly within the range defined as plus or minus one standard deviation of the consensus value. Larger variations in performance were observed for the PCB analyses (Figure 83). The results submitted by NWFSC were consistently high. NWFSC later determined that the high results were a result of a problem with the standard used to calculate the concentrations. The overall precision and accuracy decreased for PCBs 170/190, 180, 195, and 209, that are present in low concentrations in this material. The results for DDT and metabolites are shown in Figure 84. The standard deviations of the NIST-calculated consensus values were high for this material. With the exception of the TAMU result for 2,4'-DDD, all mean results were within the range defined as plus or minus one standard deviation of the consensus value. The same observation generally applies for the cyclopentadiene pesticides (Figure 85). TAMU reported low results for *cis*-chlordane, and BATTELLE high results for dieldrin. The consensus values calculated for heptachlor and heptachlor epoxide were low and standard deviations high, so the lower limits of the accepted concentration ranges are negative. The results for three other low-level chlorinated pesticides are shown in Figure 86. The levels of gamma-HCH and hexachlorobenzene were very low and the standard deviations of the consensus values high. The means of the results for mirex were within the range defined as plus or minus one standard deviation of the consensus value.

The ratios of the analytically determined mean values to those of the consensus values were again used as indicators of bias and are shown in Figures 87 - 89. NWFSC results are mostly low. No other clear bias could be observed in the PAH analyses results (Figure 87). The results submitted by NWFSC for PCBs were biased high (Figure 88). No clear bias trends could be determined for the other PCB analyses or for the chlorinated pesticides except for the TAMU results for pesticides which are mostly low (Figure 89).

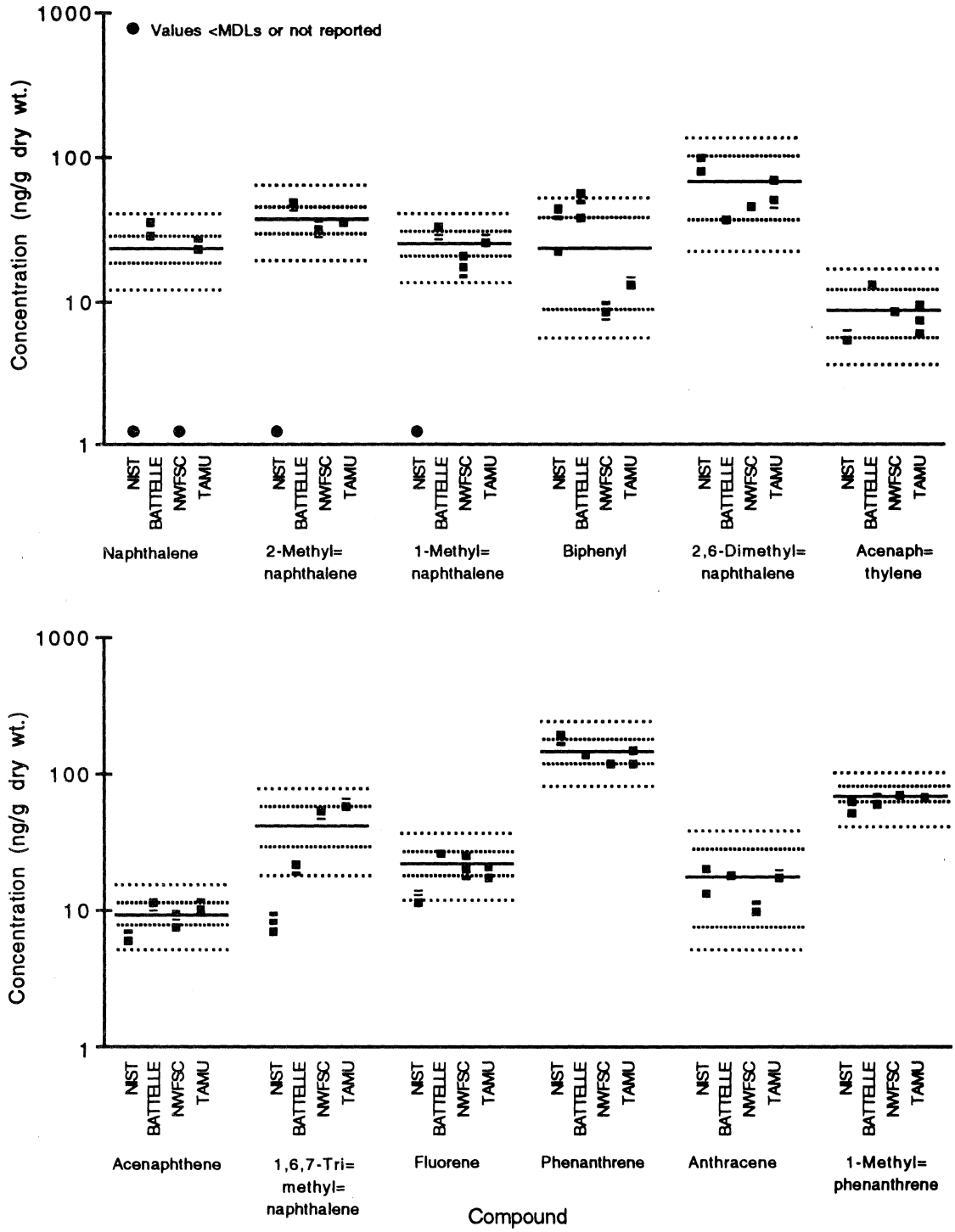
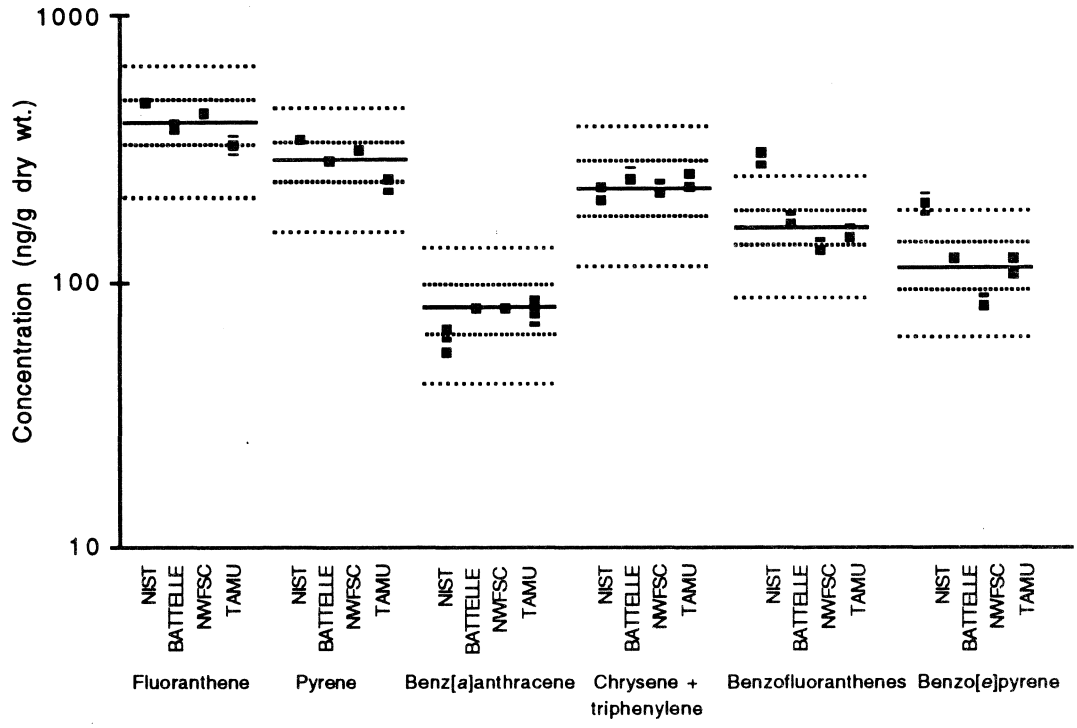


Figure 81. 1992 Mussel Tissue IV (QA92TIS4) intercomparison exercise results of low molecular weight PAHs (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).



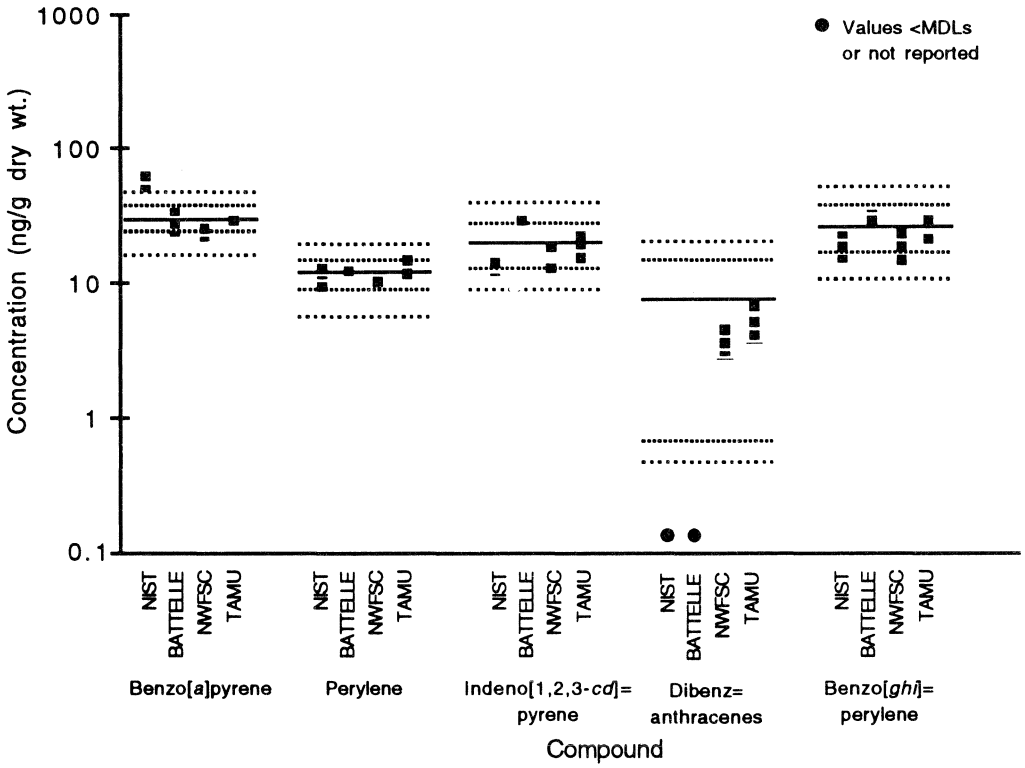


Figure 82. 1992 Mussel Tissue IV (QA92TIS4) intercomparison exercise results of high molecular weight PAHs (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

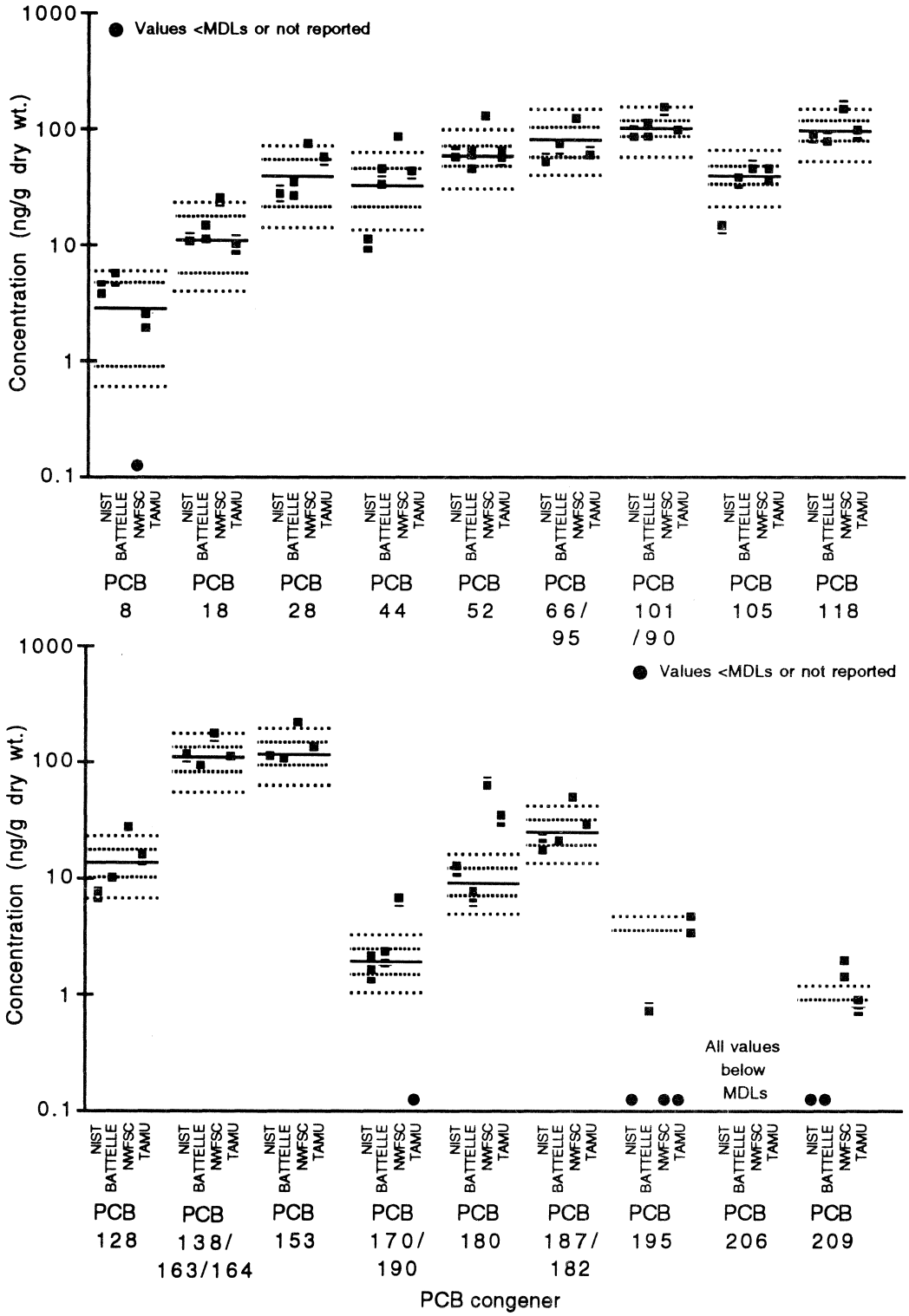


Figure 83. 1992 Mussel Tissue IV (QA92TIS4) intercomparison exercise results of PCB congener analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

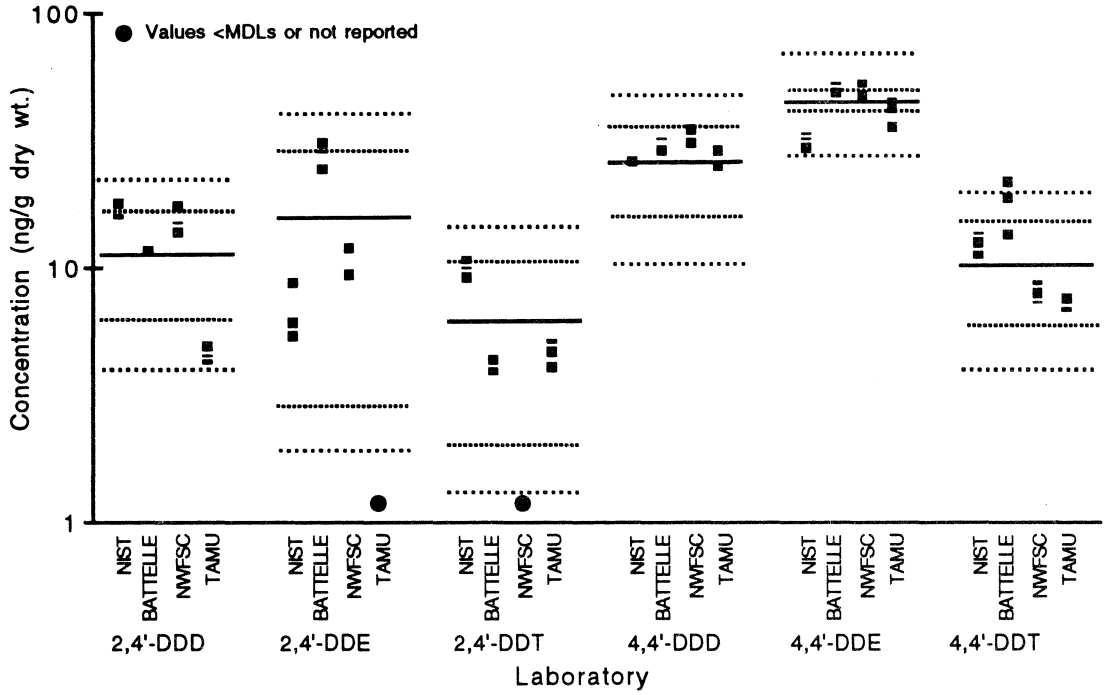


Figure 84. 1992 Mussel Tissue IV (QA92TIS4) intercomparison exercise results of DDT and metabolite analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

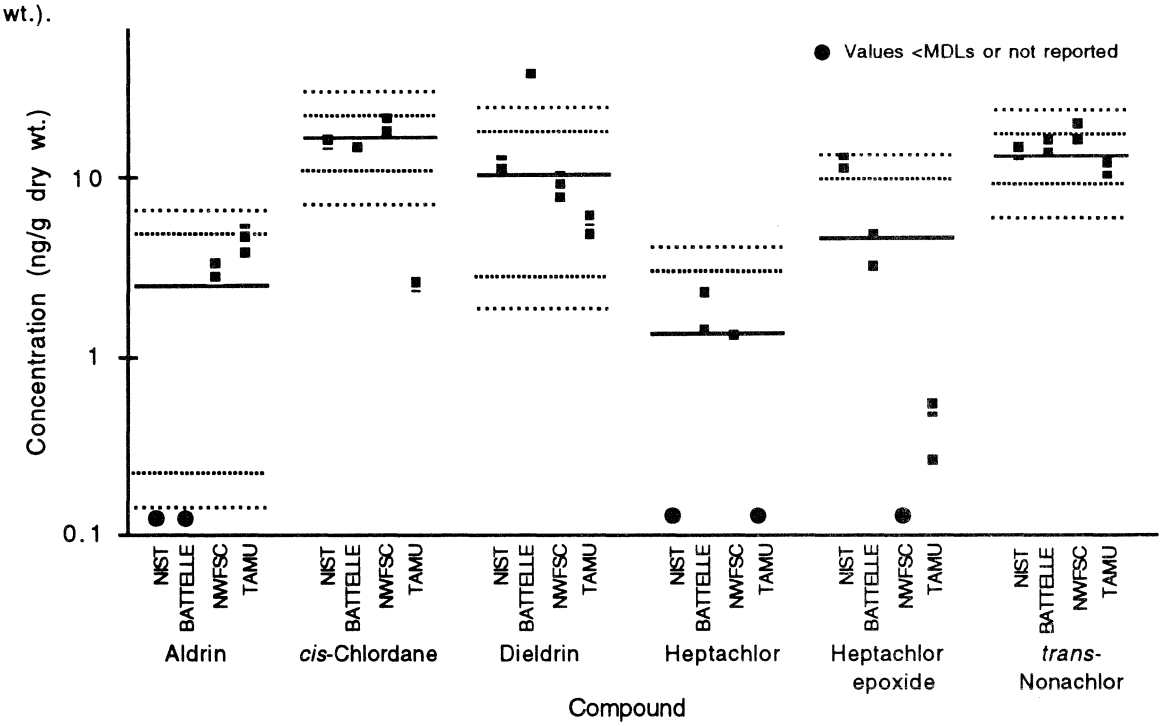


Figure 85. 1992 Mussel Tissue IV (QA92TIS4) intercomparison exercise results of cyclopentadiene pesticide analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

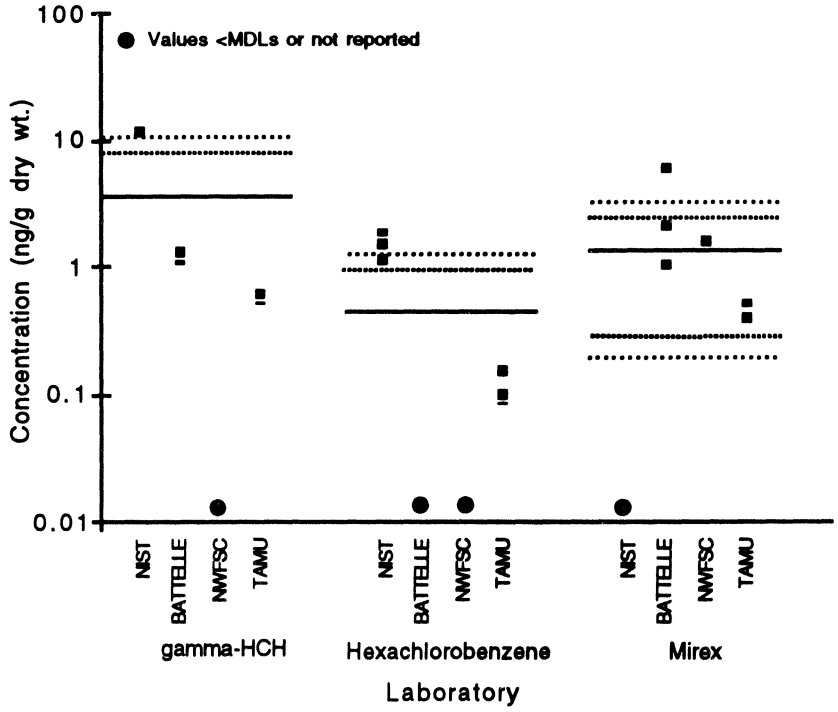


Figure 86. 1992 Mussel Tissue IV (QA92TIS4) intercomparison exercise results of gamma-HCH, hexachlorobenzene, and mirex analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

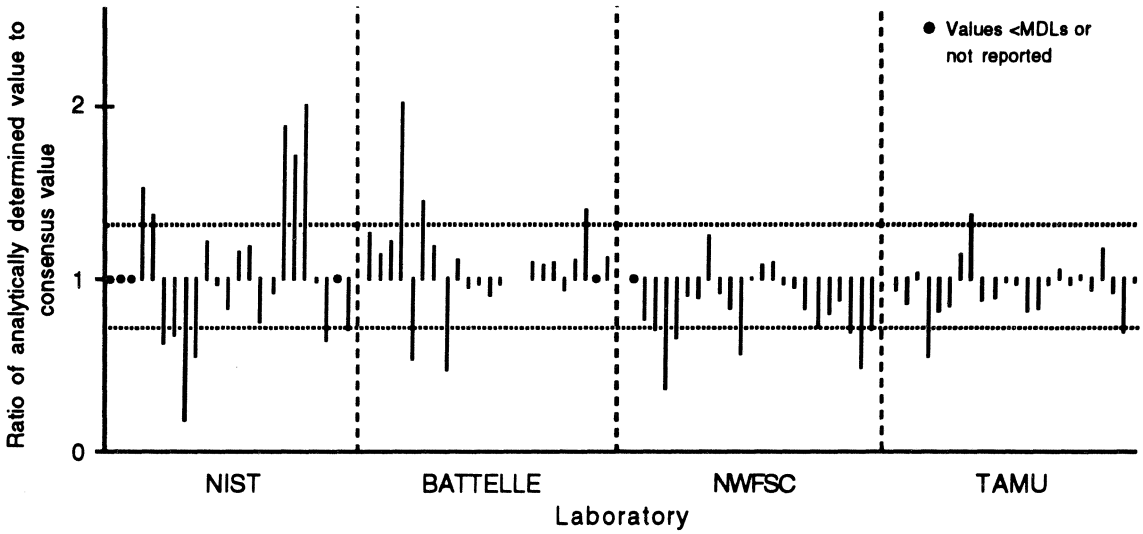


Figure 87. 1992 Mussel Tissue IV (QA92TIS4) intercomparison exercise PAHs ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table V.1, Appendix V. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

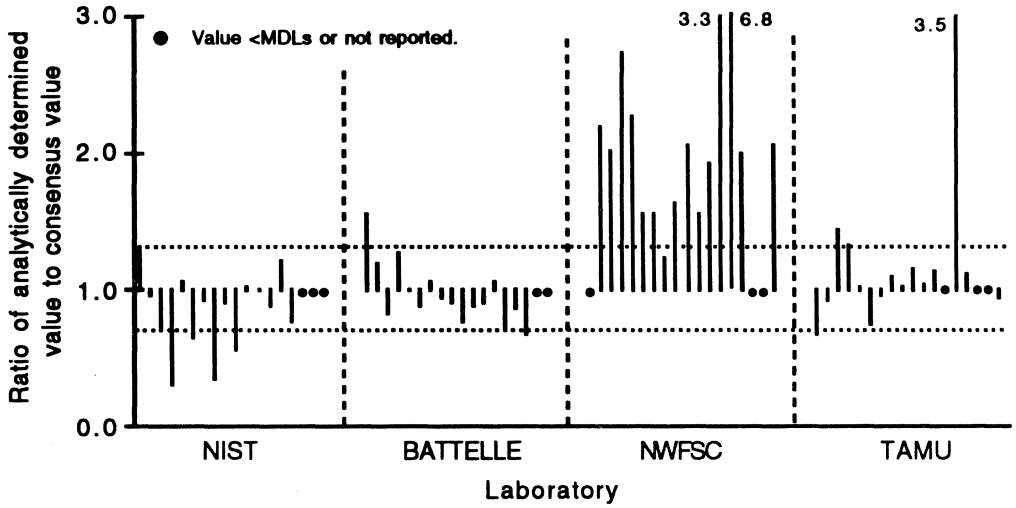


Figure 88. 1992 Mussel Tissue IV (QA92TIS4) intercomparison exercise PCB congener ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table IV.1, Appendix V. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

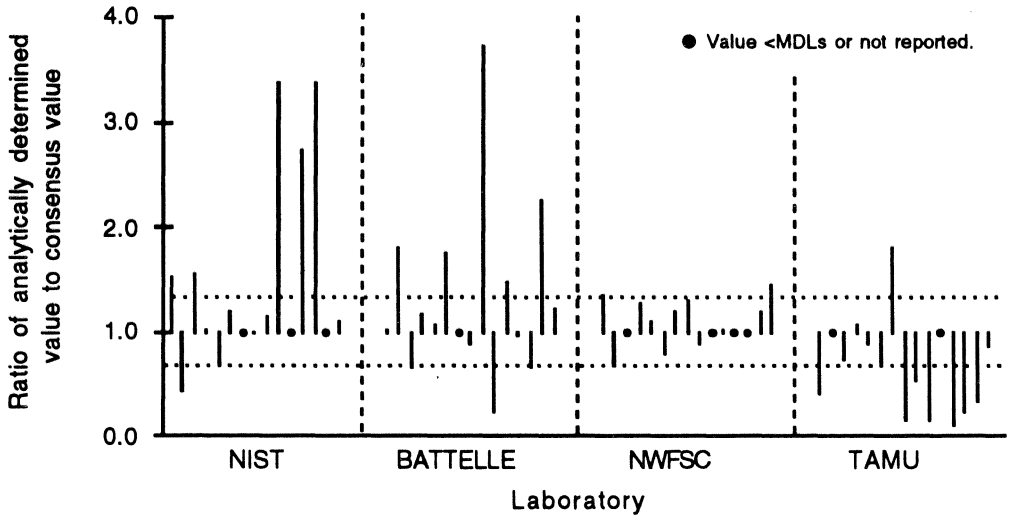


Figure 89. 1992 Mussel Tissue IV (QA92TIS4) intercomparison exercise pesticides ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table V.1, Appendix V. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

5.2.4. Performance evaluation of NS&T laboratories

The accuracy and precision scale described in Section 4.1.4 was used to evaluate the performance of the NS&T cooperating laboratories in the 1992 exercise. The results of this evaluation is shown in Table 18. The same results are shown graphically in Figure 90 - 92. This graphical presentation does not take into account the concentration of the analyte in the exercise materials when compared to the MDLs of the participating laboratories. Typically, as the analyte concentration approaches the MDL of a method, the error increases. The accuracy of the PAH analyses were mixed with some results outside the accuracy criteria reported by all three laboratories (Figure 90). High results for the PCB congener determinations were reported by NMFSC for the Mussel Tissue IV (Figure 91). The evaluation of the results for the chlorinated pesticides is shown in Figure 92. As for previous exercises, when the analyte levels were low, the laboratories were unable to measure concentrations. The precision of the results was good.

5.3. 1993 Exercise

The 1993 trace organic intercomparison exercise was organized by NIST. The materials used were Mussel Tissue V (QA93TIS5) and Fish Homogenate I (QA93FSH1). The NS&T cooperating laboratories were NWFSC, BATTELLE, and TAMU as in previous years. Materials were sent to additional laboratories that participated on a voluntary basis. Mussel Tissue V samples were sent to 40 additional laboratories, 25 of which submitted results. Fish Homogenate I samples were sent to 41 additional laboratories, 22 of which submitted results. The results are listed in Appendix VI. In previous years, NIST participated in the intercomparison exercises primarily as a participant, reporting the results of analysis of three samples obtained using one analytical method. With the addition of a number of new laboratories to the QA Program and the use of natural, unspiked matrix materials, the determination of the accepted concentrations became more difficult. Therefore NIST analyzed the exercise materials using at least two methods

5.3.1. Description of materials and exercise

The Mussel Tissue V (QA93TIS5) was candidate SRM 1974a (NIST, 1994b). The material was prepared using mussels (*Mytilus edulis*) collected in Dorchester Bay, Boston, MA. The mussels were collected by hand during low tide, rinsed, stored in polyethylene bags, frozen, and shipped to NIST. The mussels were subsequently shucked, cryogenically homogenized, and blended following protocols of the NIST National Biomonitoring Specimen Bank. The blended, frozen material was stored in Teflon bags in a liquid nitrogen freezer prior to bottling. Portions of approximately 15 g (wet weight) of the mussel homogenate were aliquoted into pre-cooled cleaned and labeled bottles. All manipulation was done in the liquid nitrogen freezer to avoid warming of the homogenate or condensation in the frozen material. Approximately 400 bottles of the homogenate were labeled as Mussel Tissue V.

The Fish Homogenate I (QA93FSH1) was NRC candidate carp CRM and the first fish matrix to be used as part of the NS&T intercomparison exercises. Ampoules of the candidate carp CRM were purchased by NIST from NRC. The carp were harvested in Saginaw Bay, Lake Huron. The carp were comminuted and high-pressure homogenized. A small amount of water was added to raise the moisture content to 85%, and ethoxyquin (0.02%) was added to this slurry as an antioxidant. The material was dispensed into ampoules, sealed, and heated for a short time at 121°C to destroy the enzyme that promotes rancidity. Each ampoule contained approximately 9 g wet weight of the carp homogenate. The material was relabeled and shipped to the exercise participants.

Table 18. Laboratory performance evaluation for 1992 trace organic intercomparison exercise (First letter is the evaluation of the accuracy and the second of the precision.).

Accuracy:	E	-	Excellent accuracy. All replicates are within the range defined by the consensus value calculated by NIST using exercise results plus or minus one standard deviation.
	G	-	Good accuracy. The mean of the replicates is within the range defined by the consensus value plus or minus one standard deviation, but one or more of the replicates is outside.
	L	-	Low results. The mean of the replicates is lower than the defined range.
	L-	-	Results lower than -30% of the lower limit of the defined range.
	H	-	High results. The mean of the replicates is larger than the defined range.
	H+	-	Results higher than +30% of the higher limit of the defined range.
Precision:	G	-	Good precision. The intralaboratory precision is within the following criteria for various analyte concentrations: Concentration ≥50 ng/g, expected RSD ±10%; concentration ≥20 - <50 ng/g, expected RSD ±20%; and concentration <20 ng/g, expected RSD ±40%.
	X	-	The intralaboratory precision is not within the criteria described above.
	-	-	No results or a "less than" value submitted.

	Marine Sediment III (QA92SED3)			Mussel Tissue IV (QA92TIS4)		
Compound	BATTELLE	NWFSC	TAMU	BATTELLE	NWFSC	TAMU
PAHs						
Naphthalene	E G	E G	E G	H G	- -	E G
2-Methylnaphthalene	E G	E X	E G	E G	G G	E G
1-Methylnaphthalene	E G	E X	G G	H G	G G	E G
Biphenyl	E G	E X	E G	H X	L G	E G
2,6-Dimethylnaphthalene	E G	- -	H G	E G	E G	E X
Acenaphthylene	E G	- -	E X	H G	E G	E G
Acenaphthene	E G	- -	E G	G G	G G	G G
1,6,7-Trimethylnaphthalene	E G	- -	E X	L G	E G	E G
Fluorene	E G	E X	E G	E G	G G	G G
Phenanthrene	E G	E G	E G	E G	G G	G G
Anthracene	L X	E G	E X	E G	E G	E G
1-Methylphenanthrene	E G	G X	E G	G G	E G	E G
Fluoranthene	E G	E G	E G	E G	E G	G G
Pyrene	E G	E G	E G	E G	E G	G G
Benz[*a*]anthracene	E G	H G	G X	E G	E G	E G
Chrysene + triphenylene	E G	H G	E X	E G	E G	E G
Benzofluoranthenes	E G	H G	E G	E G	G G	E G
Benzo[*e*]pyrene	E G	E G	E X	E G	L G	E G
Benzo[*a*]pyrene	H X	G G	E X	G G	G G	E G
Perylene	E X	G X	E X	E G	E G	E G
Indeno[1,2,3-*cd*]pyrene	E G	E G	E G	H G	G G	E G
Dibenzanthracenes	E G	E X	E X	- -	E G	E G
Benzo[ghi]perylene	E G	E G	E X	E G	G X	E G

Table 18. Laboratory performance evaluation for 1992 trace organic intercomparison exercise (First letter is the evaluation of the accuracy and the second of the precision.) (cont.).

	Marine Sediment III QA92SED3)			Mussel Tissue IV (QA92TIS4)		
Compound	BATTELLE	NWFSC	TAMU	BATTELLE	NWFSC	TAMU
PCB congeners						
PCB 8	H+ G	- -	E G	E G	- -	E G
PCB 18	- -	- -	E G	E G	H G	E G
PCB 28	L G	H G	E G	E G	H G	E G
PCB 44	E G	H+ G	E G	E G	H+ G	E G
PCB 52	E G	H G	E G	E X	H+ G	E G
PCB 66/95	E G	G G	E G	E G	H G	E G
PCB 101/90	E G	H G	E G	G G	H G	E G
PCB 105	- -	E G	E G	E G	H G	G G
PCB 118	H+ G	H G	E G	E G	H G	E G
PCB 128	E G	E G	H+ G	- -	H+ G	E G
PCB 138/163/164	L G	E G	E G	E G	H G	E G
PCB 153	E G	H G	E G	E G	H+ G	E G
PCB 170/190	E G	E G	H+ G	G G	H+ G	- -
PCB 180	G G	E G	E G	L G	H+ G	H+ G
PCB 187/182	E G	E G	E G	E G	H+ G	E G
PCB 195	E G	E G	H G	- -	E G	- -
PCB 206	E G	E G	E G	- -	- -	- -
PCB 209	G G	E G	G G	- -	H+ G	E G
Chlorinated pesticides						
2,4'-DDD	- -	- -	- -	E G	G G	L G
2,4'-DDE	- -	- -	- -	G G	E G	- -
2,4'-DDT	- -	- -	- -	E G	- -	E G
4,4'-DDD	L G	E G	E G	E G	E G	E G
4,4'-DDE	E G	E G	E G	G G	G G	G G
4,4'-DDT	E G	E G	E G	H G	E G	E G
Aldrin	- -	- -	- -	- -	E G	G G
cis-Chlordane	E G	E G	E G	E G	G G	L- G
Dieldrin	G G	E G	G G	H+ G	E G	E G
gamma-HCH	E G	- -	- -	- -	- -	E G
Heptachlor	- -	- -	- -	E G	E G	- -
Heptachlor epoxide	G G	- -	H G	E G	- -	E G
Hexachlorobenzene	E G	E G	E G	- -	- -	E G
Mirex	- -	- -	- -	H X	E G	E G
trans-Nonachlor	- -	- -	- -	E G	H G	E G

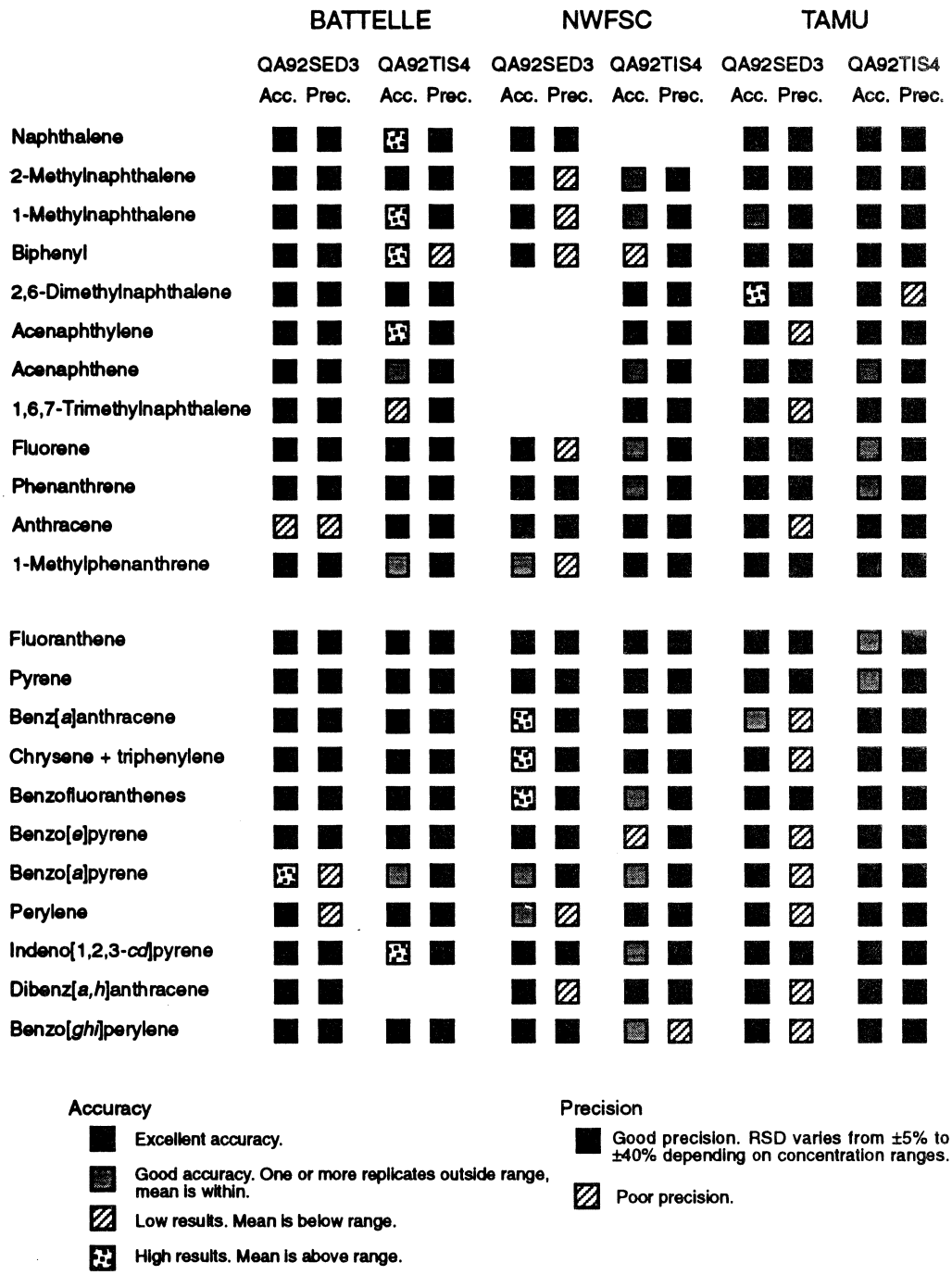


Figure 90. 1992 PAH determination performance evaluation.

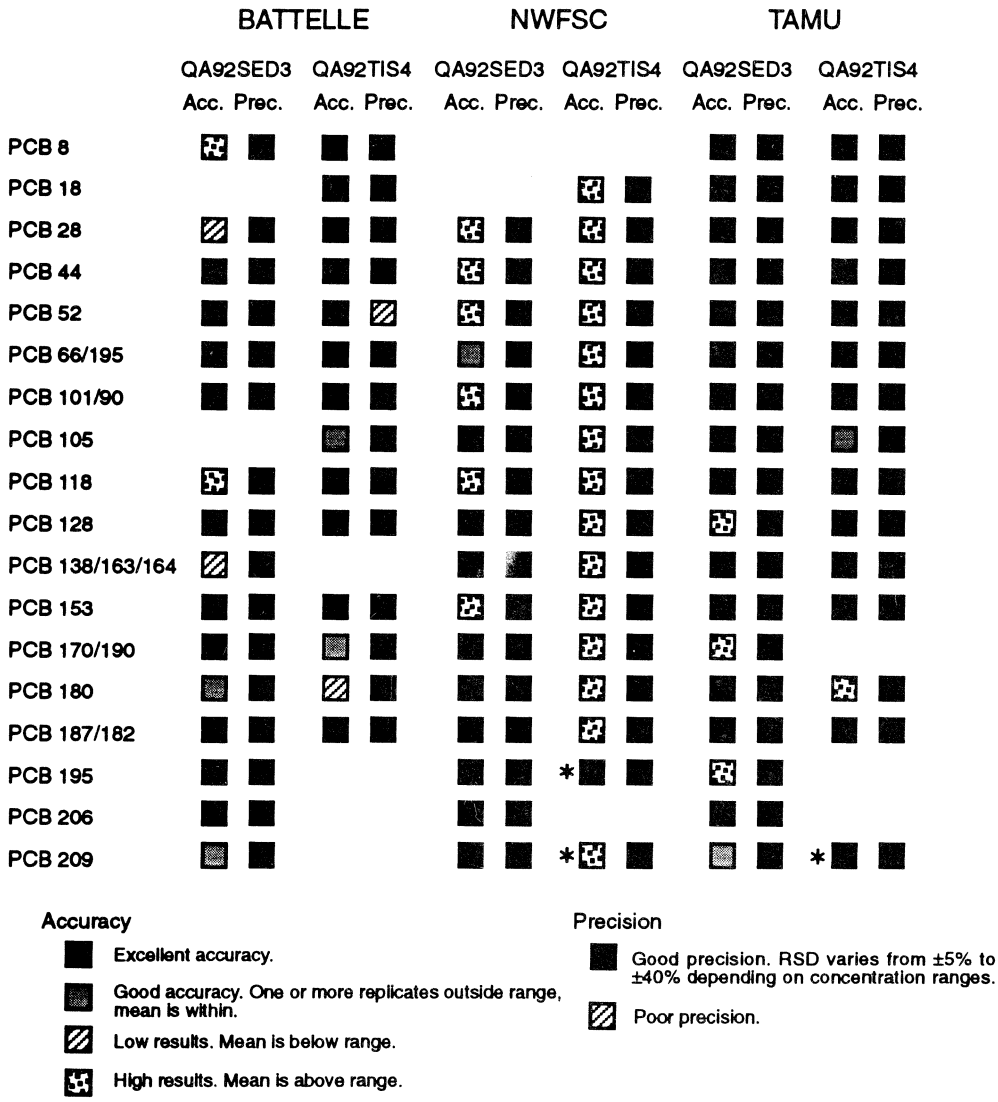


Figure 91. 1992 PCB determination performance evaluation (* - Consensus value low and standard deviation high so lower limit of accepted concentration range is negative.).

