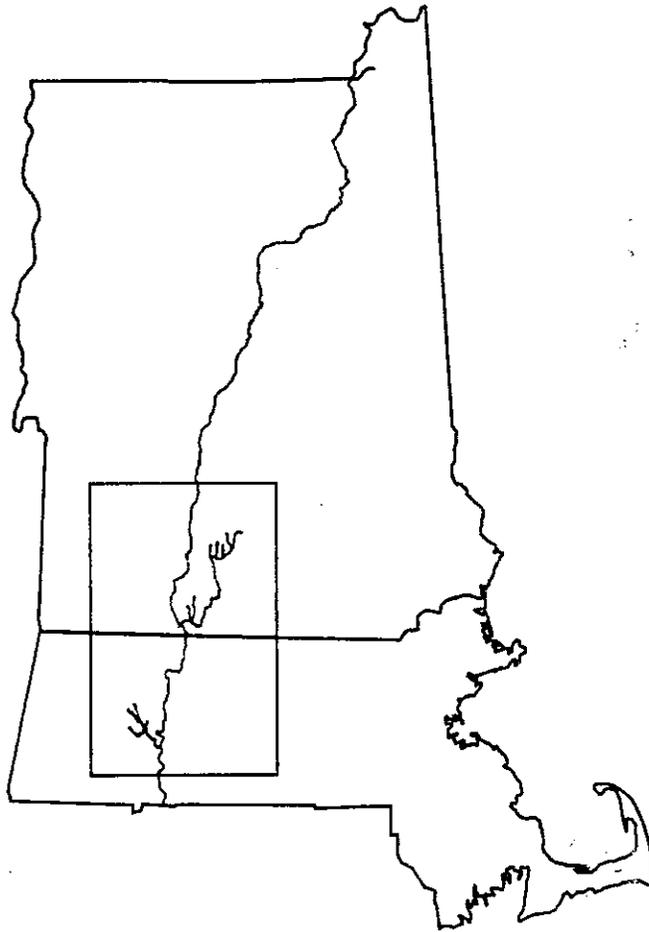


CONTAMINANT ANALYSIS OF DWARF WEDGE MUSSEL
(Alasmidonta heterodon)
HABITAT IN NEW ENGLAND



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INTRODUCTION

The dwarf wedge mussel (*Alasmidonta heterodon*) is a small freshwater mussel that was Federally listed as Endangered in 1990 (50 CFR 944)7), due to a severe decline in documented occurrences. Although the Recovery Plan for this species is in the process of being developed, successful restoration will undoubtedly require a greater understanding of the species' life requisites and the reasons for its decline.

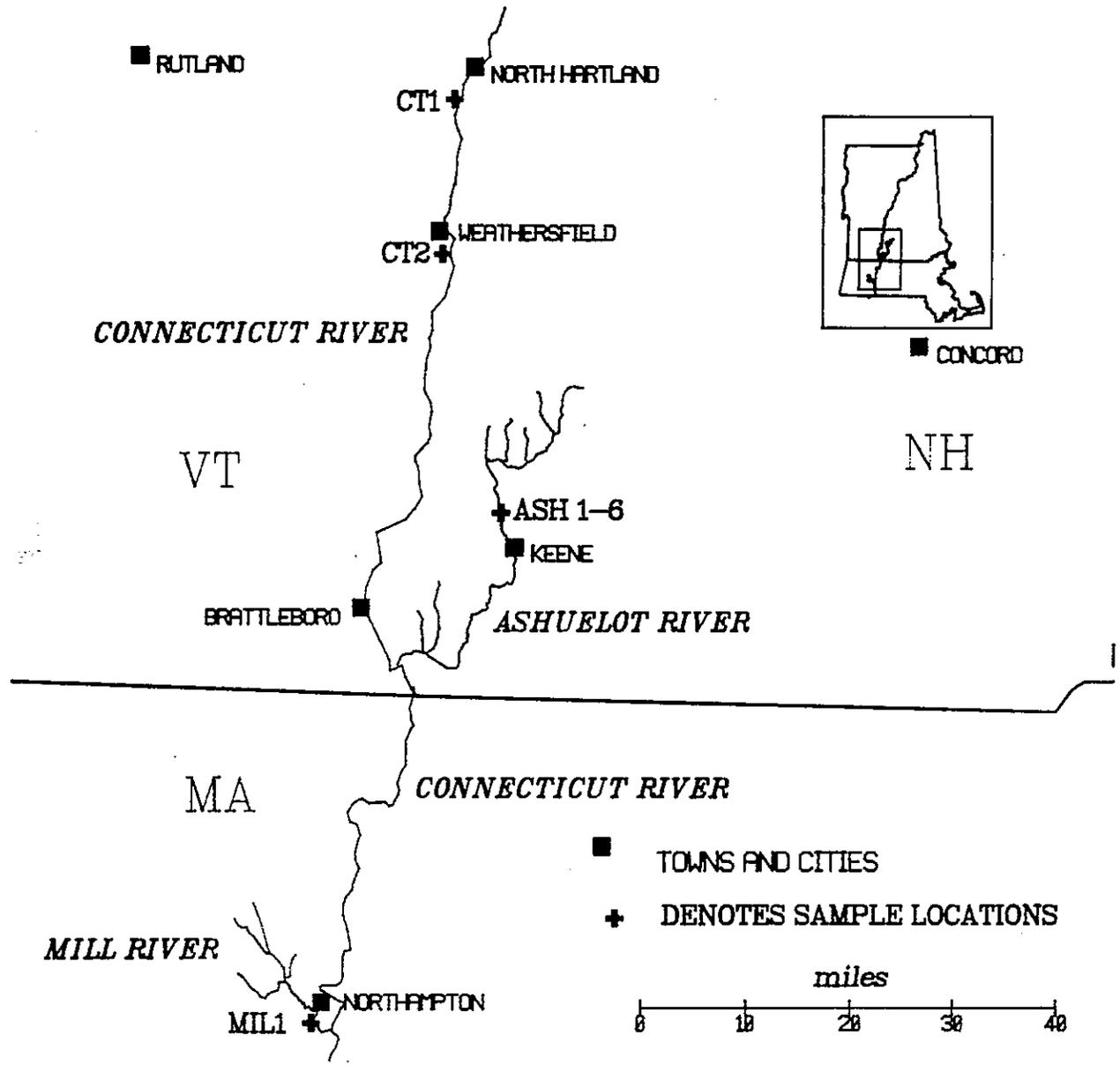
The dwarf wedge mussel is a member of the Family Unionidae. It is small in size, rarely exceeding 1.5 inches in length, and lives on muddy sand and gravel bottoms in streams and rivers of slow to moderate current, with little silt deposition. A host fish is required for the development of the larvae, or glochidia, of most freshwater mussels. The host fish for the dwarf wedge mussel has not yet been identified. The dwarf wedge mussel is usually found in association with the common elliptio (*Elliptio complanata*), a larger fresh water mussel, throughout its range (Clarke 1981). In New England, the triangle floater (*A. undulata*), the alewife floater (*Anodonta undulata*), and the eastern lamp mussel (*Lampsilis radiata*) are also often found with the dwarf wedge mussel.

According to Master (1986), the dwarf wedge mussel was discovered in the 1800's, and has always been considered rare. The species was found solely in Atlantic slope drainages from North Carolina to New Brunswick. Originally the mussel was known to exist in 70 localities in 15 major drainages. In recent years, it has only been found at 14 sites. Only two viable populations are presently known to exist in New England; one in the Ashuelot River in Keene, New Hampshire, and one in the Connecticut River through an approximately 16 mile stretch that runs from North Hartland (Summers Falls), Vermont to just south of Weathersfield, Vermont. The Ashuelot River population appears to be declining. The status of the Connecticut River population is presently under study (S. von Oettingen, USFWS, pers. commun.).

Few rivers in New England have not been dramatically altered by human activities, including damming, channelization, industrial and municipal discharges, as well as non-point runoff. Freshwater mussels have been reported to be adversely impacted by poor water quality. Specific factors that have been implicated include: low dissolved oxygen, low pH, siltation, low alkalinity and hardness, and pollutants including potassium, copper, chlorine, cadmium, and arsenic (Fuller 1974). Master (1986) discusses evidence that the dwarf wedge mussel is intolerant of poor water quality. Dwarf wedge mussels may also have been displaced from some locations by construction activities such as bridges, and riprap for bank stabilization.

The Ashuelot River is a small tributary to the Connecticut River that traverses a rural area of southwestern New Hampshire. However, the Ashuelot River has been dramatically altered by the construction of an Army Corps of Engineers flood control dam, the Surry Mountain Dam, just upstream of the dwarf wedge mussel population. Also, along the banks of the Ashuelot, in the vicinity of the dwarf wedge mussel population, a golf course and agricultural land potentially provide opportunities for pesticide and fertilizer runoff into the river. The Connecticut River has been severely altered by numerous hydroelectric dams, which have created a series of unnatural impoundments, which have highly fluctuating water levels. The water quality of the Connecticut River has also historically received industrial and sewage effluents, and has experienced siltation and shoreline devegetation.

Fig. 1. Contaminant sampling locations in the Connecticut, Ashuelot, and Mill Rivers, 1990.



The purpose of this study was to provide a cursory screening for heavy metals, pesticides, and organochlorine compounds in the locations of the Connecticut and Ashuelot populations as a means of exploring potential pressures that may be affecting the mussels. A third location, in the Mill River just below Northampton, Massachusetts, was investigated because a population of dwarf wedge mussels existed there as recently as 1973, and is now believed to be extirpated (Master 1986). This location could be considered as a candidate for population reestablishment should this strategy be deemed feasible and necessary for recovery of the species.

STUDY AREA

The Connecticut River is the largest and longest river in New England, draining a watershed of 11,265 square miles from the Connecticut Lakes in northern New Hampshire to Long Island Sound in Saybrook, Connecticut (Merriman and Thorpe 1976). The Connecticut River was the natural route for commerce for interior New England before the development of railroads (McNary et al. 1913). Through the construction of dams, locks, and canals, the Connecticut River became the first river in North America to be developed for navigation (Martin 1951). Later, the river provided power for industry. At present, five dams provide for hydroelectric facilities along the mainstem of the Connecticut River.

The section of the Connecticut River where the mussels are known to exist traverses primarily rural countryside, so the banks of the river are either vegetated by native trees and shrubs, or by farm crops. The river is mostly deep and slow moving, with the dwarf wedge mussels inhabiting gravelly shallows in locations along the edge of the river. It should be noted that the Connecticut River exists within the State of New Hampshire to the high water mark on the west bank. However, dwarf wedge mussel occurrences along the west bank of the Connecticut River are usually described as being located in the State of Vermont.

The Ashuelot River drains an area of 71.1 square miles (USGS 1972), and flows into the Connecticut River near the southwest corner of the State of New Hampshire (Fig. 1). North of the City of Keene, the Ashuelot River traverses a mostly rural area which has historically been farmed. Much of the area is now forested, with some home development. The dwarf wedge mussel is known to exist primarily throughout an approximately three mile stretch of the river below the Surry Mountain Dam and above the City of Keene. The Bretwood Golf Course exists along the east bank and a portion of the west bank in this stretch, and farmland planted to corn comprises much of the rest of the west bank. Presently, there are plans to convert the farmland to additional golf course (City of Keene Conserv. Comm., pers. commun.).

The Mill River flows from the northwest into the Connecticut River at Northampton, Massachusetts, after draining an area of 52.8 square miles (USGS 1972) (Fig. 1). The river is mostly quick-flowing and shallow with a sandy gravel substrate. Except for passing through Northampton, the river is rural, with forest and farmland bordering its banks.

METHODS

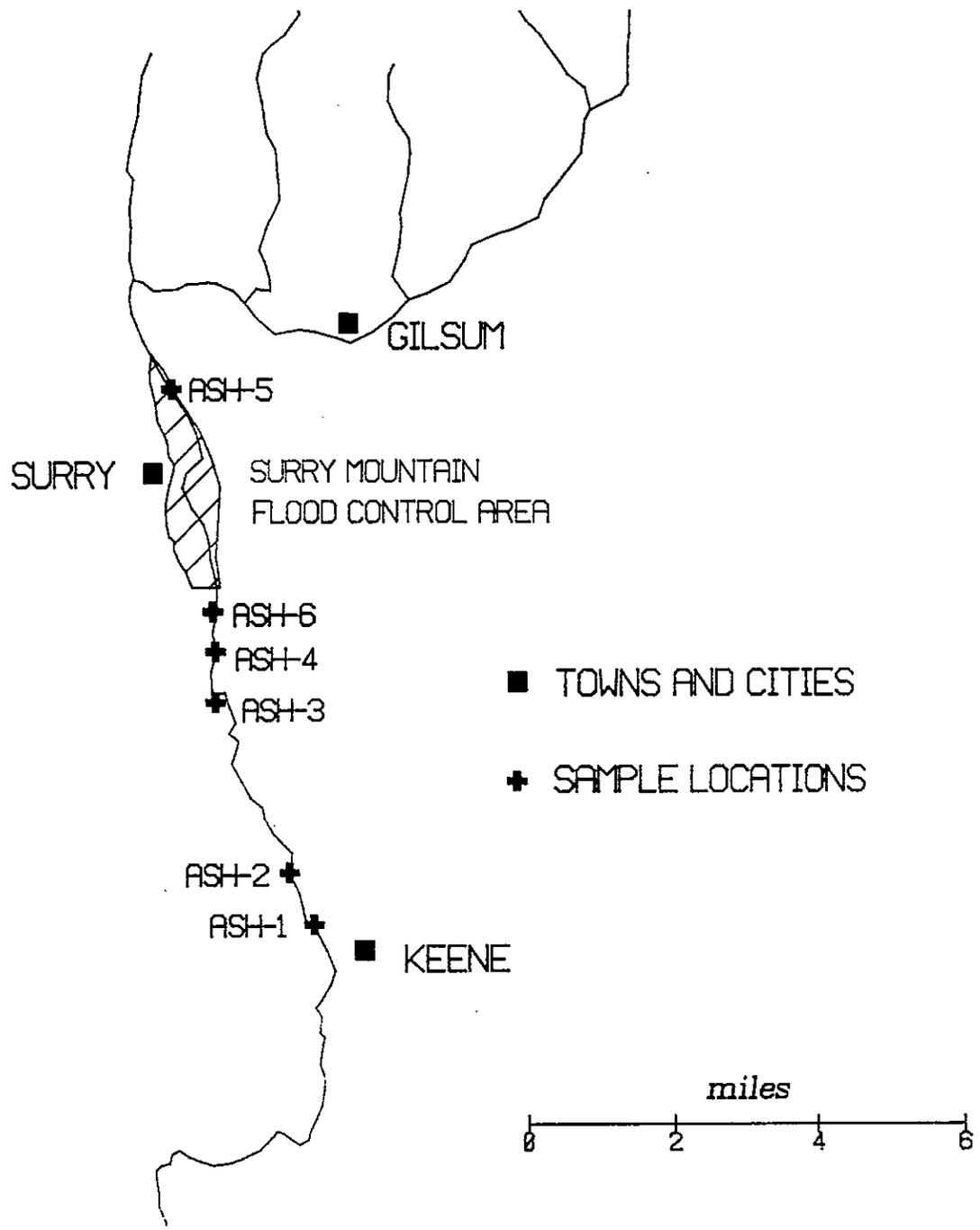
In the Connecticut River, two sampling stations were chosen; one in each of the two dwarf wedge mussel occurrences known in 1990. During the summer of 1991, mussels were found scattered throughout the reach. Figure 1 shows the two locations, CT1 in North Hartland, Vermont, and CT2 in Weathersfield, Vermont. Connecticut River samples were collected in July of 1990. One sediment sample was collected from each station. Sediments from an area near dwarf wedge mussels were collected with a stainless steel spoon, and placed in a acid-rinsed, solvent-rinsed glass jar. Sediments were stored by freezing before shipping. Twenty of the largest *Elliptio complanata* were collected from around dwarf wedge mussels at each station. *Elliptio* was selected as a surrogate for *A. heterodon* because of its usual co-occurrence. The ten mussels collected for organochlorine analyses were wrapped in aluminum foil, placed in plastic bags, and frozen. The ten mussels collected for metal analyses were placed in acid-rinsed, solvent-rinsed jars and frozen before shipping. Water samples were collected from each station by emersing a cubitainer. Water samples were also frozen before shipping.