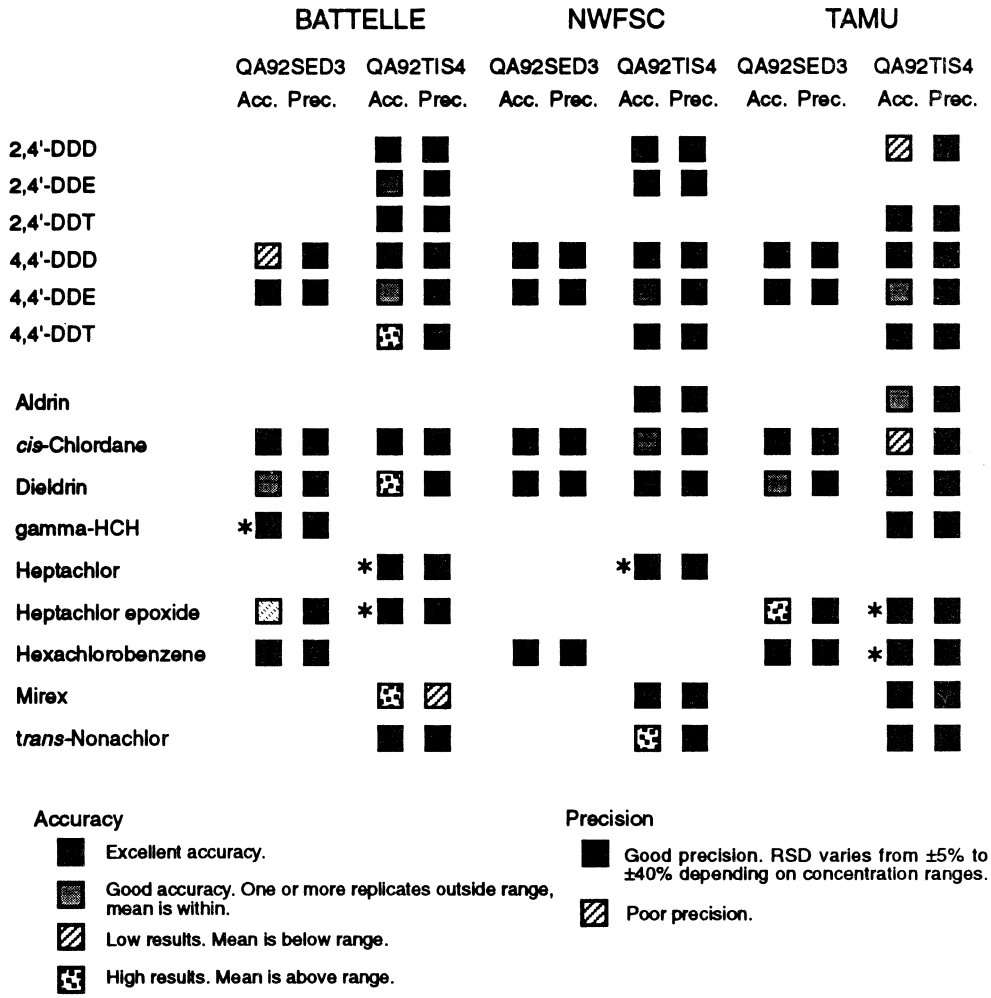


Figure 92. 1992 Chlorinated pesticides determination performance evaluation (No consensus values could be calculated for 2,2'-DDT, aldrin, heptachlor, or mirex.) (* - Consensus value low and standard deviation high so lower limit of accepted concentration range is negative.).

Each laboratory received three ampoules or jars of each unknown, and were asked to extract the materials and perform triplicate injections of the extract of one sample, and single injections of the other two. Two ampoules of concentrated PCB solution (candidate SRM 2262) were also sent to each participant. As for previous exercises, a computer diskette with appropriate files accompanied the samples to facilitate data reporting. The analytes determined are the organic compounds listed in Table 1.

5.3.2. Consensus values

The consensus values were calculated as described in Section 5.1.2. In addition, NIST analyzed the exercise materials using two different analytical methods in order to obtain reference values for comparison.

5.3.3. Results

5.3.3.1. Mussel Tissue V (QA93TIS5)

The results of determinations of the 2- and 3-ring PAHs (low molecular weight) and the 4- and 5-ring (high molecular weight) PAHs by the NS&T cooperating laboratories are shown graphically in Figures 93 and 94, respectively. The results of the laboratories were within the NS&T specified range, and most were within the smaller range defined as plus or minus one standard deviation of the consensus value. BATTELLE reported several concentrations as below the MDLs. The results of the PCB analyses are shown in Figure 95. All laboratories reported results for some PCB congeners that were higher than the consensus values plus or minus one standard deviation. The results submitted by BATTELLE for PCB 180 and by NWFSC for PCB 170/190 were higher than the NS&T limit of acceptability. The differences between the consensus values and the two reported means for these analytes were not very large and within reasonable analytical error for low concentration ranges. BATTELLE results were high for the low chlorination PCB congeners (PCBs 8 through PCB 105). The results for the DDT and metabolites analyses for the Mussel Tissue V are shown in Figure 96. The levels of some of these compounds were low and the accuracy and precision of the analyses were low. The levels of 4,4'-DDD and 4,4'-DDE were the highest of this group of analytes and the results for these were within the range defined by plus or minus one standard deviation of the consensus value. The levels of the cyclopentadiene pesticides were also low and one or more of the laboratories reported values below the MDLs for aldrin, heptachlor, and heptachlor epoxide (Figure 97). Except for the results submitted by NWFSC for *cis*-chlordane, the results submitted for *cis*-chlordane, dieldrin and *trans*-nonachlor were within acceptable limits. The levels of gamma-HCH, hexachlorobenzene and mirex were low and several values below the MDLs were reported by the laboratories (Figure 98). The means reported for these three compounds, however, were within the limits of acceptability.

The ratios of the analytically determined mean values to those of the consensus values are shown in Figure 99 - 101. The order of the analytes is the same as those in Appendix VI. BATTELLE results for the high molecular weight PAHs were biased high. TAMU results for the low molecular weight PAHs are biased high, and those for the high molecular weight PAHs low (Figure 99). No other pattern in the bias distribution could be found. The ratios for the PCB congeners are shown in Figure 100 and the results for BATTELLE and NWFSC are biased high. No obvious pattern could be found in the bias of the chlorinated pesticides (Figure 101).

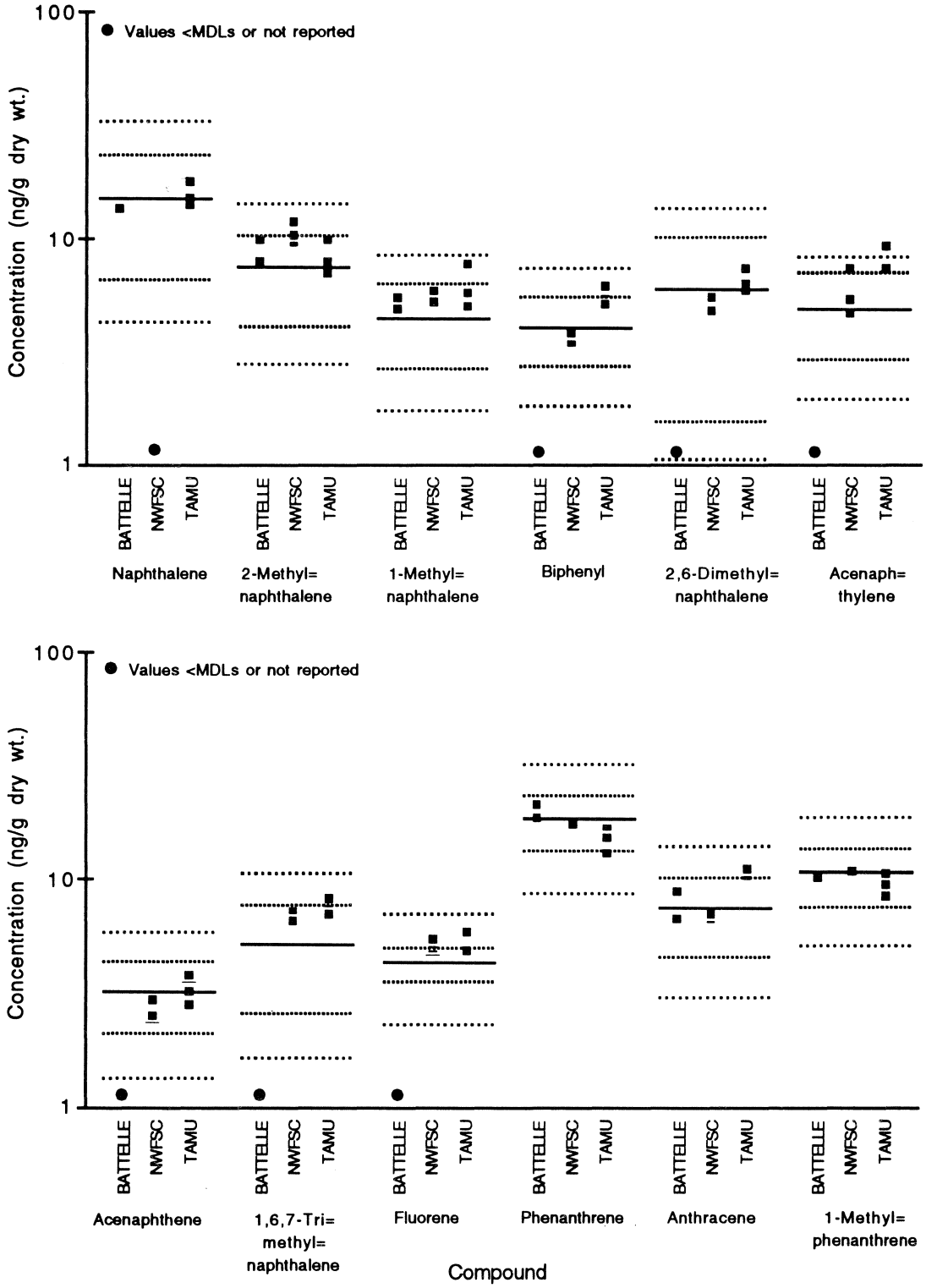


Figure 93. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results of low molecular weight PAHs (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

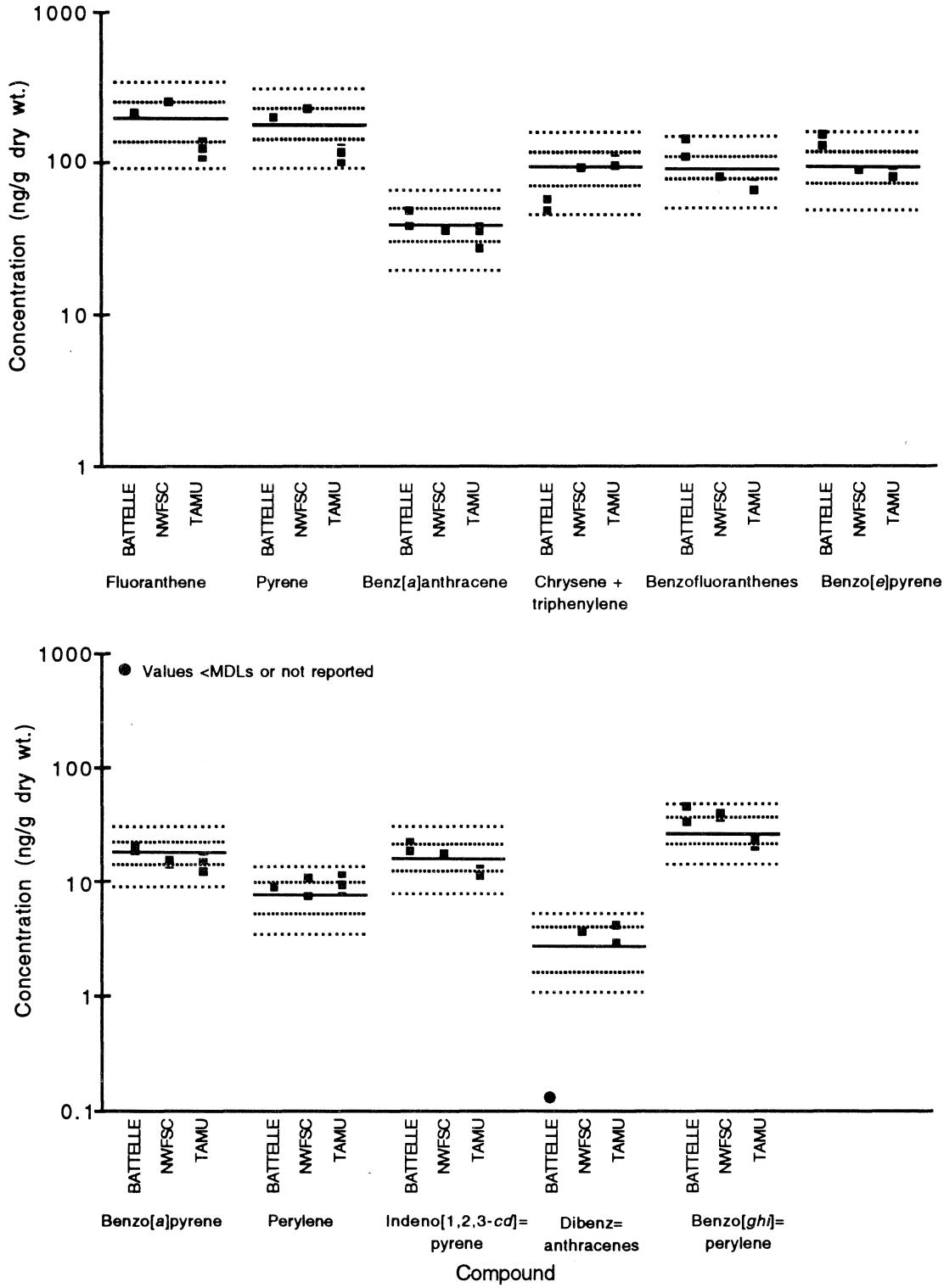


Figure 94. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results of high molecular weight PAHs (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

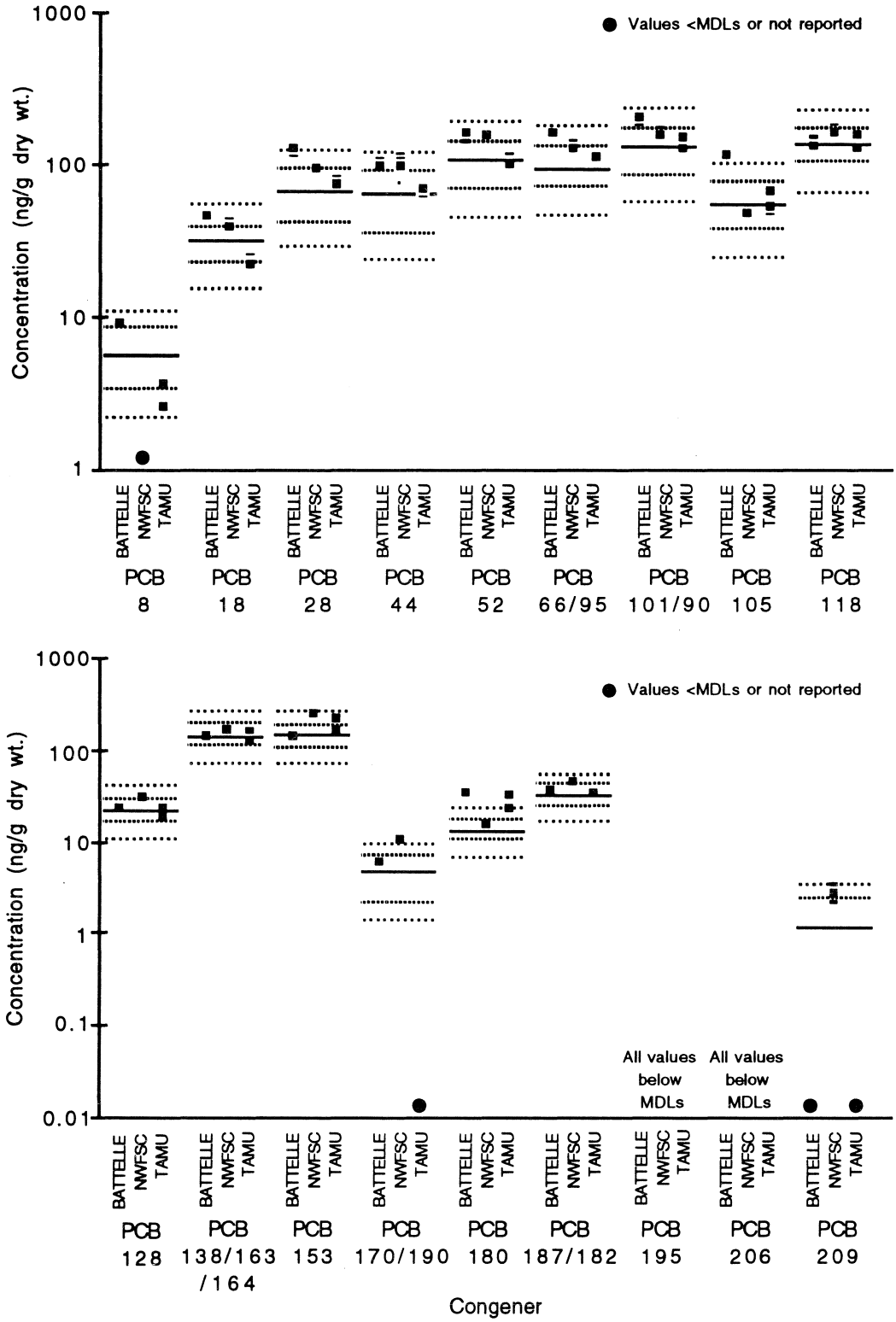


Figure 95. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results of PCB congener analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

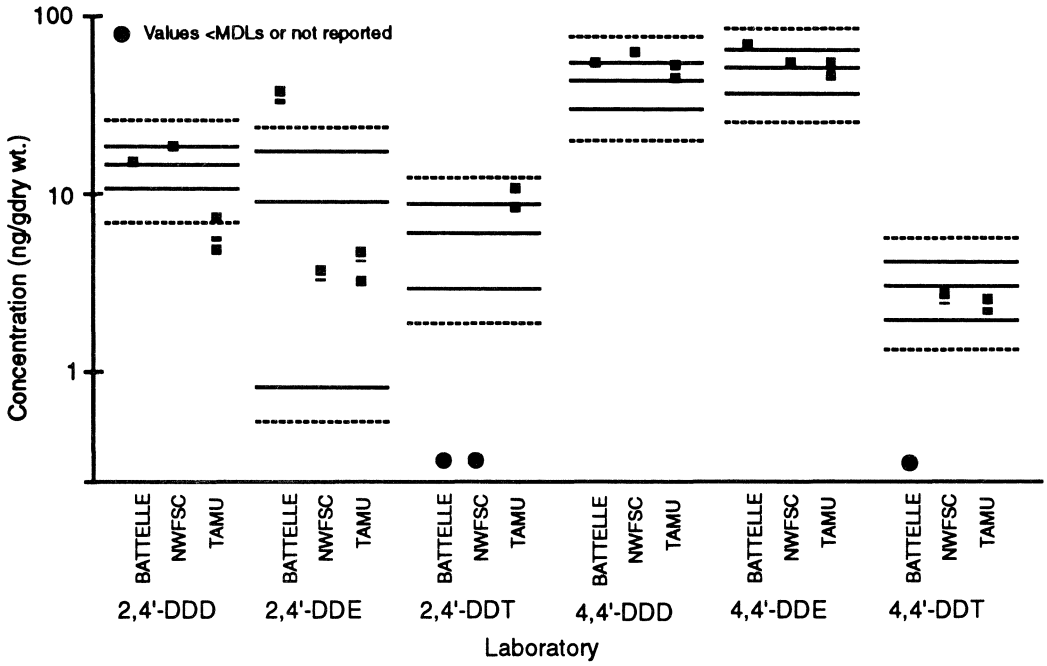


Figure 96. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results of DDT and metabolite analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

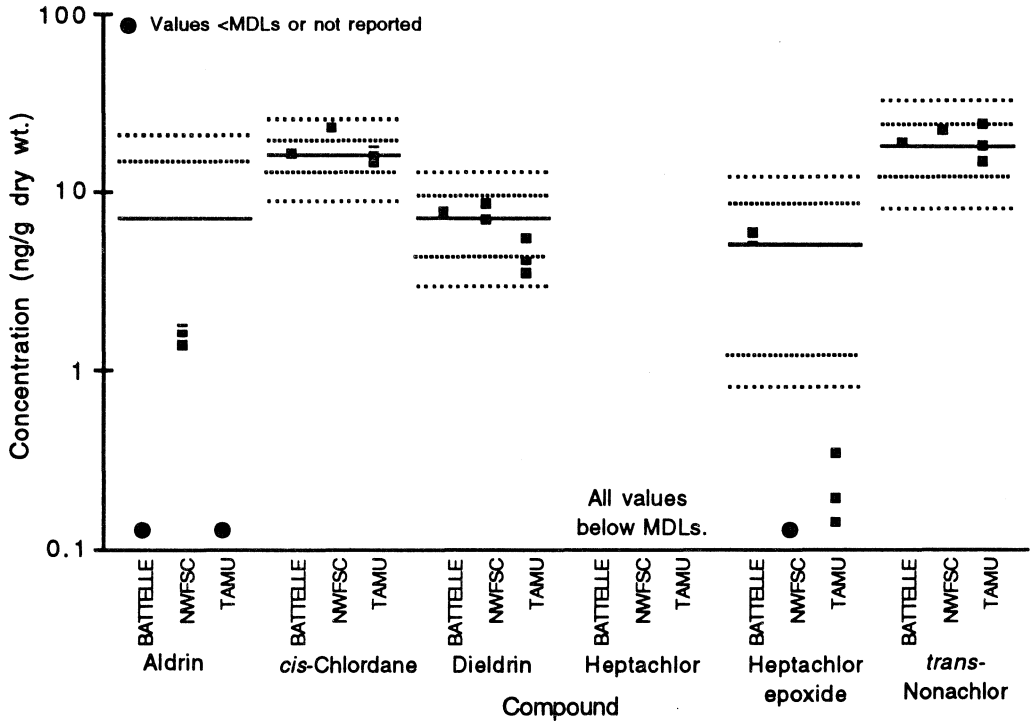


Figure 97. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results of cyclopentadiene pesticide analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g dry wt.).

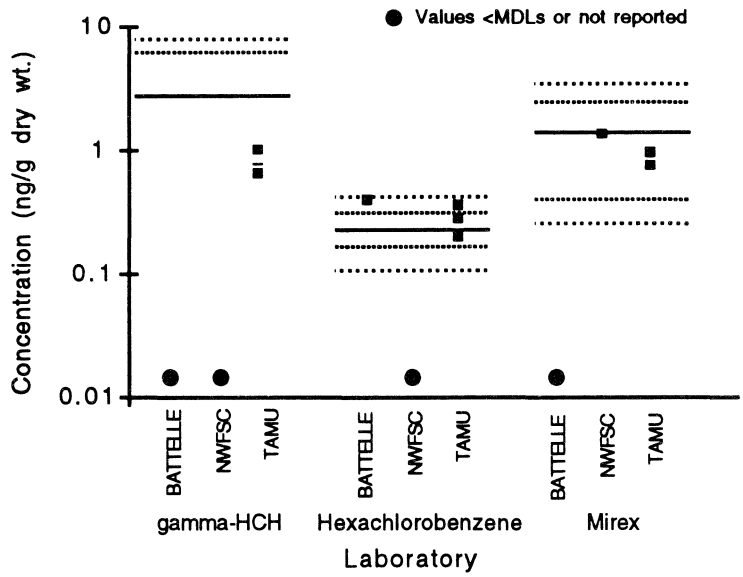


Figure 98. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results of gamma-HCH, hexachlorobenzene, and mirex analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted. Consensus value for gamma-HCH was low and the standard deviation high so lower limit of acceptability range is negative.) (ng/g dry wt.).

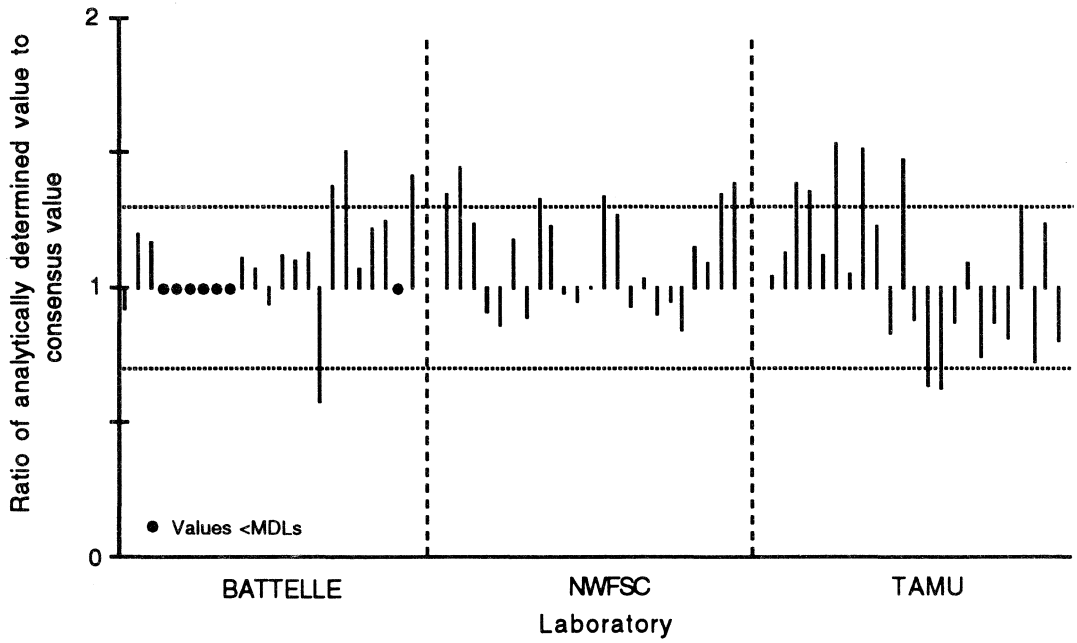


Figure 99. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise PAHs ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table VI.1, Appendix VI. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

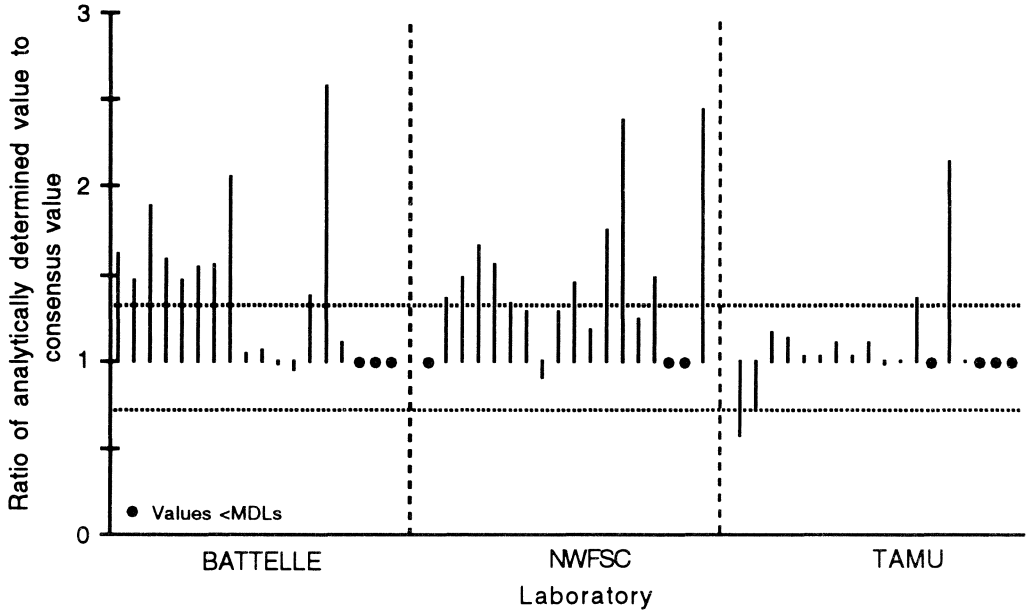


Figure 100. 1993 Mussel Tissue V (QA92TIS5) intercomparison exercise PCB congener ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table VI.1, Appendix VI. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

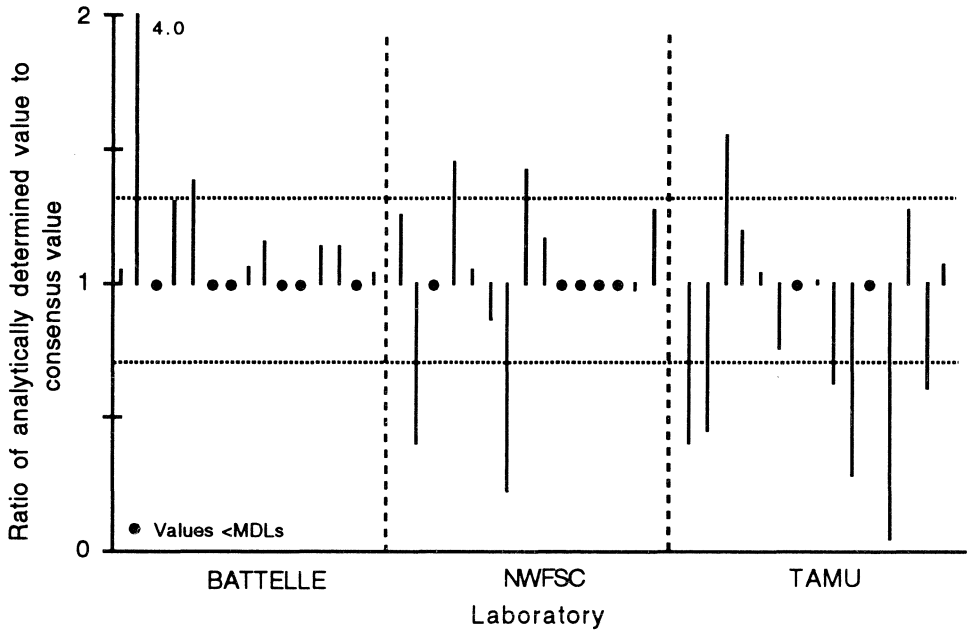


Figure 101. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise pesticides ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table VI.1, Appendix VI. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

5.3.3.2. Fish Homogenate I (QA93FSH1)

The results of the intercomparison exercise are shown graphically in Figures 102 - 105. The levels of PAHs in fish flesh are extremely low due to metabolism of the compounds. Therefore, analysis of these compounds in the Fish Homogenate was not required. The concentrations of PCBs and pesticides for the Fish Homogenate I were reported on a wet weight basis, hence the PCB concentrations are 3 to 60 times higher than those found in the Mussel Tissue V material, and the pesticides are 3 to 15 times, and up to 100, higher in the Fish Homogenate than in the mussel material. The Mussel Tissue V concentrations were reported on a dry weight basis. Despite the difference in concentration, the relative percent standard deviation of the consensus means were similar for both materials.

The results for the analyses of PCBs are shown in Figure 102. The results submitted by BATTELLE are high for the low chlorination level congeners (PCB 8, 18, 28, 44, 52, 66/95, 101/90, and 105). Some of these results are above the NS&T limit of acceptability defined as ±35% of the high and low limits of the consensus value range. The means submitted by NWFSC for PCBs 206 and 209 were above the NS&T limit of acceptability. The results of the DDT and metabolites analyses are shown in Figure 103. The results reported by NWFSC and BATTELLE for 2,4'-DDD were good, although the BATTELLE results were slightly low. The TAMU results were below the NS&T limit of acceptability. The results for 4,4'-DDD and 4,4'-DDE were good for NWFSC and TAMU. The BATTELLE results were slightly high for 4,4'-DDD and outside the upper NS&T limit of acceptability for 4,4'-DDE. BATTELLE results for 2,4'-DDE were very high. The results of the cyclopentadiene compounds are shown in Figure 104. All three laboratories reported values below the MDLs for aldrin and heptachlor. The standard deviation of the consensus values of heptachlor epoxide and *trans*-nonachlor were high, so the lower limits of the accepted concentration range are negative. Overall, the results were good considering the analyte levels in the exercise material. The results of the analyses of gamma-HCH, hexachlorobenzene, and mirex are shown in Figure 105. The results were good.

The ratios of the analytically determined mean values to those of the consensus values were again used as indicators of bias and are shown in Figures 106 and 107. The BATTELLE results for the low chlorination level PCB congeners are biased high. The results reported by NWFSC for the high chlorination level PCBs are biased slightly high. No clear bias could be observed for the TAMU results. No clear biases could be discerned from the pesticide results exercise results (Figure 107).

5.3.4. Performance evaluation of NS&T laboratories

The accuracy and precision scale described in Section 4.1.4 was used to evaluate the performance of the NS&T cooperating laboratories in the 1993 exercise. The results of this evaluation are shown in Table 19. The same results are shown graphically in Figures 108 - 110. This graphical presentation does not take into account the concentration of the analytes in the exercise materials when compared to the MDLs of the participating laboratories. Typically, as the analyte concentration approaches the MDL of a method, the error increases. The results of the PAH analyses were mixed (Figure 108). BATTELLE reported many values below the MDLs and the accuracies of the results reported by the three laboratories were variable. This may be, in part, the result of low analyte concentrations in the exercise materials. Many of the BATTELLE PCB analyses results were high, some exceeding the NS&T limit of acceptability (Figure 109). The results for NWFSC were high for the Mussel Tissue V and good for the Fish Homogenate. The results for TAMU were good for both materials, but the precision could be improved. The evaluation of the results for the chlorinated pesticides is shown in Figure 110. The analyte levels in these materials were low and many laboratories were unable to measure concentrations. It is difficult to make an overall assessment. The results of the analyses of some analytes such as 2,4'-DDD, dieldrin, *trans*-nonachlor, *cis*-chlordane, and gamma-HCH were good.

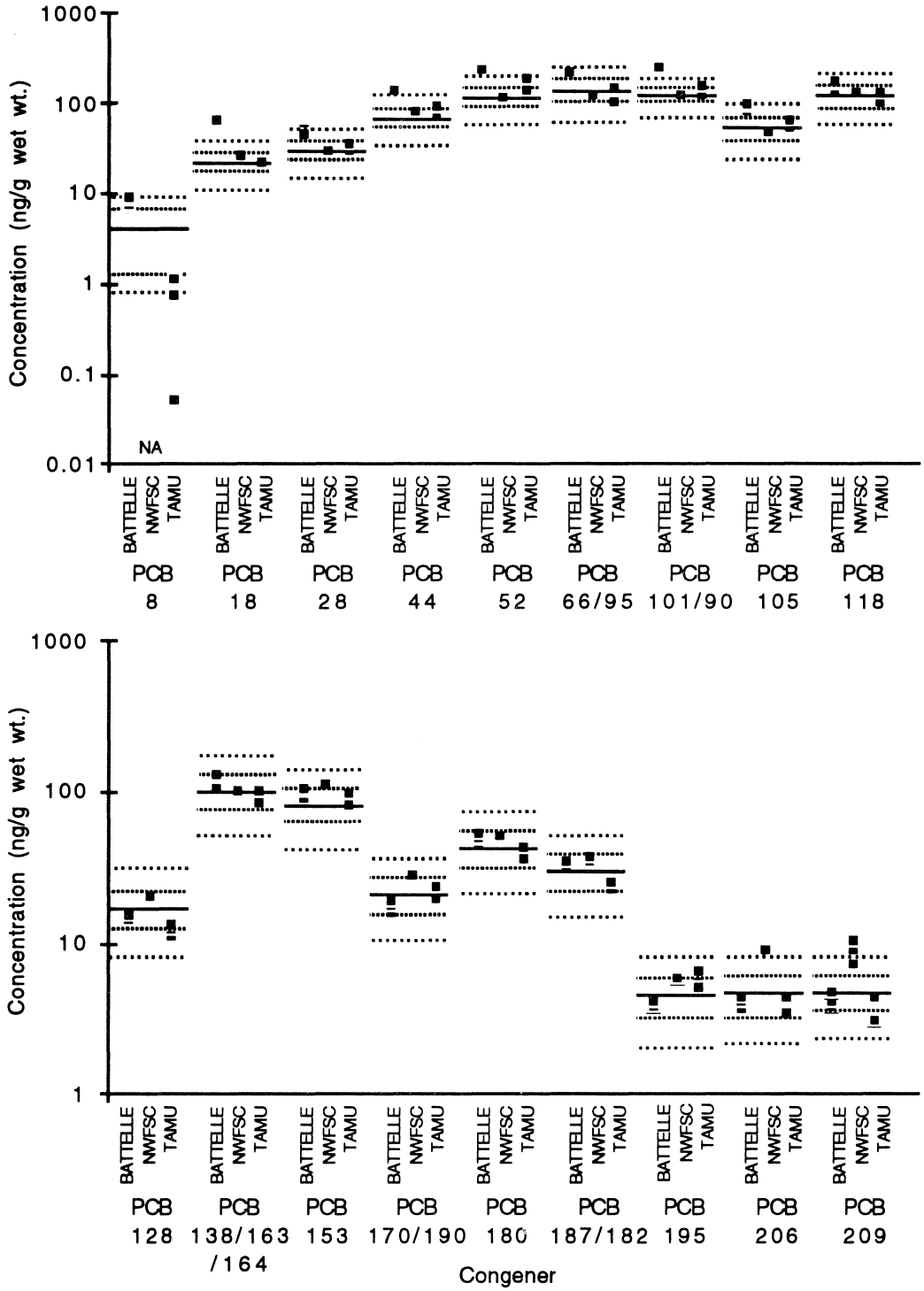


Figure 102. 1993 Fish Homogenate I (QA93FSH1) intercomparison exercise results of PCB congener analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g wet wt.).

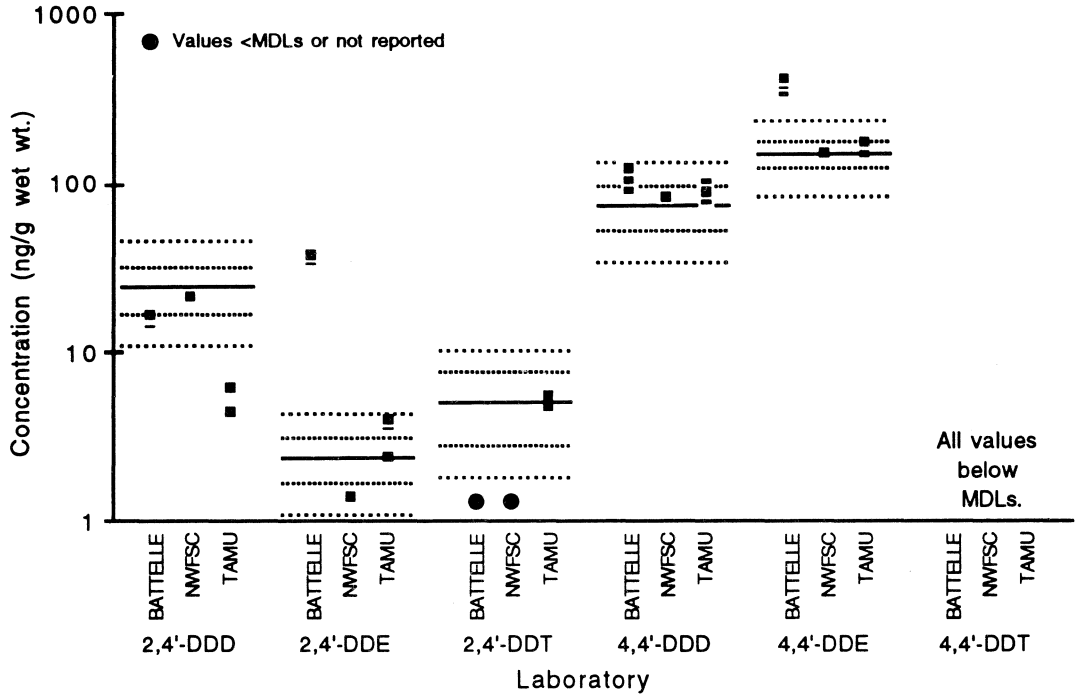


Figure 103. 1993 Fish Homogenate I (QA93FSH1) intercomparison exercise results of DDT and metabolite analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g wet wt.).

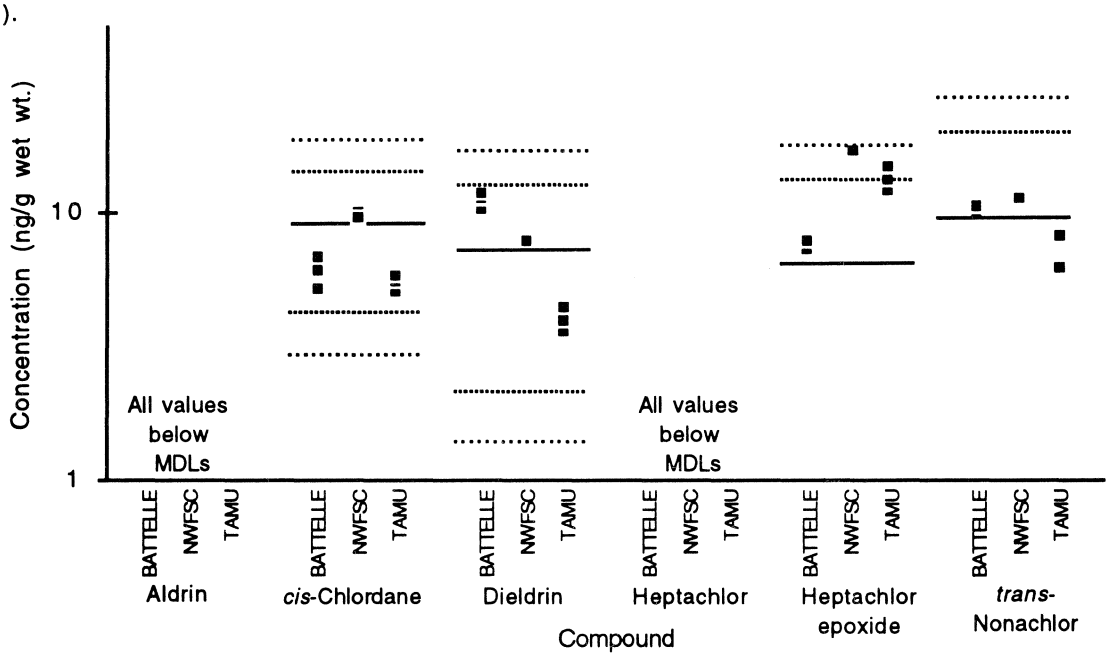


Figure 104. 1993 Fish Homogenate I (QA93FSH1) intercomparison exercise results of cyclopentadiene pesticide analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g wet wt.).

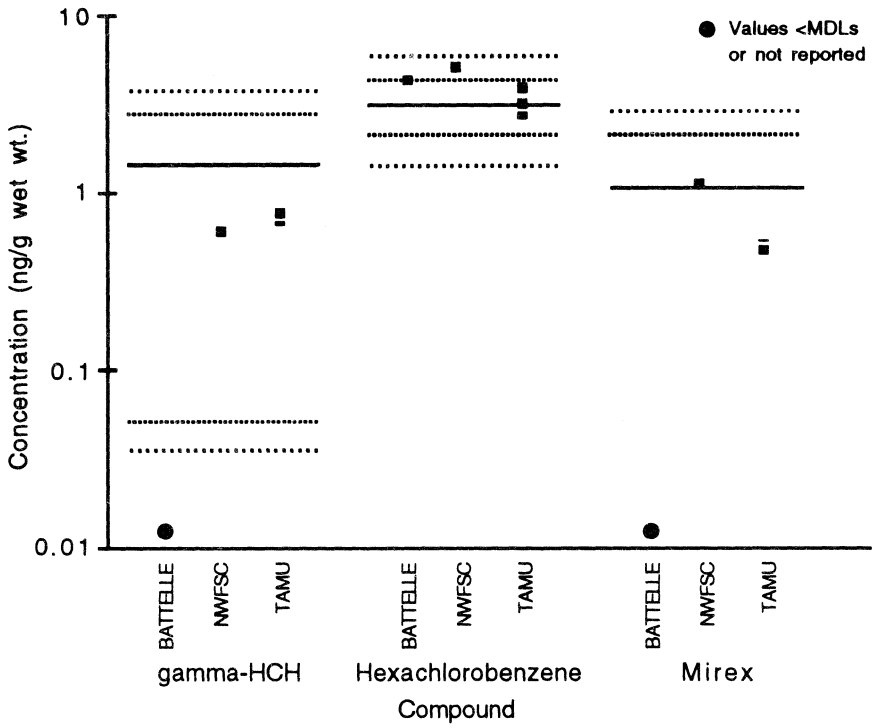


Figure 105. 1993 Fish Homogenate I (QA93FSH1) intercomparison exercise results of gamma-HCH, hexachlorobenzene and mirex analyses of three samples (Solid line is the consensus value calculated by NIST using exercise results. Dotted line is the range defined as plus or minus one standard deviation of the consensus value. The dashed line is ±35% of this range. Circles indicate values below the MDLs or not submitted.) (ng/g wet wt.).

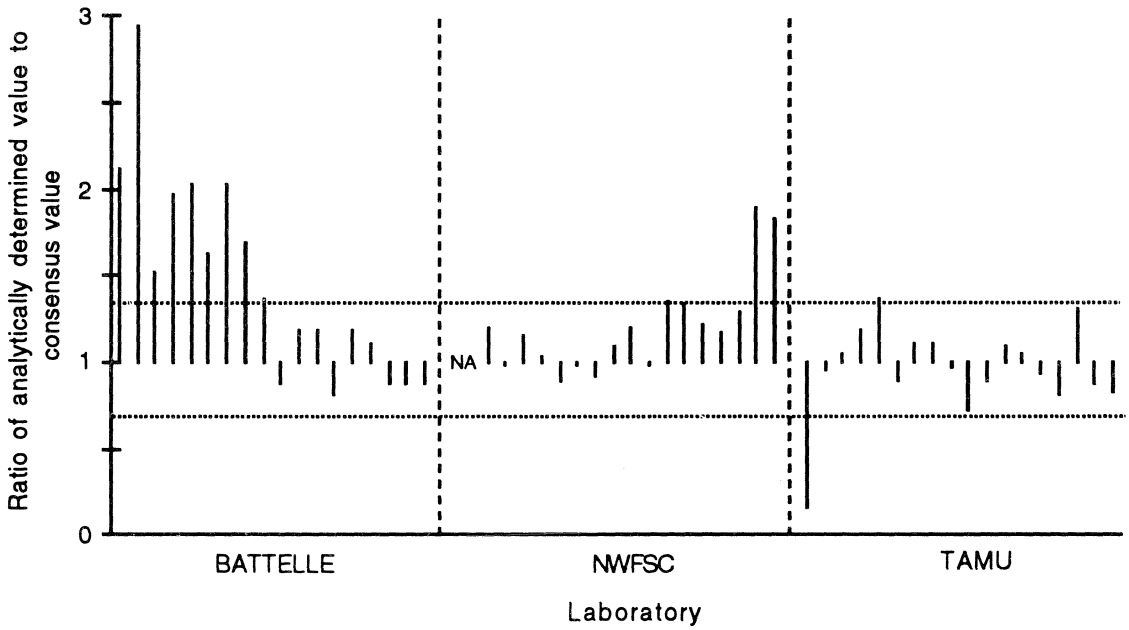


Figure 106. 1993 Fish Homogenate I (QA93FSH1) intercomparison exercise PCB congener ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table VI.2, Appendix VI. Dotted lines are ±30% of consensus value.). NA - Not available.

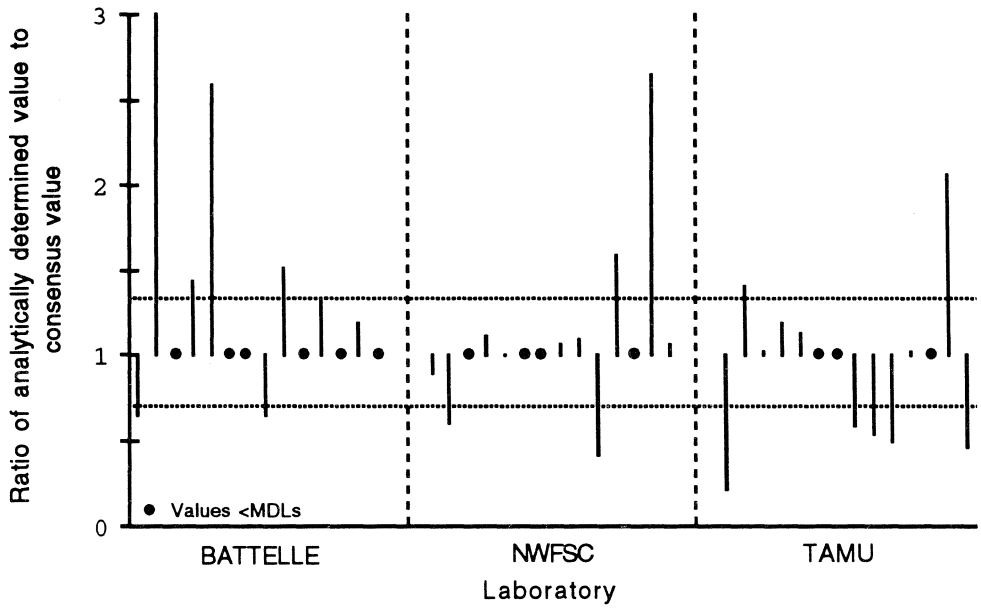


Figure 107. 1993 Fish Homogenate I (QA93FSH1) intercomparison exercise pesticides ratios of analytically determined mean value of three samples to consensus value (Order of analytes same as in Table VI.2 Appendix VI. Dotted lines are ±30% of consensus value. Circles indicate values below the MDLs or not submitted.).

5.4. Overall evaluations

5.4.1. HORRAT values

Horwitz (1993) observed that similar relative standard deviation (RSD) values are obtained for similar analyte levels regardless of the nature of the analyte, matrix, or analytical method. The Horwitz equation resulting from that emperical observation is:

$$\text{RSD (predicted)} = 2^{(1 - 0.5 \log C)} = 2C^{-0.1505}$$

where C is the concentration expressed as a decimal fraction. The HORRAT value is the ratio of the observed versus the predicted RSD,

$$\text{HORRAT} = \frac{\text{RSD}_R \text{ (observed)}}{\text{RSD (predicted)}} .$$

An analytical procedure can be considered acceptable if the HORRAT values are less than 2. This criteria has been adopted by the International Union of Pure and Applied Chemistry (IUPAC) and is found in the harmonized protocol for the adoption of standardized analytical methods. This is considered as acceptable precision of method performance among laboratories. Within-laboratory precision is often one-half to two-thirds of these values.

To evaluate the precisions achieved by the NS&T cooperating laboratories, the predicted RSD's were calculated for the results submitted by BATTELLE, NWFSC, and TAMU for PAHs, PCBs, and chlorinated pesticides in Mussel Tissue IV (QA92TIS4) and compared to the observed RSDs. Several of the other exercise materials contained very low levels of the analytes of interest resulting in many results below the MDLs of the laboratories so these results could no be used

Table 19. Laboratory performance evaluation for 1993 trace organic intercomparison exercise (First letter is the evaluation of the accuracy and the second of the precision.).

	Mussel Tissue V (QA93TIS5)			Fish Homogenate I (QA93FSH1)		
Compound	BATTELLE	NWFSC	TAMU	BATTELLE	NWFSC	TAMU
PAHs						
Naphthalene	E G	- -	E G	PAH determinations of this material not required		
2-Methylnaphthalene	E G	H G	E G			
1-Methylnaphthalene	E G	E G	G G			
Biphenyl	- -	E G	H G			
2,6-Dimethylnaphthalene	- -	E G	E G			
Acenaphthylene	- -	G G	H G			
Acenaphthene	- -	E G	E G			
1,6,7-Trimethylnaphthalene	- -	E G	H G			
Fluorene	- -	H G	H G			
Phenanthrene	E G	E G	E G			
Anthracene	E G	E G	G G			
1-Methylphenanthrene	E G	E G	E G			
Fluoranthene	E G	H G	L G			
Pyrene	E G	H G	L G			
Benz[*a*]anthracene	G G	E G	G G			
Chrysene + triphenylene	L G	E G	E G			
Benzofluoranthenes	H X	E G	L G			
Benzo[*e*]pyrene	H X	E G	E G			
Benzo[*a*]pyrene	E G	E G	G G			
Perylene	E G	G G	G G			
Indeno[1,2,3-*cd*]pyrene	G G	E G	G G			
Dibenzanthracenes	- -	E G	G G			
Benzo[*ghi*]perylene	H G	H G	E G			
Chlorinated pesticides						
2,4'-DDD	E G	E G	L G	G G	E G	L- X
2,4'-DDE	H+ G	E G	E G	H+ G	L G	H G
2,4'-DDT	- -	- -	H G	- -	- -	E G
4,4'-DDD	H G	H G	E G	H X	E G	E X
4,4'-DDE	H G	E G	E G	H+ G	E G	G G
4,4'-DDT	- -	E G	E G	- -	- -	- -
Aldrin	- -	E G	- -	- -	- -	- -
cis-Chlordane	E G	H G	E G	E G	E G	E G
Dieldrin	E G	E G	G G	E G	E G	E G
gamma-HCH	- -	- -	E G	- -	E G	E G
Heptachlor	- -	- -	- -	- -	- -	- -
Heptachlor epoxide	E G	- -	L- G	E G	H G	G G
Hexachlorobenzene	H G	- -	G G	G G	H G	E G
Mirex	- -	E G	E G	- -	E G	E G
trans-Nonachlor	E G	E G	E G	E G	E G	E G

Table 19. Laboratory performance evaluation for 1993 trace organic intercomparison exercise (First letter is the evaluation of the accuracy and the second of the precision.) (cont.).

	Mussel Tissue V (QA93TIS5)			Fish Homogenate I (QA93FSH1)		
Compound	BATTELLE	NWFSC	TAMU	BATTELLE	NWFSC	TAMU
PCB congeners						
PCB 8	H G	- -	L G	H G	- -	L X
PCB 18	H G	H G	G G	H+ G	E G	E G
PCB 28	H G	H G	E G	H G	E G	E G
PCB 44	H G	H G	E G	H+ G	E G	E G
PCB 52	H G	H G	E G	H+ G	E G	G X
PCB 66/195	H G	H G	E G	H G	E G	E X
PCB 101/90	H G	G G	E G	H+ G	E G	G X
PCB 105	H+ G	E G	E X	H G	E G	E X
PCB 118	E G	H G	E X	H G	E G	E X
PCB 128	E G	H G	E G	E G	E G	L G
PCB 138/163/164	E G	E G	E X	G G	E G	E G
PCB 153	E G	H G	H X	G G	H G	E G
PCB 170/190	E G	H G	- -	E G	H G	E G
PCB 180	H+ G	G G	H G	E G	E G	E G
PCB 187/182	E G	H G	E G	E G	E G	E G
PCB 195	- -	- -	- -	E G	E G	G G
PCB 206	- -	- -	- -	E G	H+ G	E G
PCB 209	- -	H G	- -	E G	H+ G	G G

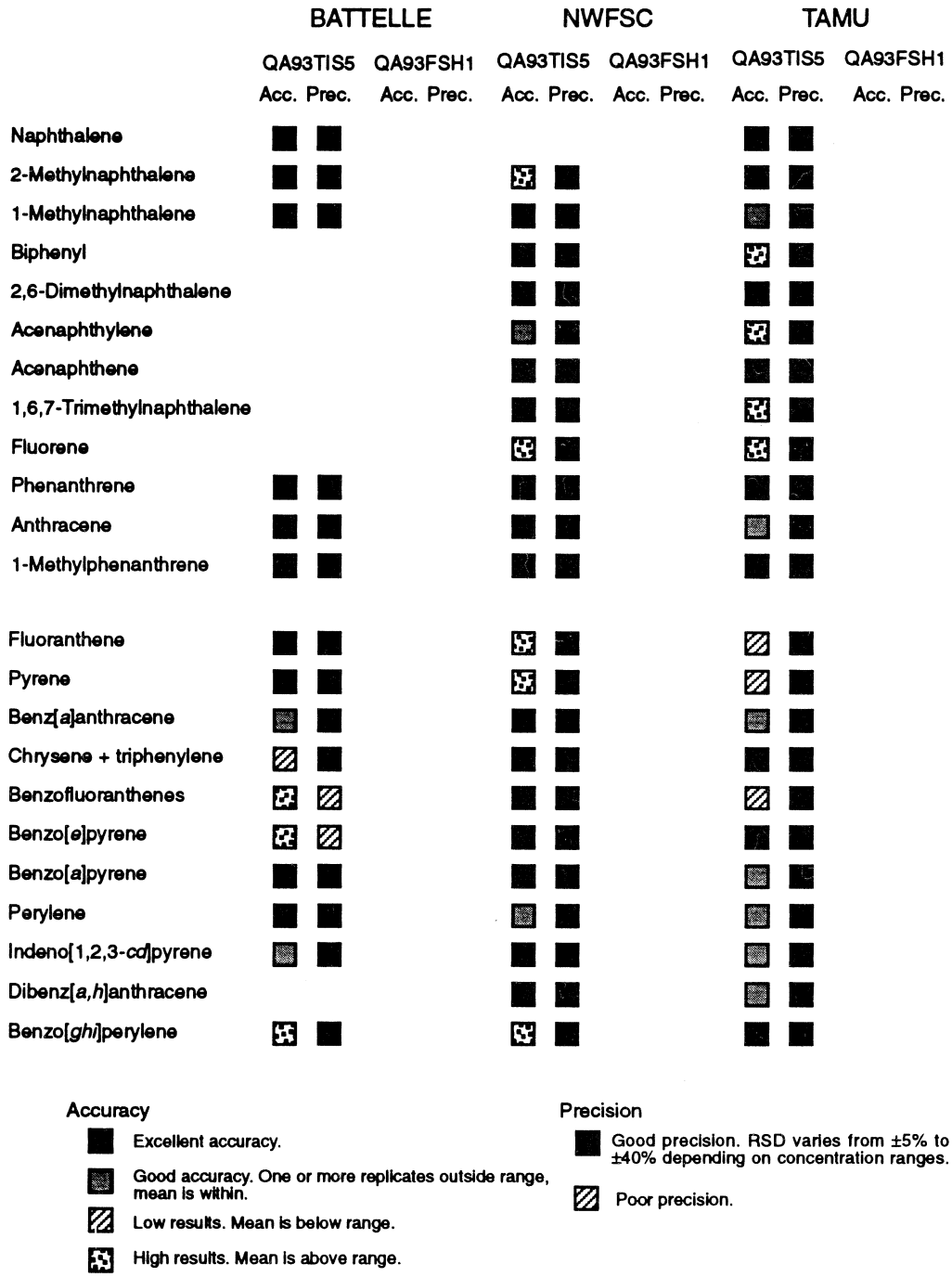


Figure 108. 1993 PAH determination performance evaluation (QA93FSH1 was not analyzed for PAHs.).

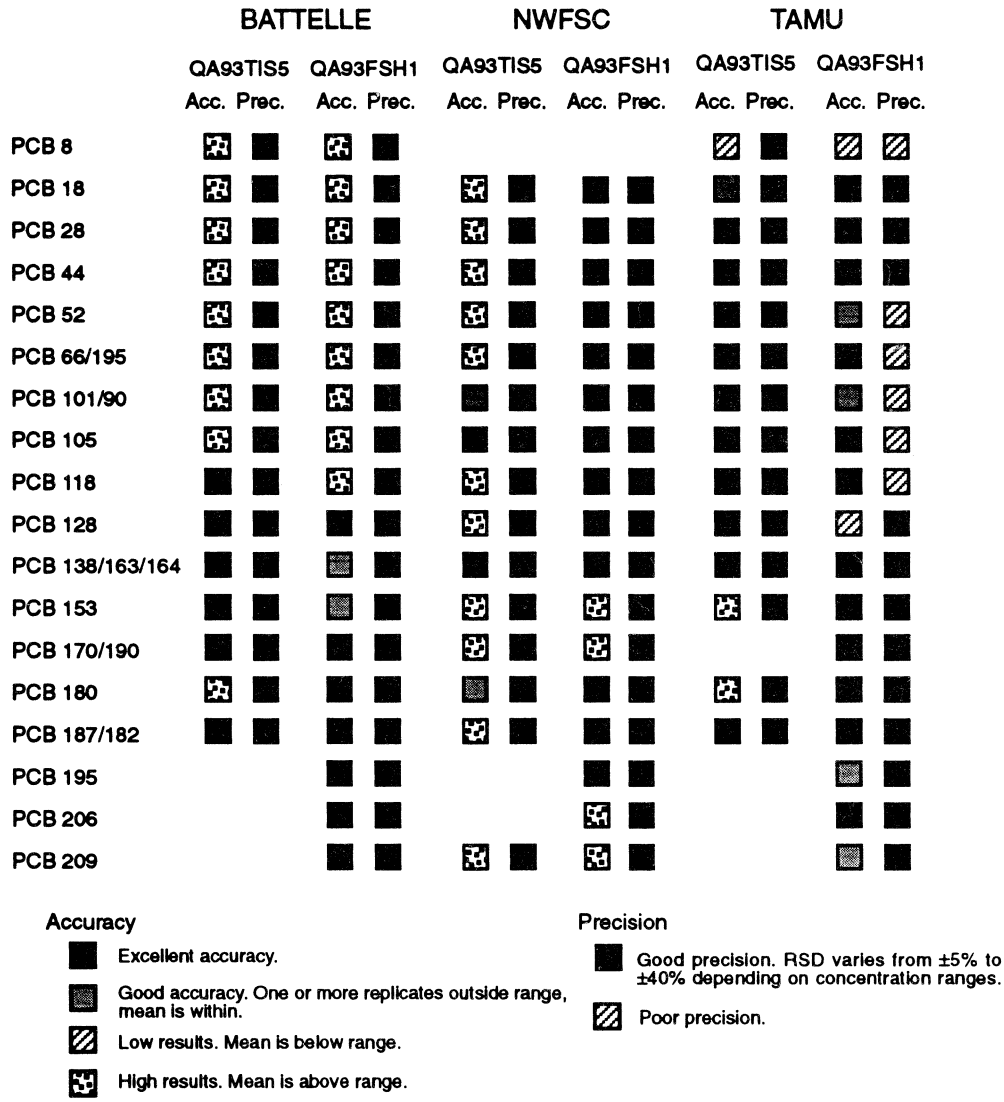


Figure 109. 1993 PCB determination performance evaluation.

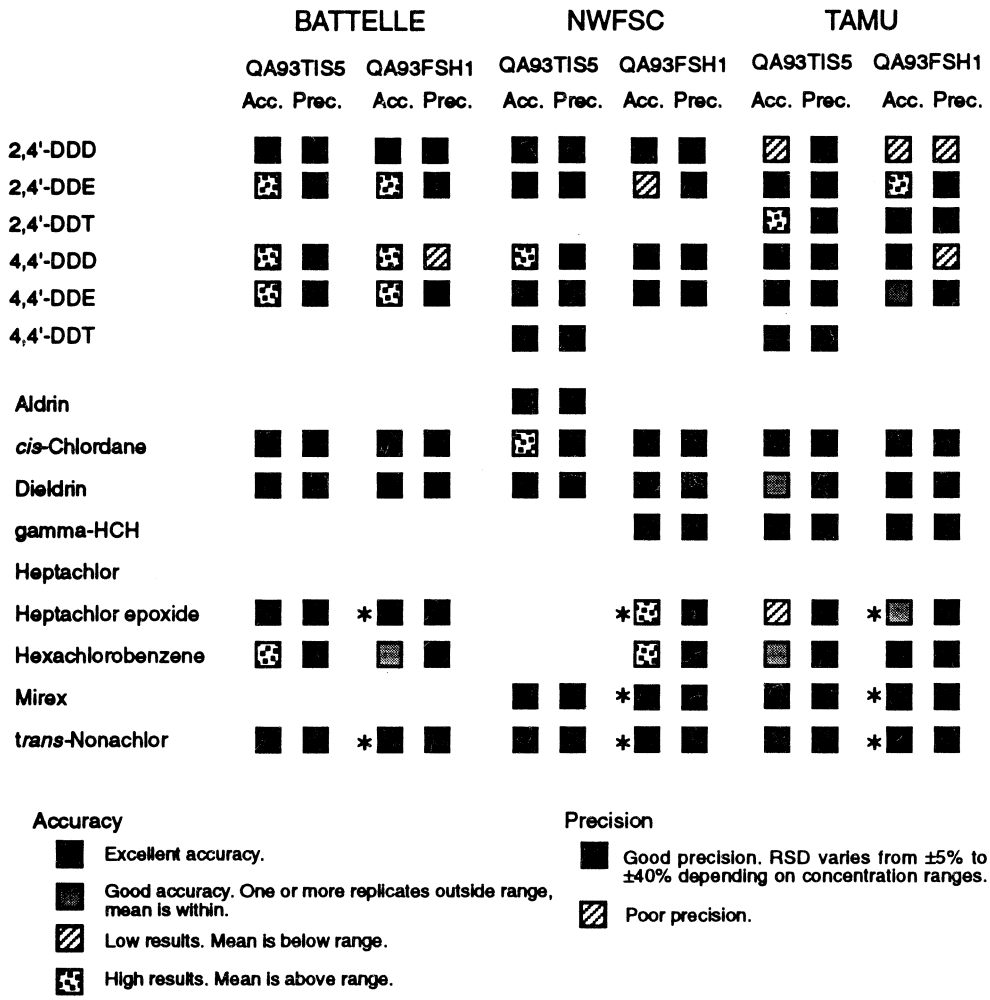


Figure 110. 1993 Chlorinated pesticides determination performance evaluation (* - Consensus value low and standard deviation high so lower limit of accepted concentration range is negative.).

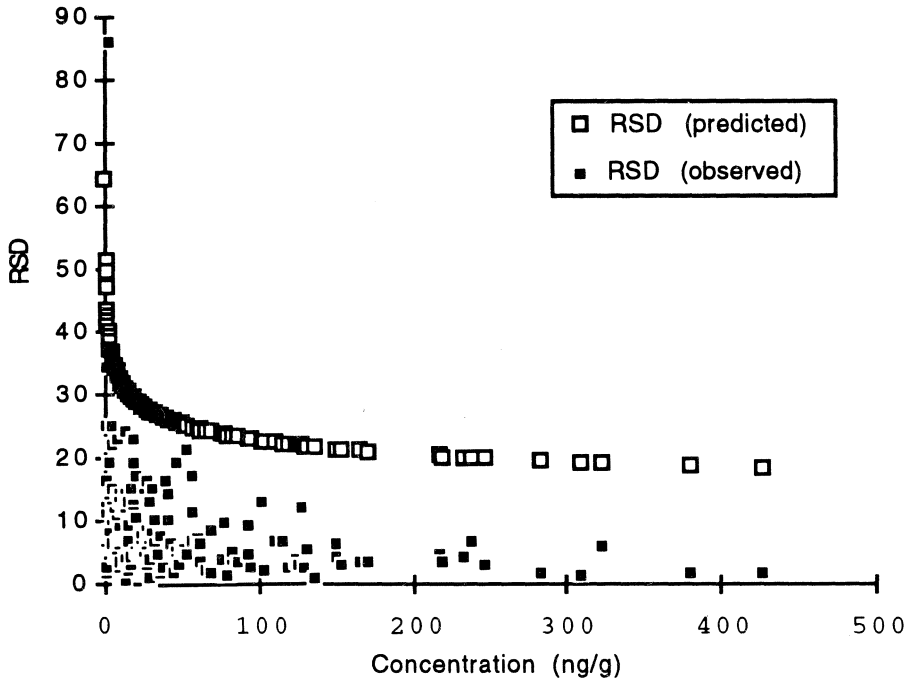


Figure 111. Predicted and observed relative standard deviations of results submitted by BATTELLE, NWFSC and TAMU for PAHs, PCBs and chlorinated pesticides in Mussel Tissue IV (QA92TIS4). (Predicted RSD_R were calculated using the Horwitz equation. Values below MDLs were removed from the data set prior to calculations.).

in these calculations. In most instances, the NS&T observed RSD were lower than the predicted RSD (Figure 111).

5.4.2. z scores

z scores can be used as an assessment of accuracy and are calculated using the formula,

$$z = \frac{(x - \hat{X})}{s}$$

where x is a laboratory concentration, $\hat{X}$ is the consensus mean concentration, and s is the target standard deviation. For well-behaved analytical systems, the z scores are normally distributed with a mean of zero, and the z scores will be outside $|z| \leq 2$ in about 5% of the cases and outside $|z| \leq 3$ only in about 0.3%. When s is defined as 0.25 $\hat{X}$, z scores, with due caution, can be used to compare results among analytes, test materials, and methods. When the target standard deviation is set to 0.25 $\hat{X}$, the International Organization for Standardization (ISO) (1993) guidelines suggest that z scores can be classified as follows:

$\lvert z \rvert \leq 2$	Satisfactory
$2 < \lvert z \rvert < 3$	Questionable
$\lvert z \rvert \geq 3$	Unsatisfactory

z scores were calculated for two of the exercises using the standard deviation of the consensus value and 0.25 $\hat{X}$ as the target s's. The latter z scores are noted as 25% z scores in Appendix V and VI. When using 0.25 $\hat{X}$ as the target s, the laboratory mean is $\leq$50% from the assigned value when $|z| \leq 2$ (ISO, 1993). The laboratory mean is $\leq$75% from the assigned value when $|z| > 3$. The 25% z scores calculated were for all possible cases and are listed in the Appendices. No z scores were analyzed for values reported as below the MDL.

An example of the distribution of the 25% z scores is shown in Figure 112 using the 1992 Mussel Tissue IV (QA92TIS4) exercise results for all analytes. Values $|z| > 3$ are not shown in the figure. Values $|z| \leq 2$ are considered satisfactory. BATTELLE z scores were mostly within the acceptable range, only 7 results are outside. There were many z scores for NWFSC above 2, indicating high results. There were 6 TAMU z scores less than -2, and two above three. The observations of the z scores distribution are similar to those of the ratios of the analytically determined values to the consensus values (Figures 87 - 89).

The ISO classification and summary of z scores for the trace inorganic and organic intercomparison exercises are summarized in Tables 20 and 21. All the z scores for the inorganic intercomparison exercises were in the acceptable range, except for the results of BATTELLE for Fish Q. More than 80% of the z scores of the trace organic intercomparison exercises for all three laboratories were within the satisfactory range (Table 21). The percentages of the z scores that were within the satisfactory range for the NWFSC results for the Tissue Control Material III (QCTC90) and for the Mussel Tissue IV Homogenate (QA92TIS4) were 74% and 69%, respectively. Considering the difficulties in analyses, it is encouraging that most results were in the satisfactory range.

6. CONCLUSIONS

The NS&T QA Project is an essential part of the NS&T Program as it ensures data quality, documents the performance of the laboratories and ensures a continued high level of performance. The level of analytical performance for the trace metal intercomparison exercises is good, although problems are still encountered in the analyses of some elements. There are still problems in the analyses of some organic compounds. Some of these problems are related to analytical limitations, such as coelution of compounds and others to the low levels of analytes present in the exercise materials. Overall, the performance of the NS&T cooperating laboratories continues to be acceptable as evidenced by the results of these exercises.

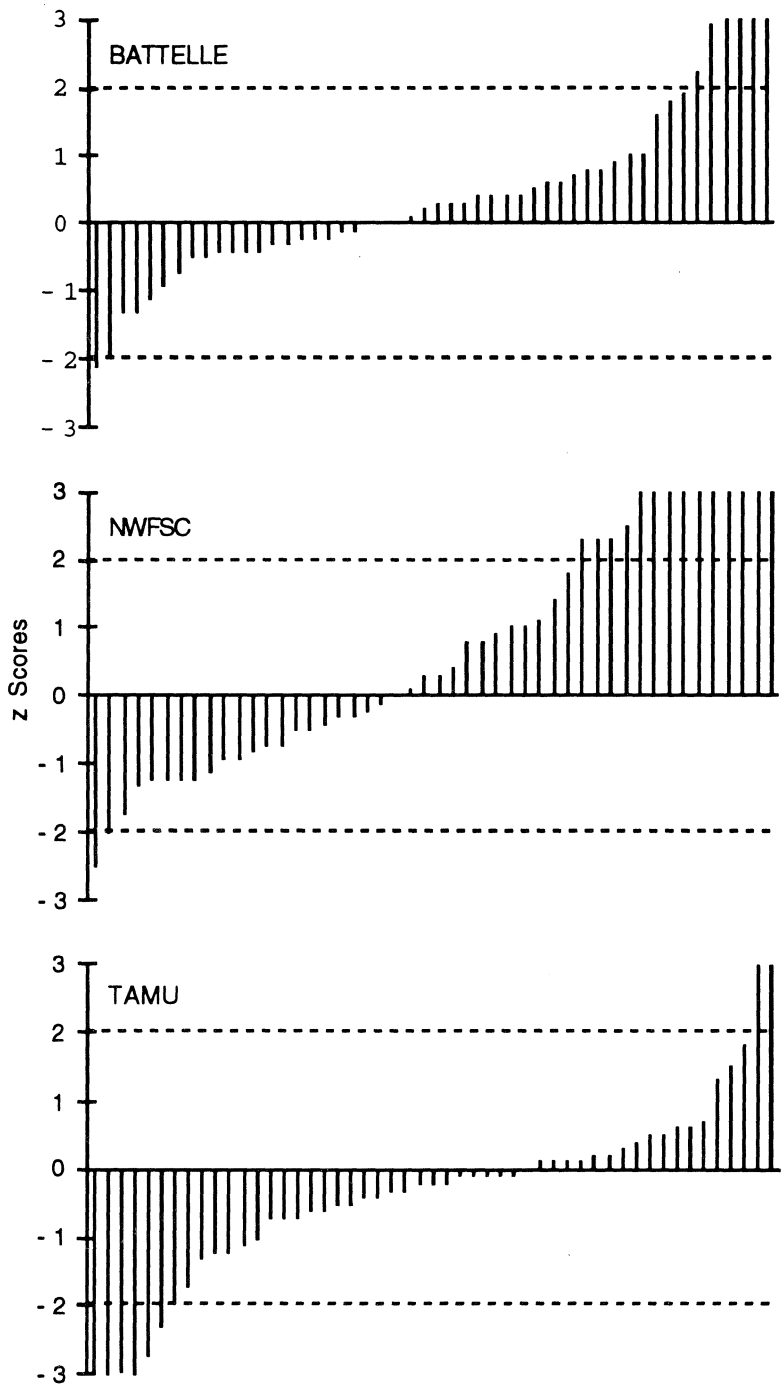


Figure 112. z Scores (25%) calculated for Mussel IV (QA92TIS4) intercomparison exercise results of all analytes above the MDL (z Scores higher than 3 or lower than -3 not shown. Z Scores were sorted by increasing value.).

Table 20. ISO classification and summary of z scores for inorganic intercomparison exercises.

Basic statistics and percent of results in each category	BATTELLE	NWFSC	TAMU	BATTELLE	NWFSC	TAMU
			1991			
	Sediment N			BCSS-1		
Mean z score	-0.1	0.1	0.2	0.1	0.2	0.1
Minimum	-0.8	-0.4	-0.5	-0.5	-0.3	-0.9
Maximum	0.6	0.6	1.0	0.8	1.6	0.6
n	13	11	12	12	11	12
$\lvert z \rvert \leq 2$	100	100	100	100	100	100
$2 < \lvert z \rvert < 3$	0	0	0	0	0	0
$\lvert z \rvert \geq 3$	0	0	0	0	0	0
	Mussel P			SRM 1566a		
Mean z score	0.3	0.5	0.0	-0.4	0.0	0.0
Minimum	-0.6	-0.1	-0.8	-2.0	-0.9	-0.3
Maximum	1.2	1.9	0.8	0.1	0.4	0.3
n	11	9	11	12	10	12
$\lvert z \rvert \leq 2$	100	100	100	100	100	100
$2 < \lvert z \rvert < 3$	0	0	0	0	0	0
$\lvert z \rvert \geq 3$	0	0	0	0	0	0
			1992			
	Sediment R			BCSS-1		
Mean z score	0.2	0.2	0.1	-0.1	0.2	0.0
Minimum	-0.7	-0.7	-1.6	-0.3	-1.4	-0.3
Maximum	0.6	0.8	1.6	0.8	0.7	1.6
n	13	14	14	15	14	14
$\lvert z \rvert \leq 2$	100	100	100	100	100	100
$2 < \lvert z \rvert < 3$	0	0	0	0	0	0
$\lvert z \rvert \geq 3$	0	0	0	0	0	0

Table 20. ISO classification and summary of z scores for inorganic intercomparison exercises (cont.).

Basic statistics and percent of results in each category	BATTELLE	NWFSC	TAMU	BATTELLE	NWFSC	TAMU
	1992					
	Fish Q			DORM-1		
Mean z score	0.6	0.1	0.2	0.1	-0.2	0.1
Minimum	-1.2	-0.5	-0.2	-0.8	-1.2	-0.2
Maximum	6.1	1.4	0.7	0.8	0.4	1.1
n	12	11	11	12	11	11
$\lvert z \rvert \leq 2$	92	100	100	100	100	100
$2 < \lvert z \rvert < 3$	0	0	0	0	0	0
$\lvert z \rvert \geq 3$	8	0	0	0	0	0
	1993					
	Sediment N			BCSS-1		
Mean z score	-0.1	0.1	0.2	0.1	0.2	0.1
Minimum	-0.8	-0.4	-0.5	-0.5	-0.3	-0.9
Maximum	0.6	0.6	1.0	0.8	1.6	0.6
n	13	11	12	12	11	12
$\lvert z \rvert \leq 2$	100	100	100	100	100	100
$2 < \lvert z \rvert < 3$	0	0	0	0	0	0
$\lvert z \rvert \geq 3$	0	0	0	0	0	0
	Mussel P			SRM 1566a		
Mean z score	0.3	0.5	0.0	-0.4	0.0	0.0
Minimum	-0.6	-0.1	-0.8	-2.0	-0.9	-0.3
Maximum	1.2	1.9	0.8	0.1	0.4	0.3
n	11	9	11	12	11	12
$\lvert z \rvert \leq 2$	100	100	100	100	100	100
$2 < \lvert z \rvert < 3$	0	0	0	0	0	0
$\lvert z \rvert \geq 3$	0	0	0	0	0	0

n is the number of reported results that were above the MDLs.

Table 21. ISO classification and summary of z scores for organic intercomparison exercises.

Basic statistics and percent of results in each category	BATTELLE	NWFSC	TAMU	BATTELLE	NWFSC	TAMU
			1991			
	Tissue Control Material III (QATC90)			Bivalve Tissue Extract II (QA91BE2)		
Mean z score	0.54	0.95	-1	0.46	0.84	-0.52
Minimum	-2.9	-2.9	-3.6	-1.6	-2.2	-2.8
Maximum	5.3	5.2	3.5	3.4	13	1.7
n	53	53	46	48	49	54
$\lvert z \rvert \leq 2$	87%	74%	85%	94%	86%	93%
$2 < \lvert z \rvert < 3$	6%	15%	9%	4%	8%	7%
$\lvert z \rvert \geq 3$	8%	11%	7%	2%	6%	0%
			1992			
	Mussel Tissue IV Homogenate (QA92TIS4)			Marine Sediment III (QA92SED3)		
Mean z score	0.6	1.4	-0.25	5.8	0.88	0.29
Minimum	-2.1	-2.5	-3.6	-3	-1.6	-2
Maximum	11	23	9.9	248	7.1	7.2
n	50	48	51	43	40	46
$\lvert z \rvert \leq 2$	86%	69%	84%	86%	85%	91%
$2 < \lvert z \rvert < 3$	6%	10%	6%	9%	8%	2%
$\lvert z \rvert \geq 3$	8%	21%	10%	5%	8%	7%
			1993			
	Mussel Tissue V Homogenate (QA93TIS5)			Fish Homogenate I (QA93FSH1)		
Mean z score	1.3	0.86	0	1.9	0.38	-0.11
Minimum	-1.7	-3.1	-3.8	-0.7	-1.2	-1.7
Maximum	12	5.7	4.5	29	3.3	2.2
n	40	47	50	27	28	30
$\lvert z \rvert \leq 2$	80%	85%	86%	81%	96%	97%
$2 < \lvert z \rvert < 3$	10%	9%	10%	7%	0%	0%
$\lvert z \rvert \geq 3$	10%	6%	4%	11%	4%	3%

n is the number of reported results that were above the MDLs.

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APPENDIX I

1991 TRACE METAL INTERCOMPARISON EXERCISE RESULTS

NRC:	National Research Council of Canada
BATTELLE:	Battelle Ocean Sciences
SEFSC:	NOAA/NMFS/Southeast Fisheries Science Center
TAMU:	Texas A&M University/GERG

Cases in which outliers were identified using the Q test for outliers and, when warranted, were omitted from the mean, are noted with an apostrophe (').

Means that are outliers from the accepted or certified value are indicated with an asterisk (*).

S1, S2, S3, S4, S5: Results from five independent sample preparations and analyses.
S1-5 Mean: Mean of the five replicates.
SD: Standard deviation.
%RSD: Percent relative standard deviation.
Accepted value: Certified value or NRC-calculated consensus value for exercise material and uncertainty..
z Score: The ratio of a bias estimate to a performance criterion. The difference between the laboratory mean and the accepted mean was used as the bias estimate. z Scores were calculated in two ways, using the SD of the S1-5 mean, and 25% of the accepted value as performance criteria.
N R : Not reported.

Table I.1. 1991 NOAA/5 Sediment N composition and intercomparison exercise results (µg/g dry weight unless noted) (Ag not required.).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
BATTELLE													
Al (%)	5.8	5.6	5.6	5.6	5.5	5.6	0.1	1.8	5.27	±	1.3	0.3	0.3
Si (%)	24	24	24	23	23	24	1	4.2	25.9	±	4.1	-0.5	-0.3
Cr	65	51	45	56	62	56	8	14.3	63.1	±	15.7	-0.5	-0.5
Mn	434	481	467	481	456	464	20	4.3	495	±	103	-0.3	-0.3
Fe (%) '	2.9	3.0	3.0	3.0	3.0	3.0	0	0	2.97	±	0.4	0.1	0.0
Cu	128	122	128	141	124	129	7	5.4	129	±	26	0.0	0.0
Zn	311	322	346	333	328	328	13	4	325	±	55	0.1	0.0
As	15	17	16	16	15	16	1	6.2	19.8	±	5.8	-0.7	-0.8
Se	1.5	1.3	1.1	1.2	1.4	1.3	0.2	15.4	1.54	±	0.7	-0.3	-0.6
Cd	2.3	2.2	2.3	2.3	2.2	2.3	0.1	4.3	2.03	±	0.58	0.5	0.5
Sn	82	73	80	66	75	75	6	8	65.4	±	19.1	0.5	0.6
Sb	0.78	0.67	0.67	0.77	0.89	0.76	0.09	12.1					
Hg	1.35	1.3	1.19	1.09	1.38	1.26	0.12	9.5	1.34	±	0.47	-0.2	-0.2
Pb	220	219	232	262	233	233	17	7.3	211	±	46	0.5	0.4
SEFSC													
Al (%)	5.12	4.99	4.99	5.37	5.31	5.16	0.18	3.5	5.27	±	1.3	-0.1	-0.1
Si (%)	NR												
Cr	NR												
Mn	455	457	457	462	448	456	5	1.1	495	±	103	-0.4	-0.3
Fe (%)	2.83	2.81	2.84	2.87	2.85	2.84	0.02	0.7	2.97	±	0.4	-0.3	-0.2
Cu	143	142	153	148	134	144	7	4.9	129	±	26	0.6	0.5
Zn	390	357	347	343	345	356	20	5.6	325	±	55	0.6	0.4
As	21.5	21.9	22	21.8	20.8	21.6	0.5	2.3	19.8	±	5.8	0.3	0.4
Se	1.31	1.5	1.41	1.4	1.39	1.4	0.07	5	1.54	±	0.7	-0.2	-0.4
Cd	2.22	2.13	2.09	2.00	2.02	2.09	0.09	4.3	2.03	±	0.58	0.1	0.1
Sn	61	61	84	67	59	66	10	15.1	65.4	±	19.1	0.0	0.0
Sb	NR												
Hg	1.43	1.22	1.56	1.60	1.29	1.42	0.17	12	1.34	±	0.47	0.2	0.2
Pb	242	257	230	262	236	245	14	5.7	211	±	46	0.7	0.6

Table I.1. 1991 NOAA/5 Sediment N composition and intercomparison exercise results (µg/g dry weight unless noted) (Ag not required.) (cont.).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
TAMU													
Al (%)	5.44	5.52	5.49	5.48	5.43	5.47	0.04	0.7	5.27	±	1.3	0.2	0.2
Si (%)	N R								25.9	±	4.1		
Cr	71.1	71.2	69.8	70.9	68.2	70.2	1.3	1.8	63.1	±	15.7	0.5	0.5
Mn	500	502	528	511	512	511	11	2.1	495	±	103	0.2	0.1
Fe (%)	3.10	3.21	3.22	3.24	3.21	3.20	0.06	1.9	2.97	±	0.4	0.6	0.3
Cu	123	129	129	140	134	131	6	4.6	129	±	26	0.1	0.1
Zn	332	340	335	334	333	335	3	0.9	325	±	55	0.2	0.1
As	22.2	22.7	22.6	22	22.3	22.4	0.3	1.3	19.8	±	5.8	0.4	0.5
Se	1.4	1.38	1.27	1.45	1.26	1.35	0.08	5.9	1.54	±	0.7	-0.3	-0.5
Cd	2.57	2.54	2.55	2.45	2.51	2.52	0.05	2	2.03	±	0.58	0.8	1.0
Sn	68.4	74.2	60.8	66.2	69.3	67.8	5	7.2	65.4	±	19.1	0.1	0.1
Sb	N R												
Hg	1.31	1.33	1.34	1.39	1.46	1.37	0.06	4.4	1.34	±	0.47	0.1	0.1
Pb	227	221	227	238	227	227	6	2.6	211	±	46	0.3	0.3

Table I.2. 1991 NOAA/5 BCSS-1 composition and intercomparison exercise results (µg/g dry weight unless noted) (Ag not required.).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
BATTELLE													
Al (%)	6.7	6.4	6.9	6.9	6.8	6.7	0.2	3	6.26	±	0.41	1.1	0.3
Si (%)	30	29	30	29	29	29	1	3.4	30.8	±	1.0	-1.8	-0.2
Cr	119	126	124	136	126	126	6	4.8	123	±	14	0.2	0.1
Mn	224	226	216	213	220	220	5	2.3	229	±	15	-0.6	-0.2
Fe (%)	3.4	3.4	3.4	3.3	3.3	3.4	0.1	2.9	3.28	±	0.14	0.9	0.1
Cu	19	19	20	19	20	19	1	5.3	18.5	±	2.7	0.2	0.1
Zn	104	109	106	105	99	105 *	4	3.8	119	±	12	-1.2	-0.5
As	12	11	12	12	11	12	1	8.3	11.1	±	1.4	0.6	0.3
Se	<0.8	<0.8	<0.8	<0.8	<0.8				0.43	±	0.06		
Cd	0.3	0.31	0.28	0.3	0.3	0.30 *	0.01	3.3	0.25	±	0.04	1.3	0.8
Sn	2.2	2.1	2.3	2.1	2.2	2.2 *	0.1	4.5	1.85	±	0.2	1.8	0.8
Sb	0.6	0.48	0.48	0.59	0.6	0.55	0.06	10.9	0.59	±	0.06	-0.7	-0.3
Hg	NR												
Pb	24	24	21	23	24	23	1	4.3	22.7	±	3.4	0.1	0.1
SEFSC													
Al (%)	6.40	6.31	6.24	5.89	6.17	6.20	0.19	3.1	6.26	±	0.41	-0.1	0.0
Si (%)	NR								30.8	±	1.0		
Cr	NR								123	±	14		
Mn	221	224	209	218	223	219	6	2.7	229	±	15	-0.7	-0.2
Fe (%)	3.01	3.08	2.97	3.07	3.16	3.06	0.07	2.3	3.28	±	0.14	-1.6	-0.3
Cu	19.7	20.8	20.6	20.3	20.8	20.4	0.5	2.4	18.5	±	2.7	0.7	0.4
Zn	110	116	114	110	111	112	3	2.7	119	±	12	-0.6	-0.2
As	11.7	12.2	12.6	11.8	11.8	12	0.4	3.3	11.1	±	1.4	0.6	0.3
Se '	0.62	0.49	0.49	0.5	0.47	0.49	0.01	2	0.43	±	0.06	1.0	0.6
Cd	0.282	0.27	0.266	0.261	0.255	0.267	0.01	3.7	0.25	±	0.04	0.4	0.3
Sn'	1.92	1.84	1.63	1.87	1.84	1.86	0.04	2.1	1.85	±	0.2	0.1	0.0
Sb	NR												
Hg	0.240	0.234	0.250	0.237	0.266	0.245	0.013	5.3	0.174	±	0.081	0.9	1.6
Pb	22.1	22.5	22.1	21.7	23.1	22.3	0.5	2.2	22.7	±	3.4	-0.1	-0.1

Table I.2. 1991 NOAA/5 BCSS-1 composition and intercomparison exercise results (µg/g dry weight unless noted) (Ag not required.) (cont.).