Six locations were chosen for sampling in the Ashuelot River (Fig. 2). ASH5 was located above the Surry Mountain Dam Reservoir. ASH6 was located just below the dam, ASH 4, 3, and 2 were located along the golf course, and ASH 1 was located below the golf course. Sediments were collected from the stations in June and September, (high and low water events), in a similar manner as for the Connecticut River. In June, *Elliptio complanata* and water samples were also collected from each station in a similar manner as for the Connecticut River. Mussels were not collected from ASH5 as none were located.

Only one sample was collected from the Mill River. MIL1 was located just below the Route 10 bridge in Northampton (Fig. 1). Sediments, water, and *Elliptio complanata* were collected in August of 1990. Since no dwarf wedge mussel are presently known to exist in the Mill River, *Elliptio* were collected from an area considered to be suitable habitat for *Alasmidonta heterodon*.

Organophosphate and carbamate pesticide analyses were conducted by the Patuxent Analytical Control Facility. Organochlorine analyses were conducted by the Environmental Trace Substance Laboratory. Mussels were analyzed, by site, as a composite of soft body parts. Sediments were analyzed for grain size. Mussel tissues and sediments were analyzed for organochlorine, organophosphate, and carbamate pesticides, and heavy metals. Water samples were analyzed for heavy metals only. Sediments were analyzed for twenty-one metals. Tissue and water samples were analyzed for 12 metals. Mercury was detected using cold vapor atomic absorption. The other metals were quantified by ICP (inductively coupled plasma) analyses. All metals reported by the laboratory as "not detected" are reported here as half the detection limit.

Fig. 2. Specific sampling locations in the Ashuelot River, 1990.



RESULTS

Sediments

The sediment characteristics at each of the sample stations are provided in table 1, including percent sand, silt, clay, and moisture, and the total weight of the samples. All of the samples were over 90% sand except ASH5, CT1, and CT2, which ranged from 57% sand (ASH5 in September) to 76.5% sand (ASH5 in June) (Fig. 3). The percent silt in the sediment collected from the Ashuelot River was generally higher in September samples than in the June samples (Fig. 4).

Organochlorine compounds were not detected in any of the sediment samples, with the exception of a trace amount of chlordane at ASH1 and p,p'-DDE at ASH5 (Appendix 1). Organophosphates and carbamates also were not detected at any of the stations (Appendix 2).

Table 2 displays the metals found in the sediment samples. Levels of arsenic, chromium, cadmium, copper, lead, mercury, nickel, and zinc were compared to criteria developed by Bahnick *et al.* (1981) for Great Lakes harbors sediments. Arsenic exceeded the Bahnick *et al.*'s criterion for unpolluted sediment (<3 ppm) at all of the stations. Levels ranged from 3.5 to 5.0 ppm. Chromium and nickel levels exceeded the unpolluted level reported by Bahnick *et al.* of <25 and <20 ppm, respectively, at stations ASH5 and CT1. CT2 also exceeded the unpolluted level for nickel. ASH5 exceeded the unpolluted level of copper (<25 ppm) and zinc (<90 ppm). Mercury, lead, and cadmium were detected in all of the sediment samples below concentrations considered polluted by Bahnick *et al.*, <1.0, <40.0, and <6.0, respectively. Figures 5, 6, and 7 illustrate the levels of copper, lead, and zinc in the sediments.

Long and Morgan (1990) provide a literature review for silver and concluded that effects to aquatic biota have generally been observed when sediment levels are greater than 1.7 ppm. Sediments from all of the sample stations in the Ashuelot River exceeded this level. The concentrations of silver in sediments from the stations in the Connecticut and Mill Rivers were found to be below the 2.0 ppm detection limit for this study. Figure 8 illustrates the levels of silver in the river sediments.

Little literature exists regarding toxicity or sediment quality criteria for the other metals. However, in reviewing the data it appears that metal concentrations in the sediments in general, were higher at stations ASH5, and CT1 and CT2 than at the other stations. Also, levels tended to be higher in the samples collected in September from the Ashuelot River than in June. These trends may be explained by the higher silt content in these samples (Fig. 3).

Table 2 (Continued).

Reference Number	Ag	Al	As	B	Ba	Be	Cu
ASH1-SA	3.0	6870.0	4.0	1.0	35.0	0.3	9.2
ASH1-SB	3.0	9420.0	4.5	1.0	44.6	0.4	8.3
ASH2-SA	3.0	8420.0	4.0	1.0	39.8	0.2	5.4
ASH2-SB	4.0	8790.0	4.5	1.0	36.8	0.4	7.5
ASH3-SA	3.0	8510.0	4.0	1.0	40.0	0.4	5.4
ASH3-SB	3.0	9010.0	4.5	1.0	41.9	0.4	9.2
ASH4-SA	4.0	11700.0	5.0	1.0	51.9	0.4	6.0
ASH4-SB	5.0	11700.0	5.0	1.0	48.6	0.7	12.0
ASH5-SA	5.0	15500.0	5.0	1.0	77.5	0.8	19.0
ASH5-SB	1.0	15700.0	5.0	1.0	89.3	0.7	33.3
ASH6-SA	4.0	8940.0	4.5	1.0	39.3	0.4	8.0
ASH6-SB	5.0	11500.0	5.0	2.0	51.0	0.6	12.0
CT1-S	1.0	12900.0	5.0	1.0	47.7	0.4	21.0
CT2-S	1.0	11500.0	5.0	1.0	49.9	0.4	20.0
MIL-S	1.0	4700.0	3.5	1.0	33.2	0.3	5.1

Table 2 (Continued).

Reference Number	Fe	Mg	Mn	Mo	Se	Sr	Tl	V	Zn
ASH1-SA	9830.0	1990.0	231.0	0.5	4.0	4.4	3.0	15.0	29.0
ASH1-SB	12600.0	2890.0	269.0	0.5	4.5	4.6	3.0	20.0	39.2
ASH2-SA	12100.0	2600.0	277.0	0.5	4.5	4.1	3.0	18.0	30.0
ASH2-SB	13000.0	2880.0	224.0	0.5	4.5	3.0	3.5	19.0	36.1
ASH3-SA	12200.0	2660.0	192.0	0.5	4.5	4.6	3.0	17.0	27.0
ASH3-SB	13300.0	3020.0	176.0	0.5	4.5	3.4	3.0	19.0	41.6
ASH4-SA	17300.0	3180.0	900.0	0.5	5.0	6.8	3.0	21.0	29.0
ASH4-SB	17400.0	3990.0	284.0	0.5	5.0	5.6	3.0	26.0	53.0
ASH5-SA	17900.0	4620.0	362.0	0.5	5.0	9.2	3.5	34.0	72.1
ASH5-SB	25500.0	5490.0	295.0	0.5	5.0	14.2	3.5	30.0	93.8
ASH6-SA	15900.0	2960.0	239.0	0.5	0.5	3.9	3.0	20.0	35.0
ASH6-SB	17600.0	3840.0	300.0	0.5	5.0	4.4	3.5	26.0	43.7
CT1-S	24400.0	6460.0	585.0	0.5	5.0	25.2	3.5	24.0	69.5
CT2-S	21600.0	5130.0	659.0	0.5	5.0	20.8	3.0	23.0	63.9
MIL-S	7350.0	1610.0	107.0	0.5	4.0	2.9	3.5	10.0	40.0

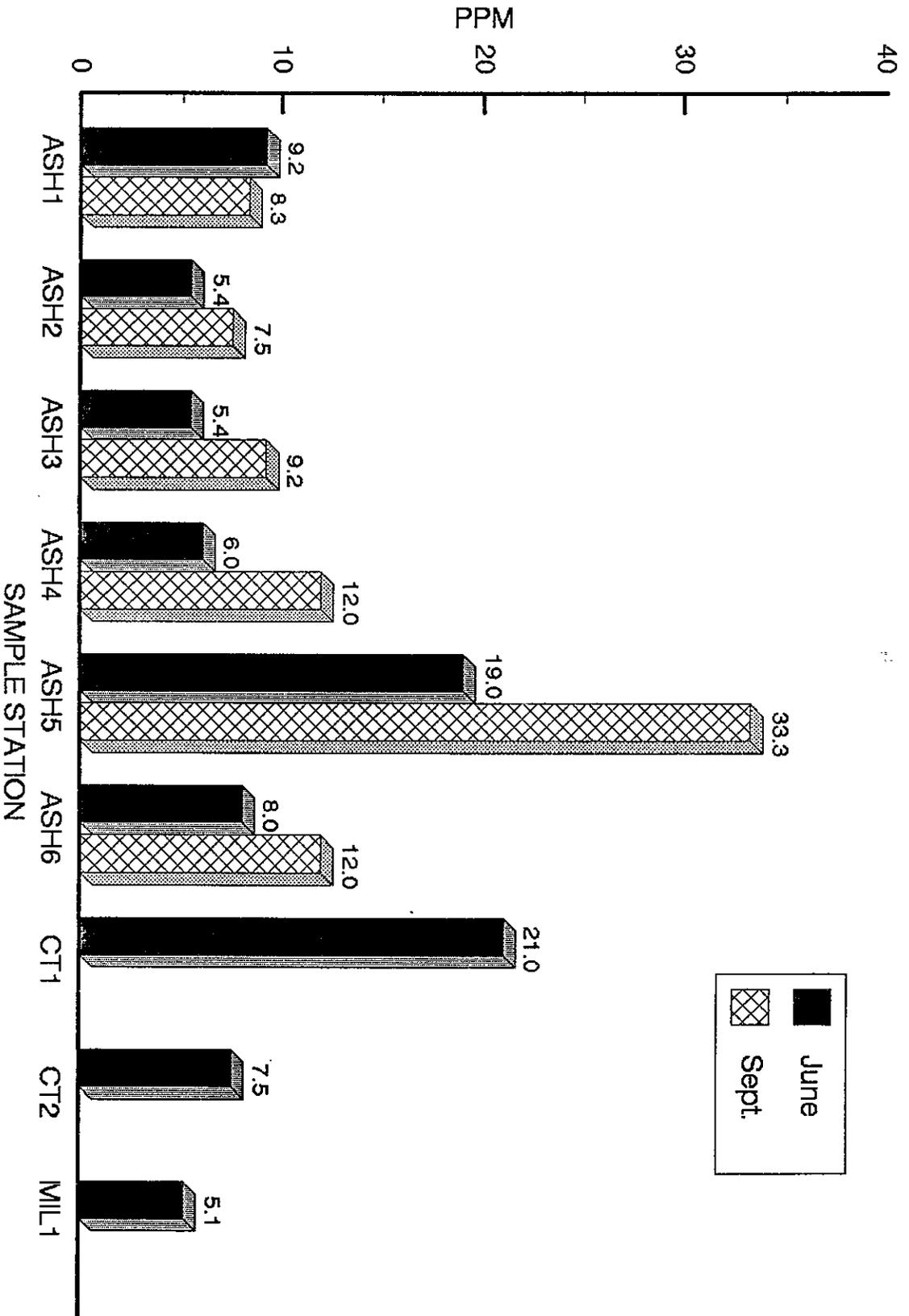


Fig. 5. Copper levels in sediments (ppm DW) collected from the Ashuelot, Connecticut, and Mill Rivers in 1990.