TAMU	Replicates S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			z Score for S1-5 mean calculated using SD of S1-5	Mean	25% Accepted value
Al (%)	6.41	6.25	6.13	6.25	6.64	6.34	0.2	3.1	6.26	±	0.41	0.2		0.1
Si (%)	NR								30.8	±	1.0			
Cr	127	121	125	124	129	125	3	2.4	123	±	14	0.1		0.1
Mn	241	236	237	241	238	239	2	0.8	229	±	15	0.7		0.2
Fe (%)	3.57	3.56	3.5	3.54	3.53	3.54*	0.03	0.8	3.28	±	0.14	1.9		0.3
Cu	19.1	18.7	20	19.9	20.9	19.7	0.9	4.6	18.5	±	2.7	0.4		0.3
Zn	120	118	116	116	120	118	2	1.7	119	±	12	-0.1		0.0
As	10.8	11.1	11.2	10.8	10.8	10.9	0.2	1.8	11.1	±	1.4	-0.1		-0.1
Se	0.4	0.43	0.43	0.37	0.45	0.42	0.03	7.1	0.43	±	0.06	-0.2		-0.1
Cd	0.28	0.29	0.28	0.29	0.28	0.28	0.01	3.6	0.25	±	0.04	0.8		0.5
Sn	2.23	2.1	2.22	2.0	2.11	*2.13	0.1	4.7	1.85	±	0.2	1.4		0.6
Sb	NR													
Hg	0.13	0.13	0.13	0.14	0.14	0.13	0	2.2	0.174	±	0.08	-0.5		-0.9
Pb	24.5	26.4	24.4	25	24.2	24.9	0.9	3.6	22.7	±	3.4	0.6		0.4

Table I.3. 1991 NOAA/5 Mussel P composition and intercomparison exercise results (µg/g dry weight unless noted) (Si, Mn, and Sb analysis not required.).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
BATTELLE													
Al	486	481	531	508	543	510	27	5.3					
Cr	3.5	3.5	3.1	3.1	3.2	3.3	0.2	6.1	2.52	±	0.75	1.0	1.2
Fe	567	636	685	626	691	641	50	7.8	575	±	172	0.4	0.5
Cu	7.5	8.3	9.5	9.5	9.5	8.9	0.9	10.1	7.81	±	3.07	0.4	0.6
Zn	152	160	167	157	167	161	7	4.3	146	±	19	0.8	0.4
As '	11	11	11	11	13	11	9	5	8.56	±	5.0	0.1	0.2
Se	2.7	2.4	3.1	3.4	2.7	2.9	0.4	13.8	2.86	±	1.2	0.0	0.1
Ag	0.74	0.73	0.7	0.68	0.66	0.7	0.03	4.3	0.59	±	0.26	0.4	0.8
Cd	4.2	4.0	4.1	4.0	4.0	4.1	0.1	2.4	3.96	±	1.14	0.1	0.1
Sn	0.21	0.18	0.17	0.19	0.17	0.18	0.02	11.1	0.19	±	0.07	-0.2	-0.3
Hg	0.16	0.17	0.17	0.16	0.17	0.16	0	1.2	0.16	±	0.07	0.1	0.1
Pb	1.6	1.5	1.6	1.5	1.5	1.5	0.1	6.7	1.75	±	0.67	-0.4	-0.6
SEFSC													
Al (%)	NR												
Cr	NR												
Fe	545	543	613	568	559	566	28	4.9	575	±	172	-0.1	-0.1
Cu	11.6	11.4	11.7	12.5	10.5	11.5	0.72	6.3	7.81	±	3.07	1.2	1.9
Zn	162	158	159	164	162	161	2	1.2	146	±	19	0.8	0.4
As	10.4	10.1	10.5	10.5	10.8	10.5	0.3	2.8	8.56	±	5.0	0.4	0.9
Se	3.0	2.8	3.1	2.8	2.8	2.9	0.1	3.4	2.86	±	1.2	0.0	0.1
Ag	0.59	0.63	0.55	0.53	0.57	0.57	0.04	7	0.59	±	0.26	-0.1	-0.1
Cd	4.49	4.55	4.58	4.73	4.68	4.61	0.1	2.2	3.96	±	1.14	0.6	0.7
Sn	<0.2	<0.2	<0.2	<0.2	<0.2								
Sb	NR												
Hg	0.18	0.19	0.19	0.19	0.18	0.19	0	1.6	0.16	±	0.07	0.4	0.7
Pb	1.84	1.95	1.84	2.01	1.93	1.91	0.07	3.7	1.75	±	0.67	0.2	0.4

Table I.3. 1991 NOAA/5 Mussel P composition and intercomparison exercise results (µg/g dry weight unless noted) (Si, Mn, and Sb analysis not required) (cont.).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
TAMU													
Al	649	732	664	679	678	680	31	4.7					
Cr	2.22	2.19	2.21	2.36	2.46	2.29	0.12	5.2	2.52	±	0.75	-0.3	-0.4
Fe	526	536	533	558	554	541	14	2.6	575	±	172	-0.2	-0.2
Cu	5.97	6.64	6.19	6.36	6.34	6.3	0.25	4.0	7.81	±	3.07	-0.5	-0.8
Zn	143	137	139	138	138	139	2	1.4	146	±	19	-0.4	-0.2
As	9.24	8.89	8.26	9.34	9.9	9.13	0.6	6.6	8.56	±	5.0	0.1	0.3
Se	2.76	2.66	2.64	2.64	2.71	2.68	0.05	1.9	2.86	±	1.2	-0.2	-0.3
Ag	0.72	0.72	0.70	0.67	0.68	0.70	0.02	2.9	0.59	±	0.26	0.4	0.8
Cd	4.14	4.11	4.23	4.10	4.12	4.14	0.05	1.3	3.96	±	1.14	0.2	0.2
Sn	0.26	0.24	0.21	0.22	0.23	0.23	0.02	8.7	0.19	±	0.07	0.5	0.8
Hg	0.13	0.13	0.13	0.13	0.14	0.13	0.004	3	0.16	±	0.07	-0.4	-0.7
Pb	1.81	1.85	1.89	1.88	1.91	1.87	0.04	2.1	1.75	±	0.67	0.2	0.3

Table I.4. 1991 NOAA/5 SRM 1566a composition and intercomparison exercise results (µg/g dry weight unless noted) (Al, Mn, and Sb analysis not required).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
BATTELLE													
Al	110	110	91	94	95	*100	9	9	203	±	12.5	-8.2	-2.0
Cr	1.4	1.4	1.4	1.5	1.6	1.46	0.09	6.2	1.43	±	0.46	0.1	0.1
Fe	526	497	515	540	566	529	26	4.9	539	±	15	-0.7	-0.1
Cu	69	67	68	69	69	68	1	1.5	66.3	±	4.3	0.4	0.1
Zn	855	831	847	860	862	851	13	1.5	830	±	57	0.4	0.1
As '	15	15	14	15	15	12	7		14	±	1.2	-1.7	-0.6
Se	2.0	2.0	2.2	2.2	1.7	2.0	0.2	10	2.21	±	0.24	-0.9	-0.4
Ag	1.74	1.66	1.67	1.71	1.68	1.69	0.03	1.8	1.68	±	0.15	0.1	0.0
Cd '	3.9	3.9	3.8	3.9	3.9	3.1	1.7		4.15	±	0.38	-2.8	-1.0
Sn	2.1	2.2	2.1	2.0	2.1	2.1	0.1	4.8	2.18	±	0.27	-0.3	-0.1
Hg (ng/g)	57	58	57	58	59	58	1	1.7	64	±	7	-0.9	-0.4
Pb	0.30	0.26	0.32	0.31	0.30	*0.30	0.02	0	0.37	±	0.01	-5.1	-0.8
SEFSC													
Al (%)	NR												
Cr	NR												
Fe	527	535	546	526	524	532	9	1.7	539	±	15	-0.5	-0.1
Cu	72	73	71	71	71	72	1	1.4	66.3	±	4.3	1.3	0.3
Zn	840	853	859	858	840	850	9	1.1	830	±	57	0.4	0.1
As	13.4	13.1	13.3	13.2	13.3	13.3	0.1	0.7	14	±	1.2	-0.6	-0.2
Se	2.1	2.2	2.1	2.1	2.1	2.1	0		2.21	±	0.24	-0.5	-0.2
Ag	1.66	1.59	1.62	1.57	1.54	1.6	0.05	3.1	1.68	±	0.15	-0.5	-0.2
Cd	4.45	4.41	4.24	4.38	4.35	4.37	0.08	1.8	4.15	±	0.38	0.6	0.2
Sn	1.68	1.69	1.79	1.69	1.68	*1.71	0.05	2.9	2.18	±	0.27	-1.7	-0.9
Hg (ng/g)	70	75	72	65	71	71	4	5.6	64	±	7	1.0	0.4
Pb	0.37	0.36	0.41	0.43	0.41	*0.40	0.03	7.5	0.37	±	0.01	2.1	0.3

Table I.4. 1991 NOAA/5 SRM 1566a composition and intercomparison exercise results (µg/g dry weight unless noted) (Al, Mn, and Sb analysis not required) (cont.).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
TAMU													
Al	181	181	178	201	207	190	13	6.8	203	±	12.5	-1.0	-0.2
Cr	1.45	1.57	1.44	1.45	1.54	1.49	0.06	4.0	1.43	±	0.46	0.1	0.2
Fe	523	546	523	524	551	533	14	2.6	539	±	15	-0.4	0.0
Cu	62.8	64.1	63.2	64.3	63.7	63.6	0.6	0.9	66.3	±	4.3	-0.6	-0.2
Zn	802	802	802	810	818	897	7	0.8	830	±	57	1.2	0.3
As	13.8	12.7	11.9	12.5	14.2	13.0	1.0	7.7	14	±	1.2	-0.8	-0.3
Se	2.20	2.30	2.22	2.08	2.20	2.20	0.08	3.6	2.21	±	0.24	0.0	0.0
Ag	1.73	1.8	1.79	1.76	1.68	1.75	0.05	2.9	1.68	±	0.15	0.5	0.2
Cd	4.08	3.96	4.01	4.06	4.01	4.02	0.05	1.2	4.15	±	0.38	-0.3	-0.1
Sn	2.17	2.06	2.16	2.34	2.38	2.22	0.13	5.9	2.18	±	0.27	0.1	0.1
Hg (ng/g)	58.7	60.6	61.9	64.5	67.0	62.5	3.3	5.3	64.2	±	6.7	-0.3	-0.1
Pb	0.35	0.38	0.36	0.34	0.36	0.36	0.01	2.8	0.37	±	0.01	-0.8	-0.1

APPENDIX II

1992 TRACE METAL INTERCOMPARISON EXERCISE RESULTS

NRC:	National Research Council of Canada
BATTELLE:	Battelle Ocean Sciences
SEFSC:	NOAA/NMFS/Southeast Fisheries Science Center
TAMU:	Texas A&M University/GERG

Cases in which outliers were identified using the Q test for outliers and, when warranted, were omitted from the mean, are noted with an apostrophe (').

Means that are outliers from the accepted or certified value are indicated with an asterisk (*).

S1, S2, S3, S4, S5: Results from five independent sample preparations and analyses.
Mean: Mean of the five replicates.
SD: Standard deviation.
%RSD: Percent relative standard deviation.
Accepted value: Certified value or NRC-calculated consensus value for exercise material.
z Score: The ratio of a bias estimate to a performance criterion. The difference between the laboratory mean and the accepted mean was used as the bias estimate. z Scores were calculated in two ways, using the SD of the S1-5 mean, and 25% of the accepted value as performance criteria.
N R : Not reported.

Table II.1. 1992 NOAA/6 Fish Q composition and intercomparison exercise results (µg/g dry weight unless noted) (Si, Mn, Sb, and Tl analysis not required.).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
BATTELLE													
Al	6.0	5.4	12	10	11	8.9	3	33.7	8.48	±	1.08	0.4	0.2
Cr	6.1	5.9	6.3	5.4	5.1	5.8	0.5	8.6	6.45	±	2.07	-0.3	-0.4
Fe	49	46	53	47	49	49	3	5.5	42.0	±	19.9	0.4	0.7
Ni	2.6	2.2	3.0	2.0	2.2	2.4	0.4	16.7	3.40	±	1.39	-0.7	-1.2
Cu	4.0	3.7	3.6	3.4	4.1	3.8	0.3	7.7	3.15	±	0.77	0.8	0.8
Zn '	23	22	22	22	22	22	0	0	22.3	±	2.9	-0.1	-0.1
As	140	140	140	140	140	140	0	0	117	±	24	1.0	0.8
Se	6.0	5.4	5.6	5.9	5.6	5.7	0.2	4.3	5.08	±	2.14	0.3	0.5
Ag	0.5	0.45	0.54	0.5	0.27	0.45	0.11	23.6	0.45	±	0.15	0.0	0.0
Cd *	0.098	0.082	0.042	0.140	0.066	0.086	0.037	43	0.034	±	0.081	6.4	6.1
Sn	0.084	0.052	0.225	0.152	0.060	0.115	0.073	63.9					
Hg	0.33	0.33	0.32	0.34	0.32	0.33	0.01	2.6	0.30	±	0.06	0.6	0.5
Pb	0.25	0.28	0.42	0.37	0.33	0.33	0.07	20.7	0.42	±	0.24	-0.4	-0.9
SEFSC													
Al	NR								8.48	±	1.08		
Cr '	6.3	6.4	6.2	6.4	7.2	6.4	0.1	1.5	6.45	±	2.07	0.0	0.0
Fe	45	43	48	44	47	45	2	4.6	42.0	±	19.9	0.2	0.3
Ni	3.0	2.8	3.4	3.5	3.1	3.2	0.3	9.1	3.40	±	1.39	-0.1	-0.2
Cu	3.3	3.9	3.6	3.5	3.1	3.5	0.3	8.7	3.15	±	0.77	0.5	0.4
Zn	21.5	22.6	21.2	21.8	21.9	21.8	0.5	2.4	22.3	±	2.9	-0.2	-0.1
As	117	115	108	105	105	110	6	5.1	117	±	24	-0.3	-0.2
Se	5.1	5.1	5.3	5.3	5.4	5.2	0.1	2.6	5.08	±	2.14	0.1	0.1
Ag	0.40	0.38	0.40	0.38	0.40	0.39	0.01	2.8	0.45	±	0.15	-0.4	-0.5
Cd	0.030	0.032	0.040	0.034	0.030	0.033	0.004	12.5	0.034	±	0.081	-0.1	-0.1
Sn	0.16	0.18	0.06	0.07	0.11	0.12	0.05	45.9					
Hg	0.303	0.265	0.252	0.267	0.262	0.270	0.019	7.2	0.30	±	0.06	-0.4	-0.4
Pb	0.45	0.32	0.76	0.60	0.70	0.57	0.18	31.9	0.42	±	0.24	0.6	1.4

Table II.1. 1992 NOAA/6 Fish Q composition and intercomparison exercise results (µg/g dry weight unless noted) (Si, Mn, Sb, and Tl analysis not required.) (cont.).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
TAMU													
Al	NR								8.48	±	1.08		
Cr	7.26	7.28	7.69	7.73	7.49	7.49	0.22	2.9	6.45	±	2.07	0.5	0.6
Fe	39.1	38.9	43	42.6	38.3	40.4	2.2	5.5	42.0	±	19.9	-0.1	-0.2
Ni	4.1	3.78	3.7	3.8	3.67	3.81	0.17	4.5	3.40	±	1.39	0.3	0.5
Cu	3.07	3.05	2.97	2.99	2.93	3.00	0.06	1.9	3.15	±	0.77	-0.2	-0.2
Zn	22	22.5	22.2	22	22	22.1	0.2	1	22.3	±	2.9	-0.1	0.0
As	123	123	123	122	122	123	1.0	0.4	117	±	24	0.3	0.2
Se	5.47	5.3	5.35	5.43	5.33	5.38	0.07	1.3	5.08	±	2.14	0.1	0.2
Ag	0.517	0.52	0.55	0.54	0.52	0.53	0.01	2.7	0.45	±	0.15	0.6	0.7
Cd	0.032	0.031	0.032	0.034	0.033	0.032	0.001	3.5	0.034	±	0.081	-0.2	-0.2
Sn	0.272	0.114	0.112	0.212	0.124	0.167	0.072	43.2					
Hg	0.301	0.304	0.307	0.300	0.314	0.304	0.004	1.2	0.30	±	0.06	0.1	0.1
Pb	0.48	0.4	0.44	0.43	0.41	0.43	0.03	7.2	0.42	±	0.24	0.0	0.1

Table II.2. 1992 NOAA/6 DORM-1 composition and intercomparison exercise results (µg/g dry weight unless noted) (Si, Mn, Sb, and Tl analysis not required.).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
BATTELLE													
Al '	8.2	12	8.3	8.6	8.5	8.4	0.2	2	8.17	±	3.69	0.1	0.1
Cr *	3.8	4.3	3.9	4.5	4.5	4.2	0.3	7.9	3.6	±	0.4	1.5	0.7
Fe	67	70	69	70	70	69	1	1.9	63.6	±	5.3	1.0	0.3
Ni	1.3	1.2	0.99	1.4	1.1	1.2	0.2	13.5	1.2	±	0.3	0.0	0.0
Cu *	5.9	6.4	6.3	6.1	6.1	6.2	0.2	3.2	5.22	±	0.33	3.0	0.8
Zn	20	20	21	20	21	20	1	2.7	21.3	±	1.0	-1.3	-0.2
As	18	19	18	19	19	19	1	2.9	17.7	±	2.1	0.6	0.3
Se	1.7	1.8	1.6	1.5	1.5	1.6	0.1	8	1.62	±	0.12	-0.2	0.0
Ag	0.17	0.15	0.22	0.26	0.16	0.19	0.05	24.3	0.180	±	0.02	0.5	0.2
Cd *	0.04	0.03	0.08	0.1	0.08	0.07	0.03	41.7	0.09	±	0.01	-1.5	-0.8
Sn	0.14	0.09	0.08	0.02	0.08	0.08	0.04	53.1					
Hg *	0.93	0.91	0.97	0.89	0.89	0.92	0.03	3.6	0.80	±	0.07	1.6	0.6
Pb '	0.38	0.39	0.48	0.40	0.38	0.39	0.01	2.6	0.40	±	0.12	-0.1	-0.1
SEFSC													
Al	NR								8.17	±	3.69		
Cr	3.3	4.6	3.4	3.6	4.1	3.8	0.5	14.3	3.6	±	0.4	0.5	0.2
Fe *	71	67	68	73	73	70	3	4	63.6	±	5.3	1.2	0.4
Ni *'	0.87	0.85	0.79	0.85	0.85	0.84	0.03	3.6	1.2	±	0.3	-1.2	-1.2
Cu	5.1	5.0	5.1	5.4	5.4	5.2	0.2	3.6	5.22	±	0.33	-0.1	0.0
Zn *	18.9	20	20.8	19.5	19.1	19.7	0.8	3.9	21.3	±	1.0	-1.6	-0.3
As	16.2	16	14.5	15	16.4	15.6	0.8	5.3	17.7	±	2.1	-1.0	-0.5
Se	1.7	1.6	1.7	1.6	1.7	1.7	0.1	3.3	1.62	±	0.12	0.7	0.2
Ag *'	0.15	0.15	0.15	0.16	0.15	0.15	0	2.9	0.180	±	0.02	-1.6	-0.6
Cd	0.08	0.08	0.08	0.08	0.08	0.08	0	2.6	0.09	±	0.01	-0.4	-0.2
Sn	0.22	0.19	0.11	0.07	0.31	0.18	0.09	52.4					
Hg	0.77	0.79	0.81	0.8	0.79	0.79	0.02	2.2	0.80	±	0.07	-0.1	0.0
Pb	0.43	0.36	0.25	0.33	0.68	0.41	0.16	40	0.40	±	0.12	0.1	0.1

Table II.2. 1992 NOAA/6 DORM-1 composition and intercomparison exercise results (µg/g dry weight unless noted) (Si, Mn, Sb, and Tl analysis not required.) (cont.).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
TAMU													
Al	N R								8.17	±	3.69		
Cr	3.67	3.91	3.59	3.38	3.57	3.62	0.19	5.3	3.6	±	0.4	0.1	0.0
Fe	67.8	64.6	67.7	62.8	66.4	65.9	2.1	3.3	63.6	±	5.3	0.4	0.1
Ni	1.17	1.21	1.26	1.28	1.10	1.20	0.07	6.0	1.2	±	0.3	0.0	0.0
Cu	5.16	5.22	5.25	5.30	5.14	5.21	0.07	1.3	5.22	±	0.33	0.0	0.0
Zn	21.1	21.2	21.4	21.4	21.4	21.3	0.1	0.7	21.3	±	1.0	0.0	0.0
As	17.0	17.1	17.0	16.8	17.0	17.0	0.1	0.6	17.7	±	2.1	-0.3	-0.2
Se	1.51	1.52	1.56	1.58	1.60	1.55	0.04	2.5	1.62	±	0.12	-0.6	-0.2
Ag *	0.24	0.24	0.24	0.21	0.22	0.23	0.01	5.2	0.180	±	0.02	2.3	1.1
Cd	0.08	0.08	0.08	0.09	0.08	0.08	0.003	3.5	0.09	±	0.01	-0.2	-0.1
Sn	0.46	0.51	0.42	0.42	0.45	0.45	0.04	8.3					
Hg	0.78	0.81	0.81	0.77	0.77	0.79	0.02	2.5	0.80	±	0.07	-0.1	-0.1
Pb	0.37	0.39	0.39	0.39	0.42	0.39	0.02	4.6	0.40	±	0.12	-0.1	-0.1

Table II.3. 1992 NOAA/6 Sediment R composition and intercomparison exercise results (µg/g dry weight unless noted).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
BATTELLE													
Al (%)	2.1	1.9	2.2	2.2	2.0	2.1	0.1	6.3	2.19	±	0.44	-0.2	-0.2
Si	40	40	40	40	40	40	0	0					
Cr	38	26	31	41	30	33	6	18.5	37.5	±	12.3	-0.4	-0.5
Mn	210	190	180	190	180	190	12	6.4	217	±	50	-0.5	-0.5
Fe (%)	1.8	1.7	1.6	1.7	1.8	1.7	0.1	4.9	1.88	±	0.25	-0.7	-0.4
Ni	20	19	17	18	18	18	1	6.2	20.6	±	2.9	-0.9	-0.5
Cu	9.8	11	9.0	9.6	11	10.1	0.9	8.8	9.81	±	1.84	0.2	0.1
Zn	45	44	40	40	42	42	2	5.4	44.2	±	10.8	-0.2	-0.2
As	7.2	7.0	5.8	6.0	6.8	6.6	0.6	9.5	6.22	±	2.33	0.2	0.2
Se	ND	ND	ND	ND	ND				0.17	±	0.1		
Ag	0.03	0.03	0.04	0.03	0.03	0.03	0	8.3	0.04	±	0.02	-0.3	-0.6
Cd '	0.16	0.16	0.16	0.17	0.16	0.16	0	0	0.14	±	0.05	0.4	0.6
Sn '	1.2	1.2	1.3	1.2	1.2	1.2	0	0	1.11	±	0.14	0.6	0.3
Sb	0.33	0.34	0.34	0.33	0.33	0.33	0.01	1.6	0.32	±	0.15	0.1	0.1
Hg	0.03	0.04	0.03	0.03	0.03	0.03	0	13.8	0.04	±	0.03	-0.3	-0.7
Pb	8.8	9.4	9.5	9.9	10	9.5	0.5	5	10.4	±	5.1	-0.2	-0.3
SEFSC													
Al (%)	2.21	2.07	2.11	2.09	2.06	2.11	0.06	2.9	2.19	±	0.44	-0.2	-0.1
Si	N R												
Cr	36	35	35	35	33	35	1	3.1	37.5	±	12.3	-0.2	-0.3
Mn	216	262	246	221	248	239	19	8.1	217	±	50	0.4	0.4
Fe (%) *	2.25	2.2	2.25	2.19	2.23	2.22	0.03	1.3	1.88	±	0.25	1.4	0.7
Ni *	23.2	25.5	26.5	24.4	23.8	24.7	1.3	5.4	20.6	±	2.9	1.4	0.8
Cu	11.2	11.2	11.3	10.8	11.1	11.1	0.2	1.7	9.81	±	1.84	0.7	0.5
Zn	48	48	45	46	43	46	2	4.6	44.2	±	10.8	0.2	0.2
As	8.2	8.5	6.2	6.3	6.8	7.2	1.1	15	6.22	±	2.33	0.4	0.6
Se	0.13	0.17	0.12	0.15	0.12	0.14	0.02	15.7	0.17	±	0.1	-0.3	-0.7
Ag	0.05	0.05	0.03	0.05	0.07	0.05	0.01	26.9	0.04	±	0.02	0.4	0.8
Cd	0.14	0.16	0.12	0.12	0.13	0.14	0.02	11.9	0.14	±	0.05	-0.1	-0.1
Sn	1.3	1.4	0.9	0.8	1.2	1.1	0.3	23.1	1.11	±	0.14	-0.1	0.0
Sb	N R								0.32	±	0.15		
Hg '	0.018	0.027	0.027	0.035	0.082	0.038	0.01	2.6	0.04	±	0.03	8.5	24.2
Pb	11.3	11.6	10.8	11.2	11.7	11.3	0.4	3.1	10.4	±	5.1	0.2	0.3

Table II.3. 1992 NOAA/6 Sediment R composition and intercomparison exercise results (µg/g dry weight unless noted) (cont.).

	Replicates											z Score for S1-5 mean calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
TAMU													
Al (%)	2.13	2.15	2.15	2.15	2.16	2.15	0.01	0.5	2.19	±	0.44	-0.1	-0.1
Si	N R												
Cr	40.4	41.1	40.9	40.8	41.1	40.9	0.3	0.7	37.5	±	12.3	0.3	0.4
Mn	N R								217	±	50		
Fe (%)	2.01	2.01	1.98	1.98	2.01	2.00	0.02	0.8	1.88	±	0.25	0.5	0.3
Ni	21.9	21.8	22.1	21.1	21.0	21.6	0.5	2.3	20.6	±	2.9	0.3	0.2
Cu	10.4	10.3	10.4	10.4	10.4	10.4	0	0.4	9.81	±	1.84	0.3	0.2
Zn	51.4	50.7	51.4	50.6	51.6	51.1	0.5	0.9	44.2	±	10.8	0.6	0.6
As	6.72	6.65	6.54	6.65	6.71	6.65	0.07	1.1	6.22	±	2.33	0.2	0.3
Se	0.125	0.095	0.090	0.102	0.096	0.102	0.014	13.5	0.17	±	0.1	-0.7	-1.6
Ag	0.05	0.07	0.06	0.06	0.06	0.056	0.056	14.4	0.04	±	0.02	0.7	1.6
Cd	0.12	0.13	0.12	0.13	0.12	0.124	0	2.9	0.14	±	0.05	-0.3	-0.4
Sn *	0.96	0.92	0.92	0.96	0.96	0.94	0.02	2.3	1.11	±	0.14	-1.2	-0.6
Sb	0.34	0.33	0.31	0.35	0.37	0.34	0.02	6.6	0.32	±	0.15	0.1	0.3
Hg	0.037	0.034	0.040	0.034	0.040	0.037	0.003	8.1	0.038	±	0.027	0.0	-0.1
Pb	10.8	11.1	10.9	11.2	11.0	11.0	0.2	1.4	10.4	±	5.1	0.1	0.2

Table II.4. 1992 NOAA/6 BCSS-1 composition and intercomparison exercise results (µg/g dry weight unless noted).

	Replicates											calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
BATTELLE													
Al (%) *	6.6	7.0	6.8	6.8	6.7	6.8	0.1	2.2	6.26	±	0.41	1.3	0.3
Si	30	30	30	30	30	30	0	0	30.8	±	1.0	-0.8	-0.1
Cr	120	120	120	120	120	120	0	0	123	±	14	-0.2	-0.1
Mn	210	230	210	220	240	222	13	5.9	229	±	15	-0.5	-0.1
Fe (%)	3.3	3.3	3.3	3.3	3.3	3.3	0	0	3.28	±	0.14	0.1	0.0
Ni	55	59	58	55	59	57	2	3.6	55.3	±	3.6	0.5	0.1
Cu	20	22	21	21	18	20	2	7.4	18.5	±	2.7	0.6	0.3
Zn	110	110	110	110	110	110	0	0	119	±	12	-0.8	-0.3
As	12	12	13	13	12	12	1	4.4	11.1	±	1.4	0.6	0.3
Se	0.37	0.37	0.37	0.46	0.46	0.41	0.05	12.1	0.43	±	0.06	-0.3	-0.2
Ag	0.12	0.10	0.10	0.11	0.10	0.11	0.01	8.4	0.102	±	0.04	0.2	0.3
Cd	0.27	0.29	0.3	0.29	0.29	0.29	0.01	3.8	0.25	±	0.04	1.0	0.6
Sn '	2.0	2.0	2.0	2.1	2.0	2.0	0	0	1.85	±	0.2	0.8	0.3
Sb *	0.70	0.69	0.71	0.74	0.71	0.71	0.02	2.6	0.59	±	0.06	2.0	0.8
Hg	NR								0.175	±	0.08		
Pb '	23	22	22	22	22	22	0	0	22.7	±	3.4	-0.2	-0.1
SEFSC													
Al (%)	6.18	6.13	6.36	6.42	6.13	6.24	0.14	2.2	6.26	±	0.41	0.0	0.0
Si	NR								30.8	±	1.0		
Cr *	94	90	92	91	93	92	2	1.7	123	±	14	-2.2	-1.0
Mn	190	241	244	202	236	223	25	11.1	229	±	15	-0.4	-0.1
Fe (%) '	3.4	3.37	3.38	3.1	3.36	3.37	0.02	0.5	3.28	±	0.14	0.6	0.1
Ni	51	56	58	54	55	55	3	4.7	55.3	±	3.6	-0.1	0.0
Cu	19.5	18.1	18.3	19.4	19.5	19	0.7	3.7	18.5	±	2.7	0.2	0.1
Zn	116	115	111	112	110	113	3	2.3	119	±	12	-0.5	-0.2
As	12.0	10.7	11.4	10.8	11.8	11.3	0.6	5.1	11.1	±	1.4	0.1	0.1
Se *	0.3	0.29	0.27	0.25	0.27	0.28	0.02	7.1	0.43	±	0.06	-2.5	-1.4
Ag	0.13	0.10	0.12	0.10	0.15	0.12	0.02	17.7	0.102	±	0.04	0.4	0.7
Cd	0.26	0.26	0.25	0.24	0.25	0.25	0.01	3.7	0.25	±	0.04	0.1	0.0
Sn *	1.6	1.5	1.4	1.7	1.8	1.6	0.2	9.9	1.85	±	0.2	-1.3	-0.5
Sb	NR								0.59	±	0.06		
Hg	0.162	0.185	0.187	0.178	0.204	0.183	0.015	8.3	0.175	±	0.08	0.1	0.2
Tl	NR												
Pb	21.7	21.9	22.1	24.1	22.6	22.5	1	4.3	22.7	±	3.4	-0.1	0.0

Table II.4. 1992 NOAA/6 BCSS-1 composition and intercomparison exercise results (µg/g dry weight unless noted) (cont.).

	Replicates											calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
TAMU													
Al (%) '	6.29	6.16	6.34	6.32	6.30	6.31	0.02	0.3	6.26	±	0.41	0.1	0.0
Si	NR								30.8	±	1.0		
Cr	124	122	123	123	121	123	1	0.9	123	±	14	0.0	0.0
Mn	NR								229	±	15		
Fe (%)	3.28	3.26	3.27	3.27	3.29	3.27	0.01	0.3	3.28	±	0.14	-0.1	0.0
Ni	55.2	53.5	54.7	53.7	55.3	54.5	0.8	1.5	55.3	±	3.6	-0.2	-0.1
Cu	17.9	19.0	18.6	18.3	18.4	18.4	0.4	2.2	18.5	±	2.7	0.0	0.0
Zn	115	113	115	115	115	115	0	0	119	±	12	-0.3	-0.1
As	11.0	10.9	11.7	11.2	10.4	11.0	0.5	4.3	11.1	±	1.4	-0.1	0.0
Se	0.43	0.40	0.39	0.39	0.42	0.41	0.02	4.5	0.43	±	0.06	-0.3	-0.2
Ag	0.14	0.13	0.16	0.14	0.14	0.14	0.01	6.0	0.102	±	0.04	1.0	1.6
Cd	0.22	0.23	0.24	0.23	0.23	0.23	0.01	2.0	0.25	±	0.04	-0.5	-0.3
Sn	1.80	1.87	1.92	1.72	1.67	1.80	0.10	5.7	1.85	±	0.2	-0.3	-0.1
Sb	0.49	0.52	0.59	0.67	0.60	0.57	0.07	12.4	0.59	±	0.06	-0.3	-0.1
Hg	0.17	0.17	0.16	0.17	0.17	0.17	0.01	3.2	0.175	±	0.08	-0.1	-0.2
Pb	22.6	22.9	23.2	22.6	22.7	22.8	0.3	1.1	22.7	±	3.4	0.0	0.0

APPENDIX III

1993 TRACE METAL INTERCOMPARISON EXERCISE RESULTS

NRC:	National Research Council of Canada
BATTELLE:	Battelle Ocean Sciences
SEFSC:	NOAA/NMFS/Southeast Fisheries Science Center
TAMU:	Texas A&M University/GERG

Cases in which outliers were identified using the Q test for outliers and, when warranted, were omitted from the mean, are noted with an apostrophe (').

Means that are outliers from the accepted or certified value are indicated with an asterisk (*).

S1, S2, S3, S4, S5: Results from five independent sample preparations and analyses.
Mean: Mean of the five replicates.
SD: Standard deviation.
%RSD: Percent relative standard deviation.
Accepted value: Certified value or NRC-calculated consensus value for exercise material.
z Score: The ratio of a bias estimate to a performance criterion. The difference between the laboratory mean and the accepted mean was used as the bias estimate. z Scores were calculated in two ways, using the SD of the S1-5 mean, and 25% of the accepted value as performance criteria.
N R : Not reported.

Table III.1. 1993 NOAA/7 Sediment T composition and intercomparison exercise results (µg/g dry weight unless noted) (Ag not required.).

	Replicates											calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 / Mean	25% / Accepted value
BATTELLE													
Be	1.86	1.96	1.97	1.94	1.94	1.93	0.1	2.5	2.06	±	0.56	-0.2	-0.3
Al (%)	5.8	5.6	5.6	5.6	5.5	5.6	0.1	1.8	5.27	±	1.3	0.3	0.3
Al (%)	7.3	7.7	7.3	7.5	7.5	7.5	0.2	2.2	7.12	±	0.92	0.4	0.2
Si (%)	28	28	28	29	28	28	0.0	0.0	30.5	±	3.6	-0.7	-0.3
Cr	78	73	65	78	80	75	6.0	8.1	82	±	23	-0.3	-0.3
Mn	720	730	710	710	710	716	9.0	1.2	673	±	98	0.4	0.3
Fe (%)	3.6	3.6	3.6	3.6	3.6	3.6	0.0	0.0	3.64	±	0.55	-0.1	0.0
Ni	39	39	40	36	39	39	1.0	1.6	36	±	5.5	0.5	0.3
Cu	25	26	26	26	24	25	1.0	3.5	25.4	±	2.9	-0.1	-0.1
Zn	120	130	120	120	130	124	5.0	4.4	123	±	12	0.1	0.0
As	12	13	12	13	12	12	1.0	4.4	11.8	±	1.6	0.1	0.1
Se	0.34	0.24	0.29	0.29	0.34	0.30	0.0	13.9	0.35	±	0.13	-0.4	-0.6
Ag	0.20	0.20	0.20	0.20	0.20	0.20	0.0	0.0	0.22	±	0.09	-0.2	-0.4
Cd	0.50	0.49	0.48	0.51	0.50	0.50	0.0	2.3	0.45	±	0.08	0.6	0.4
Sn	3.63	3.68	3.41	3.54	3.46	3.54	0.1	3.2	3.48	±	1.1	0.1	0.1
Sb	0.95	0.95	0.95	0.95	0.92	0.94	0.0	1.4	1.05	±	0.35	-0.3	-0.4
Hg	0.11	0.11	0.11	0.11	0.11	0.11	0.0	0.0	0.107	±	0.02	0.2	0.1
Tl	0.60	0.58	0.58	0.59	0.61	0.59	0.0	2.2	0.63	±	0.39	-0.1	-0.3
Pb	36	38	34	33	32	35	2.0	7.0	32.1	±	6.7	0.4	0.4

Table III.1. 1993 NOAA/7 Sediment T composition and intercomparison exercise results (µg/g dry weight unless noted) (Ag not required.) (cont.).

	Replicates											calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
SEFSC													
Be	-	-	-	-	-				2.06	±	0.56	-3.7	-4.0
Al (%)	7.14	7.03	7.04	6.85	7.13	7.04	0.1	1.7	7.12	±	0.92	-0.1	0.0
Si (%)	-	-	-	-	-				30.5	±	3.6	-8.5	-4.0
Cr	75	81	73	73	78	76	3.0	4.6	82	±	23	-0.3	-0.3
Mn	487	487	467	496	499	487	12.0	2.6	673	±	98	-1.9	-1.1
Fe (%)	3.53	3.57	3.47	3.51	3.60	3.54	0.1	1.4	3.64	±	0.55	-0.2	-0.1
Ni	33	33	34	34	30	34	1.0	2.9	36	±	5.5	-0.4	-0.2
Cu	25	25	25	25	24	25	0.5	2.0	25.4	±	2.9	-0.2	-0.1
Zn	122	131	126	127	124	126	3.0	2.7	123	±	12	0.3	0.1
As	11	11	12	12	11	11	0.5	4.1	11.8	±	1.6	-0.5	-0.3
Se	0.04	0.04	0.00	0.09	0.05	0.04	0.0	72.9	0.35	±	0.13	-2.4	-3.5
Ag	0.207	0.249	0.205	0.297	0.259	0.243	0.0	15.8	0.22	±	0.09	0.3	0.4
Cd	0.44	0.44	0.43	0.45	0.44	0.44	0.0	1.5	0.45	±	0.08	-0.2	-0.1
Sn	2.45	2.51	2.18	2.17	2.40	2.30	0.2	6.5	3.48	±	1.1	-1.1	-1.4
Sb	0.70	0.80	0.70	0.70	0.70	0.70	0.0	0.0	1.05	±	0.35	-1.0	-1.3
Hg	0.17	0.16	0.16	0.17	0.16	0.16	0.0	2.9	0.107	±	0.02	2.8	2.1
Tl	-	-	-	-	-				0.63	±	0.39	-1.6	-4.0
Pb	34	34	32	33	33	33	0.8	2.4	32.1	±	6.7	0.1	0.1

Table III.1. 1993 NOAA/7 Sediment T composition and intercomparison exercise results (µg/g dry weight unless noted) (Ag not required.) (cont.).

	Replicates											calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
TAMU													
Be	-	-	-	-	-				2.06	±	0.56	-3.7	-4.0
Al (%)	7.46	7.17	7.20	7.29	7.30	7.28	0.1	1.6	7.12	±	0.92	0.2	0.1
Si (%)	-	-	-	-	-				30.5	±	3.6	-8.5	-4.0
Cr	82.8	83.2	82.1	82.6	82.8	82.7	0.4	0.5	82	±	23	0.0	0.0
Mn	754	754	747	747	750	750	4.0	0.5	673	±	98	0.8	0.5
Fe (%)	3.79	3.81	3.83	3.83	3.86	3.82	0.0	0.7	3.64	±	0.55	0.3	0.2
Ni	38	38	38	37	38	38	0.3	0.9	36	±	5.5	0.4	0.2
Cu	25	26	26	26	25	26	0.2	0.9	25.4	±	2.9	0.2	0.1
Zn	148	148	146	146	146	147	1.0	0.7	123	±	12	2.0	0.8
As	13.0	13.0	12.0	12.0	13.0	12.0	0.2	1.3	11.8	±	1.6	0.1	0.1
Se	0.38	0.40	0.41	0.35	0.38	0.38	0.0	6.0	0.35	±	0.13	0.2	0.3
Ag	0.256	0.256	0.252	0.252	0.255	0.254	0.0	0.8	0.22	±	0.09	0.4	0.6
Cd	0.55	0.55	0.55	0.55	0.55	0.55	0.0	0.0	0.45	±	0.08	1.3	0.9
Sn	3.48	3.51	3.53	3.53	3.46	3.50	0.0	0.9	3.48	±	1.1	0.0	0.0
Sb	0.90	0.92	0.93	0.94	0.96	0.93	0.0	2.4	1.05	±	0.35	-0.3	-0.5
Hg	0.11	0.11	0.11	0.11	0.11	0.11	0.0	1.2	0.107	±	0.02	0.3	0.2
Tl	-	-	-	-	-				0.63	±	0.39	-1.6	-4.0
Pb	34	34	34	34	34	34	0.1	0.2	32.1	±	6.7	0.3	0.2

Table III.2. 1993 NOAA/7 BCSS-1 composition and intercomparison exercise results (µg/g dry weight unless noted) (Ag not required.).

	Replicates											calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 / Mean	25% / Accepted value
BATTELLE													
Al (%)	6.7	6.4	6.9	6.9	6.8	6.7	0.2	3	6.26	±	0.41	1.1	0.3
Si (%)	30	29	30	29	29	29	1	3.4	30.8	±	1	-1.8	-0.2
Cr	119	126	124	136	126	126	6	4.8	123	±	14	0.2	0.1
Mn	224	226	216	213	220	220	5	2.3	229	±	15	-0.6	-0.2
Fe (%)	3.4	3.4	3.4	3.3	3.3	3.4	0.1	2.9	3.28	±	0.14	0.9	0.1
Cu	19	19	20	19	20	19	1	5.3	18.5	±	2.7	0.2	0.1
Zn	104	109	106	105	99	105 *	4	3.8	119	±	12	-1.2	-0.5
As	12	11	12	12	11	12	1	8.3	11.1	±	1.4	0.6	0.3
Se	<0.8	<0.8	<0.8	<0.8	<0.8				0.43	±	0.06	-7.2	-4.0
Cd	0.30	0.31	0.28	0.30	0.30	0.30 *	0.01	3.3	0.25	±	0.04	1.3	0.8
Sn	2.2	2.1	2.3	2.1	2.2	2.2 *	0.1	4.5	1.85	±	0.2	1.8	0.8
Sb	0.60	0.48	0.48	0.59	0.60	0.55	0.06	10.9	0.59	±	0.06	-0.7	-0.3
Hg	NR												
Pb	24	24	21	23	24	23	1	4.3	22.7	±	3.4	0.1	0.1
SEFSC													
Al (%)	6.4	6.31	6.24	5.89	6.17	6.2	0.19	3.1	6.26	±	0.41	-0.1	0.0
Si (%)	NR												
Cr	NR												
Mn	221	224	209	218	223	219	6	2.7	229	±	15	-0.7	-0.2
Fe (%)	3.01	3.08	2.97	3.07	3.16	3.06	0.07	2.3	3.28	±	0.14	-1.6	-0.3
Cu	19.7	20.8	20.6	20.3	20.8	20.4	0.5	2.4	18.5	±	2.7	0.7	0.4
Zn	110	116	114	110	111	112	3	2.7	119	±	12	-0.6	-0.2
As	11.7	12.2	12.6	11.8	11.8	12	0.4	3.3	11.1	±	1.4	0.6	0.3
Se '	0.62	0.49	0.49	0.5	0.47	0.49	0.01	2	0.43	±	0.06	1.0	0.6
Cd	0.28	0.27	0.27	0.26	0.26	0.27	0.01	3.7	0.25	±	0.04	0.4	0.3
Sn'	1.92	1.84	1.63	1.87	1.84	1.86	0.04	2.1	1.85	±	0.2	0.1	0.0
Sb	NR												
Hg	0.24	0.23	0.25	0.24	0.27	0.25	0.01	5.3	0.174	±	0.08	0.9	1.6
Pb	22.1	22.5	22.1	21.7	23.1	22.3	0.5	2.2	22.7	±	3.4	-0.1	-0.1

Table III.2. 1993 NOAA/7 BCSS-1 composition and intercomparison exercise results (µg/g dry weight unless noted) (Ag not required.) (cont.).