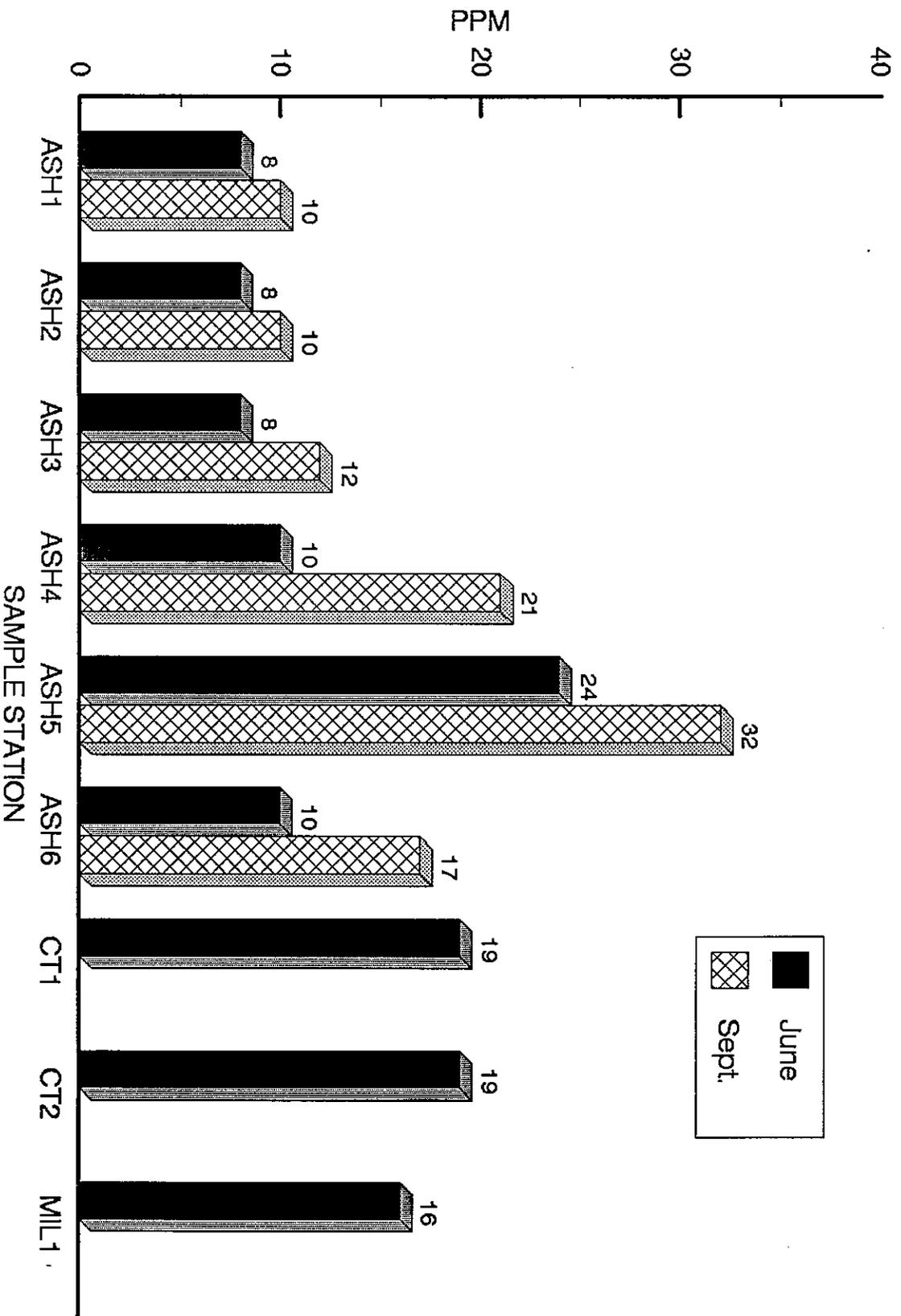


Fig. 6. Lead levels in sediments (ppm DW) collected from the Ashuelot, Connecticut, and Mill Rivers in 1990.

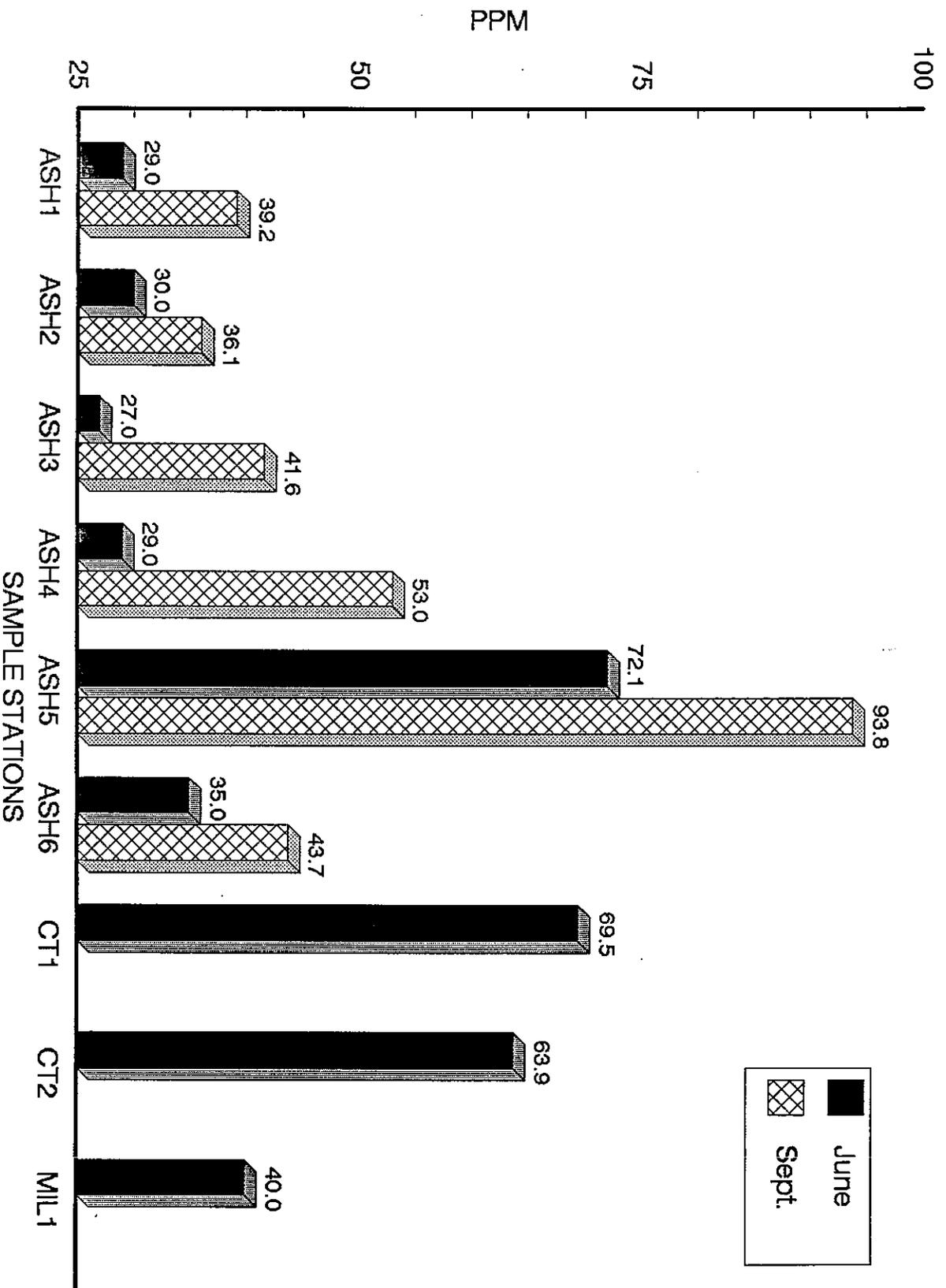


Fig. 7. Zinc in sediments (ppm DW) collected from the Ashuelot, Connecticut, and Mill Rivers in 1990.

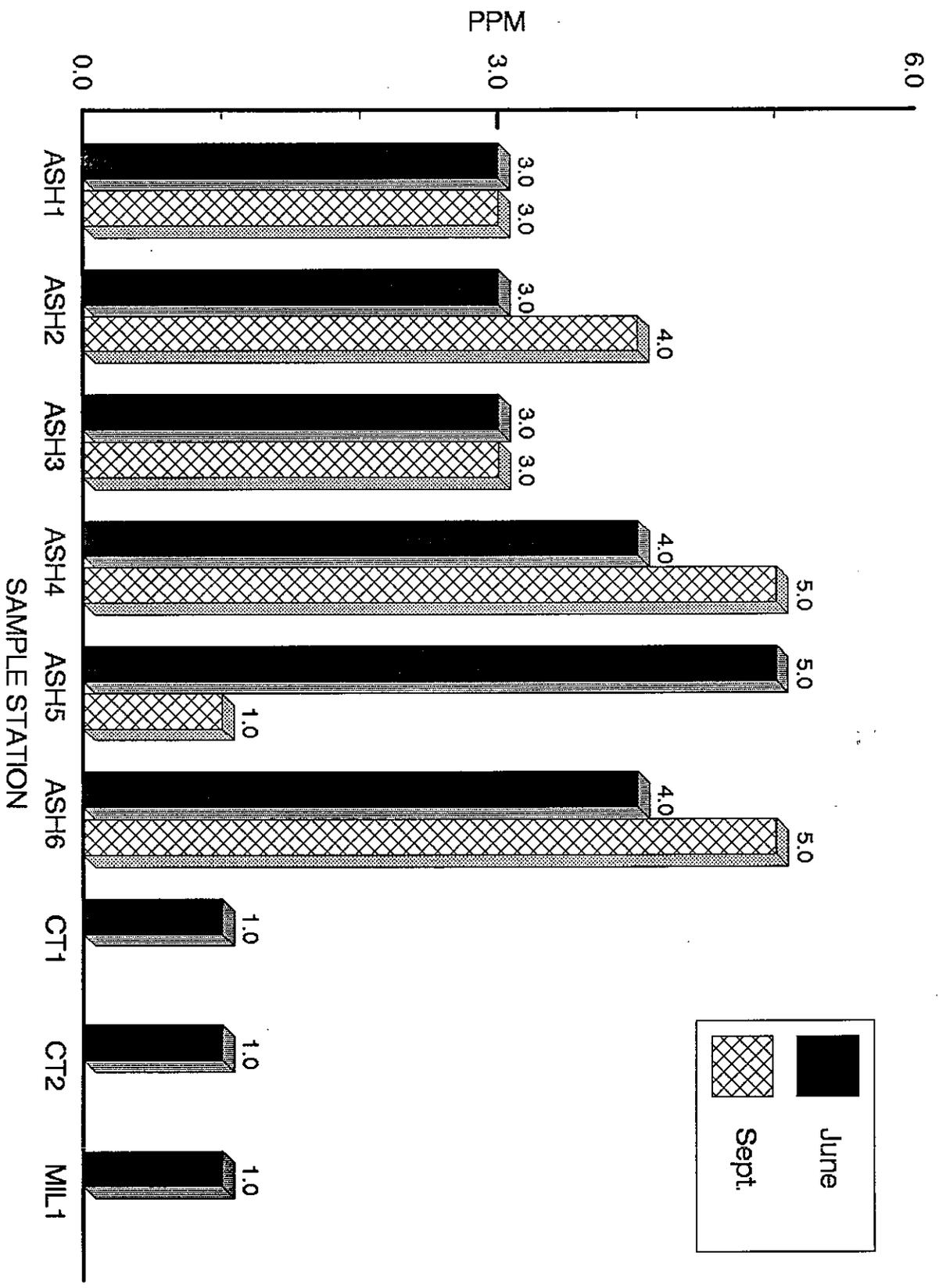


Fig. 8. Silver in sediments (ppm DW) collected from the Ashuelot, Connecticut, and Mill Rivers in 1990.

Water

Results for the metal concentrations in water are displayed in table 3.

According to EPA's Quality Criteria for Water (1986), freshwater biota should not be affected unacceptably if the 4-day concentration of mercury does not exceed 0.012 ug/L more than once every three years on average, and if the 1-hour average does not exceed 2.4 ug/L more than once every three years on average. This study did not detect mercury in the water, however, the detection limit was 0.3 ug/L, which is above the 4-day limit recommended by EPA.

Hardness has been demonstrated to have an antagonistic effect on the acute toxicity of cadmium and copper on aquatic organisms (USEPA 1986). Therefore, criteria for these metals is dependent, in part, on water hardness. Water in the Connecticut, Ashuelot, and Mill Rivers is relatively soft (< 50 mg/L as CaCO₃) (USGS 1972). The 4-day average criteria for cadmium for a hardness of 50 mg/L is 0.66 ug/L, and the 1-hour average is 1.8 ug/L (USEPA 1986). Cadmium concentrations in this study ranged from 0 to 0.99 ug/L, with the highest concentrations found in the Ashuelot River samples. For copper, the 4-day average criterion for a hardness of 50 mg/L, is 6.5 ug/L, and the 1-hour average is 9.2 ug/L (USEPA 1986). In this study, copper levels remained below the recommended levels, and ranged from 0 to 3.6 ug/L, with the highest concentration found in the Mill River.

Due to the number of chemical forms of nickel and aluminum, and the relative lack of information regarding the toxicity of these metals, no clear definitive guidance has been provided for the protection of aquatic biota (USEPA 1986b and 1988). However, the little toxicity information that does exist can serve for comparisons with our study. For nickel, it has been predicted that 5 ug/L would affect the productivity of *Daphnia magna* (Lazareva 1985). In this study, concentrations of nickel ranged from 0.5 to 2.0 ug/L. For aluminum, the lowest acute values for invertebrates are for ceriodaphnids and range from 1,900 ug/L (McCauley et al. 1986) to 3,690 ug/L (USEPA 1988). The concentrations of aluminum in this study are well below these values, ranging from 13 to 250 ug/L.

The water quality criteria recommended for iron by the EPA (1986) for the protection of aquatic biota, is 1.0 mg/L. This was exceeded at one sample station in our study, ASH5, with a level of 1.4 mg/L. The concentrations at the other stations ranged from 81 to 753 ug/L. Concentrations of beryllium, chromium, lead, thallium, and zinc found in this study were all well below the recommended criteria for the protection of aquatic life (USEPA 1986). Manganese is considered by EPA (1986) to be an essential nutrient that is rarely found in concentrations above 1 mg/L, therefore, it is not considered a problem in fresh waters. In this study, manganese levels were found to range from 1.7 to 138.0 ug/L, with the highest concentration at ASH5.

Table 3. Metal concentrations in water (ppb) collected from the Ashuelot River (ASH), Connecticut River (CT), and the Mill River (MIL) in 1990.

Reference Number	*Hg	Al	Be	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Tl	Zn
ASH1-W	0.15	28.0	0.0	0.40	0.5	0.0	235.0	1.7	1.0	2.5	4.0	1.1
ASH2-W	0.15	13.0	0.0	0.50	0.5	0.0	217.0	5.2	1.0	2.0	3.5	16.0
ASH3-W	0.15	250.0	0.0	0.40	0.5	0.75	753.0	22.0	2.0	2.5	3.5	40.7
ASH4-W	0.15	38.0	0.0	0.99	0.5	0.73	349.0	16.0	2.0	2.0	3.5	37.4
ASH5-W	0.15	66.0	0.0	0.40	1.0	1.4	1440.0	138.0	2.0	2.0	3.5	28.0
ASH6-W	0.15	23.0	0.0	0.0	1.0	0.0	318.0	12.0	2.0	2.0	3.0	8.6
CT1-W	0.15	49.0	0.0	0.0	0.5	0.0	81.0	4.9	0.5	2.0	3.0	8.3
CT2-W	0.15	93.0	0.0	0.5	0.5	0.96	330.0	20.0	0.5	2.0	3.5	10.0
MIL-W	0.15	79.0	0.0	0.15	0.5	3.6	495.0	30.2	2.0	2.0	3.0	18.0

* No mercury was found at a detectable level. Therefore, mercury was reported as one-half the detection limit of 0.3 ppb.

Mussel Tissue

Metal concentrations in mussel tissue are displayed in table 4. No clear trends were evident in the data.

Table 5 compares concentrations of metals found in mussel tissue in this study to concentrations found in the literature. Levels found in our study were generally either similar to, or lower than, levels published in the literature. No literature was found that provided concentrations of beryllium or thallium in mussel tissue.

Organochlorines, organophosphates, and carbamates were not detected in any of the mussel tissue samples (Appendices 1 and 2).