	Replicates											calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
TAMU													
Al (%)	6.41	6.25	6.13	6.25	6.64	6.34	0.2	3.1	6.26	±	0.41	0.2	0.1
Si (%)	NR								30.8	±	1		
Cr	127	121	125	124	129	125	3	2.4	123	±	14	0.1	0.1
Mn	241	236	237	241	238	239	2	0.8	229	±	15	0.7	0.2
Fe (%)	3.57	3.56	3.5	3.54	3.53	3.54*	0.03	0.8	3.28	±	0.14	1.9	0.3
Cu	19.1	18.7	20.0	19.9	20.9	19.7	0.9	4.6	18.5	±	2.7	0.4	0.3
Zn	120	118	116	116	120	118	2	1.7	119	±	12	-0.1	0.0
As	10.8	11.1	11.2	10.8	10.8	10.9	0.2	1.8	11.1	±	1.4	-0.1	-0.1
Se	0.40	0.43	0.43	0.37	0.45	0.42	0.03	7.1	0.43	±	0.06	-0.2	-0.1
Cd	0.28	0.29	0.28	0.29	0.28	0.28	0.01	3.6	0.25	±	0.04	0.8	0.5
Sn	2.23	2.1	2.22	2.00	2.11	*2.13	0.1	4.7	1.85	±	0.2	1.4	0.6
Sb	NR												
Hg	0.13	0.13	0.13	0.14	0.14	0.13	0	2.2	0.174	±	0.08	-0.5	-0.9
Pb	24.5	26.4	24.4	25	24.2	24.9	0.9	3.6	22.7	±	3.4	0.6	0.4

Table III.3. 1993 NOAA/7 Mussel P composition and intercomparison exercise results (µg/g dry weight unless noted) (Si, Mn, and Sb analysis not required.).

	Replicates												calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value				SD of S1-5 Mean	25% Accepted value
BATTELLE														
Ag	<0.01	<0.01	<0.01	<0.01	<0.01				0.011	±	0.006		-1.8	-4.0
Al	107	94	97	93	84	95	8.0	8.7	123	±	46		-0.6	-0.9
As	15	14	15	14	15	15	0.5	4.0	13.5	±	2.5		0.6	0.4
Be	-	-	-	-	-									
Cd	0.90	0.90	0.88	0.96	0.89	0.89	0.0	1.1	0.83	±	0.11		0.5	0.3
Cr	0.83	1.05	1.07	0.80	0.81	0.91	0.1	14.9	0.5	±	0.3		1.4	3.3
Cu	4.0	3.4	3.4	4.2	4.1	3.8	0.4	10.2	4.13	±	0.46		-0.7	-0.3
Fe	170	160	170	160	160	164	5.0	3.3	171	±	35		-0.2	-0.2
Hg	0.06	0.06	0.06	0.06	0.06	0.06	0.0	3.7	0.062	±	0.0209		0.0	-0.1
Mn	-	-	-	-	-									
Ni	0.97	0.88	0.96	0.86	0.99	0.94	0.1	6.5	0.88	±	0.31		0.2	0.3
Pb	1.27	1.27	1.21	1.25	1.28	1.26	0.0	2.2	1.14	±	0.31		0.4	0.4
Sb	-	-	-	-	-									
Se	1.6	1.7	1.3	1.6	1.3	1.5	0.2	12.5	1.87	±	0.54		-0.7	-0.8
Si	-	-	-	-	-									
Sn	0.09	0.09	0.07	0.07	0.07	0.08	0.0	14.0	0.08	±	0.053		0.0	0.0
Tl	-	-	-	-	-									
Zn	130	140	140	140	140	140	0.0	0.0	139	±	10		0.1	0.0

Table III.3. 1993 NOAA/7 Mussel P composition and intercomparison exercise results (µg/g dry weight unless noted) (Si, Mn, and Sb analysis not required) (cont.).

	Replicates											calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 / Mean	25% / Accepted value
SEFSC													
Ag	0.00	0.01	0.02	0.02	0.01	0.01	0.0	69.7	0.011	±	0.006	-0.2	-0.4
Al	-	-	-	-	-								
As	8.5	7.2	7.2	7.3	7.8	7.6	0.6	7.4	13.5	±	2.5	-2.4	-1.7
Be	-	-	-	-	-								
Cd	0.64	0.64	0.64	0.67	0.66	0.65	0.0	2.2	0.83	±	0.11	-1.6	-0.9
Cr	0.38	0.33	0.33	0.32	0.33	0.33	0.0	3.0	0.5	±	0.3	-0.6	-1.4
Cu	4.2	4.1	4.3	4.0	4.3	4.2	0.1	3.1	4.13	±	0.46	0.2	0.1
Fe	172	170	171	164	169	169	3.0	1.8	171	±	35	-0.1	0.0
Hg	0.04	0.07	0.06	0.05	0.04	0.05	0.0	24.2	0.062	±	0.0209	-0.4	-0.6
Mn	-	-	-	-	-								
Ni	0.68	0.63	0.66	0.62	0.65	0.65	0.0	3.7	0.88	±	0.31	-0.7	-1.0
Pb	0.90	0.94	0.96	0.98	0.93	0.94	0.0	3.2	1.14	±	0.31	-0.6	-0.7
Sb	-	-	-	-	-								
Se	1.8	1.5	1.4	1.5	1.6	1.6	0.2	9.7	1.87	±	0.54	-0.5	-0.6
Si	-	-	-	-	-								
Sn	0.10	0.10	0.10	0.00	0.00	0.10	0.1	91.3	0.08	±	0.053	0.4	1.0
Tl	-	-	-	-	-								
Zn	129	132	134	133	135	133	2.0	1.7	139	±	10	-0.6	-0.2

Table III.3. 1993 NOAA/7 Mussel P composition and intercomparison exercise results (µg/g dry weight unless noted) (Si, Mn, and Sb analysis not required) (cont.).

	Replicates											calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
TAMU													
Ag	0.012	0.012	0.013	0.014	0.012	0.013	0.0	7.1	0.011	±	0.006	0.3	0.7
Al	149	149	144	145	145	146	2.0	1.6	123	±	46	0.5	0.7
As	13.6	13.8	13.8	13.8	13.4	13.7	0.2	1.3	13.5	±	2.5	0.1	0.1
Be	-	-	-	-	-								
Cd	0.78	0.78	0.78	0.77	0.78	0.78	0.0	0.0	0.83	±	0.11	-0.5	-0.2
Cr	0.50	0.50	0.53	0.54	0.49	0.51	0.0	4.2	0.5	±	0.3	0.0	0.1
Cu	3.19	3.22	3.22	3.15	3.15	3.19	0.0	1.1	4.13	±	0.46	-2.0	-0.9
Fe	175	176	172	174	174	174	1.0	0.9	171	±	35	0.1	0.1
Hg	0.07	0.07	0.06	0.07	0.07	0.07	0.0	1.7	0.062	±	0.0209	0.2	0.2
Mn	-	-	-	-	-								
Ni	0.84	0.84	0.85	0.82	0.83	0.84	0.0	1.4	0.88	±	0.31	-0.1	-0.2
Pb	1.16	1.17	1.15	1.16	1.16	1.16	0.0	0.6	1.14	±	0.31	0.1	0.1
Sb	-	-	-	-	-								
Se	1.70	1.71	1.72	1.67	1.67	1.69	0.0	1.4	1.87	±	0.54	-0.3	-0.4
Si	-	-	-	-	-								
Sn	0.02	0.02	0.02	0.02	0.01	0.02	0.0	21.7	0.08	±	0.053	-1.2	-3.1
Tl	-	-	-	-	-								
Zn	159	159	160	154	155	157	3.0	1.7	139	±	10	1.8	0.5

Table III.4. 1993 NOAA/7 SRM 1566a composition and intercomparison exercise results (µg/g dry weight unless noted) (Al, Mn, and Sb analysis not required).

	Replicates											calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 Mean	25% Accepted value
BATTELLE													
Al	110	110	91	94	95	*100	9	9	203	±	12.5	-8.2	-2.0
Cr	1.4	1.4	1.4	1.5	1.6	1.46	0.09	6.2	1.43	±	0.46	0.1	0.1
Fe	526	497	515	540	566	529	26	4.9	539	±	15	-0.7	-0.1
Cu	69	67	68	69	69	68	1	1.5	66.3	±	4.3	0.4	0.1
Zn	855	831	847	860	862	851	13	1.5	830	±	57	0.4	0.1
As '	15	15	14	15	15	12	7		14	±	1.2	-1.7	-0.6
Se	2.0	2.0	2.2	2.2	1.7	2.0	0.2	10	2.21	±	0.24	-0.9	-0.4
Ag	1.74	1.66	1.67	1.71	1.68	1.69	0.03	1.8	1.68	±	0.15	0.1	0.0
Cd '	3.9	3.9	3.8	3.9	3.9	3.1	1.7		4.15	±	0.38	-2.8	-1.0
Sn	2.1	2.2	2.1	2.0	2.1	2.1	0.1	4.8	2.18	±	0.27	-0.3	-0.1
Hg (ng/g)	57	58	57	58	59	58	1	1.7	64	±	7	-0.9	-0.4
Pb	0.30	0.26	0.32	0.31	0.30	*0.30	0.02	0	0.37	±	0.01	-5.1	-0.8
SEFSC													
Al (%)	NR												
Cr	NR												
Fe	527	535	546	526	524	532	9	1.7	539	±	15	-0.5	-0.1
Cu	72	73	71	71	71	72	1	1.4	66.3	±	4.3	1.3	0.3
Zn	840	853	859	858	840	850	9	1.1	830	±	57	0.4	0.1
As	13.4	13.1	13.3	13.2	13.3	13.3	0.1	0.7	14	±	1.2	-0.6	-0.2
Se	2.1	2.2	2.1	2.1	2.1	2.1	0		2.21	±	0.24	-0.5	-0.2
Ag	1.66	1.59	1.62	1.57	1.54	1.6	0.05	3.1	1.68	±	0.15	-0.5	-0.2
Cd	4.45	4.41	4.24	4.38	4.35	4.37	0.08	1.8	4.15	±	0.38	0.6	0.2
Sn	1.68	1.69	1.79	1.69	1.68	*1.71	0.05	2.9	2.18	±	0.27	-1.7	-0.9
Hg (ng/g)	70	75	72	65	71	71	4	5.6	64	±	7	1.0	0.4
Pb	0.37	0.36	0.41	0.43	0.41	*0.40	0.03	7.5	0.37	±	0.01	2.1	0.3

Table III.4. 1993 NOAA/7 SRM 1566a composition and intercomparison exercise results (µg/g dry weight unless noted) (Al, Mn, and Sb analysis not required) (cont.).

	Replicates											calculated using	
	S1	S2	S3	S4	S5	Mean	SD	%RSD	Accepted value			SD of S1-5 / Mean	25% Accepted value
TAMU													
Al	181	181	178	201	207	190	13	6.8	203	±	12.5	-1.0	-0.2
Cr	1.45	1.57	1.44	1.45	1.54	1.49	0.06	4.0	1.43	±	0.46	0.1	0.2
Fe	523	546	523	524	551	533	14	2.6	539	±	15	-0.4	0.0
Cu	62.8	64.1	63.2	64.3	63.7	63.6	0.6	0.9	66.3	±	4.3	-0.6	-0.2
Zn	802	802	802	810	818	897	7	0.8	830	±	57	1.2	0.3
As	13.8	12.7	11.9	12.5	14.2	13.0	1.0	7.7	14	±	1.2	-0.8	-0.3
Se	2.20	2.30	2.22	2.08	2.20	2.20	0.08	3.6	2.21	±	0.24	0.0	0.0
Ag	1.73	1.80	1.79	1.76	1.68	1.75	0.05	2.9	1.68	±	0.15	0.5	0.2
Cd	4.08	3.96	4.01	4.06	4.01	4.02	0.05	1.2	4.15	±	0.38	-0.3	-0.1
Sn	2.17	2.06	2.16	2.34	2.38	2.22	0.13	5.9	2.18	±	0.27	0.1	0.1
Hg (ng/g)	58.7	60.6	61.9	64.5	67.0	62.5	3.3	5.3	64.2	±	6.7	-0.3	-0.1
Pb	0.35	0.38	0.36	0.34	0.36	0.36	0.01	2.8	0.37	±	0.01	-0.8	-0.1

APPENDIX IV

1991 TRACE ORGANIC INTERCOMPARISON EXERCISE RESULTS

NIST:	National Institute of Standards and Technology
BATTELLE:	Battelle Ocean Sciences
NWFSC:	NOAA/NMFS/Northwest Fisheries Science Center
TAMU:	Texas A&M University/GERG

S1-A, S1-B, S1-C: Results from three gas chromatographic analyses of S1.
S1, S2, S3: Results from three independent sample preparations and analyses.
S1 Mean: The mean value of the reported S1 replicates, S1-A, S1-B, and S1-C.
S1-3 Mean: The mean concentration of the three samples, S1, S2, and S3, in which the mean value of the three GC replicates was used for the S1 concentration.
S1 %RSD: The percent relative standard deviation of the S1 replicates, S1-A, S1-B, and S1-C.
S1-3 %RSD: The percent relative standard deviation of the S1 Mean and the reported samples, S2 and S3.
Consensus value: NIST-calculated consensus value and standard deviation (s).
Mean Absolute %Error The mean of the absolute percent errors of the S1 Mean and the reported samples, S2 and S3 relative to the exercise consensus value.
z Score: The ratio of a bias estimate to a performance criterion. The difference between the laboratory mean and the accepted mean was used as the bias estimate. z Scores were calculated in two ways, using the SD of the S1-3 mean, and 25% of the accepted value as performance criteria.
N R : Not reported.
Z R : Zero or below MDL.

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight).

NIST

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PAHs														
Naphthalene	64.1	64.4	64.3	62.7	59.1	64.3	62.0	0.2	4.3	42.3	15.9	47	1.2	1.9
2-Methylnaphthalene	67.8	66.9	66.4	69.9	65.2	67.0	67.4	1.1	3.5	68.5	29.3	3	0.0	-0.1
1-Methylnaphthalene	37.7	37.2	36.8	36.2	39.9	37.2	37.8	1.2	5.1	40.6	21.0	7	-0.1	-0.3
Biphenyl	<30	<30	<30	<30	<30					12.7	3.7			
2,6-Dimethyl= naphthalene	88.7	87.4	87.5	89.2	86.4	87.9	87.8	0.8	1.6	65.7	37.7	34	0.6	1.3
Acenaphthylene	<30	<30	<30	<30	<30					9.1	4.3			
Acenaphthene	<30	<30	<30	<30	<30					13.5	6.2			
1,6,7-Trimethyl= naphthalene	76.5	77.8	77.2	75.1	78.6	77.2	77.0	0.8	2.3	86.3	45.7	11	-0.2	-0.4
Fluorene	34.4	35.2	34.8	33.8	35.2	34.8	34.6	1.1	2.1	31.8	9.9	9	0.3	0.4
Phenanthrene	109	111	107	117	114	109	113	1.8	3.6	119	32.8	5	-0.2	-0.2
Anthracene	<30	<30	<30	<30	<30					19.6	16.9			
1-Methylphenanthrene	92.3	93.1	92.1	94.6	95.7	92.5	94.3	0.6	1.7	83.5	37.7	13	0.3	0.5
Fluoranthene	329	334	333	341	345	332	339	0.8	2.0	226	96.0	50	1.2	2.0
Pyrene	252	255	251	249	246	253	249	0.8	1.3	170	86.1	47	0.9	1.9
Benz[*a*]anthracene	38.1	37.7	36.9	35.4	34.9	37.6	36	1.6	3.9	35.3	9.9	3	0.1	0.1
Chrysene	146	141	144	149	147	144	147	1.7	1.8	103	58.3	43	0.8	1.7
Benzofluoranthenes	74.5	74.9	74.1	72.8	70.3	74.5	72.5	0.5	2.9	62.0	19.9	17	0.5	0.7
Benzo[*e*]pyrene	34.6	33.9	34.4	36.7	35.9	34.3	35.6	1.1	3.4	40.1	8.7	11	-0.5	-0.4
Benzo[*a*]pyrene	<30	<30	<30	<30	<30					11.4	4.3			
Perylene	<30	<30	<30	<30	<30					4.7	2.1			
Indeno[1,2,3-*cd*]= pyrene	<30	<30	<30	<30	<30					5.8	2.9			
Dibenz[*a,h*]anthracene	<30	<30	<30	<30	<30					1.2	1.0			
Benzo[*ghi*]perylene	<30	<30	<30	<30	<30					6.9	3.7			

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight) (cont.).

NIST

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCBs														
PCB 8	<2	<2	<2	<2	<2					12.5	5.1			
PCB 18	28.9	29.7	29.9	26.9	29.7	29.5	28.7	1.8	5.5	9.0	4.4	220	4.5	8.8
PCB 28	30.9	33.2	32.9	33.3	33.4	32.3	33.0	3.9	1.8	29.2	7.3	13	0.5	0.5
PCB 44	37.1	38.0	38.6	38.6	39.0	37.9	38.5	2.0	1.5	29.5	6.7	30	1.3	1.2
PCB 52	54.7	58.2	57.8	56.2	58.2	56.9	57.1	3.4	1.8	49.2	10.0	16	0.8	0.6
PCB 66	39.2	39.0	38.3	37.9	38.1	38.8	38.3	1.2	1.3	44.5	12.9	14	-0.5	-0.6
PCB 101	103	105	106	105	102	105	104	1.5	1.7	91.1	17.8	14	0.7	0.6
PCB 105	19.0	19.3	19.1	18.5	18.5	19.2	18.7	0.8	2.0	28.0	11.4	33	-0.8	-1.3
PCB 118	105	104	102	107	103	104	105	1.5	2.2	91.2	30.2	15	0.5	0.6
PCB 128	3.14	3.01	3.35	3.55	3.35	3.17	3.36	5.4	5.8	14.0	5.6	76	-1.9	-3.0
PCB 138	104	101	98.2	106	101	101	103	2.9	2.7	99.4	28.1	3	0.1	0.1
PCB 153	104	102	103	105	106	103	105	1.0	1.3	113	30.2	7	-0.3	-0.3
PCB 170	<2	<2	<2	<2	<2					3.16	1.0			
PCB 180	8.89	9.16	9.23	8.82	9.23	9.09	9.05	2.0	2.3	13.4	7.2	33	-0.6	-1.3
PCB 187	20.9	21.4	20.4	20.8	21.9	20.9	21.2	2.4	2.7	18.4	1.8	15	1.6	0.6
PCB 195	<2	<2	<2	<2	<2					0.82	0.8			
PCB 206	<2	<2	<2	<2	<2					0.83	0.9			
PCB 209	<2	<2	<2	<2	<2					1.00	0.8			

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight) (cont.).

NIST

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	8.00	7.59	7.93	7.45	7.11	7.84	7.47	2.8	4.9	8.21	3.95	9	-0.2	-0.4
2,4'-DDE	13.7	13.8	13.5	14.0	14.1	13.6	13.9	1.1	1.7	15.0	10.9	7	-0.1	-0.3
2,4'-DDT	<2	<2	<2	<2	<2					7.15	8.79			
4,4'-DDD	41.9	41.2	41.6	40.5	40.3	41.6	40.8	0.8	1.6	29.2	9.37	40	1.2	1.6
4,4'-DDE	73.5	73.8	73.6	75.1	69.6	73.6	72.8	0.2	3.9	71.2	16.5	4	0.1	0.1
4,4'-DDT	4.03	4.24	4.24	3.90	4.24	4.17	4.10	2.9	4.4	5.74	4.68	29	-0.4	-1.1
Aldrin	<2	<2	<2	<2	<2					0.55	0.78			
cis-Chlordane	20.5	19.5	19.5	20.2	19.8	19.9	20.0	2.9	1.3	17.1	2.96	16	1.0	0.7
Dieldrin	10.0	10.2	9.84	10.3	10.7	10.0	10.3	1.8	3.5	12.8	9.23	19	-0.3	-0.8
gamma-HCH	2.73	2.60	2.80	2.94	3.08	2.71	2.91	3.7	6.3	2.48	1.27	18	0.3	0.7
Heptachlor	<2	<2	<2	<2	<2					0.90	0.65			
Heptachlor epoxide	2.39	2.39	2.26	2.12	2.12	2.35	2.19	3.2	6.0	1.62	1.26	35	0.5	1.4
Hexachlorobenzene	<2	<2	<2	<2	<2					1.45	1.06			
Mirex	<2	<2	<2	<2	<2					1.21	0.93			
trans-Nonachlor	16.4	16.8	16.3	16.8	16.2	16.5	16.5	1.6	1.9	15.7	3.38	5	0.2	0.2

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight) (cont.).

BATTELLE

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PAHs														
Naphthalene	29.2	29.4	29.7	29.4	32.6	29.4	30.5	0.9	5.9	42.3	15.9	28	-0.7	-1.1
2-Methylnaphthalene	57.3	57.4	57.9	58.4	60.6	57.5	58.8	0.6	2.7	68.5	29.3	14	-0.3	-0.6
1-Methylnaphthalene	37.6	37.8	38.1	38.4	39.4	37.8	38.5	0.7	2.0	40.6	21.0	5	-0.1	-0.2
Biphenyl	16.9	17.1	17.5	17.9	16.1	17.1	17.0	1.8	5.5	12.7	3.7	34	1.2	1.4
2,6-Dimethyl= naphthalene	94.5	96.2	97.2	99.7	100	96.0	98.6	1.4	2.3	65.7	37.7	50	0.9	2.0
Acenaphthylene	6.76	7.66	7.89	6.98	7.31	7.44	7.24	8.0	3.3	9.1	4.3	21	-0.4	-0.8
Acenaphthene	11.8	13.7	12.7	12.2	10.9	12.7	11.9	7.5	8.2	13.5	6.2	12	-0.3	-0.5
1,6,7-Trimethyl= naphthalene	69.0	70.0	74.7	74.2	76.8	71.2	74.1	4.3	3.8	86.3	45.7	14	-0.3	-0.6
Fluorene	27.9	27.0	28.4	28.0	25.9	27.8	27.2	2.6	4.2	31.8	9.9	14	-0.5	-0.6
Phenanthrene	150	152	155	165	150	152	156	1.7	5.3	119	32.8	31	1.1	1.2
Anthracene	11.7	11.9	9.56	10.8	8.35	11.0	10.1	11.8	15	19.6	16.9	48	-0.6	-1.9
1-Methylphenanthrene	60.7	62.3	70.6	64.6	62.6	64.5	63.9	8.2	1.8	83.5	37.7	23	-0.5	-0.9
Fluoranthene	270	278	279	298	294	276	289	1.8	4.1	226	96.0	28	0.7	1.1
Pyrene	170	175	178	187	185	174	182	2.3	3.7	170	86.1	7	0.1	0.3
Benz[*a*]anthracene	32.1	32.5	33.3	36	40.4	32.6	36.3	1.9	11	35.3	9.9	8	0.1	0.1
Chrysene	97.7	98.1	101	107	116	99.1	107	1.8	8.0	103	58.3	7	0.1	0.2
Benzofluoranthenes	72.6	71.8	71.5	72.5	64.8	72.0	69.8	0.8	6.1	62	19.9	13	0.4	0.5
Benzo[*e*]pyrene	52.6	52.5	54.0	53.3	46.1	53.0	50.8	1.6	8.0	40.1	8.7	27	1.2	1.1
Benzo[*a*]pyrene	12.1	12.1	12.7	13.0	12.6	12.3	12.6	2.8	2.8	11.4	4.3	11	0.3	0.4
Perylene	5.27	5.10	5.71	5.52	4.86	5.36	5.25	5.9	6.6	4.7	2.1	12	0.3	0.5
Indeno[1,2,3-*cd*]= pyrene	7.18	7.56	7.71	8.17	8.32	7.48	7.99	3.7	5.6	5.8	2.9	38	0.8	1.5
Dibenz[*a,h*]anthracene	1.66	1.52	1.88	1.75	1.51	1.69	1.65	10.7	7.6	1.2	1.0	33	0.5	1.5
Benzo[*ghi*]perylene	9.04	8.52	9.07	9.93	9.17	8.88	9.32	3.5	5.8	6.9	3.7	34	0.7	1.4

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight) (cont.).

BATTELLE

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PCBs														
PCB 8	16.7	16.1	16.3	13.7	15.5	16.4	15.2	1.9	9.1	12.5	5.1	22	0.5	0.9
PCB 18	10.4	10.3	10.5	10.4	11.0	10.4	10.6	1.0	3.3	9.00	4.4	18	0.4	0.7
PCB 28	31.4	32.1	32.9	29.9	33.1	32.1	31.7	2.3	5.2	29.2	7.3	9	0.3	0.3
PCB 44	36.5	37.2	37.1	26.8	28.4	36.9	30.7	1.0	18	29.5	6.7	13	0.2	0.2
PCB 52	60.6	63.5	64.2	50.6	53.5	62.8	55.6	3.0	11	49.2	10.0	13	0.6	0.5
PCB 66	60.1	63.8	64.6	66.7	69.7	62.9	66.4	3.8	5.1	44.5	12.9	49	1.7	2.0
PCB 101	113	118	120	111	117	117	115	3.1	2.8	91.1	17.8	26	1.3	1.0
PCB 105	39.4	39.3	40.4	37.4	37.7	39.7	38.3	1.5	3.2	28.0	11.4	37	0.9	1.5
PCB 118	107	110	115	109	119	111	113	3.6	5.0	91.2	30.2	24	0.7	1.0
PCB 128	14.6	13.8	14.3	16.4	16.8	14.2	15.8	2.8	8.9	14.0	5.60	13	0.3	0.5
PCB 138	133	134	138	128	135	135	133	2.0	3.0	99.4	28.1	33	1.2	1.4
PCB 153	165	172	177	157	167	171	165	3.5	4.4	113	30.2	47	1.7	1.8
PCB 170	3.53	3.25	3.27	3.48	3.54	3.35	3.46	4.7	2.7	3.16	1.0	10	0.3	0.4
PCB 180	10.5	10.1	10.5	7.33	8.02	10.4	8.57	2.2	19	13.4	7.2	36	-0.7	-1.4
PCB 187	21.9	21.4	21.6	18.5	19.5	21.6	19.9	1.2	7.9	18.4	1.8	8	0.8	0.3
PCB 195	1.64	1.61	1.60	1.88	1.68	1.62	1.73	1.3	8.1	0.82	0.8	110	1.1	4.4
PCB 206	1.90	1.88	1.88	2.00	1.92	1.89	1.94	0.6	3.1	0.83	0.9	140	1.2	5.3
PCB 209	1.79	1.67	1.73	1.34	1.22	1.73	1.43	3.5	19	1.00	0.8	43	0.5	1.7

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight) (cont.).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	4.61	4.28	4.45	3.65	3.92	4.44	4.00	3.7	10	8.21	3.95	51	-1.1	-2.1
2,4'-DDE	4.03	4.02	4.21	4.21	4.54	4.09	4.28	2.6	5.5	15.0	10.9	72	-1.0	-2.9
2,4'-DDT	7.27	7.04	7.23	6.82	7.35	7.18	7.12	1.7	3.8	7.15	8.79	3	0.0	0.0
4,4'-DDD	20.0	19.4	19.5	22.5	23.1	19.6	21.7	1.6	8.6	29.2	9.37	25	-0.8	-1.0
4,4'-DDE	87.8	87.6	90.2	86.6	95.2	88.5	90.1	1.6	5.0	71.2	16.5	26	1.1	1.1
4,4'-DDT	2.49	2.23	2.61	1.8	2.18	2.45	2.14	7.9	15	5.74	4.68	63	-0.8	-2.5
Aldrin	ZR	ZR	ZR	ZR	ZR					0.55	0.78			
cis-Chlordane	17.1	16.0	16.2	12.8	13.8	16.4	14.3	3.6	13	17.1	2.96	16	-0.9	-0.7
dieldrin	29.7	28.1	28.5	22.5	22.9	28.8	24.7	2.9	14	12.8	9.23	93	1.3	3.7
gamma-HCH	4.23	4.13	4.13	2.98	2.96	4.16	3.37	1.4	21	2.48	1.27	36	0.7	1.4
Heptachlor	1.20	1.13	1.15	0.82	0.81	1.16	0.93	3.1	21	0.90	0.65	16	0.0	0.1
Heptachlor epoxide	ZR	ZR	ZR	ZR	ZR					1.62	1.26			
Hexachlorobenzene	3.25	3.20	3.20	2.69	2.40	3.22	2.77	0.9	15	1.45	1.06	90	1.2	3.6
Mirex	ZR	ZR	ZR	ZR	ZR					1.21	0.93			
trans-Nonachlor	17.2	16.2	16.2	11.4	12.0	16.6	13.3	3.5	21	15.7	3.38	19	-0.7	-0.6

Z R - Not detected.

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight) (cont.).

NWFSC

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PAHs														
Naphthalene	44.8	46.5	48.8	40.1	47.3	46.7	44.7	4.3	8.9	42.3	15.9	9	0.2	0.2
2-Methylnaphthalene	76.7	74.5	77.4	78.6	83.6	76.2	79.5	2.0	4.8	68.5	29.3	16	0.4	0.6
1-Methylnaphthalene	47.0	41.6	50.5	45.4	51.3	46.4	47.7	9.7	6.6	40.6	21.0	17	0.3	0.7
Biphenyl	22.0	17.5	15.9	15.2	12.8	18.5	15.5	17.1	18	12.7	3.7	22	0.8	0.9
2,6-Dimethyl= naphthalene	105	107	102	102	106	105	104	2.4	2.0	65.7	37.7	58	1.0	2.3
Acenaphthylene	16.0	15.4	15.9	12.5	14.7	15.8	14.3	2.0	12	9.1	4.3	57	1.2	2.3
Acenaphthene	14.0	12.4	16.5	10.1	11.5	14.3	12.0	14.5	18	13.5	6.2	15	-0.2	-0.4
1,6,7-Trimethyl= naphthalene	74.8	92.5	79.1	80.6	82.7	82.1	81.8	11.2	1.3	86.3	45.7	5	-0.1	-0.2
Fluorene	26.8	30.6	30.0	26.0	27.4	29.1	27.5	7.0	5.7	31.8	9.9	14	-0.4	-0.5
Phenanthrene	129	128	124	124	138	127	130	2.1	5.7	119	32.8	9	0.3	0.4
Anthracene	21.1	24.5	18.3	21.0	23.6	21.3	22.0	14.6	6.5	19.6	16.9	12	0.1	0.5
1-Methylphenanthrene	97.6	98.4	101	97.6	103	99	99.9	1.8	2.8	83.5	37.7	20	0.4	0.8
Fluoranthene	359	372	372	361	380	368	370	2.0	2.6	226	96.0	64	1.5	2.5
Pyrene	231	239	235	227	242	235	235	1.7	3.2	170	86.1	38	0.8	1.5
Benz[*a*]anthracene	30.9	29.3	28.9	28.4	30.2	29.7	29.4	3.6	3.2	35.3	9.9	17	-0.6	-0.7
Chrysene	154	147	149	149	157	150	152	2.4	2.9	103	58.3	48	0.8	1.9
Benzofluoranthenes	68.0	67.0	69.0	65.0	70.0	68.0	67.7	1.5	3.7	62.0	19.9	9	0.3	0.4
Benzo[*e*]pyrene	33.7	45.4	44.7	43.8	47.4	41.3	44.2	15.9	7.0	40.1	8.7	10	0.5	0.4
Benzo[*a*]pyrene	13.5	8.54	9.11	9.16	8.41	10.4	9.32	26.1	11	11.4	4.3	18	-0.5	-0.7
Perylene	4.77	3.87	4.2.0	4.27	3.73	4.28	4.09	14.9	7.7	4.7	2.1	13	-0.3	-0.5
Indeno[1,2,3-*cd*]= pyrene	7.30	9.37	7.77	8.72	10.0	8.15	8.96	13.3	11	5.8	2.9	54	1.1	2.2
Dibenz[*a,h*]anthracene	3.06	3.15	2.04	2.27	2.53	2.75	2.52	22.4	9.6	1.2	1.0	100	1.3	4.4
Benzo[*ghi*]perylene	9.75	9.43	8.51	8.62	9.93	9.23	9.26	7.0	7.1	6.9	3.7	33	0.6	1.4

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight) (cont.).

NWFSC

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCBs														
PCB 8	*	*	*	*	*					12.5	5.1			
PCB 18	15.6	19.7	16.0	15.2	15.4	17.1	15.9	13.2	6.6	9.0	4.4	76	1.6	3.1
PCB 28	37.3	35.6	30.6	41.2	46.5	34.5	40.7	10.1	15	29.2	7.3	40	1.6	1.6
PCB 44	35.4	36.3	36.2	35.3	37.8	36.0	36.4	1.4	3.6	29.5	6.7	23	1.0	0.9
PCB 52	72.4	72.3	71.3	59.7	61.8	72.0	64.5	0.8	10	49.2	10.0	31	1.5	1.2
PCB 66	106	107	107	101	98.9	107	102	0.5	3.9	44.5	12.9	130	4.5	5.2
PCB 101	109	108	108	102	105	108	105	0.5	3.0	91.1	17.8	15	0.8	0.6
PCB 105	31.0	30.9	31.0	28.5	29.2	31.0	29.6	0.2	4.3	28.0	11.4	6	0.1	0.2
PCB 118	109	107	109	98.6	101	108	103	1.1	4.9	91.2	30.2	13	0.4	0.5
PCB 128	19.3	19.4	19.4	18.7	19.4	19.4	19.2	0.3	2.1	14.0	5.6	37	0.9	1.5
PCB 138	122	123	123	116	118	123	119	0.5	2.9	99.4	28.1	20	0.7	0.8
PCB 153	139	139	139	136	139	139	138	0.0	1.3	113	30.2	22	0.8	0.9
PCB 170	3.73	3.81	3.88	3.53	3.62	3.81	3.65	2.0	3.9	3.16	1.0	16	0.5	0.6
PCB 180	22.3	22.5	23.1	21.8	23.6	22.6	22.7	1.8	4.0	13.4	7.2	70	1.3	2.8
PCB 187	17.7	17.8	17.5	15.7	17.4	17.7	16.9	0.9	6.3	18.4	1.8	8	-0.8	-0.3
PCB 195	1.51	1.16	1.15	1.28	1.37	1.27	1.31	16.1	4.1	0.82	0.8	60	0.6	2.4
PCB 206	0.27	<0.23	<0.23	0.21	0.25					0.83	0.9			
PCB 209	1.73	1.71	1.88	1.98	1.90	1.77	1.88	5.2	5.5	1.00	0.8	88	1.1	3.5

* Coeluting contaminant.

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight) (cont.).

NWFSC

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PESTICIDES														
2,4'-DDD	12.2	13.1	12.8	11.2	10.8	12.7	11.6	3.6	8.7	8.21	3.95	41	0.9	1.7
2,4'-DDE	11.6	11.4	11.1	10.6	11.2	11.4	11.1	2.2	3.7	15.0	10.9	26	-0.4	-1.0
2,4'-DDT	2.26	2.42	2.67	1.94	1.39	2.45	1.93	8.4	28	7.15	8.79	73	-0.6	-2.9
4,4'-DDD	30.3	30.8	30.8	27.0	28.7	30.6	28.8	0.9	6.3	29.2	9.37	5	0.0	-0.1
4,4'-DDE	67.9	68.1	64.9	71.1	81.4	67.0	73.2	2.7	10	71.2	16.5	7	0.1	0.1
4,4'-DDT	2.59	2.51	2.48	1.92	1.8	2.53	2.08	2.2	19	5.74	4.68	64	-0.8	-2.6
Aldrin	<0.39	<0.37	<0.37	<0.29	<0.24					0.55	0.78			
cis-Chlordane	17.9	17.9	18.0	17.4	18.6	17.9	18.0	0.3	3.3	17.1	2.96	5	0.3	0.2
Dieldrin	23.1	22.9	21.8	23.8	26.1	22.6	24.2	3.1	7.4	12.8	9.23	89	1.2	3.6
gamma-HCH	2.30	2.38	1.96	1.76	2.03	2.21	2.00	10.1	11	2.48	1.27	19	-0.4	-0.8
Heptachlor	1.23	1.08	1.26	1.15	1.18	1.19	1.17	8.1	1.8	0.90	0.65	30	0.4	1.2
Heptachlor epoxide	2.93	3.06	2.99	2.85	3.00	2.99	2.95	2.2	2.9	1.62	1.26	82	1.1	3.3
Hexachlorobenzene	2.16	2.26	2.23	2.2	2.03	2.22	2.15	2.3	4.8	1.45	1.06	48	0.7	1.9
Mirex	1.34	1.29	1.32	1.02	0.73	1.32	1.02	1.9	29	1.21	0.93	22	-0.2	-0.6
trans-Nonachlor	19.0	19.2	19.1	17.9	18.8	19.1	18.6	0.5	3.4	15.7	3.38	18	0.9	0.7

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight) (cont.).

TAMU

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PAHs														
Naphthalene	21.5	22.8	23.4	20.6	21.5	22.6	21.5	4.3	4.6	42.3	15.9	49	-1.3	-2.0
2-Methylnaphthalene	42.4	45.6	44.3	40.2	38.1	44.1	40.8	3.6	7.5	68.5	29.3	40	-0.9	-1.6
1-Methylnaphthalene	26.9	29.7	28.9	26.1	23.9	28.5	26.2	5.1	8.8	40.6	21.0	36	-0.7	-1.4
Biphenyl	10.9	10.2	12.7	10.3	10.7	11.3	10.8	11.4	4.7	12.7	3.7	15	-0.5	-0.6
2,6-Dimethyl= naphthalene	58.0	54.5	58.7	60.8	58.4	57.1	58.7	3.9	3.2	65.7	37.7	11	-0.2	-0.4
Acenaphthylene	4.43	4.43	5.29	4.80	4.19	4.72	4.57	10.5	7.2	9.1	4.3	50	-1.1	-2.0
Acenaphthene	8.59	8.39	10.3	7.46	7.60	9.10	8.05	11.5	11	13.5	6.2	40	-0.9	-1.6
1,6,7-Trimethyl= naphthalene	64.7	59.6	68.6	69.7	66.8	64.3	66.9	7.0	4.0	86.3	45.7	22	-0.4	-0.9
Fluorene	17.7	17.3	19.8	17.7	18.6	18.3	18.2	7.3	2.6	31.8	9.9	43	-1.4	-1.7
Phenanthrene	107	98.8	103	93.1	92.1	103	96.0	4.0	6.1	119	32.8	19	-0.7	-0.8
Anthracene	11.4	10.4	10.8	12.1	9.98	10.9	11.0	4.6	9.8	19.6	16.9	44	-0.5	-1.8
1-Methylphenanthrene	35.2	32.3	32.3	45.7	35.2	33.3	38.1	5.0	18	83.5	37.7	54	-1.2	-2.2
Fluoranthene	216	200	205	198	199	207	201	4.0	2.5	226	96.0	11	-0.3	-0.4
Pyrene	139	136	139	133	129	138	133	1.3	3.6	170	86.1	21	-0.4	-0.9
Benz[*a*]anthracene	27.0	24.8	25.4	19.8	22.1	25.7	22.5	4.4	13	35.3	9.9	36	-1.3	-1.5
Chrysene	83.3	81.2	80.8	80.1	80.2	81.8	80.7	1.6	1.2	103	58.3	22	-0.4	-0.9
Benzofluoranthenes	39.2	38.9	38.5	46.1	45.3	38.9	43.4	0.9	9.1	62.	19.9	30	-0.9	-1.2
Benzo[*e*]pyrene	33.5	33.1	34.8	32.7	31.4	33.8	32.6	2.6	3.8	40.1	8.7	18	-0.9	-0.7
Benzo[*a*]pyrene	8.68	9.16	8.60	7.24	8.98	8.81	8.34	3.4	12	11.4	4.3	27	-0.7	-1.1
Perylene	5.78	6.06	6.18	5.16	5.20	6.01	5.46	3.4	8.8	4.7	2.1	16	0.4	0.6
Indeno[1,2,3-*cd*]= pyrene	4.86	5.00	5.18	5.41	5.59	5.01	5.34	3.2	5.5	5.8	2.9	8	-0.2	-0.3
Dibenz[*a,h*]anthracene	1.23	1.33	1.70	1.78	1.82	1.42	1.67	17.4	13	1.2	1.0	35	0.5	1.6
Benzo[*ghi*]perylene	6.89	7.58	7.17	6.23	6.44	7.21	6.63	4.8	7.8	6.9	3.7	7	-0.1	-0.2

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight) (cont.).

TAMU

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCBs														
PCB 8	ZR	ZR	ZR	ZR	ZR					12.5	5.1			
PCB 18	3.97	3.68	4.76	4.67	3.8	4.13	4.2	13.5	10	9.00	4.4	54	-1.1	-2.1
PCB 28	18.6	20.0	19.5	22.1	19.7	19.4	20.4	3.7	7.1	29.2	7.3	30	-1.2	-1.2
PCB 44	26.9	27.1	24.5	27.3	24.0	26.1	25.8	5.5	6.5	29.5	6.7	13	-0.6	-0.5
PCB 52	43.5	44.8	38.1	44.4	38.5	42.1	41.7	8.4	7.1	49.2	10.0	15	-0.8	-0.6
PCB 66	35.4	36.3	33.7	34.6	33.3	35.1	34.3	3.8	2.8	44.5	12.9	23	-0.8	-0.9
PCB 101	74.6	75.0	75.3	76.0	71.6	75.0	74.2	0.5	3.1	91.1	17.8	19	-0.9	-0.7
PCB 105	21.9	20.0	16.4	23.7	24.5	19.4	22.6	14.4	12	28.0	11.4	20	-0.5	-0.8
PCB 118	67.4	67.8	62.2	65.3	64.9	65.8	65.4	4.7	0.7	91.2	30.2	28	-0.9	-1.1
PCB 128	13.3	12.9	12.8	13.2	12.7	13.0	13.0	2.0	1.9	14.0	5.6	7	-0.2	-0.3
PCB 138	86.4	86.6	82.8	86.7	82.9	85.3	85.0	2.5	2.3	99.4	28.1	15	-0.5	-0.6
PCB 153	113	101	97.1	109	103	104	105	8.0	2.8	113	30.2	7	-0.3	-0.3
PCB 170	1.13	1.12	1.61	1.62	1.53	1.29	1.48	21.7	12	3.16	1.0	53	-1.7	-2.1
PCB 180	25.1	24.6	22.2	26.9	24.1	24.0	25.0	6.5	6.7	13.4	7.2	86	1.6	3.5
PCB 187	16.9	17.1	15.7	19.3	16.8	16.6	17.6	4.6	8.8	18.4	1.8	8	-0.4	-0.2
PCB 195	ZR	ZR	ZR	ZR	ZR					0.82	0.8			
PCB 206	ZR	ZR	ZR	ZR	ZR					0.83	0.9			
PCB 209	ZR	ZR	ZR	ZR	ZR					1.0	0.8			

Z R - Not detected.

Table IV.1. 1991 Tissue control material III (QC90TC) intercomparison exercise results (ng/g dry weight) (cont.).

TAMU

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	3.97	4.47	3.97	4.41	4.49	4.14	4.35	7.0	4.3	8.21	3.95	47	-1.0	-1.9
2,4'-DDE	1.75	1.36	1.52	1.83	1.67	1.54	1.68	12.7	8.7	15.0	10.9	89	-1.2	-3.6
2,4'-DDT	ZR	ZR	ZR	ZR	ZR					7.15	8.79			
4,4'-DDD	21.1	20.7	21.6	21.0	20.2	21.1	20.8	2.1	2.5	29.2	9.37	29	-0.9	-1.2
4,4'-DDE	50.2	50.3	50.4	48.1	49.7	50.3	49.4	0.2	2.3	71.2	16.5	31	-1.3	-1.2
4,4'-DDT	3.39	2.72	2.46	3.06	2.92	2.86	2.95	16.8	3.5	5.74	4.68	49	-0.6	-1.9
Aldrin	ZR	ZR	ZR	ZR	ZR						0.55			
cis-Chlordane	13.6	13.5	13.4	13.4	12.9	13.5	13.3	0.7	2.5	17.1	2.96	23	-1.3	-0.9
Dieldrin	5.69	5.63	4.95	5.72	5.14	5.42	5.43	7.6	5.3	12.8	9.23	58	-0.8	-2.3
gamma-HCH	0.48	0.52	0.53	0.51	0.47	0.51	0.50	5.2	4.9	2.48	1.27	80	-1.6	-3.2
Heptachlor	ZR	ZR	ZR	ZR	ZR					0.90	0.65			
Heptachlor epoxide	ZR	ZR	ZR	ZR	ZR					1.62	1.26			
Hexachlorobenzene	ZR	ZR	ZR	ZR	ZR					1.45	1.06			
Mirex	ZR	ZR	ZR	ZR	ZR					1.21	0.93			
trans-Nonachlor	10.7	10.5	10.3	10.3	9.82	10.5	10.2	1.9	3.4	15.7	3.38	35	-1.6	-1.4

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule).