DISCUSSION

Freshwater mussels are relatively long-lived, are sedentary, and come into contact with both sediment and water during feeding and respiration. They have also been found to accumulate trace metals and other persistent pollutants, and have, therefore, been studied extensively as potential biological indicators of pollution. Havlik and Marking (1987) provide an extensive literature review on this topic. However, relatively little information is available on the toxicity of the various pollutants on freshwater mussels.

Freshwater mussels have been found to be vulnerable to some pesticides, including Thimet and Satox (Salanki and Varanka 1978), and some fish toxicants such as antimycin (Antonioni 1974), TFM lampricide (Maki *et al.* 1975), and rotenone (Heard 1970). It has also been reported that insecticides are readily taken up and eliminated by freshwater mussels (Godsil and Johnson 1968). In this study, little or no evidence of organochlorines or pesticides were found in any of the samples collected. This suggests that these compounds have not made a contribution to the population declines of mussels in these areas. However, the sediments collected were predominantly large grained sand, since this is the substrate preferred by the dwarf wedge mussel. Since contaminants are known to bind most easily to fine grained sediments and organic matter, the sediments collected may serve as good examples of the sediments ingested by the mussels, but perhaps not of the persistent pollutants absorbed by the rivers over time. Further, most of the pesticides in common use are "non-persistent", and are, therefore, unlikely to be detected in significant amounts in the river sediments after a few days or weeks after application. The water samples, similarly, only represent one moment in time. It is plausible that pesticides could be washed into the river in a pulse soon after application. Several weeks later there would be little or no residue of the pesticide in the water, and any biota killed would have already decomposed, leaving no evidence in sediments.

The literature review by Havlik and Marking (1987) reported that zinc, manganese, copper, cadmium, and lead are the metals in mussels that have been studied the most. They reported that cadmium has been found to be the most toxic of the metals, with toxicity reported at a concentration of 2 mg/L (no hardness reported), and an acute exposure of As_2O_3 at 16 mg/L (12 ppm as As) was also found to be toxic to mussels. Imlay (1973) reported that 11 mg/L of potassium was lethal to mussels within two months of exposure, and 7 mg/L was lethal within eight months of exposure. Imlay (1980) also reported that chronic exposures of freshwater mussels to a copper

Table 4. Metal concentrations in mussel tissue (*Elliptio complanata*) (ppm) collected from the Ashuelot River (ASH), the Connecticut River (CT), and the Mill River (MIL) in 1990.

Reference Number	Hg		Cd		Cr		Al		Be		Cu	
	(DW)	(WW)	(DW)	(WW)	(DW)	(WW)	(DW)	(WW)	(DW)	(WW)	(DW)	(WW)
ASH1-B	0.970	0.07	13.8	1.0	1.6	0.1	690.1	51.8	0.2	0.0	8.5	0.6
ASH2-B	0.930	0.06	14.1	0.9	1.8	0.1	572.3	5.5	0.3	0.0	8.0	0.5
ASH3-B	0.758	0.07	11.5	1.0	1.4	0.1	322.0	29.0	0.3	0.0	6.8	0.6
ASH4-B	0.686	0.06	9.3	0.8	1.7	0.2	416.3	7.0	0.3	0.0	7.3	0.6
ASH6-B	0.774	0.06	10.1	0.8	1.2	0.1	309.0	23.5	0.4	0.0	6.3	0.5
MIL-B	0.613	0.05	10.2	0.8	1.1	0.1	340.0	27.2	0.3	0.0	7.3	0.6
CT1-B	0.637	0.05	2.8	0.2	11.0	0.8	465.3	5.3	0.1	0.0	10.5	0.8
CT2-B	0.420	0.03	2.4	0.2	7.1	0.5	392.0	29.4	0.1	0.0	10.1	0.8

Table 4. Continued.

Reference Number	Fe		Mn		Ni		Pb		Tl		Zn	
	(DW)	(WW)	(DW)	(WW)	(DW)	(WW)	(DW)	(WW)	(DW)	(WW)	(DW)	(WW)
ASH1-B	5170.0	387.8	5750.0	431.3	2.6	0.2	8.9	0.7	0.4	0.0	167.0	12.5
ASH2-B	6380.0	395.6	7230.0	448.2	3.0	0.2	12.0	0.7	0.4	0.0	192.0	11.9
ASH3-B	4550.0	409.5	5600.0	504.0	5.0	0.5	11.0	1.0	0.4	0.0	169.0	15.2
ASH4-B	7190.0	639.9	4590.0	408.5	4.4	0.4	13.0	1.2	0.4	0.0	160.0	14.2
ASH6-B	6180.0	469.7	7940.0	603.4	2.8	0.2	9.2	0.7	0.4	0.0	176.0	13.4
MIL-B	5580.0	446.4	4890.0	391.2	3.0	0.2	9.6	0.8	0.4	0.0	170.0	13.6
CT1-B	2930.0	222.7	3790.0	288.0	4.2	0.3	2.0	0.2	0.5	0.0	148.0	11.3
CT2-B	2630.0	197.3	3240.0	243.0	4.2	0.3	4.1	0.3	0.4	0.0	163.0	12.2

Table 5. Metal concentrations found in mussels in our study as compared to other studies.

Metal	Our Study	Other Studies		
	Concentration (ppm WW) in <u>Elliptio complanata</u>	Concentration (ppm) in soft tissue	Mussel Species	Citation
Mn	243.0-603.4	3,500 11,367	Anodonta grandis Lampsilis ventricosa	Forester 1980 Schmitt and Finger 1982
Hg	0.03-0.07	0.001-0.087 0.001-0.00025	8 species 9 taxa	Price and Knight 1978 Yokely 1972
Cd	0.2-1.0	17.0 0.086-0.311 5.9 33.0	Anodonta grandis 8 species Amblema plicata Lampsilis ventricosa	Forester 1980 Price and Knight 1978 Gardner et al. 1981 Schmitt and Finger 1982
Al	5.3-51.8	1,500	Anodonta grandis	Forester 1980
Cu	0.5-0.8	6.0 61.0	Anodonta grandis Lampsilis ventricosa	Forester 1980 Schmitt and Finger 1982
Pb	0.7-1.2	18.0 0.33-9.43 387.0	Anodonta grandis 8 species Lampsilis ventricosa	Forester 1980 Price and Knight 1978 Schmitt and Finger 1982
Zn	11.3-15.2	200.0 5,967.0	Anodonta grandis Lampsilis ventricosa	Forester 1980 Schmitt and Finger 1982
Ni	0.2-0.5	1.2	Anodonta grandis	Forester 1980
Cr	0.1-0.8	0.4-9.4	23 species	Ahlstedt and Jenkinson 1983
Fe	197.3-639.9	183.17-832.50	23 species	Ahlstedt and Jenkinson 1983

concentration of 0.025 mg/L was lethal. Zinc has not been found to be highly toxic, but effects in mussels have been reported with concentrations of 20 mg/L and greater (Millington and Walker 1983).

In this study, the highest concentration of cadmium in water was found to be 0.99 ug/L at station ASH4, which is well below the reported lethal level. Zinc was also well below the reported effect level at all stations, and potassium, and arsenic were not tested in the water in this study. Arsenic was found to be slightly elevated at all stations in the sediments relative to criteria designed for the Great Lakes. However, a study conducted jointly by NH Division of Public Health Services and the US Fish and Wildlife Service in 1989 tested soils at 129 public school yards across the State for selected metals. The mean arsenic level was 5.5 ppm, which is slightly higher than the levels found in the river sediments of this study. This suggests that these levels of arsenic represent background levels for the region rather than evidence of contamination.