NIST

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PAHs														
Naphthalene	36.2	35.8	35.9	33.8	34.6	36.0	34.8	0.6	3.2	39.4	15.2	12	-0.3	-0.5
2-Methylnaphthalene	56.9	56.1	56.4	51.8	50.2	56.5	52.8	0.7	6.2	45.8	16.4	15	0.4	0.6
1-Methylnaphthalene	28.1	28.3	27.8	25.2	26.3	28.1	26.5	0.9	5.5	25.5	7.5	5	0.1	0.2
Biphenyl	17.2	16.9	16.8	18.1	17.5	17.0	17.5	1.2	3.2	10.8	6.5	62	1.0	2.5
2,6-Dimethyl= naphthalene	28.2	28.6	28.5	30.1	29.9	28.4	29.5	0.7	3.1	26.5	6.0	11	0.5	0.5
Acenaphthylene	16.1	16.0	15.8	17.3	17.6	16.0	17.0	1.0	5.1	22.6	16.3	25	-0.3	-1.0
Acenaphthene	18.0	17.6	17.9	18.5	18.7	17.8	18.3	1.2	2.5	15.4	3.1	19	0.9	0.8
1,6,7-Trimethyl= naphthalene	49.8	49.1	49.3	51.6	50.6	49.4	50.5	0.7	2.2	41.6	7.4	21	1.2	0.9
Fluorene	32.6	32.1	32.3	30.9	31.6	32.3	31.6	0.8	2.3	20.7	7.8	53	1.4	2.1
Phenanthrene	89.1	88.6	88.5	86.2	87.3	88.7	87.4	0.4	1.5	82.8	7.5	6	0.6	0.2
Anthracene	22.2	21.8	22.1	24.2	24.6	22.0	23.6	0.9	5.9	28.0	8.8	16	-0.5	-0.6
1-Methylphenanthrene	286	284	284	280	276	285	280	0.4	1.6	284	63.6	2	-0.1	-0.1
Fluoranthene	699	698	697	690	689	698	692	0.1	0.7	654	111	6	0.3	0.2
Pyrene	729	731	732	739	736	731	735	0.2	0.6	642	94.6	14	1.0	0.6
Benz[*a*]anthracene	101	103	101	108	104	102	105	1.1	3.1	102	15.9	3	0.2	0.1
Chrysene	331	331	329	325	333	330	329	0.3	1.2	321	32.1	3	0.2	0.1
Benzofluoranthenes	233	232	232	225	229	232	229	0.2	1.6	226	41.8	2	0.1	0.1
Benzo[*e*]pyrene	227	229	228	233	230	228	230	0.4	1.1	206	21.9	12	1.1	0.5
Benzo[*a*]pyrene	50.2	50.6	49.9	53.6	52.1	50.2	52.0	0.7	3.2	42.3	9.1	23	1.1	0.9
Perylene	23.6	23.4	23.0	21.0	21.9	23.3	22.1	1.3	5.3	20.4	4.7	8	0.4	0.3
Indeno[1,2,3-*cd*]= pyrene	37.6	37.2	37.8	35.1	34.6	37.5	35.7	0.8	4.4	31.3	10.4	14	0.4	0.6
Dibenz[*a,h*]anthracene	<10	<10	<10		<10		<10			9.90	4.1			
Benzo[*ghi*]perylene	52.2	52.6	52.5	55.9	54.8	52.4	54.4	0.4	3.3	46.3	17.3	17	0.5	0.7

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule) (cont.).

NIST

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCBs														
PCB 8	5.31	5.55	5.19	5.57	5.17	5.35	5.36	3.4	3.7	14.8	7.0	64	-1.3	-2.6
PCB 18	91.9	92.3	93.1	91.1	93.4	92.4	92.3	0.7	1.3	50.7	13.4	82	3.1	3.3
PCB 28	190	186	186	190	183	187	187	1.2	1.9	159	32.7	18	0.9	0.7
PCB 44	109	111	109	128	127	110	122	1.0	8.5	140	29.4	13	-0.6	-0.5
PCB 52	249	247	249	283	284	248	272	0.5	7.5	212	52.0	28	1.2	1.1
PCB 66	284	289	286	297	292	286	292	0.9	1.8	234	48.9	25	1.2	1.0
PCB 101	237	235	239	220	216	237	224	0.8	5.0	255	52.5	12	-0.6	-0.5
PCB 105	96.0	96.9	95.1	95.6	105	96.0	98.9	0.9	5.4	102	13.5	5	-0.2	-0.1
PCB 118	378	373	377	384	388	376	383	0.7	1.6	250	47.6	54	2.8	2.1
PCB 128	41.1	42.9	42.1	41.1	44.3	42.0	42.5	2.1	3.9	34.9	2.8	22	2.7	0.9
PCB 138	298	298	301	319	310	299	309	0.6	3.2	243	35.3	27	1.9	1.1
PCB 153	382	383	380	377	385	382	381	0.4	1.1	305	78.5	25	1.0	1.0
PCB 170	11.0	11.1	11.3	11.9	11.7	11.1	11.6	1.4	3.4	7.80	3.6	48	1.1	1.9
PCB 180	31.4	31.4	32.9	30.6	33.8	31.9	32.1	2.7	5.0	26.8	4.6	20	1.2	0.8
PCB 187	101	101	102	103	99.2	101	101	0.6	1.9	57.8	6.6	75	6.5	3.0
PCB 195	<3	<3	<3	<3	<3					1.40	0.7			
PCB 206	<3	<3	<3	<3	<3					0.90	0.3			
PCB 209	116	116	117	119	112	116	116	0.5	3.1	89.4	16.2	29	1.6	1.2

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule) (cont.).

NIST	Within sample			Between samples						Accepted			z Score	
Compound	S1-A	S1-B	S1-C	S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Value	s	Mean abs. % error	S1-3 mean	25% Accep. value
PESTICIDES														
2,4'-DDD	43.9	44.9	44.7	45.4	44.3	44.5	44.7	1.2	1.3	40.6	16.7	10	0.2	0.4
2,4'-DDE	53.0	54.1	54.6	48.8	54.8	53.9	52.5	1.5	6.2	48.1	14.8	9	0.3	0.4
2,4'-DDT	5.60	5.30	5.40	5.60	5.60	5.43	5.54	2.8	1.7	31.1	18.2	82	-1.4	-3.3
4,4'-DDD	134	133	134	134	134	134	134	0.4	0.1	114	25.2	18	0.8	0.7
4,4'-DDE	131	138	138	135	138	136	136	3.0	1.2	94.1	25.5	45	1.6	1.8
4,4'-DDT	3.40	3.40	3.20	3.50	3.30	3.33	3.38	3.5	3.2	27.0	16.3	87	-1.4	-3.5
Aldrin	<3	<3	<3	<3	<3					10.2	7.2			
cis-Chlordane	74.2	73.9	74.4	68.6	66.5	74.2	69.8	0.3	5.7	51.2	10.6	36	1.8	1.5
Dieldrin	23.4	22.1	22.4	22.9	22.4	22.6	22.6	3.0	1.1	21.7	8.5	4	0.1	0.2
gamma-HCH	3.33	3.41	3.37	3.10	3.21	3.37	3.23	1.2	4.2	4.3	2.6	25	-0.4	-1.0
Heptachlor	<3	<3	<3	<3	<3					5.00	4.3			
Heptachlor epoxide	3.94	3.67	3.76	3.52	3.87	3.79	3.73	3.6	4.9	3.40	2.5	10	0.1	0.4
Hexachlorobenzene	98.0	98.1	98.7	118	95.8	98.3	104	0.4	12	86.2	16.4	21	1.1	0.8
Mirex	53.4	53.1	53.6	51.7	52.9	53.4	52.7	0.5	1.6	39.8	13.1	32	1.0	1.3
trans-Nonachlor	61.4	61.1	61.2	59.1	57.7	61.2	59.3	0.2	3.0	45.2	12.3	31	1.1	1.2

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule) (cont.).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PAHs														
Naphthalene	45.8	45.3	45.3	54.4	52.4	45.4	50.8	0.6	9.3	39.4	15.2	29	0.8	1.2
2-Methylnaphthalene	34.9	33.5	35.8	40.2	45.3	34.7	40.1	3.3	13	45.8	16.4	12	-0.3	-0.5
1-Methylnaphthalene	20.5	22.1	18.1	25.2	26.3	20.3	23.9	9.9	14	25.5	7.5	8	-0.2	-0.3
Biphenyl	3.90	8.20	5.48	8.92	4.61	5.86	6.46	37.1	34	10.8	6.5	40	-0.7	-1.6
2,6-Dimethyl= naphthalene	23.7	23.6	24.2	24.1	25.2	23.8	24.4	1.4	2.9	26.5	6.0	8	-0.4	-0.3
Acenaphthylene	19.5	18.3	18.9	16.9	18.7	18.9	18.2	3.2	6.1	22.6	16.3	20	-0.3	-0.8
Acenaphthene	13.0	10.7	13.5	16.8	7.59	12.4	12.3	12.0	38	15.4	3.1	26	-1.0	-0.8
1,6,7-Trimethyl= naphthalene	35.5	36.7	37.5	29.1	35.6	36.6	33.8	2.8	12	41.6	7.4	19	-1.1	-0.8
Fluorene	14.8	15.3	15.8	17.2	19.2	15.3	17.2	3.3	11	20.7	7.8	17	-0.4	-0.7
Phenanthrene	98.8	92.5	97.8	96.8	83.6	96.4	92.2	3.5	8.1	82.8	7.5	11	1.3	0.5
Anthracene	35.8	33.5	33.4	37.5	28.1	34.2	33.3	4.0	14	28.0	8.8	19	0.6	0.8
1-Methylphenanthrene	325	316	318	302	282	320	301	1.5	6.2	284	63.6	7	0.3	0.2
Fluoranthene	655	643	643	612	610	647	623	1.1	3.3	654	111	5	-0.3	-0.2
Pyrene	657	640	650	632	607	649	629	1.3	3.3	642	94.6	3	-0.1	-0.1
Benz[*a*]anthracene	96.4	91.6	92.2	88.2	95.1	93.4	92.2	2.8	3.9	102	15.9	9	-0.6	-0.4
Chrysene	306	297	298	291	285	300	292	1.6	2.7	321	32.1	9	-0.9	-0.4
Benzofluoranthenes	220	226	209	227	256	218	234	4.0	8.5	226	41.8	6	0.2	0.1
Benzo[*e*]pyrene	210	216	213	233	230	213	225	1.4	4.8	205	21.9	10	0.9	0.4
Benzo[*a*]pyrene	39.4	42.3	38.6	36.7	47.5	40.1	41.4	4.9	13	42.3	9.1	10	-0.1	-0.1
Perylene	23.0	24.5	21.2	27.9	29.5	22.9	26.8	7.2	13	20.4	4.7	31	1.4	1.3
Indeno[1,2,3-*cd*]pyrene	36.9	36.7	32.3	38.8	38.9	35.3	37.7	7.4	5.4	31.3	10.4	20	0.6	0.8
Dibenz[*a,h*]anthracene	10.6	8.7	8.25	9.74	16.6	9.19	11.9	13.6	35	9.9	4.1	25	0.5	0.8
Benzo[*ghi*]perylene	54.1	53.3	52.3	57.6	58.5	53.2	56.4	1.7	5.0	46.3	17.3	22	0.6	0.9

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule) (cont.).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCBs														
PCB 8	ZR	ZR	ZR	ZR	ZR					14.8	7.0			
PCB 18	72.2	66.5	66.2	56.3	59.7	68.3	61.4	4.9	10	50.7	13.4	21	0.8	0.8
PCB 28	218	204	203	181	180	208	190	4.0	8.4	159	32.7	20	0.9	0.8
PCB 44	232	212	212	189	178	219	195	5.3	11	140	29.4	40	1.9	1.6
PCB 52	362	318	333	304	265	338	302	6.6	12	212	52.0	42	1.7	1.7
PCB 66	369	339	328	307	305	345	319	6.2	7.1	234	48.9	36	1.7	1.5
PCB 101	428	378	378	341	321	395	352	7.3	11	255	52.5	38	1.8	1.5
PCB 105	92.0	95.5	98.9	102	87.6	95.4	94.9	3.6	7.4	102	13.5	7	-0.5	-0.3
PCB 118	270	263	263	268	258	265	264	1.5	2.1	249	47.6	6	0.3	0.2
PCB 128	35.1	33.3	33.7	33.7	32.9	34.0	33.5	2.8	1.8	34.9	2.8	4	-0.5	-0.2
PCB 138	262	255	268	266	254	262	261	2.5	2.4	243	35.3	7	0.5	0.3
PCB 153	399	391	391	381	383	394	386	1.2	1.8	305	78.5	27	1.0	1.1
PCB 170	15.6	14.7	15.0	13.1	12.4	15.1	13.5	3.0	10	7.80	3.6	73	1.6	2.9
PCB 180	27.4	31.7	26.9	33.2	31.9	28.7	31.2	9.2	7.4	26.8	4.6	17	1.0	0.7
PCB 187	64.0	63.7	66.4	66.3	63.4	64.7	64.8	2.3	2.3	57.8	6.6	12	1.1	0.5
PCB 195	ZR	ZR	ZR	ZR	ZR					1.40	0.7			
PCB 206	ZR	ZR	ZR	ZR	ZR					0.90	0.3			
PCB 209	107	105	108	105	98.9	107	104	1.4	4.0	89.4	16.2	16	0.9	0.7

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule) (cont.).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	43.6	42.8	43.1	39.6	41.1	43.2	41.3	0.9	4.4	40.6	16.7	3	0.0	0.1
2,4'-DDE	ZR	ZR	ZR	ZR	ZR					48.1	14.8			
2,4'-DDT	20.5	21.1	21.4	22.6	20.1	21.0	21.2	2.2	5.9	31.1	18.2	32	-0.5	-1.3
4,4'-DDD	112	110	114	112	110	112	111	1.8	1.3	113.6	25.2	2	-0.1	-0.1
4,4'-DDE	113	111	115	112	112	113	113	1.8	0.4	94.1	25.5	19	0.7	0.8
4,4'-DDT	21.5	23.8	24.0	31.6	24.1	23.1	26.3	6.0	18	27.0	16.3	14	0.0	-0.1
Aldrin	ZR	ZR	ZR	ZR	ZR					10.2	7.2			
cis-Chlordane	73.6	66.7	67.0	60.0	57.9	69.1	62.3	5.6	9.5	51.2	10.6	22	1.0	0.9
Dieldrin	28.8	33.6	33.0	35	34.6	31.8	33.8	8.2	5.1	21.7	8.5	56	1.4	2.2
gamma-HCH	ZR	ZR	ZR	ZR	ZR					4.30	2.6			
Heptachlor epoxide	ZR	ZR	ZR	ZR	ZR					3.40	2.5			
Heptachlor	ZR	ZR	ZR	ZR	ZR					5.00	4.3			
Hexachlorobenzene	247	282	278	85.4	125	269	160	7.1	61	86.2	16.4	86	4.5	3.4
Mirex	53.3	52.4	54.1	48.3	47.7	53.3	49.8	1.6	6.1	39.8	13.1	25	0.8	1.0
trans-Nonachlor	74.1	64.5	65.1	59.6	52.4	67.9	60.0	7.9	13	45.2	12.3	33	1.2	1.3

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule) (cont.).

NWFSC

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PAHs														
Naphthalene	162	163	166	188	153	164	168	1.3	11	39.4	15.2	330	8.5	13.1
2-Methylnaphthalene	69.3	72.7	71.3	76.1	68.9	71.1	72.0	2.4	5.1	45.8	16.4	57	1.6	2.3
1-Methylnaphthalene	44.6	38.6	40.3	46.6	39.4	41.2	42.4	7.5	8.9	25.5	7.5	66	2.3	2.7
Biphenyl	21.6	18.1	20.4	20.4	19.5	20.0	20.0	8.9	2.3	10.8	6.5	85	1.4	3.4
2,6-Dimethyl= naphthalene	36.1	30.8	43.9	42.1	31.1	36.9	36.7	17.9	15	26.5	6.0	39	1.7	1.5
Acenaphthylene	44.8	45.1	44.8	47.3	44.1	44.9	45.4	0.4	3.7	22.6	16.3	100	1.4	4.0
Acenaphthene	16.7	18.4	18.0	19.4	17.0	17.7	18.0	5.0	6.8	15.4	3.1	17	0.8	0.7
1,6,7-Trimethyl= naphthalene	56.7	42.4	55.9	44.3	52.6	51.7	49.5	15.5	9.2	41.6	7.4	19	1.1	0.8
Fluorene	28.5	23.9	28.7	30.9	33.3	27.0	30.4	10.1	10	20.7	7.8	47	1.2	1.9
Phenanthrene	84.5	90.7	88.8	87.6	83.7	88.0	86.4	3.6	2.8	82.8	7.5	4	0.5	0.2
Anthracene	41.4	41.6	43.2	35.9	38.4	42.1	38.8	2.3	8.0	28.0	8.8	39	1.2	1.5
1-Methylphenanthrene	378	365	383	378	373	375	375	2.5	0.7	284	63.6	32	1.4	1.3
Fluoranthene	843	892	856	838	811	864	838	2.9	3.1	654	111.1	28	1.7	1.1
Pyrene	784	814	788	766	748	795	770	2.0	3.1	642	94.6	20	1.4	0.8
Benz[*a*]anthracene	113	112	112	118	109	112	113	0.5	4.0	102	15.9	11	0.7	0.4
Chrysene	340	336	336	358	328	337	341	0.7	4.5	321	32.1	6	0.6	0.2
Benzofluoranthenes	249	242	239	245	239	243	242	2.1	1.3	226	41.8	7	0.4	0.3
Benzo[*e*]pyrene	223	220	215	223	220	219	221	1.8	0.9	205	21.9	7	0.7	0.3
Benzo[*a*]pyrene	43.7	42.8	39.7	44.1	42.2	42.1	42.8	5.0	2.7	42.3	9.1	2	0.1	0.0
Perylene	19.7	18.9	18.3	19.1	30.2	19.0	22.8	3.7	28	20.4	4.7	20	0.5	0.5
Indeno[1,2,3-*cd*]= pyrene	41.9	35.0	33.9	47.5	42.0	36.9	42.1	11.8	13	31.3	10.4	35	1.0	1.4
Dibenz[*a,h*]anthracene	10.2	10.6	8.06	11.2	9.89	9.62	10.2	14.2	8.3	9.90	4.1	5	0.1	0.1
Benzo[*ghi*]perylene	49.0	48.6	47.4	55.5	54.2	48.3	52.7	1.7	7.3	46.3	17.3	14	0.4	0.6

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule) (cont.).

NWFSC

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCBs														
PCB 8	NR	NR	NR	NR	NR					14.8	7.0			
PCB 18	61.8	57.6	56.6	56.4	55.3	58.7	56.8	4.7	3.1	50.7	13.4	12	0.5	0.5
PCB 28	184	177	173	163	163	178	168	3.1	5.2	159	32.7	6	0.3	0.2
PCB 44	164	153	151	152	142	156	150	4.5	4.7	140	29.4	7	0.3	0.3
PCB 52	249	232	228	232	217	236	228	4.7	4.4	212	52.0	8	0.3	0.3
PCB 66	271	251	243	263	241	255	253	5.7	4.5	234	48.9	8	0.4	0.3
PCB 101	310	288	282	284	261	293	280	5.0	6.0	255	52.5	10	0.5	0.4
PCB 105	97.0	90.2	88.5	87.4	80.3	91.9	86.5	4.9	6.8	102	13.5	15	-1.1	-0.6
PCB 118	281	263	260	257	236	268	254	4.2	6.4	249	47.6	5	0.1	0.1
PCB 128	38.5	35.6	35.0	34.6	31.7	36.4	34.2	5.1	6.9	34.9	2.8	5	-0.2	-0.1
PCB 138	296	275	270	268	246	280	265	4.9	6.6	243	35.3	9	0.6	0.4
PCB 153	401	373	366	368	338	380	362	4.9	6.0	305	78.5	19	0.7	0.7
PCB 170	3.88	3.63	3.47	3.59	3.38	3.66	3.54	5.6	4.2	7.80	3.6	55	-1.2	-2.2
PCB 180	33.4	30.8	30.2	29.9	27.5	31.4	29.6	5.4	6.7	26.8	4.6	10	0.6	0.4
PCB 187	74.4	68.7	67.4	66.9	61.1	70.2	66.1	5.3	6.9	57.8	6.6	14	1.3	0.6
PCB 195	<2.75	<2.49	<2.40	<2.43	<2.18					1.40	0.7			
PCB 206	<3.05	<2.76	<2.66	<2.71	<2.43					0.90	0.3			
PCB 209	107	101	101	99.2	92.0	103	98.1	3.4	5.8	89.4	16.2	10	0.5	0.4

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule) (cont.).

NWFSC	Within sample			Between samples						Accepted			z Score	
Compound	S1-A	S1-B	S1-C	S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Value	s	Mean abs. % error	S1-3 mean	25% Accep. value
PESTICIDES														
2,4'-DDD	28.0	25.8	25.4	25.7	23.8	26.4	25.3	5.3	5.4	40.6	16.7	38	-0.9	-1.5
2,4'-DDE	33.1	31.1	29.4	30.8	28.7	31.2	30.2	5.9	4.5	48.1	14.8	37	-1.2	-1.5
2,4'-DDT	46.0	42.7	40.6	43.0	39.6	43.1	41.9	6.3	4.8	31.1	18.2	35	0.6	1.4
4,4'-DDD	147	140	139	138	128	142	136	3.1	5.4	114	25.2	20	0.9	0.8
4,4'-DDE	74.1	68.1	67.1	69.1	62.1	69.8	67.0	5.4	6.3	94.1	25.5	29	-1.1	-1.2
4,4'-DDT	27.8	25.5	24.9	25.8	23.7	26.1	25.2	5.9	5.1	27.0	16.3	7	-0.1	-0.3
Aldrin	<5.48	<4.95	<4.78	<4.96	<4.45					10.2	7.2			
cis-Chlordane	46.5	44.2	43.6	44.6	41.5	44.8	43.6	3.4	4.3	51.2	10.6	15	-0.7	-0.6
Dieldrin	25.0	24.7	23.6	22.9	22.3	24.4	23.2	3.0	4.7	21.7	8.5	7	0.2	0.3
gamma-HCH	<16.5	<14.9	<14.4	<15.7	<14.0					4.3	2.6			
Heptachlor	<15.6	<14.1	<13.6	<14.7	<13.2					5.0	4.3			
Heptachlor epoxide	<9.77	9.39	9.33	10.4	9.93					3.4	2.5			
Hexachlorobenzene	77.7	74.4	73.2	82.3	82.4	75.1	79.9	3.1	5.2	86.2	16.4	7	-0.4	-0.3
Mirex	69.7	62.7	61.1	62.4	58.1	64.5	61.7	7.1	5.3	39.8	13.1	55	1.7	2.2
trans-Nonachlor	62.1	58.7	57.7	60.0	55.7	59.5	58.4	3.9	4.1	45.2	12.3	29	1.1	1.2

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule) (cont.).

TAMU

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PAHs														
Naphthalene	47.5	38.5	39.2	38.4	42.9	41.7	41.0	12.0	5.7	39.4	15.2	6	0.1	0.2
2-Methylnaphthalene	37.4	28.1	29.6	32.8	37.2	31.7	33.9	15.8	8.5	45.8	16.4	26	-0.7	-1.0
1-Methylnaphthalene	20.5	18.0	20.3	20.5	21.2	19.6	20.4	7.1	3.9	25.5	7.5	20	-0.7	-0.8
Biphenyl	7.35	6.34	8.38	8.00	6.32	7.36	7.23	13.9	12	10.8	6.5	33	-0.5	-1.3
2,6-Dimethyl= naphthalene	20.1	21.7	18.5	19.3	20.5	20.1	19.9	8.0	3.2	26.5	6.0	25	-1.1	-1.0
Acenaphthylene	7.7	5.72	7.67	6.05	6.76	7.03	6.61	16.1	7.7	22.6	16.3	71	-1.0	-2.8
Acenaphthene	10.5	12.6	11.7	12.9	12.6	11.6	12.4	9.1	5.6	15.4	3.1	20	-1.0	-0.8
1,6,7-Trimethyl= naphthalene	41.1	39.7	42.1	31.6	37.3	41.0	36.6	2.9	13	41.6	7.4	12	-0.7	-0.5
Fluorene	17.2	17.4	17.4	16.0	19.7	17.3	17.6	0.7	11	20.7	7.8	15	-0.4	-0.6
Phenanthrene	71.5	61.6	64.4	66.9	69.1	65.8	67.3	7.8	2.4	82.8	7.5	19	-2.1	-0.7
Anthracene	18.3	14.7	15.8	19.7	16.9	16.3	17.6	11.3	10	28.0	8.8	37	-1.2	-1.5
1-Methylphenanthrene	234	234	228	233	220	232	228	1.5	3.1	284	63.6	20	-0.9	-0.8
Fluoranthene	549	487	511	519	500	516	511	6.1	2.0	654	111	22	-1.3	-0.9
Pyrene	542	484	504	511	484	510	502	5.8	3.1	642	94.6	22	-1.5	-0.9
Benz[*a*]anthracene	93.5	101	92.7	101	94.1	95.5	97	4.8	4.0	102	15.9	5	-0.3	-0.2
Chrysene	295	304	312	307	324	304	312	2.8	3.4	321	32.1	4	-0.3	-0.1
Benzofluoranthenes	181	188	189	193	205	186	195	2.3	4.9	226	41.8	14	-0.7	-0.5
Benzo[*e*]pyrene	169	172	179	176	188	173	179	3.0	4.5	205	21.9	13	-1.2	-0.5
Benzo[*a*]pyrene	37.4	36.8	35.3	38.1	37.7	36.5	37.4	3.0	2.2	42.3	9.1	11	-0.5	-0.5
Perylene	22.2	21.3	20.3	21.0	21.6	21.2	21.3	4.5	1.3	20.4	4.7	4	0.2	0.2
Indeno[1,2,3-*cd*]= pyrene	30.9	30.9	29.5	31.4	33.3	30.4	31.7	2.7	4.6	31.3	10.4	3	0.0	0.1
Dibenz[*a,h*]anthracene	5.74	5.57	6.41	6.4	6.84	5.91	6.38	7.5	7.3	9.9	4.1	35	-0.9	-1.4
Benzo[*ghi*]perylene	47.9	48.8	48.0	50.1	51.1	48.2	49.8	1.0	3.0	46.3	17.3	8	0.2	0.3

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule) (cont.).

TAMU

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCBs														
PCB 8	13.1	12.0	12.7	15.3	14.9	12.6	14.3	4.4	10	14.8	7.0	6	-0.1	-0.1
PCB 18	39.6	40.3	42.4	42.8	46.5	40.8	43.4	3.6	6.8	50.7	13.4	14	-0.5	-0.6
PCB 28	165	172	183	179	161	173	171	5.2	5.4	159	32.7	8	0.4	0.3
PCB 44	141	142	141	146	147	141	145	0.4	2.1	140	29.4	4	0.2	0.1
PCB 52	217	217	221	218	216	219	217	1.1	0.6	212	52.0	3	0.1	0.1
PCB 66	199	211	214	194	213	208	205	3.8	4.8	234	48.9	12	-0.6	-0.5
PCB 101	233	237	240	239	234	236	237	1.5	1.0	255	52.5	7	-0.3	-0.3
PCB 105	93.9	86.0	103	110	100	94.3	102	9.0	7.8	102	13.5	6	0.0	0.0
PCB 118	209	217	225	223	213	217	217	3.7	2.3	249	47.6	13	-0.7	-0.5
PCB 128	29.4	30.9	31.5	34.0	30.2	30.6	31.6	3.5	6.6	34.9	2.8	10	-1.2	-0.4
PCB 138	203	211	212	221	209	209	213	2.4	3.5	243	35.3	12	-0.8	-0.5
PCB 153	266	277	270	282	272	271	275	2.1	2.2	305	78.5	10	-0.4	-0.4
PCB 170	9.97	12.6	12.9	11.3	9.71	11.8	10.9	13.7	10	7.80	3.6	40	0.9	1.6
PCB 180	25.1	26.4	26.7	29.3	25.9	26.1	27.1	3.3	7.0	26.8	4.6	5	0.1	0.0
PCB 187	53.1	55.1	55.8	58.6	54.4	54.7	55.9	2.6	4.2	57.8	6.6	4	-0.3	-0.1
PCB 195	1.05	0.98	0.96	1.22	0.99	1.00	1.07	4.7	13	1.40	0.7	24	-0.5	-0.9
PCB 206	1.08	1.10	1.11	1.65	1.06	1.10	1.27	1.4	26	0.90	0.3	41	1.2	1.6
PCB 209	62.0	63.8	64.0	75.9	57.4	63.3	65.5	1.7	14	89.4	16.2	27	-1.5	-1.1

Table IV.2. 1991 Bivalve Tissue Extract II (QA91BE2) intercomparison exercise results (ng/ampoule) (cont.).

TAMU

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	12.2	12.7	13.9	12.4	13.2	12.9	12.8	6.8	2.9	40.6	16.7	68	-1.7	-2.7
2,4'-DDE	NR	NR	NR	NR	NR					48.1	14.8			
2,4'-DDT	12.0	14.9	13.0	14.9	12.8	13.3	13.7	11.1	8.1	31.1	18.2	56	-1.0	-2.2
4,4'-DDD	77.1	84.8	86.1	95.4	86.8	82.7	88.3	5.9	7.4	114	25.2	22	-1.0	-0.9
4,4'-DDE	77.9	80.1	84.5	87.9	84.7	80.8	84.5	4.2	4.2	94.1	25.5	10	-0.4	-0.4
4,4'-DDT	13.8	12.1	12.5	13.9	12.7	12.8	13.1	6.9	4.9	27.0	16.3	51	-0.9	-2.1
Aldrin	7.32	6.51	6.64	6.55	5.41	6.82	6.26	6.4	12	10.2	7.2	39	-0.5	-1.5
cis-Chlordane	41.4	42.3	43.5	48.0	46.9	42.4	45.8	2.5	6.5	51.2	10.6	11	-0.5	-0.4
Dieldrin	20.8	23.9	19.4	23.3	19.8	21.4	21.5	10.8	8.1	21.7	8.5	6	0.0	0.0
gamma-HCH	NR	NR	NR	NR	NR					4.30	2.6			
Heptachlor	4.14	4.04	3.35	3.09	3.44	3.84	3.46	11.2	11	5.00	4.3	31	-0.4	-1.2
Heptachlor epoxide	4.93	5.31	5.04	6.27	3.06	5.09	4.81	3.8	34	3.40	2.5	48	0.6	1.7
Hexachlorobenzene	122	124	124	102	39.4	123	88.4	0.9	49	86.2	16.4	38	0.1	0.1
Mirex	36.9	38.2	38.4	41.5	38.9	37.8	39.4	2.2	4.8	39.8	13.1	4	0.0	0.0
trans-Nonachlor	36.3	36.9	37.6	39.7	40.0	36.9	38.9	1.8	4.4	45.2	12.3	14	-0.5	-0.6

APPENDIX V

1992 TRACE ORGANIC INTERCOMPARISON EXERCISE RESULTS

NIST:	National Institute of Standards and Technology
BATTELLE:	Battelle Ocean Sciences
NWFSC:	NOAA/NMFS/Northwest Fisheries Science Center
TAMU:	Texas A&M University/GERG

S1-A, S1-B, S1-C: Results from three gas chromatographic analyses of S1.
S1, S2, S3: Results from three independent sample preparations and analyses.
S1 Mean: The mean value of the reported S1 replicates, S1-A, S1-B, and S1-C.
S1-3 Mean: The mean concentration of the three samples, S1, S2, and S3, in which the mean value of the three GC replicates was used for the S1 concentration.
S1 %RSD: The percent relative standard deviation of the S1 replicates, S1-A, S1-B, and S1-C.
S1-3 %RSD: The percent relative standard deviation of the S1 Mean and the reported samples, S2, and S3.
Consensus value: NIST-calculated consensus value and standard deviation (s).
Mean Absolute %Error The mean of the absolute percent errors of the S1 Mean and the reported samples, S2 and S3 relative to the exercise consensus value.
z Score: The ratio of a bias estimate to a performance criterion. The difference between the laboratory mean and the accepted mean was used as the bias estimate. z Scores were calculated in two ways, using the SD of the S1-3 mean, and 25% of the accepted value as performance criteria.
N R : Not reported.
Z R : Zero or below MDL.

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight).

NIST

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
Water (%)	51.0	ZR	ZR	51.1	51.1		51.1		0.1	53.0	1.2		-1.6	-0.1
PAHs														
Naphthalene	995	1001	998	980	982	998	987	0.3	1.0	716	300	38	0.9	1.5
2-Methylnaphthalene	341	342	343	347	348	342	346	0.3	0.9	281	114	23	0.6	0.9
1-Methylnaphthalene	147	145	144	141	146	145	144	1.1	1.9	138	51.2	4	0.1	0.2
Biphenyl	89.5	90.5	88.5	89.9	95.9	89.5	91.8	1.1	3.9	96.6	18.1	5	-0.3	-0.2
2,6-Dimethyl= naphthalene	110	109	111	117	115	110	114	0.9	3.2	129	86.5	12	-0.2	-0.5
Acenaphthylene	73.6	74.2	74.9	76.9	77.1	74.2	76.1	0.9	2.1	76.3	49.7	2	0.0	0.0
Acenaphthene	55.8	55.1	54.9	57.8	56.8	55.3	56.5	0.9	2.3	47.5	25.8	19	0.3	0.8
1,6,7-Trimethyl= naphthalene	54.6	54.3	54.4	56.8	55.1	54.4	55.4	0.3	2.2	79.5	43.4	30	-0.6	-1.2
Fluorene	100	100	101	100	102	100	101	0.6	1.2	99.0	42.6	2	0.0	0.1
Phenanthrene	458	459	459	475	477	459	470	0.1	2.1	432	128	9	0.3	0.4
Anthracene	205	209	205	210	208	206	208	1.1	0.9	177	56.3	18	0.6	0.7
1-Methylphenanthrene	86.8	86.1	86.3	84.3	84.9	86.4	85.2	0.4	1.3	83.6	27.0	2	0.1	0.1
Fluoranthene	1090	1096	1083	1064	1054	1090	1069	0.6	1.7	834	336	28	0.7	1.1
Pyrene	926	929	925	910	913	927	917	0.2	1.0	737	231	24	0.8	1.0
Benz[*a*]anthracene	516	516	519	549	539	517	535	0.3	3.1	405	101	32	1.3	1.3
Chrysene + triphenylene	622	621	624	637	629	622	629	0.2	1.2	520	141	21	0.8	0.8
Benzofluoranthenes (*b+j+k*)	1562	1590	1593	1607	1618	1582	1602	1.1	1.2	1149	408	39	1.1	1.6
Benzo[*e*]pyrene	616	611	608	592	594	612	599	0.7	1.8	488	145	23	0.8	0.9
Benzo[*a*]pyrene	615	611	605	639	633	610	627	0.8	2.4	475	157	32	1.0	1.3
Perylene	444	448	445	412	408	446	422	0.5	4.9	353	149	19	0.5	0.8
Indeno[1,2,3-*cd*]= pyrene	595	599	596	609	605	597	604	0.3	1.0	463	172	30	0.8	1.2
Dibenz[*a,h*]- and dibenz[a,c]anthracene	106	106	109	112	111	107	110	1.6	2.4	148	78.4	26	-0.5	-1.0
Benzo[*ghi*]perylene	557	551	546	537	544	551	544	1.0	1.3	456	142	19	0.6	0.8

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight) (cont.).

NIST

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCB CONGENERS														
PCB 8	0.88	0.74	0.89	0.99	1.04	0.84	0.96	10.	11	3.27	2.77	71	-0.8	-2.8
PCB 18	3.44	3.47	3.42	3.83	3.56	3.44	3.61	0.7	5.5	3.84	0.96	6	-0.2	-0.2
PCB 28	9.08	9.00	9.05	8.87	8.95	9.04	8.95	0.4	1.0	10.6	5.81	16	-0.3	-0.6
PCB 44	4.11	4.13	4.09	3.97	4.37	4.11	4.15	0.5	4.9	5.39	1.69	23	-0.7	-0.9
PCB 52	11.0	11.1	11.1	11.8	11.5	11.1	11.5	0.5	3.2	10.6	4.81	11	0.2	0.5
PCB 66/95	13.1	13.1	12.9	13.4	12.9	13.0	13.1	0.9	2.0	10.3	3.11	27	0.9	1.1
PCB 101/90	15.1	14.9	15.1	15.8	15.7	15.0	15.5	0.8	2.7	14.5	4.18	7	0.2	0.3
PCB 105	5.44	5.45	5.46	5.62	5.58	5.45	5.55	0.2	1.6	4.89	1.73	13	0.4	0.5
PCB 118	9.85	9.82	8.70	9.61	9.52	9.46	9.53	6.9	0.8	11.7	4.31	19	-0.5	-0.7
PCB 128	3.56	3.48	3.48	3.89	3.84	3.51	3.75	1.3	5.6	3.17	2.17	18	0.3	0.7
PCB 138/163/164	16.0	15.9	15.8	16.4	16.5	15.9	16.3	0.6	2.0	14.1	3.64	16	0.6	0.6
PCB 153	16.9	16.9	16.9	17.0	17.1	16.9	17.0	0.2	0.6	18.0	6.38	5	-0.2	-0.2
PCB 170/190	4.95	4.87	4.86	4.61	4.78	4.89	4.76	1.0	3.0	11.5	11.5	58	-0.6	-2.3
PCB 180	14.4	14.1	14.3	13.9	13.7	14.3	14.0	1.1	2.1	12.1	4.18	15	0.4	0.6
PCB 187/182	8.33	8.36	8.29	8.87	8.73	8.33	8.64	0.4	3.3	8.05	3.57	7	0.2	0.3
PCB 195	3.13	3.15	3.13	3.45	3.51	3.14	3.37	0.4	6.0	2.80	1.19	20	0.5	0.8
PCB 206	2.53	2.59	2.56	2.47	2.36	2.56	2.46	1.2	4.1	4.58	2.87	46	-0.7	-1.8
PCB 209	5.39	5.41	5.48	5.55	5.51	5.43	5.50	0.9	1.1	12.1	4.48	54	-1.5	-2.2

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight) (cont.).

NIST

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	1.73	1.69	1.67	1.59	1.59	1.70	1.63	1.8	3.8	1.41	0.50	15	0.4	0.6
2,4'-DDE	1.41	1.37	1.40	1.26	1.44	1.39	1.36	1.5	6.8	2.54	1.78	46	-0.7	-1.9
2,4'-DDT	<2	<2	<2	<2	<2					N C				
4,4'-DDD	5.14	5.15	5.02	4.84	5.08	5.10	5.01	1.4	2.9	6.78	2.72	26	-0.6	-1.0
4,4'-DDE	6.75	6.72	6.81	6.94	6.98	6.76	6.89	0.7	1.7	7.50	1.83	8	-0.3	-0.3
4,4'-DDT	1.41	1.39	1.35	1.25	1.27	1.38	1.30	2.2	5.5	2.11	1.40	38	-0.6	-1.5
Aldrin	<1	<1	<1	<1	<1					N C				
cis-Chlordane	2.61	2.66	2.68	2.99	2.72	2.65	2.79	1.4	6.4	2.63	1.08	6	0.1	0.2
Dieldrin	1.82	1.88	1.87	1.90	1.83	1.86	1.86	1.7	1.9	2.11	0.86	12	-0.3	-0.5
gamma-HCH	0.69	0.68	0.66	0.72	0.74	0.68	0.71	2.3	4.5	1.95	2.13	63	-0.6	-2.5
Heptachlor	<1	<1	<1	<1	<1					N C				
Heptachlor epoxide	0.48	0.44	0.45	0.57	0.55	0.46	0.53	4.6	12	1.63	1.00	68	-1.1	-2.7
Hexachlorobenzene	76.7	76.6	75.6	74.1	74.7	76.3	75.0	0.8	1.5	57.1	20.8	31	0.9	1.3
Mirex	<2	<2	<2	<2	<2					N C				
trans-Nonachlor	1.09	1.10	1.11	1.19	1.25	1.10	1.18	0.9	6.4	1.17	0.62	5	0.0	0.0

N C - Not computed.

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight) (cont.).

BATTELLE

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
Water (%)	53.8	0.0	0.0	53.7	53.8		53.7		0.1	53.0	1.2		0.6	0.0
PAHs														
Naphthalene	816	832	856	799	790	834	808	2.4	2.9	716	300	13	0.3	0.5
2-Methylnaphthalene	333	340	345	320	322	339	327	1.8	3.2	281	114	16	0.4	0.6
1-Methylnaphthalene	158	162	164	152	154	161	156	1.7	3.2	138	51.2	13	0.3	0.5
Biphenyl	96.8	97.8	100	95.4	105	98.2	99.6	1.8	5.0	96.6	18.1	4	0.2	0.1
2,6-Dimethyl= naphthalene	95.7	93.7	95.0	85	87	95	89	1.1	6.1	129	86.5	31	-0.5	-1.3
Acenaphthylene	102	104	108	96	100	104	100	3.1	4.2	76.3	49.7	31	0.5	1.3
Acenaphthene	47.4	47.8	50.7	40.9	44.0	48.6	44.5	3.7	8.7	47.5	25.8	8	-0.1	-0.2
1,6,7-Trimethyl= naphthalene	49.7	45.8	46.2	45.1	45.9	47.2	46.1	4.6	2.3	79.5	43.4	42	-0.8	-1.7
Fluorene	104	107	111	97.5	98.4	108	101	3.6	5.5	99.0	42.6	4	0.0	0.1
Phenanthrene	475	489	514	447	463	493	467	3.9	5.0	432	128	8	0.3	0.3
Anthracene	139	148	150	101	88.9	146	112	4.0	27	177	56.3	37	-1.2	-1.5
1-Methylphenanthrene	96.8	95.7	101	91.1	87.6	97.7	92.1	2.7	5.6	83.6	27.0	10	0.3	0.4
fluoranthene	901	923	965	870	874	929	891	3.5	3.7	834	336	7	0.2	0.3
Pyrene	774	792	839	727	733	802	754	4.2	5.6	737	231	4	0.1	0.1
Benz[a]anthracene	396	394	394	372	366	394	377	0.4	4.0	405	101	7	-0.3	-0.3
Chrysene + triphenylene	578	565	577	588	580	573	580	1.3	1.2	520	141	12	0.4	0.5
Benzofluoranthenes (*b+j+k*)	1400	1330	1340	1470	1450	1357	1426	2.8	4.2	1149	408	24	0.7	1.0
Benzo[*e*]pyrene	557	524	532	579	569	538	562	3.2	3.8	488	145	15	0.5	0.6
Benzo[*a*]pyrene	648	747	806	592	623	733	649	10.9	12	475	157	37	1.1	1.5
Perylene	313	293	295	241	216	300	252	3.7	17	353	149	29	-0.7	-1.1
Indeno[1,2,3-*cd*]= pyrene	619	559	552	655	656	577	629	6.4	7.2	463	172	36	1.0	1.4
Dibenz[*a,h*]- and dibenz[a,c]anthracene	137	123	121	149	144	127	140	6.9	8.2	148	78.4	6	-0.1	-0.2
Benzo[*ghi*]perylene	566	501	500	603	583	522	570	7.3	7.4	456	142	25	0.8	1.0

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight) (cont.).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCB CONGENERS														
PCB 8	96.5	92.3	106	160	359	98.3	206	7.1	66	3.27	2.77	6200	73.1	248.0
PCB 18	ZR	ZR	ZR	ZR	ZR					3.84	0.96			
PCB 28	4.80	4.35	5.04	3.66	3.93	4.73	4.11	7.4	14	10.6	5.81	61	-1.1	-2.5
PCB 44	6.91	6.87	7.10	6.53	5.45	6.96	6.31	1.8	12	5.39	1.69	17	0.5	0.7
PCB 52	6.55	7.70	6.86	7.31	6.17	7.04	6.84	8.5	8.7	10.3	4.81	34	-0.7	-1.3
PCB 66/95	10.8	11.4	12.0	10.7	10.3	11.4	10.8	5.3	5 .2	10.3	3.11	5	0.2	0.2
PCB 101/90	16.8	16.4	16.2	16.9	14.2	16.5	15.9	1.9	9 .1	14.5	4.18	11	0.3	0.4
PCB 105	ZR	ZR	ZR	ZR	ZR					4.89	1.73			
PCB 118	28.5	29.4	30.3	26.4	30.8	29.4	28.9	3.1	7.8	11.7	4.31	147	4.0	5.9
PCB 128	2.55	2.70	2.83	2.32	2.96	2.69	2.66	5.2	12	3.17	2.17	16	-0.2	-0.6
PCB 138/163/164	8.21	8.61	8.63	7.49	9.05	8.48	8.34	2.8	9.5	14.1	3.64	41	-1.6	-1.6
PCB 153	17.1	17.7	17.5	15.8	18.5	17.4	17.2	1.8	7.9	18.0	6.38	6	-0.1	-0.2
PCB 170/190	2.81	3.25	3.68	2.75	2.60	3.25	2.87	13	12	11.5	11.5	75	-0.7	-3.0
PCB 180	7.68	7.98	8.25	7.27	8.86	7.97	8.03	3.6	9.9	12.1	4.18	34	-1.0	-1.3
PCB 187/182	5.24	5.85	5.59	4.91	5.51	5.56	5.33	5.5	6.8	8.05	3.57	34	-0.8	-1.4
PCB 195	2.32	2.44	2.59	2.22	2.56	2.45	2.41	5.5	7.2	2.80	1.19	14	-0.3	-0.6
PCB 206	6.73	6.25	5.72	7.10	5.42	6.23	6.25	8.1	13	4.58	2.87	37	0.6	1.5
PCB 209	13.0	14.1	14.6	11.2	11.9	13.9	12.3	5.9	11	12.1	4.48	8	0.1	0.1

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight) (cont.).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	1.98	1.87	2.39	2.14	2.38	2.08	2.20	13.2	7.2	1.41	0.50	56	1.6	2.2
2,4'-DDE	ZR	ZR	ZR	ZR	ZR					2.54	1.78			
2,4'-DDT	ZR	ZR	ZR	ZR	ZR					NC				
4,4'-DDD	3.66	3.90	3.80	3.13	4.42	3.79	3.78	3.2	17	6.78	2.72	44	-1.1	-1.8
4,4'-DDE	7.92	8.16	8.11	7.88	7.13	8.06	7.69	1.6	6.4	7.50	1.83	6	0.1	0.1
4,4'-DDT	ZR	ZR	ZR	ZR	ZR					2.11	1.40			
Aldrin	ZR	ZR	ZR	ZR	ZR					NC				
cis-Chlordane	1.44	1.95	2.03	2.56	2.95	1.81	2.44	18	23.8	2.63	1.08	15	-0.2	-0.3
Dieldrin	2.45	2.65	2.77	2.28	2.92	2.62	2.61	6.2	12.3	2.11	0.86	23	0.6	0.9
gamma-HCH	1.86	1.99	1.78	1.66	1.76	1.88	1.77	5.6	6.1	1.95	2.13	10	-0.1	-0.4
Heptachlor	ZR	ZR	ZR	ZR	ZR					NC				
Heptachlor epoxide	2.64	2.67	2.64	2.71	2.32	2.65	2.56	0.7	8.2	1.63	1.00	57	0.9	2.3
Hexachlorobenzene	60.1	59.1	58.9	61.2	58.9	59.4	59.8	1.1	2.0	57.1	20.8	5	0.1	0.2
Mirex	ZR	ZR	ZR	ZR	ZR					NC				
trans-Nonachlor	ZR	ZR	ZR	ZR	ZR					1.17	0.62			

N C - Not computed.

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight).

NWFSC

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
Water (%)	46.7	46.7	46.7	47.3	47.1		47.0		0.6	53.0	1.2		-5.0	-0.2
PAHs														
Naphthalene	1010	1040	937	960	1010	996	989	5.3	2.6	716	300	38	0.9	1.5
2-Methylnaphthalene	353	304	355	354	283	337	325	8.6	11	281	114	15	0.4	0.6
1-Methylnaphthalene	150	135	159	174	107	148	143	8.2	24	138	51	19	0.1	0.1
Biphenyl	98.0	65.7	72.0	103	90.2	78.6	90.6	22	14	96.6	18.1	11	-0.3	-0.3
2,6-Dimethyl= naphthalene	69.2	86.0	102	<58.1	<60.1					129	86.5			
Acenaphthylene	<33.6	<36.3	<36	<35.7	<36.9					76.3	49.7			
Acenaphthene	<50.5	<54.6	<54.1	<51	<52.7					47.5	25.8			
1,6,7-Trimethyl= naphthalene	<57.2	<61.9	<61.3	<60.6	<62.6					79.5	43.4			
Fluorene	66.5	56.5	78.1	76.7	58.6	67.0	67.4	16	13	99.0	42.6	32	-0.7	-1.3
Phenanthrene	421	401	445	490	439	422	450	5.2	7.8	432	128	6	0.1	0.2
Anthracene	156	199	180	200	191	178	190	12	5.7	177	56.3	10	0.2	0.3
1-Methylphenanthrene	58.6	80.8	76.9	89.1	49.5	72.1	70.2	16	28	83.6	27.0	20	-0.5	-0.6
fluoranthene	1030	1070	1060	1070	1170	1053	1098	2.0	5.7	834	336	32	0.8	1.3
Pyrene	870	934	861	880	990	888	919	4.5	6.7	737	231	25	0.8	1.0
Benz[a]anthracene	495	501	491	510	573	496	526	1.0	7.8	405	101	30	1.2	1.2
Chrysene + triphenylene	723	741	695	681	689	720	697	3.2	2.9	520	141	34	1.2	1.4
Benzofluoranthenes (*b+j+k*)	1610	1675	1647	1612	1718	1644	1658	2.0	3.3	1149	408	44	1.2	1.8
Benzo[*e*]pyrene	609	613	612	618	628	611	619	0.3	1.4	488	145	27	0.9	1.1
Benzo[*a*]pyrene	583	575	564	569	661	574	601	1.7	8.6	475	157	27	0.8	1.1
Perylene	174	181	178	240	234	178	217	2.0	16	353	149	39	-0.9	-1.5
Indeno[1,2,3-*cd*]= pyrene	550	596	597	587	648	581	605	4.6	6.1	463	172	31	0.8	1.2
Dibenz[*a,h*]- and dibenz[a,c]anthracene	138	124	134	91.6	130	132	118	5.5	19	148	78.4	20	-0.4	-0.8
Benzo[*ghi*]perylene	538	539	572	525	574	550	550	3.5	4.5	456	142	20	0.7	0.8

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight) (cont.).

NWFSC

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCB CONGENERS														
PCB 8	NR	NR	NR	NR	NR					3.27	2.77			
PCB 18	<10.1	<9.86	<10	<10.5	<9.91					3.84	0.96			
PCB 28	19.0	19.4	17.8	18.4	16.3	18.7	17.8	4.4	7.4	10.6	5.81	67	1.2	2.7
PCB 44	14.4	14.6	14.4	13.9	14.5	14.5	14.3	0.8	2.4	5.39	1.69	165	5.3	6.6
PCB 52	21.4	21.6	18.4	20.0	17.9	20.5	19.5	8.8	7.0	10.3	4.81	89	1.9	3.6
PCB 66/95	15.4	14.7	12.3	13.0	12.6	14.1	13.2	12	6.0	10.3	3.11	29	0.9	1.1
PCB 101/90	22.6	22.5	22.2	22.3	21.2	22.4	22.0	0.9	3.1	14.5	4.18	51	1.8	2.1
PCB 105	4.11	4.07	3.78	4.16	3.81	3.99	3.99	4.5	4.4	4.89	1.73	19	-0.5	-0.7
PCB 118	13.8	13.5	10.7	12.9	11.2	12.7	12.3	14	7.5	11.7	4.31	9	0.1	0.2
PCB 128	4.75	4.96	5.04	4.65	4.57	4.92	4.71	3.0	3.9	3.17	2.17	49	0.7	2.0
PCB 138/163/164	17.4	17.3	17.2	17.4	16.3	17.3	17.0	0.6	3.6	14.1	3.64	21	0.8	0.8
PCB 153	29.1	28.8	26.8	29.4	27.4	28.2	28.3	4.4	3.5	18.0	6.38	58	1.6	2.3
PCB 170/190	32.5	32.5	32.4	31.8	31.4	32.5	31.9	0.2	1.7	11.5	11.5	178	1.8	7.1
PCB 180	15.8	14.2	14.1	13.9	13.4	14.7	14.0	6.5	4.7	12.1	4.18	16	0.4	0.6
PCB 187/182	9.84	9.72	9.54	9.63	9.09	9.70	9.47	1.6	3.5	8.05	3.57	18	0.4	0.7
PCB 195	1.81	1.80	1.77	1.69	1.63	1.79	1.70	1.2	4.6	2.80	1.19	39	-0.9	-1.6
PCB 206	3.27	3.22	3.15	2.98	2.72	3.21	2.97	1.9	8.3	4.58	2.87	35	-0.6	-1.4
PCB 209	15.4	15.4	15.6	14.8	11.7	15.5	14.0	0.7	14	12.1	4.48	18	0.4	0.6

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight) (cont.).

NWFSC

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PESTICIDES														
2,4'-DDD	<3.04	<2.96	<3.00	<3.15	<3.00					1.41	0.50			
2,4'-DDE	<3.04	<2.96	<3.00	<3.15	<3.00					2.54	1.78			
2,4'-DDT	<2.78	<2.71	<2.75	<2.88	<2.77					N C				
4,4'-DDD	5.37	5.31	4.78	4.80	4.71	5.15	4.89	6.3	4.8	6.78	2.72	28	-0.7	-1.1
4,4'-DDE	5.99	5.96	5.84	5.63	5.69	5.93	5.75	1.3	2.8	7.50	1.83	23	-1.0	-0.9
4,4'-DDT	2.52	2.61	2.48	<2.39	2.38					2.11	1.40			
Aldrin	<2.08	<2.03	<2.06	<2.16	<2.06					N C				
cis-Chlordane	2.03	2.06	2.28	2.37	2.06	2.12	2.18	6.4	7.5	2.63	1.08	17	-0.4	-0.7
Dieldrin	2.68	2.76	2.63	2.41	2.35	2.69	2.48	2.4	7.3	2.11	0.86	18	0.4	0.7
gamma-HCH	<1.96	<1.9	<1.93	<2.03	<1.95					1.95	2.13			
Heptachlor	<2.12	<2.07	<2.1	<2.2	<2.14					N C				
Heptachlor epoxide	<2.06	<2.01	<2.04	<2.14	<2.05					1.63	1.00			
Hexachlorobenzene	78.0	77.8	77.6	76.2	72.8	77.8	75.6	0.3	3.4	57.1	20.8	32	0.9	1.3
Mirex	<1.98	<1.93	<1.96	<2.05	<1.95					N C				
trans-Nonachlor	<1.67	<1.63	<1.65	<1.73	<1.65					1.17	0.62			

N C - Not computed.

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight).

TAMU

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
Water (%)		47.8		47.7	48.0		47.9		0.3	53.0	1.2		-4.3	-0.2
PAHs														
Naphthalene		875		867	870	875	871		0.5	716	300	22	0.5	0.9
2-Methylnaphthalene		360		334	345	360	346		3.8	281	114	23	0.6	0.9
1-Methylnaphthalene		201		182	186	201	190		5.3	138	51.2	37	1.0	1.5
Biphenyl		96.7		88.3	89.4	96.7	91.5		5.0	96.6	18.1	5	-0.3	-0.2
2,6-Dimethyl= naphthalene		302		266	246	302	271		11	129	86.5	110	1.6	4.4
Acenaphthylene		73.5		68.1	62.4	73.5	68.0		8.1	76.3	49.7	11	-0.2	-0.4
Acenaphthene		45.7		44.0	38.9	45.7	42.8		8.2	47.5	25.8	10	-0.2	-0.4
1,6,7-Trimethyl= naphthalene		177		151	133	177	154		15	79.5	43.4	93	1.7	3.7
Fluorene		112		98.2	98.8	112	103		7.7	99.0	42.6	5	0.1	0.2
Phenanthrene		428		367	400	428	398		7.7	432	128	8	-0.3	-0.3
Anthracene		194		147	166	194	169		14.	177	56.3	11	-0.1	-0.2
1-Methylphenanthrene		75.3		74.8	77.5	75.3	75.9		1.9	83.6	27.0	9	-0.3	-0.4
fluoranthene		883		753	813	883	816		8.0	834	336	6	-0.1	-0.1
Pyrene		758		636	711	758	702		8.8	737	231	7	-0.2	-0.2
Benz[*a*]anthracene		576		436	487	576	500		14	405	101	24	0.9	0.9
Chrysene + triphenylene		570		470	425	570	489		15	520	141	12	-0.2	-0.2
Benzofluoranthenes (*b*+*j*+*k*)		1261		1043	1137	1261	1147		9.5	1149	408	7	0.0	0.0
Benzo[*e*]pyrene		527		431	428	527	462		12	488	145	11	-0.2	-0.2
Benzo[*a*]pyrene		531		416	422	531	456		14	475	157	12	-0.1	-0.2
Perylene		390		293	321	390	335		15	353	149	12	-0.1	-0.2
Indeno[1,2,3-*cd*]= pyrene		536		472	464	536	491		8.1	463	172	6	0.2	0.2
Dibenz[*a,h*]- and dibenz[a,c]anthracene		107		84.0	91.8	107	94.1		12	148	78.4	36	-0.7	-1.5
Benzo[*ghi*]perylene		555		449	471	555	492		11	456	142	9	0.2	0.3

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight) (cont.).

TAMU

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PCB CONGENERS														
PCB 8		1.84		1.55	1.47	1.84	1.62		12	3.27	2.77	50	-0.6	-2.0
PCB 18		3.33		3.00	3.16	3.33	3.17		5.2	3.84	0.96	17	-0.7	-0.7
PCB 28		8.77		9.60	9.00	8.77	9.12		4.6	10.6	5.81	14	-0.3	-0.6
PCB 52		10.9		11.4	11.9	10.9	11.4		4.5	10.3	4.81	11	0.2	0.4
PCB 44		5.28		5.73	5.76	5.28	5.59		4.9	5.39	1.69	5	0.1	0.2
PCB 66/95		8.59		8.74	8.26	8.59	8.53		2.9	10.3	3.11	17	-0.6	-0.7
PCB 101/90		13.7		13.8	14.5	13.7	14.0		3.3	14.5	4.18	4	-0.1	-0.1
PCB 118		7.97		8.11	8.59	7.97	8.22		4.0	11.7	4.31	30	-0.8	-1.2
PCB 153		16.6		17.6	18.0	16.6	17.4		4.1	18.0	6.38	3	-0.1	-0.1
PCB 105		5.29		5.27	5.19	5.29	5.25		1.0	4.89	1.73	7	0.2	0.3
PCB 138/163/164		13.0		13.5	14.4	13.0	13.6		5.1	14.1	3.64	4	-0.1	-0.1
PCB 187/182		6.54		6.71	7.38	6.54	6.88		6.5	8.05	3.57	15	-0.3	-0.6
PCB 128		8.69		8.54	9.32	8.69	8.85		4.7	3.17	2.17	179	2.6	7.2
PCB 180		11.7		12.3	12.3	11.7	12.1		3.1	12.1	4.18	2	0.0	0.0
PCB 170/190		MI		MI	MI									
PCB 195		3.88		4.29	4.27	3.88	4.15		5.7	2.80	1.19	48	1.1	1.9
PCB 206		4.95		5.52	5.43	4.95	5.30		5.7	4.58	2.87	16	0.3	0.6
PCB 209		15.0		17.4	17.4	15.0	16.6		8.2	12.1	4.48	38	1.0	1.5

M I - Matrix interference.

Table V.1. 1992 Marine Sediment III (QA92SED3) intercomparison exercise results (ng/g dry weight) (cont.).

TAMU

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PESTICIDES														
2,4'-DDD		1.03		1.21	1.27	1.03	1.17		10.6	1.41	0.50	17	-0.5	-0.7
2,4'-DDE		ZR		ZR	ZR					2.54	1.78		-1.4	-4.0
2,4'-DDT		ZR		ZR	ZR					NC				
4,4'-DDD		4.49		5.03	4.89	4.49	4.80		5.9	6.78	2.72	29	-0.7	-1.2
4,4'-DDE		6.16		6.80	6.44	6.16	6.47		4.9	7.50	1.83	14	-0.6	-0.5
4,4'-DDT		ZR		ZR	ZR					2.11	1.40		-1.5	-4.0
Aldrin		ZR		ZR	ZR					NC				
cis-Chlordane		2.59		2.38	2.55	2.59	2.50		4.3	2.63	1.08	5	-0.1	-0.2
Dieldrin		2.95		2.90	3.06	2.95	2.97		2.9	2.11	0.86	41	1.0	1.6
gamma-HCH		ZR		ZR	ZR					1.95	2.13		-0.9	-4.0
Heptachlor		ZR		ZR	ZR					NC				
Heptachlor epoxide		2.70		2.77	2.90	2.70	2.79		3.6	1.63	1.00	71	1.2	2.8
Hexachlorobenzene		39.6		42.9	36.2	39.6	39.6		8.4	57.1	20.8	31	-0.8	-1.2
Mirex		ZR		ZR	ZR					NC				
trans-Nonachlor		0.84		0.74	0.82	0.84	0.80		6.6	1.17	0.62	32	-0.6	-1.3

N C - Not computed.

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight).

NIST

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
Water (%)	91.8	91.6	91.7	91.7	NA		91.7		0.1	91.8	0.3		-0.5	0.0
PAHs														
Naphthalene	I	I	I	I	I	I				25.1	5.70			
2-Methylnaphthalene	I	I	I	I	I					40.5	10.3			
1-Methylnaphthalene	I	I	I	I	I					24.3	4.78			
Biphenyl	I	I	I	I	I					22.9	14.5			
2,6-Dimethyl= naphthalene	I	I	I	I	I					65.8	31.9			
Acenaphthylene	5.28	5.48	4.81	5.86	5.46	5.19	5.50	6.7	6.1	8.69	3.20	37	-1.0	-1.5
Acenaphthene	5.37	6.05	5.84	6.48	6.48	5.8	6.2	6.0	6.7	9.07	1.59	31	-1.8	-1.2
1,6,7-Trimethyl= naphthalene	7.3	6.7	6.6	8.8	7.8	6.9	7.8	5.7	12	41.8	14.6	81	-2.3	-3.3
Fluorene	11.8	11.4	10.8	13.1	12.2	11.3	12.2	4.7	7.3	22.2	4.64	45	-2.2	-1.8
Phenanthrene	186	187	187	174	168	186	176	0.3	5.2	144	24.7	22	1.3	0.9
Anthracene	13.6	13.1	12.6	18.4	19.6	13.1	17.0	3.9	20	17.5	10.1	14	0.0	-0.1
1-Methylphenanthrene	64.8	60.8	59.0	55.0	51.3	61.5	56.0	4.8	9.2	67.8	7.42	17	-1.6	-0.7
Fluoranthene	465	468	467	454	450	467	457	0.2	1.9	395	80.3	16	0.8	0.6
Pyrene	341	338	341	325	332	340	332	0.5	2.3	282	48.1	18	1.0	0.7
Benz[*a*]anthracene	67.0	67.4	65.0	61.4	54.0	66.5	60.6	1.9	10.	79.4	16.3	24	-1.2	-0.9
Chrysene + triphenylene	226	226	221	205	202	224	210	1.3	5.7	227	51.8	8	-0.3	-0.3
Benzofluoranthenes (*b*+*j*+*k*)	298	303	296	309	277	299	295	1.1	5.5	158	26.3	87	5.2	3.5
Benzo[e]pyrene	197	196	197	183	205	197	195	0.2	5.5	114	21.8	72	3.7	2.9
Benzo[*a*]pyrene	61.0	59.2	61.4	51.0	64.7	60.5	58.7	2.0	12	29.4	5.67	100	5.2	4.0
Perylene	9.6	9.2	8.7	11.6	12.7	9.2	11.1	4.7	16.	11.3	2.96	11	-0.1	-0.1
Indeno[1,2,3-*cd*]pyrene	14.3	14.0	13.8	11.8	13.0	14.0	12.9	1.8	8.5	20.0	7.09	35	-1.0	-1.4
Dibenz[*a,h*]- and dibenz[a,c]anthracene	<3					<3				7.6	6.89			
Benzo[*ghi*]perylene	18.0	18.8	17.4	15.0	21.8	18.1	18.3	3.8	18	26.0	9.72	30	-0.8	-1.2

I - Interference from contamination due to reroofing of laboratory building.

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight) (cont.).

NIST

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCB CONGENERS														
PCB 8	3.79	3.61	3.94	4.69	4.46	3.78	4.31	4.4	11	3.32	2.37	30	0.4	1.2
PCB 18	10.5	10.6	10.9	11.4	10.0	10.9	10.8	1.9	6.4	11.0	5.41	5	0.0	-0.1
PCB 28	26.4	27.3	27.4	24.7	29.8	27.0	27.2	2.0	9.3	37.2	16.8	27	-0.6	-1.1
PCB 44	11.2	10.7	10.8	9.81	9.12	10.9	9.9	2.5	9.2	31.7	11.9	69	-1.8	-2.7
PCB 52	57.5	54.2	54.7	60.3	63.3	55.5	59.7	3.2	6.6	55.9	11.2	8	0.3	0.3
PCB 66/95	51.7	51.4	49.2	55.1	48.4	50.7	51.4	2.6	6.6	79.3	22.1	35	-1.3	-1.4
PCB 101/90	82.4	83.0	84.3	87.8	94.7	83.2	88.6	1.2	6.5	96.3	15.0	8	-0.5	-0.3
PCB 105	14.5	14.2	14.3	13.3	13.1	14.4	13.6	0.9	4.8	37.9	6.97	64	-3.5	-2.6
PCB 118	88.9	87.4	92.0	82.8	80.6	89.4	84.3	2.6	5.5	92.1	16.5	9	-0.5	-0.3
PCB 128	7.5	7.2	7.6	6.6	7.6	7.4	7.2	3.2	7.9	12.8	3.31	44	-1.7	-1.8
PCB 138/163/164	114	113	114	106	104	114	108	0.8	4.7	106	18.3	3	0.1	0.1
PCB 153	108	113	107	120	114	109	115	3.2	4.8	114	21.3	3	0.0	0.0
PCB 170/190	1.52	1.60	1.77	1.33	2.13	1.63	1.69	7.9	24	1.90	0.38	19	-0.6	-0.4
PCB 180	11.3	12.8	13.1	10.1	10.8	12.4	11.1	7.7	11	9.16	2.32	21	0.8	0.9
PCB 187/182	16.7	17.8	16.1	20.8	19.0	16.9	18.9	5.1	10	24.3	5.46	22	-1.0	-0.9
PCB 195	<2.8	NR	NR	NR	<2.8		1.06	1.03		1.06	1.03			
PCB 206	<2.9	NR	NR	NR	<2.9		4.23	7.11		4.23	7.11			
PCB 209	<3.4	NR	NR	NR	<3.4		0.84	0.86		0.84	0.86			

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight) (cont.).

NIST

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	18.1	17.9	17.7	16.3	17.5	17.9	17.2	1.2	4.7	11.3	5.11	53	1.2	2.1
2,4'-DDE	8.18	8.84	8.98	6.11	5.52	8.67	6.77	4.9	25	15.8	12.9	57	-0.7	-2.3
2,4'-DDT	8.84	8.96	9.56	10.5	9.57	9.12	9.73	4.2	7.3	6.31	4.35	54	0.8	2.2
4,4'-DDD	26.2	26.2	26.4	25.2	26.7	26.3	26.0	0.5	3.0	25.6	9.65	3	0.0	0.1
4,4'-DDE	29.0	29.7	28.4	32.5	31.1	29.0	30.9	2.2	5.6	45.2	4.17	32	-3.4	-1.3
4,4'-DDT	12.3	12.4	12.9	11.4	13.2	12.5	12.4	2.5	7.4	10.3	4.32	20	0.5	0.8
Aldrin	<1.5	NR	NR	NR	NR					2.51	2.30			
cis-Chlordane	16.7	16.4	16.5	15.1	17.1	16.5	16.2	0.9	6.5	16.3	5.50	5	0.0	0.0
Dieldrin	11.3	11.3	11.2	11.8	12.5	11.3	11.9	0.4	5.2	10.3	7.52	16	0.2	0.6
gamma-HCH	11.1	11.2	11.9	12.5	11.8	11.4	11.9	3.8	4.6	3.53	4.24	240	2.0	9.5
Heptachlor	<1.5	NR	NR	NR	NR					1.33	1.54			
Heptachlor epoxide	10.9	11.1	11.4	12.6	12.7	11.1	12.2	2.4	7.4	4.43	5.10	180	1.5	7.0
Hexachlorobenzene	1.53	1.55	1.34	1.11	1.77	1.48	1.45	7.8	23	0.43	0.49	240	2.1	9.7
Mirex	<3.5	NR	NR	NR	NR					1.32	1.04			
trans-Nonachlor	15.0	14.7	14.4	13.6	14.1	14.7	14.2	1.8	3.8	13.0	4.17	9	0.3	0.4

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight) (cont.).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
Water (%)	91.7	92.0					91.8		0.3	91.8	0.3		0.0	0.0
PAHs														
Naphthalene	33.2	33.4	35.6	28.1	32.9	34.1	31.7	3.9	9.9	25.1	5.70	26	1.2	1.0
2-Methylnaphthalene	48.1	47.5	47.9	43.7	47.1	47.8	46.2	0.6	4.8	40.5	10.3	14	0.6	0.6
1-Methylnaphthalene	31.4	31.8	31.9	27.5	29.8	31.7	29.7	0.8	7.1	24.3	4.78	22	1.1	0.9
Biphenyl	55.1	52.5	53.8	48.3	36.4	53.8	46.2	2.4	19	22.9	14.5	100	1.6	4.1
2,6-Dimethyl= naphthalene	34.4	35.4	35.6	34.9	35.9	35.1	35.3	1.7	1.5	65.8	31.9	46	-1.0	-1.9
Acenaphthylene	12.6	12.7	12.5	12.5	12.5	12.6	12.6	0.7	0.3	8.69	3.20	44	1.2	1.8
Acenaphthene	11.2	10.7	11.2	10.5	10.5	11.0	10.7	2.5	3.2	9.07	1.59	17	1.0	0.7
1,6,7-Trimethyl= naphthalene	19.3	21.9	21.1	20.9	19.1	20.8	20.3	6.4	5.0	41.8	14.6	51	-1.5	-2.1
Fluorene	25.4	25.3	25.5	23.4	24.6	25.4	24.5	0.3	4.1	22.2	4.64	10	0.5	0.4
Phenanthrene	136	134	137	138	138	136	137	1.0	0.9	144	24.7	5	-0.3	-0.2
Anthracene	17.7	17.3	17.3	16.6	16.9	17.5	17.0	1.2	2.6	17.5	10.1	3	0.0	-0.1
1-Methylphenanthrene	56.5	59.8	58.8	65.9	61.1	58.4	61.8	2.9	6.2	67.8	7.42	9	-0.8	-0.4
Fluoranthene	374	372	375	385	384	374	381	0.4	1.7	395	80.3	3	-0.2	-0.1
Pyrene	279	278	280	288	287	279	284	0.3	1.7	282	48.1	2	0.1	0.0
Benz[a]anthracene	80.0	78.8	80.0	77.8	79.3	79.6	78.9	0.8	1.2	79.4	16.3	1	0.0	0.0
Chrysene + triphenylene	245	239	241	255	246.	242	248	1.2	2.7	227	51.8	9	0.4	0.4
Benzofluoranthenes (*b+j+k*)	162	166	166	176	173	165	171	1.6	3.2	158	26.3	8	0.5	0.3
Benzo[*e*]pyrene	119	120	123	128	123	121	124	1.8	3.1	114	21.8	9	0.5	0.4
Benzo[*a*]pyrene	26.4	25.9	30.7	32.2	23.4	27.7	27.8	9.4	16	29.4	5.67	13	-0.3	-0.2
Perylene	11.4	12.5	11.5	13.5	12.4	11.8	12.6	5.0	6.9	11.3	2.96	11	0.4	0.4
Indeno[1,2,3-*cd*]pyrene	29.7	27.0	27.6	28.3	27.8	28.1	28.1	5.1	0.7	20.0	7.09	40	1.1	1.6
Dibenz[*a,h*]- and dibenz[*a,c*]anthracene	<7.16	<7.16	<7.16	<7.16						7.56	6.89			
Benzo[*ghi*]perylene	28.2	28.7	29.1	31.3	28.4	28.7	29.4	1.5	5.4	26.0	9.72	13	0.4	0.5

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight) (cont.).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCB CONGENERS														
PCB 8	5.69	5.60	5.51	4.57	5.33	5.60	5.17	1.6	10	3.32	2.37	56	0.8	2.2
PCB 18	15.0	14.3	14.5	11.0	13.9	14.6	13.2	2.6	14	11.0	5.41	20	0.4	0.8
PCB 28	34.4	34.8	35.1	25.8	32.0	34.8	30.9	1.1	15	37.2	16.8	17	-0.4	-0.7
PCB 44	44.4	45.6	46.3	32.8	41.8	45.4	40.0	2.1	16	31.7	11.9	26	0.7	1.0
PCB 52	62.8	63.2	63.8	45.0	59.3	63.2	55.9	0.8	17	55.9	11.2	13	0.0	0.0
PCB 66/95	73.1	76.7	75.9	63.8	69.8	75.3	69.6	2.5	8.3	79.3	22.1	12	-0.4	-0.5
PCB 101/90	111	114	114	86.4	104	113	101	1.5	13	96.3	15.0	12	0.3	0.2
PCB 105	38.0	36.7	36.0	37.1	32.5	36.9	35.5	2.7	7.3	37.9	6.97	6	-0.3	-0.3
PCB 118	80.6	77.2	78.3	86.2	85.0	78.7	83.3	2.2	4.8	92.1	16.5	10	-0.5	-0.4
PCB 128	10.5	9.7	9.9	10.0	10.0	10.0	10.0	4.0	0.0	12.8	3.31	22	-0.8	-0.9
PCB 138/163/164	93.7	91.1	92.7	94.6	96.6	92.5	94.6	1.4	2.2	106	18.3	11	-0.6	-0.4
PCB 153	108	107	105	103	104	106	104	1.5	1.9	114	21.3	8	-0.4	-0.3
PCB 170/190	2.19	2.45	2.33	1.80	1.98	2.32	2.03	5.6	13	1.90	0.38	10	0.3	0.3
PCB 180	7.57	7.26	7.73	6.06	6.63	7.52	6.74	3.2	11	9.16	2.32	26	-1.0	-1.1
PCB 187/182	21.7	20.0	19.4	21.1	22.1	20.4	21.2	5.9	4.2	24.3	5.46	13	-0.6	-0.5
PCB 195	0.69	0.72	0.66	0.77	0.69	0.69	0.72	4.3	6.6	1.06	1.03	32	-0.3	-1.3
PCB 206	<0.68	<0.68	<0.68	<0.68	<0.68					4.23	7.11			
PCB 209	<0.69	<0.69	<0.69	<0.69	<0.69					0.84	0.86			

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight) (cont.).

BATTELLE

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PESTICIDES														
2,4'-DDD	11.8	11.7	11.3	11.6	11.7	11.6	11.6	2.4	0.5	11.3	5.11	3	0.1	0.1
2,4'-DDE	31.5	31.6	30.4	24.3	29.4	31.1	28.3	2.2	13	15.8	12.9	79	1.0	3.1
2,4'-DDT	4.17	4.50	4.57	4.20	3.96	4.41	4.19	4.8	5.4	6.31	4.35	34	-0.5	-1.3
4,4'-DDD	29.7	28.2	27.9	30.8	29.6	28.6	29.7	3.3	3.7	25.6	9.65	16	0.4	0.6
4,4'-DDE	49.3	47.8	47.1	50.1	47.7	48.1	48.6	2.4	2.6	45.2	4.17	8	0.8	0.3
4,4'-DDT	13.6	12.6	13.8	21.3	18.9	13.4	17.9	4.7	23	10.3	4.32	73	1.7	2.9
Aldrin	<0.66	<0.66	<0.66	<0.66	<0.66					2.51	2.30			
cis-Chlordane	15.1	14.7	14.1	14.7	14.3	14.7	14.5	3.3	1.8	16.3	5.50	11	-0.3	-0.4
Dieldrin	39.0	38.0	37.7	37.6	39.5	38.2	38.4	1.8	2.5	10.3	7.52	280	3.7	11.0
gamma-HCH	1.28	1.30	1.26	<1.02	1.11					3.53	4.24			
Heptachlor	2.03	2.30	2.35	1.39	2.24	2.23	1.95	7.8	25	1.33	1.54	47	0.4	1.9
Heptachlor epoxide	4.54	4.99	4.74	3.16	4.83	4.75	4.25	4.7	22	4.43	5.10	15	0.0	-0.2
Hexachlorobenzene	0.79	0.82	0.88	<0.56	<0.56					0.43	0.49			
Mirex	5.59	6.24	5.83	2.07	1.01	5.89	2.99	5.6	86	1.32	1.04	140	1.6	5.1
trans-Nonachlor	16.6	16.6	16.1	14.1	16.6	16.4	15.7	1.9	8.9	13.0	4.17	21	0.7	0.8

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight) (cont.).

NWFSC

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
Water (%)	91.7	91.7	91.7	91.5	92.1		91.8		0.3	91.8	0.3		-0.2	0.0
PAHs														
Naphthalene	NR	NR	NR	NR	NR					25.1	5.70			
2-Methylnaphthalene	32.0	29.9	31.9	29.2	34.1	31.3	31.5	3.8	7.8	40.5	10.3	22	-0.9	-0.9
1-Methylnaphthalene	16.6	16.5	17.1	15.1	20.1	16.7	17.3	1.9	15	24.3	4.78	29	-1.5	-1.2
Biphenyl	7.75	8.58	8.33	9.32	7.69	8.22	8.41	5.2	9.9	22.9	14.5	63	-1.0	-2.5
2,6-Dimethyl= naphthalene	41.6	43.6	45.1	43.8	44.6	43.4	43.9	4.0	1.4	65.8	31.9	33	-0.7	-1.3
Acenaphthylene	8.45	7.46	8.72	7.60	8.04	8.21	7.95	8.1	4.0	8.69	3.20	9	-0.2	-0.3
Acenaphthene	6.16	7.69	7.70	9.32	7.83	7.2	8.1	12	14	9.07	1.59	12	-0.6	-0.4
1,6,7-Trimethyl= naphthalene	55.5	49.4	52.6	54.2	48.8	52.5	51.8	5.8	5.3	41.8	14.6	24	0.7	1.0
Fluorene	20.4	20.8	17.5	17.7	24.5	19.6	20.6	9.2	17	22.2	4.64	14	-0.4	-0.3
Phenanthrene	117	114	116	119	121	116	119	1.3	2.3	144	24.7	18	-1.0	-0.7
Anthracene	8.54	10.8	9.40	10.8	9.19	9.58	9.86	12	8.5	17.5	10.1	44	-0.7	-1.7
1-Methylphenanthrene	68.3	67.5	65.4	67.8	69.3	67.1	68.1	2.2	1.7	67.8	7.42	1	0.0	0.0
Fluoranthene	427	416	424	436	425	422	428	1.3	1.7	395	80.3	8	0.4	0.3
Pyrene	315	297	305	314	310	306	310	3.0	1.3	282	48.1	10	0.6	0.4
Benz[*a*]anthracene	79.7	77.6	76.9	78.1	76.6	78.1	77.6	1.9	1.1	79.4	16.3	2	-0.1	-0.1
Chrysene + triphenylene	224	210	204	213	229	213	218	4.8	4.3	227	51.8	5	-0.2	-0.2
Benzofluoranthenes (*b*+*j*+*k*)	122	133	134	139	126	130	132	5.1	5.1	158	26.3	17	-1.0	-0.7
Benzo[*e*]pyrene	80.4	80.8	81.3	85.5	80.1	80.8	82.1	0.6	3.6	114	21.8	28	-1.4	-1.1
Benzo[*a*]pyrene	22.8	26.2	26.1	21.8	24.5	25.0	23.8	7.7	7.3	29.4	5.67	19	-1.0	-0.8
Perylene	10.5	9.1	10.2	10.2	10.0	9.9	10.0	7.3	1.4	11.3	2.96	11	-0.4	-0.5
Indeno[1,2,3-*cd*]pyrene	10.0	12.3	15.0	17.8	11.8	12.4	14.0	20	24	20.0	7.09	30	-0.9	-1.2
Dibenz[*a*,*h*]- and dibenz[*a*,*c*]anthracene	3.40	3.40	3.99	4.52	3.15	3.6	3.8	9.5	19	7.56	6.89	50	-0.6	-2.0
Benzo[*ghi*]perylene	15.7	17.7	20.1	23.2	14.6	17.8	18.5	12	23	26.0	9.72	29	-0.8	-1.2

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight) (cont.).

NWFSC

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCB CONGENERS														
PCB 8	NR	NR	NR	NR	NR					3.32	2.37			
PCB 18	25.6	25.0	23.5	22.6	25.1	24.7	24.1	4.4	5.6	11.0	5.41	120	2.4	4.8
PCB 28	73.4	75.8	75.9	72.4	77.6	75.0	75.0	1.9	3.5	37.2	16.8	100	2.2	4.1
PCB 44	85.5	85.5	86.3	83.6	89.2	85.8	86.2	0.5	3.3	31.7	11.9	170	4.6	6.9
PCB 52	125	126	126	123	130	126	126	0.5	2.8	55.9	11.2	130	6.3	5.0
PCB 66/95	121	121	123	121	129	122	124	0.9	3.6	79.3	22.1	56	2.0	2.3
PCB 101/90	154	153	156	140	157	154	150	1.0	6.1	96.3	15.0	56	3.6	2.3
PCB 105	45.5	45.5	45.8	45.6	48.6	45.6	47	0.4	3.7	37.9	6.97	23	1.3	0.9
PCB 118	145	145	147	148	157	146	150	0.8	4.0	92.1	16.5	63	3.5	2.5
PCB 128	25.6	25.7	27.2	25.8	27.0	26.2	26.3	3.4	2.3	12.8	3.31	100	4.1	4.2
PCB 138/163/164	166	169	171	160	170	169	166	1.5	3.3	106	18.3	57	3.3	2.3
PCB 153	215	215	217	215	228	216	220	0.5	3.3	114	21.3	93	5.0	3.7
PCB 170/190	6.30	6.48	6.71	6.16	5.98	6.50	6.21	3.2	4.2	1.90	0.38	230	11.4	9.1
PCB 180	60.6	61.3	61.8	62.0	65.0	61.23	62.74	1.0	3.2	9.16	2.32	590	23.1	23.4
PCB 187/182	47.8	47.8	50.9	46.9	49.5	48.8	48.4	3.7	2.8	24.3	5.46	99	4.4	4.0
PCB 195	<0.87	<0.88	<0.87	<0.72	<0.87					1.06	1.03			
PCB 206	<0.88	<0.90	<0.89	<0.72	<0.88					4.23	7.11			
PCB 209	1.91	1.88	1.97	1.41	1.83	1.92	1.72	2.4	16	0.84	0.86	110	1.0	4.2

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight) (cont.).

NWFSC

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	15.3	12.8	13.0	14.5	17.4	13.7	15.2	10.1	12.8	11.3	5.11	34	0.8	1.4
2,4'-DDE	11.7	11.8	11.9	9.5	11.5	11.8	10.9	0.8	11.7	15.8	12.9	31	-0.4	-1.2
2,4'-DDT	NR	NR	NR	NR	NR					6.31	4.35			
4,4'-DDD	30.3	30.4	30.8	31.7	34.4	30.5	32.2	0.9	6.2	25.6	9.65	26	0.7	1.0
4,4'-DDE	48.2	46.3	47.1	48.0	52.2	47.2	49.1	2.0	5.5	45.2	4.217	9	0.9	0.3
4,4'-DDT	7.96	7.92	7.82	7.47	8.49	7.90	7.95	0.9	6.4	10.3	4.32	23	-0.6	-0.9
Aldrin	3.27	3.24	3.29	2.91	2.79	3.27	2.99	0.8	8.3	2.51	2.30	19	0.2	0.8
cis-Chlordane	21.7	21.8	22.1	18.4	22.5	21.9	20.9	1.0	10.5	16.3	5.50	28	0.8	1.1
Dieldrin	9.44	8.98	8.95	7.78	10.3	9.12	9.07	3.0	13.9	10.3	7.52	12	-0.2	-0.5
gamma-HCH	<0.82	<0.83	<0.82	<0.678	<0.82					3.53	4.24			
Heptachlor	1.28	1.31	1.37	1.35	1.36	1.32	1.34	3.5	1.5	1.33	1.54	2	0.0	0.1
Heptachlor epoxide	<0.91	<0.92	<0.91	<0.74	<0.90					4.43	5.10			
Hexachlorobenzene	<0.90	<0.91	<0.90	<0.73	<0.88					0.43	0.49			
Mirex	1.54	1.53	1.53	1.57	1.61	1.53	1.57	0.4	2.4	1.32	1.04	19	0.2	0.8
trans-Nonachlor	20.4	20.2	20.8	16.2	20.0	20.5	18.9	1.5	12.4	13.0	4.17	45	1.4	1.8

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight) (cont.).

TAMU

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
Water (%)	NR	92.2	NR	92.4	92.5		92.4		0.2	91.8	0.3		1.7	0.0
PAHs														
Naphthalene	20.1	24.9	21.3	23.4	25.7	22.1	23.7	11	7.7	25.1	5.70	7	-0.2	-0.2
2-Methylnaphthalene	28.9	36.2	34.7	34.6	36.2	33.2	34.7	12	4.3	40.5	10.3	14	-0.6	-0.6
1-Methylnaphthalene	25.8	25.4	23.7	24.1	26.5	25.0	25.2	4.4	4.9	24.3	4.78	5	0.2	0.1
Biphenyl	11.6	11.6	14.3	12.8	13.4	12.5	12.9	13	3.6	22.9	14.5	44	-0.7	-1.7
2,6-Dimethyl= naphthalene	60.7	39.2	47.0	45.7	66.9	49.0	53.9	22	21	65.8	31.9	19	-0.4	-0.7
Acenaphthylene	6.06	5.28	6.19	7.11	9.24	5.84	7.40	8.4	23	8.69	3.20	19	-0.4	-0.6
Acenaphthene	11.47	7.99	9.79	10.13	10.98	9.8	10.3	18	6.1	9.07	1.59	16	0.8	0.5
1,6,7-Trimethyl= naphthalene	54.3	54.3	58.9	53.8	61.2	55.8	56.9	4.8	6.7	41.8	14.6	36	1.0	1.5
Fluorene	20.5	19.1	20.4	17.1	21.2	20.0	19.4	3.9	11	22.2	4.64	13	-0.6	-0.5
Phenanthrene	116	110	115	125	145	114	128	3.0	12	144	24.7	12	-0.7	-0.4
Anthracene	13.7	17.8	19.3	18.2	16.9	16.9	17.3	17	4.2	17.5	10.1	6	0.0	0.0
1-Methylphenanthrene	58.1	67.0	68.6	67.0	66.5	64.6	66.0	8.7	1.9	67.8	7.42	3	-0.2	-0.1
Fluoranthene	294	329	346	306	342	323	324	8.2	5.7	395	80.3	18	-0.9	-0.7
Pyrene	217	238	259	222	239	238	233	8.9	4.1	282	48.1	17	-1.0	-0.7
Benz[a]anthracene	79.0	96.3	80.9	70.7	76.2	85.4	77.4	11	9.6	79.4	16.3	8	-0.1	-0.1
Chrysene + triphenylene	219	218	232	242	253.4	223	239	3.4	6.5	227	521.8	7	0.2	0.2
Benzofluoranthenes (*b+j+k*)	146	151	145	155	156	147	153	2.0	3.0	158	26.3	3	-0.2	-0.1
Benzo[*e*]pyrene	112	107	103	119	122	107	116	4.0	6.7	114	21.8	6	0.1	0.1
Benzo[*a*]pyrene	27.7	28.7	27.6	27.0	28.3	28.0	27.7	2.3	2.5	29.4	5.67	6	-0.3	-0.2
Perylene	13.8	14.1	16.0	11.6	13.5	14.6	13.2	8.2	12	11.3	2.96	17	0.6	0.7
Indeno[1,2,3-*cd*]pyrene	17.4	14.6	13.0	18.7	21.8	15.0	18.5	15	19	20.0	7.09	14	-0.2	-0.3
Dibenz[*a,h*]- and dibenz[*a,c*]anthracene	4.64	4.25	3.09	6.58	5.09	3.99	5.22	20	25	7.56	6.89	31	-0.3	-1.2
Benzo[*ghi*]perylene	25.6	19.9	18.0	27.2	28.5	21.2	25.6	19	15	26.0	9.72	11	0.0	-0.1

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight) (cont.).

TAMU

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PCB CONGENERS														
PCB 8	2.20	1.70	1.80	2.40	2.50	1.90	2.27	14	14	3.32	2.37	32	-0.4	-1.3
PCB 18	11.2	10.8	11.3	8.70	10.8	11.1	10.2	2.4	13	11.0	5.41	8	-0.1	-0.3
PCB 28	56.1	52.5	57.9	51.1	55.3	55.5	54.0	5.0	4.6	37.2	16.8	45	1.0	1.8
PCB 44	42.1	44.1	44.3	39.0	43.5	43.5	42.0	2.8	6.2	31.7	11.9	33	0.9	1.3
PCB 52	62.9	63.5	65.2	51.1	55.3	63.9	56.8	1.9	11	55.9	11.2	8	0.1	0.1
PCB 66/95	60.3	65.6	52.6	56.4	64.9	59.5	60.3	11	7.1	79.3	22.1	24	-0.9	-1.0
PCB 101/90	97.2	95.2	99.1	89.2	94.0	97.2	93.5	2.0	4.3	96.3	15.0	4	-0.2	-0.1
PCB 105	45.7	48.3	43.5	35.4	44.6	45.8	41.9	5.2	14	37.9	76.97	15	0.6	0.4
PCB 118	94.4	99.3	100	83.5	98.4	97.9	93.3	3.1	9.1	92.1	16.5	7	0.1	0.1
PCB 128	15.1	16.7	15.4	13.8	14.6	15.7	14.7	5.4	6.6	12.8	3.31	15	0.6	0.6
PCB 138/163/164	114	117	115	103	112	115	110	1.5	6.7	106	18.3	6	0.2	0.2
PCB 153	129	134	135	127	130	132	130	2.4	2.2	114	21.3	14	0.8	0.6
PCB 170/190	ZR	ZR	ZR	ZR	ZR					1.90	0.38	100	-5.1	-4.0
PCB 180	32.4	34.0	32.2	29.8	33.0	32.87	31.89	3.0	5.7	9.16	2.32	250	9.8	9.9
PCB 187/182	27.8	29.7	27.4	25.2	27.9	28.3	27.1	4.3	6.2	24.3	5.46	12	0.5	0.5
PCB 195	ZR	ZR	ZR	ZR	ZR					1.06	1.03	100	-1.0	-4.0
PCB 206	ZR	ZR	ZR	0.10	ZR					4.23	7.11	99	-0.6	-4.0
PCB 209	0.90	0.90	0.80	0.70	0.80	0.87	0.79	6.7	11	0.84	0.86	9	-0.1	-0.2

Table V.2. 1992 Mussel IV (QA92TIS4) intercomparison exercise results (ng/g dry weight) (cont.).

TAMU

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PESTICIDES														
2,4'-DDD	4.75	5.47	4.61	4.38	4.74	4.94	4.69	9.3	6.1	11.3	5.11	59	-1.3	-2.3
2,4'-DDE	ZR	ZR	ZR	ZR	ZR					15.8	12.9			
2,4'-DDT	6.05	3.08	4.93	4.05	5.13	4.69	4.62	32	12	6.31	4.35	27	-0.4	-1.1
4,4'-DDD	29.5	29.2	27.6	24.9	28.8	28.7	27.5	3.6	8.2	25.6	9.65	9	0.2	0.3
4,4'-DDE	40.5	43.4	40.4	35.8	43.9	41.5	40.4	4.1	10	45.2	4.17	11	-1.2	-0.4
4,4'-DDT	7.36	7.53	7.61	6.96	7.65	7.50	7.37	1.7	4.9	10.3	4.32	29	-0.7	-1.2
Aldrin	5.18	4.29	1.99	5.12	4.64	3.82	4.53	43	15	2.51	2.30	85	0.9	3.2
cis-Chlordane	2.45	3.04	2.80	2.50	2.40	2.76	2.55	11	7.3	16.3	5.50	84	-2.5	-3.4
Dieldrin	5.90	6.01	6.05	5.39	4.78	5.99	5.39	1.3	11	10.3	7.52	47	-0.6	-1.9
gamma-HCH	0.61	0.56	0.60	0.52	0.56	0.59	0.56	4.5	6.3	3.53	4.24	84	-0.7	-3.4
Heptachlor	ZR	ZR	ZR	ZR	ZR					1.33	1.54			
Heptachlor epoxide	0.65	0.44	0.51	0.26	0.49	0.53	0.43	20	34	4.43	5.10	90	-0.8	-3.6
Hexachlorobenzene	0.05	0.08	0.07	0.15	0.09	0.07	0.10	23	42	0.43	0.49	76	-0.7	-3.0
Mirex	0.29	0.55	0.35	0.49	0.41	0.40	0.43	34	12	1.32	1.04	67	-0.9	-2.7
trans-Nonachlor	13.4	12.0	11.2	11.2	10.6	12.2	11.4	9.1	7.1	13.0	4.17	13	-0.4	-0.5

APPENDIX VI

1993 TRACE ORGANIC INTERCOMPARISON EXERCISE RESULTS

NIST:	National Institute of Standards and Technology
BATTELLE:	Battelle Ocean Sciences
NWFSC:	NOAA/NMFS/Northwest Fisheries Science Center
TAMU:	Texas A&M University/GERG

S1-A, S1-B, S1-C: Results from three gas chromatographic analyses of S1.
S1, S2, S3: Results from three independent sample preparations and analyses.
S1 Mean: The mean value of the reported S1 replicates, S1-A, S1-B, and S1-C.
S1-3 Mean: The mean concentration of the three samples, S1, S2, and S3, in which the mean value of the three GC replicates was used for the S1 concentration.
S1 %RSD: The percent relative standard deviation of the S1 replicates, S1-A, S1-B, and S1-C.
S1-3 %RSD: The percent relative standard deviation of the S1 Mean and the reported samples, S2 and S3.
Consensus value: NIST-calculated consensus value and standard deviation (s).
Mean Absolute %Error The mean of the absolute percent errors of the S1 Mean and the reported samples, S2 and S3 relative to the exercise consensus value.
z Score: The ratio of a bias estimate to a performance criterion. The difference between the laboratory mean and the accepted mean was used as the bias estimate. z Scores were calculated in two ways, using the SD of the S1-3 mean, and 25% of the accepted value as performance criteria.
N R : Not reported.
Z R : Zero or below MDL.

Table VI.1. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results (ng/g dry weight).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
Water (%)		90.1		89.9	NR		90.0		0.1	89.1	1.1		0.8	0.
PAHs														
Naphthalene	13.5	13.7	13.7	13.9	NR	13.6	13.8	0.65	1.4	14.9	8.50	7.6	-0.1	-0.3
2-Methylnaphthalene	10.1	9.81	9.23	7.74	NR	9.73	8.73	4.7	16	7.26	3.07	20	0.5	0.8
1-Methylnaphthalene	5.14	5.72	5.54	4.82	NR	5.47	5.14	5.4	8.9	4.41	1.85	17	0.4	0.7
Biphenyl	<8.8	<8.8	<8.8	<8.8	NR					4.08	1.35			
2,6-Dimethyl= naphthalene	<8.6	<8.6	<8.6	<8.6	NR					5.78	4.23			
Acenaphthylene	<10	<10	<10	<10	NR					4.88	1.97			
Acenaphthene	<3.8	<3.8	<3.8	<3.8	NR					3.14	1.08			
1,6,7-Trimethyl= naphthalene	<5	<5	<5	<5	NR					5.04	2.51			
Fluorene	<6.4	<6.4	<6.4	<6.4	NR					4.24	0.78			
Phenanthrene	18.6	17.8	19.4	21.0	NR	18.6	19.8	4.2	8.6	17.9	5.10	11	0.4	0.4
Anthracene	6.60	7.22	6.31	8.81	NR	6.71	7.76	6.9	19	7.25	2.75	14	0.2	0.3
1-Methylphenanthrene	9.59	10.1	10.3	10.1	NR	10.0	10.0	3.8	0.58	10.6	3.00	5.6	-0.2	-0.2
Fluoranthene	207	213	214	207	NR	211	209	1.7	1.3	187	55.0	12	0.4	0.5
Pyrene	194	197	198	194	NR	196	195	1.1	0.93	178	43.0	9.5	0.4	0.4
Benz[*a*]anthracene	37.3	36.4	37.8	47.1	NR	37.2	42.1	2.0	17	37.4	9.20	14	0.5	0.5
Chrysene + triphenylene	50.4	42.0	50.5	55.9	NR	47.7	51.8	10	11	89.0	21.9	42	-1.7	-1.7
Benzofluoranthenes (*b*+*j*+*k*)	103	101	110	141	NR	105	123	4.1	21	89.4	16.6	37	2.0	1.5
Benzo[*e*]pyrene	127	119	130	149	NR	125	137	4.3	12	91.3	21.0	50	2.2	2.0
Benzo[*a*]pyrene	19.9	17.9	20.8	17.9	NR	19.5	18.7	7.7	6.0	17.5	3.80	7.3	0.3	0.3
Perylene	8.73	8.12	9.42	8.93	NR	8.76	8.84	7.4	1.4	7.24	2.19	22	0.7	0.9
Indeno[1,2,3-*cd*]= pyrene	19.0	16.4	18.5	22.1	NR	18.0	20.1	7.6	15	16.1	4.60	25	0.9	1.0
Dibenz[*a,h*]- and dibenz[a,c]anthracene	<6.7	<6.7	<6.7	<6.7	NR					2.62	1.09			
Benzo[*ghi*]perylene	32.3	32.6	34.3	44.7	NR	33.1	38.9	3.3	21	27.5	6.70	41	1.7	1.7

Table VI.1. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results (ng/g dry weight) (cont.).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCB CONGENERS														
PCB 8	9.18	9.69	8.20	9.51	NR	9.02	9.27	8.4	3.7	5.72	2.32	62	1.5	2.5
PCB 18	46.4	46.9	44.4	44.3	NR	45.9	45.1	2.9	2.5	30.7	8.10	47	1.8	1.9
PCB 28	137	127	120	119	NR	128	124	6.7	5.1	65.8	24.7	88	2.3	3.5
PCB 44	102	102	101	94	NR	102	98	0.57	5.5	61.8	27.3	59	1.3	2.3
PCB 52	158	159	163	146	NR	160	153	1.6	6.5	104	37.0	47	1.3	1.9
PCB 66/95	163	164	162	155	NR	163	159	0.61	3.6	103	31.0	54	1.8	2.2
PCB 101/90	206	207	209	192	NR	207	200	0.74	5.4	129	44.0	55	1.6	2.2
PCB 105	114	113	116	113	NR	114	114	1.3	0.83	55.6	18.5	110	3.1	4.2
PCB 118	125	139	131	144	NR	132	138	5.3	6.3	133	33.0	4	0.1	0.1
PCB 128	22.7	22.4	22.6	23.4	NR	22.6	23.0	0.68	2.6	21.7	6.30	6	0.2	0.2
PCB 138/163/164	144	143	149	143	NR	145	144	2.2	1.1	147	36.0	2	-0.1	-0.1
PCB 153	139	138	143	137	NR	140	139	1.9	1.5	147	38.0	2	-0.2	-0.2
PCB 170/190	6.13	5.98	5.98	6.00	NR	6.03	6.02	1.4	0.35	4.39	2.33	37	0.7	1.5
PCB 180	34.1	33.8	34.1	34.0	NR	34.0	34.0	0.51	0.00	13.2	3.30	160	6.4	6.3
PCB 187/182	35.5	35.5	35.7	35.2	NR	35.6	35.4	0.32	0.73	32.2	8.90	10	0.4	0.4
PCB 195	<0.5	<0.5	<0.5	<0.5	NR					0.68	0.38			
PCB 206	<0.7	<0.7	<0.7	<0.7	NR					0.52	0.40			
PCB 209	<0.7	<0.7	<0.7	<0.7	NR					1.09	1.38			

Table VI.1. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results (ng/g dry weight) (cont.).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	14.6	15.4	14.5	15.3	N R	14.8	15.1	3.3	2.2	14.4	3.80	5	0.2	0.2
2,4'-DDE	37.8	39.0	36.6	34.0	N R	37.8	35.9	3.2	7.5	9.07	8.26	300	3.2	11.8
2,4'-DDT	<0.9	<0.9	<0.9	<0.9	N R					5.95	3.16			
4,4'-DDD	54.7	55.1	54.2	55.3	N R	54.7	55.0	0.82	0.81	42.1	12.8	31	1.0	1.2
4,4'-DDE	69.3	68.5	69.5	70.4	N R	69.1	69.8	0.77	1.3	50.5	13.6	38	1.4	1.5
4,4'-DDT	<2	<2	<2	<2	N R					3.05	1.10			
Aldrin	<0.7	<0.7	<0.7	<0.7	N R					6.98	8.24			
cis-Chlordane	17.0	15.3	16.3	16.8	N R	16.2	16.5	5.3	33	15.6	2.80	6	0.3	0.2
Dieldrin	8.07	7.08	7.89	7.88	N R	7.68	7.78	6.9	1.8	6.75	2.48	15	0.4	0.6
gamma-HCH	<1	<1	<1	<1	N R					2.73	2.87			
Heptachlor	<1.1	<1.1	<1.1	<1.1	N R					4.49	4.17			
Heptachlor epoxide	5.90	5.78	5.54	5.22	N R	5.74	5.48	3.1	6.7	4.82	3.63	14	0.2	0.5
Hexachlorobenzene	0.39	0.38	0.37	0.37	N R	0.38	0.37	3.2	87	0.22	0.07	14	0.5	0.5
Mirex	<0.6	<0.6	<0.6	<0.6	N R					1.40	1.01			
trans-Nonachlor	18.8	18.6	17.7	17.8	N R	18.4	18.1	3.2	2.2	17.5	6.20	3	0.1	0.1

Table VI.1. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results (ng/g dry weight) (cont.).

NWFSC

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
Water (%)		89.2		89.5	89.5		89.4		0.19	89.1	1.1	0.29	0.	
PAHs														
Naphthalene	NR	NR	NR	NR	NR					14.9	8.50			
2-Methylnaphthalene	10.1	10.6	10.3	9.5	11.7	10.3	10.5	2.4	11	7.26	3.07	45	1.1	1.8
1-Methylnaphthalene	5.33	4.98	5.33	5.28	5.86	5.21	5.45	3.9	6.5	4.41	1.85	24	0.6	0.9
Biphenyl	3.89	3.54	4.00	3.50	3.81	3.81	3.71	6.3	4.8	4.08	1.35	9	-0.3	-0.4
2,6-Dimethyl= naphthalene	4.69	4.71	4.72	4.81	5.45	4.71	4.99	0.32	8.1	5.78	4.23	14	-0.2	-0.6
Acenaphthylene	4.44	6.06	5.35	4.66	7.31	5.28	5.75	15.	24	4.88	1.97	23	0.4	0.7
Acenaphthene	2.87	2.67	3.28	2.53	2.97	2.94	2.81	11	8.7	3.14	1.08	11	-0.3	-0.4
1,6,7-Trimethyl= naphthalene	7.20	6.36	6.22	6.31	7.07	6.59	6.66	8.0	5.8	5.04	2.51	32	0.6	1.3
Fluorene	5.62	5.93	4.70	4.97	5.22	5.42	5.20	12	4.3	4.24	0.78	23	1.2	0.9
Phenanthrene	17.8	17.1	17.3	17.7	17.3	17.4	17.5	2.1	1.2	17.9	5.10	2	-0.1	-0.1
anthracene	7.62	6.39	7.05	6.72	6.98	7.02	6.91	8.8	2.4	7.25	2.75	6	-0.1	-0.2
1-Methylphenanthrene	11.1	10.1	10.8	10.5	10.7	10.7	10.6	4.8	1.0	10.6	3.00	2	-0.0	-0.0
Fluoranthene	245	241	243	248	256	243	249	0.82	2.6	187	55.0	33	1.1	1.3
Pyrene	223	226	218	224	232	222	226	1.8	2.3	178	43.0	27	1.1	1.1
Benz[*a*]anthracene	33.9	34.1	34.4	35.7	34.8	34.1	34.9	0.74	2.3	37.4	9.20	7	-0.3	-0.3
Chrysene + triphenylene	88.7	89.3	89.6	92.8	93.0	89.2	91.7	0.51	2.3	89.0	21.9	3	0.1	0.1
Benzofluoranthenes (*b+j+k*)	79.6	78.9	79.1	83.4	80.0	79.2	80.9	0.46	2.8	89.4	16.6	10	-0.5	-0.4
Benzo[*e*]pyrene	87.4	86.6	85.1	87.5	86.2	86.4	86.7	1.4	0.82	91.3	21.0	5	-0.2	-0.2
Benzo[*a*]pyrene	14.7	14.9	15.2	15.6	13.9	14.9	14.8	1.7	5.8	17.5	3.80	15	-0.7	-0.6
Perylene	10.4	10.4	10.5	7.18	7.28	10.4	8.30	0.55	22	7.24	2.19	15	0.5	0.6
Indeno[1,2,3-*cd*]pyrene	17.8	17.4	16.7	18.3	17.1	17.3	17.6	3.2	3.67	16.1	4.60	9	0.3	0.4
Dibenz[*a,h*]- and dibenz[a,c]anthracene	3.95	3.31	3.39	3.50	3.51	3.55	3.52	9.8	0.75	2.62	1.09	34	0.8	1.4
Benzo[*ghi*]perylene	40.2	38.7	37.0	39.1	36.2	38.6	38.0	4.1	4.1	27.5	6.70	38	1.6	1.5

Table VI.1. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results (ng/g dry weight) (cont.).

NWFSC

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCB CONGENERS														
PCB 8	NR	NR	NR	NR	NR					5.72	2.32			
PCB 18	40.9	39.3	38.7	42.9	42.2	39.6	41.6	2.9	4.1	30.7	8.10	35	1.3	1.4
PCB 28	93.4	94.1	94.4	99.7	98.8	94.0	97.5	0.55	3.2	65.8	24.7	48	1.3	1.9
PCB 44	97.9	98.5	98.5	107	104	98.3	103	0.35	4.3	61.8	27.3	67	1.5	2.7
PCB 52	156	158	157	166	164	157	162	0.64	2.9	104	37.0	56	1.6	2.2
PCB 66/95	129	130	129	141	137	129	136	0.45	4.4	103	31.0	32	1.1	1.3
PCB 101/90	156	157	156	175	166	156	166	0.37	5.6	129	44.0	29	0.8	1.2
PCB 105	47.5	47.7	47.7	52.0	50.6	47.6	50.1	0.24	4.5	55.6	18.5	10	-0.3	-0.4
PCB 118	160	162	162	176	172	161	170	0.72	4.5	133	33.0	27	1.1	1.1
PCB 128	30.9	31.0	30.9	32.0	31.7	30.9	31.5	0.19	1.7	21.7	6.30	45	1.6	1.8
PCB 138/163/164	165	166	165	178	174	165	172	0.35	3.8	147	36.0	17	0.7	0.7
PCB 153	245	246	246	268	261	246	258	0.24	4.4	147	38.0	75	2.9	3.0
PCB 170/190	10.1	10.5	10.7	10.4	10.6	10.4	10.5	2.9	1.0	4.39	2.33	140	2.6	5.6
PCB 180	15.9	15.9	16.0	16.3	16.8	15.9	16.3	0.36	2.7	13.2	3.30	24	1.0	0.9
PCB 187/182	45.1	45.6	45.7	49.8	47.7	45.5	47.7	0.71	4.6	32.2	8.90	48	1.7	1.9
PCB 195	<0.49	<0.54	<0.52	<0.98	<0.82					0.68	0.38			
PCB 206	<0.47	<0.52	<0.45	<0.95	<0.79					0.52	0.40			
PCB 209	2.45	2.86	2.61	3.12	2.21	2.64	2.66	7.83	17	1.09	1.38	140	1.1	5.7

Table VI.1. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results (ng/g dry weight) (cont.).

NWFSC

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	18.3	18.1	18.2	18.1	18.1	18.2	18.1	0.55	0.32	14.4	3.80	26	1.0	1.0
2,4'-DDE	3.67	3.68	3.65	3.85	3.50	3.67	3.67	0.42	4.8	9.07	8.26	60	-0.6	-2.4
2,4'-DDT	<0.66	<0.74	<0.70	<1.33	<1.11					5.95	3.16			
4,4'-DDD	62.5	61.6	62.1	60.2	60.8	62.1	61.0	0.73	1.6	42.1	12.8	45	1.5	1.8
4,4'-DDE	54.6	54.3	54.9	51.1	53.1	54.6	52.9	0.55	3.3	50.5	13.6	5	0.2	0.2
4,4'-DDT	2.75	2.80	2.64	2.52	2.71	2.73	2.65	3.0	4.4	3.05	1.10	13	-0.3	-0.5
Aldrin	1.26	1.24	1.64	1.70	1.58	1.38	1.55	16	10	6.98	8.24	78	-0.7	-3.1
cis-Chlordane	22.3	22.0	22.2	22.3	22.0	22.2	22.2	0.69	0.68	15.6	2.80	42	2.4	1.7
Dieldrin	8.37	8.61	8.55	6.95	8.08	8.51	7.85	1.5	10	6.75	2.48	16	0.4	0.7
gamma-HCH	<0.55	<0.62	<0.58	<1.11	<0.93					2.73	2.87			
Heptachlor	<0.49	<0.55	<0.52	<0.99	<0.83					4.49	4.17			
Heptachlor epoxide	<0.55	<0.61	<0.58	<1.11	<0.92					4.82	3.63			
Hexachlorobenzene	0.93	0.79	0.82	<1.17	<0.97					0.22	0.07			
Mirex	1.38	1.13	1.37	1.43	1.40	1.29	1.37	11	5.2	1.40	1.01	3	-0.0	-0.1
trans-Nonachlor	21.8	21.7	21.7	22.7	22.4	21.7	22.3	0.27	2.2	17.5	6.2	27	0.8	1.1

Table VI.1. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results (ng/g dry weight) (cont.).

TAMU

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
Water (%)		89.0		89.1	88.2	89.0	88.8		0.5	89.1	1.1		-0.3	0.0
PAHs														
Naphthalene	15.2	12.9	13.9	17.5	15.1	14.0	15.5	8.4	11	14.9	8.50	9	0.1	0.2
2-Methylnaphthalene	6.88	8.33	8.06	9.87	6.97	7.76	8.20	9.9	18	7.26	3.07	17	0.3	0.5
1-Methylnaphthalene	7.34	7.43	8.15	5.67	5.01	7.64	6.11	5.9	22	4.41	1.85	39	0.9	1.5
Biphenyl	5.07	4.98	5.16	6.12	5.35	5.07	5.52	1.8	9.9	4.08	1.35	35.	1.1	1.4
2,6-Dimethyl= naphthalene	8.79	7.52	5.52	5.88	6.29	7.28	6.48	23	11	5.78	4.23	13	0.2	0.5
Acenaphthylene	7.61	7.52	8.79	7.13	7.29	7.97	7.46	8.9	6.0	4.88	1.97	53	1.3	2.1
Acenaphthene	2.99	4.53	3.89	2.83	3.23	3.80	3.29	20	15	3.14	1.08	12	0.1	0.2
1,6,7-Trimethyl= naphthalene	6.86	7.16	6.70	7.72	8.16	6.91	7.60	3.3	8.3	5.04	2.51	51	1.0	2.0
Fluorene	4.35	6.79	6.52	4.84	4.84	5.89	5.19	23	12	4.24	0.78	22	1.2	0.9
Phenanthrene	15.1	17.2	13.4	16.4	13.0	15.2	14.9	13	12	17.9	5.10	17	-0.6	-0.7
Anthracene	10.2	13.7	9.3	10.8	10.3	11.1	10.7	21	3.8	7.25	2.75	48	1.3	1.9
1-Methylphenanthrene	7.34	11.77	8.88	10.42	8.33	9.33	9.36	24.	11	10.6	3.00	14.	-0.4	-0.5
Fluoranthene	115	135	121	133	105	123	120	8.2	12	187	55.0	36	-1.2	-1.4
Pyrene	102	125	111	122	99	113	111	10	10	178	43.0	38	-1.6	-1.5
Benz[a]anthracene	37.0	39.8	27.4	36.5	26.5	34.7	32.6	19	16	37.4	9.20	14	-0.5	-0.5
Chrysene + triphenylene	84.6	95.1	100	104	94.2	93.3	97.1	8.6	6.0	89.0	21.9	10	0.4	0.4
Benzofluoranthenes (*b+j+k*)	64.5	70.0	58.7	71.6	65.2	64.4	67.0	8.8	5.9	89.4	16.6	25	-1.3	-1.0
Benzo[*e*]pyrene	73.4	85.9	76.8	85.3	75.0	78.7	79.7	8.2	6.5	91.3	21.0	13	-0.6	-0.5
Benzo[*a*]pyrene	11.1	12.6	11.9	16.3	14.6	11.9	14.2	6.1	16	17.5	3.80	18	-0.8	-0.7
Perylene	8.70	10.60	8.33	11.0	7.99	9.21	9.39	13	16	7.24	2.19	30	1.0	1.2
Indeno[1,2,3-*cd*]pyrene	10.2	12.7	10.5	12.6	11.2	11.1	11.7	12	7.1	16.1	4.60	27	-1.0	-1.1
Dibenz[*a,h*]- and dibenz[a,c]anthracene	2.26	3.53	2.72	4.02	2.89	2.84	3.25	23	21	2.62	1.09	27	0.6	1.0
Benzo[*ghi*]perylene	22.8	24.0	22.2	23.5	20.0	23.0	22.2	4.0	8.4	27.5	6.70	19.	-0.8	-0.8

Table VI.1. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results (ng/g dry weight) (cont.).

TAMU

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCB CONGENERS														
PCB 8	3.61	3.19	3.90	3.57	2.62	3.57	3.25	1.0	17	5.72	2.32	43	-1.1	-1.7
PCB 18	21.4	21.9	21.4	24.5	22.6	21.6	22.9	1.5	6.5	30.7	8.10	26	-1.0	-1.0
PCB 28	70.3	76.0	72.9	77.3	80.0	73.1	76.8	3.9	4.5	65.8	24.7	17	0.5	0.7
PCB 44	66.2	65.6	65.0	73.9	69.0	65.6	69.5	0.95	6.0	61.8	27.3	12	0.3	0.5
PCB 52	99.4	99.9	100	111	106	100	106	0.34	5.3	104	37.0	4	0.0	0.1
PCB 66/95	94.4	93.3	90.0	111	113	92.5	106	2.5	11	103	31.0	10	0.1	0.1
PCB 101/90	130	130	130	151	149	130	143	0.32	8.1	129	44.0	11	0.3	0.5
PCB 105	50.5	52.8	55.9	66.9	50.1	53.1	56.7	5.0	16	55.6	18.5	12	0.1	0.1
PCB 118	132	125	126	156	156	128	147	2.7	11	133	33.0	13	0.34	0.34
PCB 128	18.8	18.3	18.6	22.6	23.1	18.6	21.4	1.5	12	21.7	6.30	8	-0.0	-0.1
PCB 138/163/164	130	126	127	155	157	128	147	1.4	11	147	36.0	8	-0.0	-0.0
PCB 153	177	169	168	203	222	171	199	2.6	13	147	38.0	35	1.4	1.4
PCB 170/190	MI	MI	MI	MI	MI					4.39	2.33			
PCB 180	24.0	22.7	23.8	29.4	31.7	23.5	28.2	2.9	15	13.2	3.30	110	4.6	4.5
PCB 187/182	28.5	27.9	28.4	34.1	34.3	28.3	32.2	1.1	11	32.2	8.90	8	0.0	0.0
PCB 195	<1.76	<1.76	<1.76	<1.76	<1.76					0.68	0.38			
PCB 206	<1.51	<1.51	<1.51	<1.51	<1.51					0.52	0.40			
PCB 209	<1.60	<1.60	<1.60	<1.60	<1.60					1.09	1.38			

M I - Matrix interference.

Table VI.1. 1993 Mussel Tissue V (QA93TIS5) intercomparison exercise results (ng/g dry weight) (cont.).

TAMU

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	4.72	4.81	4.90	7.25	5.42	4.81	5.82	1.9	22	14.4	3.80	60	-2.27	-2.39
2,4'-DDE	3.04	3.05	3.58	4.37	4.76	3.22	4.12	9.5	19	9.07	8.26	55	-0.60	-2.18
2,4'-DDT	7.90	8.81	8.57	10.5	8.73	8.43	9.22	5.6	12	5.95	3.16	55	1.04	2.20
4,4'-DDD	44.4	44.7	44.0	54.7	52.3	44.3	50.4	0.77	11	42.1	12.8	20	0.65	0.79
4,4'-DDE	47.2	47.6	43.9	55.7	55.0	46.2	52.3	4.34	10	50.5	13.6	9	0.14	0.15
4,4'-DDT	2.60	2.22	2.75	2.23	2.23	2.52	2.33	11	7.2	3.05	1.10	24	-0.65	-0.94
Aldrin	<2.40	<2.40	<2.40	<2.40	<2.40					6.98	8.24			
cis-Chlordane	14.4	14.8	14.3	16.7	15.7	14.5	15.7	1.8	7.0	15.6	2.80	5	0.03	0.02
Dieldrin	3.36	3.56	3.38	5.39	3.90	3.43	4.24	3.1	24	6.75	2.48	37	-1.01	-1.49
gamma-HCH	0.64	0.68	0.60	0.69	0.97	0.64	0.77	6.5	23	2.73	2.87	72	-0.68	-2.87
Hexachlorobenzene	0.20	0.21	0.20	0.36	0.28	0.20	0.28	2.6	27	0.22	0.07	32	0.91	1.10
Heptachlor	<2.08	<2.08	<2.08	<2.08	<2.08					4.49	4.17			
Heptachlor epoxide	0.18	0.19	0.20	0.34	0.14	0.19	0.22	6.8	47	4.82	3.63	95	-1.27	-3.81
Mirex	0.72	0.73	0.80	0.92	0.93	0.75	0.86	6.0	11	1.40	1.01	38.	-0.53	-1.53
trans-Nonachlor	14.4	15.0	14.8	18.0	23.5	14.7	18.7	2.3	24	17.5	6.20	18	0.20	0.28

Table VI.2. 1993 Fish homogenate I (QA93FSH1) intercomparison exercise results (ng/g wet weight).

BATTELLE

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PCB CONGENERS														
PCB 8	8.58	8.55	9.22	7.48	8.28	8.78	8.18	4.3	8.0	3.86	2.67	110	1.6	2.2
PCB 18	62.6	64.7	63.6	64.1	60.8	63.6	62.8	1.6	2.8	21.3	4.90	200	8.5	3.9
PCB 28	42.5	43.5	44.1	48.5	42.4	43.4	44.8	1.9	7.3	29.3	8.20	53	1.9	1.1
PCB 44	139	139	136	132	131	138	134	1.3	2.8	68.4	18.4	95	3.5	1.9
PCB 52	234	238	234	224	227	235	229	0.98	2.6	113	32.0	100	3.6	2.0
PCB 66/95	220	227	225	219	212	224	218	1.6	2.8	134	41.0	63	2.0	1.3
PCB 101/90	254	255	248	237	244	252	244	1.5	3.1	120	19.0	100	6.7	2.1
PCB 105	94.9	93.1	88.7	80.0	87.2	92.2	86.5	3.5	7.1	51.0	15.7	70	2.3	1.4
PCB 118	174	180	175	139	166	176	160	1.8	12	117	32.0	37	1.3	0.7
PCB 128	15.7	15.6	15.0	14.1	15.1	15.4	14.9	2.4	4.7	16.9	4.90	12	-0.4	-0.2
PCB 138/163/164	131	130	126	109	122	129	120	2.1	8.5	101	26.0	19	0.7	0.4
PCB 153	105	104	98.6	90.7	99.0	103	97.4	3.4	6.2	81.8	20.6	19	0.8	0.4
PCB 170/190	19.3	19.3	18.0	15.9	17.5	18.9	17.4	4.0	8.5	21.1	5.70	17	-0.6	-0.3
PCB 180	54.7	52.5	49.8	45.6	49.8	52.3	49.2	4.7	6.9	41.6	11.0	18	0.7	0.4
PCB 187/182	35.0	35.3	33.1	30.4	34.2	34.5	33.0	3.5	6.9	29.6	7.60	11	0.4	0.2
PCB 195	4.16	3.97	3.88	3.83	4.02	4.00	3.95	3.6	2.7	4.47	1.40	12	-0.4	-0.2
PCB 206	4.36	4.37	4.18	3.60	4.08	4.30	3.99	2.5	9.0	4.57	1.40	13	-0.4	-0.3
PCB 209	4.45	4.41	5.06	3.78	4.11	4.64	4.18	7.9	10	4.72	1.25	13	-0.4	-0.2

Table VI.2. 1993 Fish homogenate I (QA93FSH1) intercomparison exercise results (ng/g wet weight) (cont.).

BATTELLE

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	16.7	16.6	16.4	15.1	16.2	16.6	16.0	0.92	4.8	24.5	8.60	35	-1.0	-0.7
2,4'-DDE	38.3	38.0	37.5	38.0	34.4	37.9	36.8	1.1	5.6	2.36	0.70	1460	49.2	29.2
2,4'-DDT	<0.1	<0.1	<0.1	<0.1	<0.1					5.09	2.35			
4,4'-DDD	128	123	111	91.0	108	121	107	7.2	14	74.4	22.1	43	1.5	0.9
4,4'-DDE	432	424	402	345	391	419	385	3.7	10	149	25.0	160	9.6	3.2
4,4'-DDT	<0.2	<0.2	<0.2	<0.2	<0.2					15.0	8.10			
Aldrin	<0.1	<0.1	<0.1	<0.1	<0.1					1.42	0.57			
cis-Chlordane	6.05	5.68	6.26	6.80	5.09	6.00	5.96	4.9	14	9.06	4.64	34	-0.7	-0.7
Dieldrin	12.1	11.5	11.0	10.1	11.1	11.5	10.9	4.8	6.7	7.23	5.16	51	0.7	1.0
gamma-HCH	<0.1	<0.1	<0.1	<0.1	<0.1					1.40	1.35			
Heptachlor	<0.1	<0.1	<0.1	<0.1	<0.1					2.28	2.29			
Heptachlor epoxide	8.04	7.47	7.64	7.83	7.13	7.72	7.56	3.8	5.0	6.32	6.59	20	0.2	0.4
Hexachlorobenzene	4.28	4.17	4.36	4.09	4.22	4.27	4.19	2.2	2.2	3.16	1.04	33	1.0	0.7
Mirex	<0.05	<0.05	<0.05	<0.05	<0.05					1.02	1.10			
trans-Nonachlor	10.3	10.5	10.4	10.0	10.0	10.4	10.1	0.96	2.3	9.52	9.90	6	0.1	0.1

Table VI.2. 1993 Fish homogenate I (QA93FSH1) intercomparison exercise results (ng/g wet weight) (cont.).

NWFSC

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PCB CONGENERS														
PCB 8	NR	NR	NR	NR	NR					3.86	2.67			
PCB 18	25.3	25.9	25.5	25.6	25.4	25.6	25.5	1.2	0.42	21.3	4.90	20	0.9	0.4
PCB 28	28.9	29.1	29.1	28.8	28.6	29.0	28.8	0.40	0.75	29.3	8.20	2	-0.1	0.0
PCB 44	79.4	79.8	79.4	78.8	78.5	79.5	78.9	0.29	0.67	68.4	18.4	15	0.6	0.3
PCB 52	113	118	118	117	118	116	117	2.5	0.72	113	32.0	3	0.1	0.1
PCB 66/95	119	120	120	120	120	120	120	0.48	0.16	134	41.0	11	-0.3	-0.2
PCB 101/90	120	121	120	118	118	120	119	0.48	1.1	120	19.0	1	-0.1	0.0
PCB 105	46.6	47.8	45.9	46.8	47.9	46.8	47.2	2.1	1.4	51.0	15.7	7	-0.2	-0.1
PCB 118	126	128	127	128	128	127	128	0.79	0.45	117	32.0	9	0.3	0.2
PCB 128	19.9	20.2	20.2	20.5	20.3	20.1	20.3	0.86	0.99	16.9	4.90	20	0.7	0.4
PCB 138/163/164	98.7	100	100	100	101	100	100	0.75	0.73	101	26.0	1	0.0	0.0
PCB 153	108	109	112	112	110	110	111	1.9	1.1	81.8	20.6	35	1.4	0.7
PCB 170/190	27.8	28.3	28.0	28.3	28.0	28.0	28.1	0.90	0.58	21.1	5.70	33	1.2	0.7
PCB 180	50.2	50.9	50.9	50.8	50.6	50.7	50.7	0.80	0.20	41.6	11.0	22	0.8	0.4
PCB 187/182	36.4	36.9	36.2	32.7	34.3	36.5	34.5	0.99	5.5	29.6	7.60	16	0.6	0.3
PCB 195	5.71	5.78	5.78	5.81	5.77	5.76	5.78	0.70	0.48	4.47	1.40	29	0.9	0.6
PCB 206	8.68	8.81	8.84	8.47	8.63	8.78	8.63	0.97	1.8	4.57	1.40	89	2.9	1.8
PCB 209	10.0	10.2	10.0	8.80	7.1	10.1	8.65	1.2	17	4.72	1.25	83	3.1	1.7

Table VI.2. 1993 Fish homogenate I (QA93FSH1) intercomparison exercise results (ng/g wet weight) (cont.).

NWFSC

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PESTICIDES														
2,4'-DDD	21.7	21.2	21.7	22.4	21.8	21.5	21.9	1.3	2.0	24.5	8.60	11	-0.3	-0.2
2,4'-DDE	1.39	1.40	1.44	1.44	1.44	1.41	1.43	1.9	1.2	2.36	0.70	39	-1.3	-0.8
2,4'-DDT	<0.21	<0.22	<0.21	<0.19	<0.20					5.09	2.35			
4,4'-DDD	81.3	82.7	82.8	83.5	83.6	82.3	83.1	1.0	0.89	74.4	22.1	12	0.4	0.2
4,4'-DDE	148	150	150	152	151	149	151	0.77	0.89	149	25.0	2	0.1	0.0
4,4'-DDT	<0.18	<0.19	<0.18	<0.16	<0.17					15.0	8.10			
Aldrin	<0.17	<0.17	<0.16	<0.15	<0.16					1.42	0.57			
cis-Chlordane	9.20	9.25	9.72	9.84	9.56	9.39	9.60	3.1	2.4	9.06	4.64	6	0.1	0.1
Dieldrin	7.67	7.69	7.56	8.06	7.98	7.64	7.89	0.92	2.8	7.23	5.16	9	0.1	0.2
gamma-HCH	0.60	0.59	0.61	0.59	0.59	0.60	0.59	1.4	1.2	1.40	1.35	58	-0.6	-1.2
Heptachlor	<0.17	<0.17	<0.16	<0.14	<0.15					2.28	2.29			
Heptachlor epoxide	16.7	16.8	16.6	16.9	16.7	16.7	16.8	0.60	0.69	6.32	6.59	165	1.6	3.3
Hexachlorobenzene	5.06	5.05	5.09	5.05	5.00	5.07	5.04	0.41	0.69	3.16	1.04	59	1.8	1.2
Mirex	1.07	1.11	1.08	1.09	1.08	1.09	1.09	1.9	0.47	1.02	1.10	7	0.1	0.1
trans-Nonachlor	10.9	11.0	11.2	11.2	11.2	11.0	11.1	1.4	0.86	9.52	9.90	17	0.2	0.3

Table VI.2. 1993 Fish homogenate I (QA93FSH1) intercomparison exercise results (ng/g wet weight) (cont.).

TAMU

Compound	Within sample S1-A	Within sample S1-B	Within sample S1-C	Between samples S2	Between samples S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	Accepted s	Mean abs. % error	z Score S1-3 mean	z Score 25% Accep. value
PCB CONGENERS														
PCB 8	1.04	0.93	1.41	0.05	0.73	1.13	0.64	22	85	3.86	2.67	84	-1.2	-1.7
PCB 18	20.8	22.5	21.8	19.2	20.0	21.7	20.3	3.8	6.4	21.3	4.90	6	-0.2	-0.1
PCB 28	34.5	32.6	34.5	28.5	29.1	33.9	30.5	3.2	9.7	29.3	8.20	6	0.1	0.1
PCB 44	82.1	89.0	92.7	82.7	72.3	87.9	81.0	6.1	9.8	68.4	18.4	18	0.7	0.4
PCB 52	163	182	186	151	134	177	154	6.9	14	113	32.0	36	1.3	0.7
PCB 66/95	122	146	151	113	102	140	119	11	16	134	41.0	16	-0.4	-0.2
PCB 101/90	137	160	163	127	118	153	133	9.0	14	120	19.0	12	0.7	0.2
PCB 105	51.0	70.1	72.5	52.4	53.0	64.5	56.7	18	12	51.0	15.7	11	0.4	0.2
PCB 118	106	141	141	112	100	129	114	15	13	117	32.0	12	-0.1	-0.1
PCB 128	12.8	12.9	14.2	11.0	12.3	13.3	12.2	6.1	9.4	16.9	4.90	28	-1.0	-0.6
PCB 138/163/164	85.1	107	108	87.8	83.6	99.9	90.5	13	9.4	101	26.0	13	-0.4	-0.2
PCB 153	82.9	106	104	87.3	81.7	97.7	88.9	13	9.1	81.8	20.6	9	0.3	0.2
PCB 170/190	21.9	22.8	25.8	19.3	23.5	23.5	22.1	8.7	11	21.1	5.70	11	0.2	0.1
PCB 180	35.0	44.9	47.2	37.9	36.1	42.4	38.8	15	8.3	41.6	11.0	12	-0.3	-0.1
PCB 187/182	24.4	24.7	26.5	22.7	25.3	25.2	24.4	4.5	6.2	29.6	7.60	18	-0.7	-0.4
PCB 195	6.01	6.18	7.20	4.96	6.05	6.47	5.82	10	13	4.47	1.40	30	1.0	0.6
PCB 206	4.04	4.26	5.01	3.39	4.23	4.44	4.02	12	14	4.57	1.40	14	-0.4	-0.2
PCB 209	3.84	4.50	4.85	3.09	4.32	4.40	3.94	12	19	4.72	1.25	17	-0.6	-0.3

Table VI.2. 1993 Fish homogenate I (QA93FSH1) intercomparison exercise results (ng/g wet weight) (cont.).

TAMU

Compound	Within sample S1-A	S1-B	S1-C	Between samples S2	S3	Mean S1	Mean S1-3	%RSD S1	%RSD S1-3	Accepted Value	s	Mean abs. % error	z Score S1-3 mean	25% Accep. value
PESTICIDES														
2,4'-DDD	7.49	5.39	5.37	4.40	5.95	6.08	5.48	20	17	24.5	8.60	78	-2.2	-1.6
2,4'-DDE	3.92	3.49	4.25	2.41	3.69	3.89	3.33	9.8	24	2.36	0.70	41	1.4	0.8
2,4'-DDT	5.14	5.21	6.14	4.68	5.40	5.50	5.19	10	8.7	5.09	2.35	7	0.0	0.0
4,4'-DDD	73.9	93.2	95.7	97.9	78.9	87.6	88.1	14	11	74.4	22.1	19	0.6	0.4
4,4'-DDE	158	184	192	180	151	178	169	9.8	10	149	25.0	14	0.9	0.3
4,4'-DDT	<2.55	<2.55	<2.55	<2.55	<2.55					15.0	8.10			
Aldrin	<2.40	<2.40	<2.40	<2.40	<2.40					1.42	0.57			
cis-Chlordane	5.70	5.41	6.11	4.96	5.53	5.74	5.41	6.1	7.5	9.06	4.64	40	-0.8	-0.8
Dieldrin	4.33	4.60	4.11	3.53	3.91	4.35	3.93	5.6	10	7.23	5.16	46	-0.6	-0.9
gamma-HCH	0.73	0.75	0.77	0.66	0.69	0.75	0.70	2.8	6.3	1.40	1.35	50	-0.5	-1.0
Heptachlor	<2.08	<2.08	<2.08	<2.08	<2.08					2.28	2.29			
Heptachlor epoxide	14.4	14.5	15.0	11.8	13.0	14.6	13.1	2.1	11	6.32	6.59	110	1.0	2.2
Hexachlorobenzene	3.68	3.86	3.98	2.77	3.13	3.84	3.25	4.0	17	3.16	1.04	12	0.1	0.1
Mirex	0.49	0.39	0.53	0.46	0.50	0.47	0.48	16	4.6	1.02	1.10	53	-0.5	-1.1
trans-Nonachlor	8.53	7.47	8.71	6.18	8.09	8.24	7.50	8.1	15	9.52	9.90	21	-0.2	-0.4

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