Some studies have found that the concentration of metals in the bodies of freshwater mussels correlate with the concentrations in the sediments (Mathis and Cummings 1973; Anderson 1977). However, Tessier et al. (1984) found that the metal concentrations in *Elliptio complanata* were related to the easily extracted fraction of the metal in the sediment. In this study, the levels of metals in the mussel tissue were much lower than in the sediments, which suggests either a low availability, or selective excretion of the metals by the mussels. The fact that all the metal concentrations found in mussels in this study are similar to or lower than those found in other studies suggests that the metals examined are probably not stressing the present mussel population.

Silver was the only metal that differed notably in concentration between the rivers, with elevated levels only in the Ashuelot River. We did not analyze the mussel tissue or water samples for this metal, therefore, no conclusions should be drawn from our data as to whether it may be affecting the mussel population. It should be noted that silver is one of the most toxic metals to aquatic biota, and that it is more toxic in soft water than hard (USEPA 1980). The EC50 for silver reported for *Daphnia magna* is 1.5 ug/L (USEPA 1978).

Although no contaminants were found to be elevated in the tissues of the common elliptio, it should be kept in mind that the common elliptio is a very common mussel that frequents even areas of slightly degraded water quality. Thus, we can perhaps presume that the common elliptio is a relatively tolerant mussel as compared to the rare dwarf wedge mussel. Conclusions regarding effects to the dwarf wedge mussel based on the common elliptio should be drawn with caution.

CONCLUSIONS AND RECOMMENDATIONS

This study did not provide any conclusive evidence that any of the locations sampled have been impacted by pollution. However, the sampling scheme could not account for nonpersistent toxins, or brief but damaging pulses of toxins. Further, not all metals sampled in the sediments, such as silver, were sampled in the water or mussel tissue. It also can not be presumed that our surrogate species, the common elliptio, accurately represented the dwarf wedge mussel.

Although one study attributes the decline of mussels to eutrophication rather than to contaminants (Bauer et al. 1980), many authors have suggested that mussel populations are most often damaged by cumulative pressures rather than one specific factor (Havlik and Marking 1987). Future studies should focus on some chronic documentation of the more basic water quality parameters, (dissolved oxygen content, pH, hardness, and temperature), which in themselves could affect aquatic biota, or affect the availability and toxicity of contaminants such as metals. Future, work should also include an investigation of whether pesticides and fertilizers are getting into the rivers in concentrations that could affect mussels. This may require conducting bioassays on mussels to determine their tolerances for contaminants, and perhaps *in situ* bioassays in the rivers near potential sources of pesticides and fertilizers during the times of year that they are usually applied. Lastly, the Ashuelot River should receive further testing for silver and potassium.

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Appendix 1. Results of organochlorine analyses of sediments and mussel tissue (*Elliptio complanata*) collected from the Ashuelot, Connecticut, and Mill Rivers in 1990.

U. S. FISH AND WILDLIFE SERVICE
PATUXENT ANALYTICAL CONTROL FACILITY
QUALITY ASSURANCE REPORT

RE: 6335 REGION: 5 REGIONAL ID: 90-5-051

THE ANALYSES ON THE ABOVE MENTIONED SAMPLES WERE PERFORMED AT:

THE MISSISSIPPI STATE CHEMICAL LABORATORY
MISSISSIPPI STATE UNIVERSITY
ROOM 112, HAND CHEMICAL LABORATORY
MORRILL ROAD
MISSISSIPPI STATE, MISSISSIPPI 39762

AFTER A THOROUGH REVIEW OF THE REPORT ISSUED BY THE LABORATORY, I REPORT THE FOLLOWING OBSERVATIONS AND CONCLUSIONS:

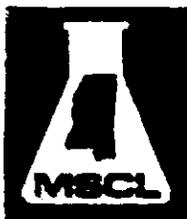
THE ACCURACY, AS MEASURED BY SPIKE RECOVERY, WAS GENERALLY ACCEPTABLE.

THE PRECISION, AS MEASURED BY DUPLICATE SAMPLE ANALYSIS, WAS ACCEPTABLE FOR ALL ANALYTES.

Craig S. Hark 3-7-91

QUALITY ASSURANCE OFFICER DATE

MISSISSIPPI STATE UNIVERSITY



MISSISSIPPI
STATE CHEMICAL LABORATORY

BOX CR - MISSISSIPPI STATE, MISSISSIPPI 39762



February 27, 1991

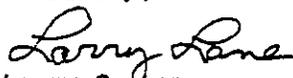
Lainie Weber
Stickel Building/Chemistry
Patuxent Wildlife Research Center
U.S. Fish and Wildlife Service
Route 197
Laurel, MD 20708

Dear Lainie:

Enclosed are analytical results for one batch of samples submitted by the U.S. Fish and Wildlife Service (Catalog# 6335, Reg.ID.# 90-5-051, Order# 85800-0-3254). The samples were analyzed by Methods 1 and 2. Descriptions are enclosed.

Please call if you have any questions.

Sincerely,


Larry G. Lane
Principal Investigator

SAMPLE TYPE: Mussels
and Sediment

CAT NO. 6335
REG. ID #: 90-5-051
ORDER NO. 85800-0-
6254

BOX CR
MISS. STATE, MS 39762
REPORT FORM
USDI/FWS

Date P.O. Recd 08/09
Date Spis Recd 10/23
Queue Date 12/20

ORGANOCHLORINES

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	ASH1-B	ASH1-Sa	ASH1-Sb	ASH2-B	ASH2-Sa	ASH2-Sb	ASH3-
LAB #	804148	804149	804150	804151	804152	804153	804154
MATRIX	Mussel	Sediment	Sediment	Mussel	Sediment	Sediment	Mussel
COMPOUND							
HCB	ND*	ND	ND	ND	ND	ND	ND
α-BHC	ND	ND	ND	ND	ND	ND	ND
γ-BHC	ND	ND	ND	ND	ND	ND	ND
β-BHC	ND	ND	ND	ND	ND	ND	ND
δ-BHC	ND	ND	ND	ND	ND	ND	ND
Oxychlorthane	ND	ND	ND	ND	ND	ND	ND
Hept. Epox.	ND	ND	ND	ND	ND	ND	ND
γ-Chlordane	ND	ND	ND	ND	ND	ND	ND
t-Nonachlor	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND
PCB's (total)	ND	ND	ND	ND	ND	ND	ND
o, p'-DDE	ND	ND	ND	ND	ND	ND	ND
α-Chlordane	ND	0.01	ND	ND	ND	ND	ND
p, p'-DDE	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND
o, p'-DDD	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
cis-nonachlor	ND	ND	ND	ND	ND	ND	ND
o, p'-DDT	ND	ND	ND	ND	ND	ND	ND
p, p'-DDD	ND	ND	ND	ND	ND	ND	ND
p, p'-DDT	ND	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND	ND
OTHER:							
WEIGHT (g)	148	403	300	133	449	406	166
MOISTURE (%)	94.0	23.4	28.6	92.0	23.0	27.2	92.5
LIPID (%)	0.300	-	-	0.240	-	-	0.280

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCBs.
For Water, LLD= 0.005 ppm for OCs, Tox, PCBs.

*ND = None Detected

**Spike = ppm for

***NS = Not Spiked

* = Confirmed by GC/Mass Spectrometry

Signature

Larry Lane

SAMPLE TYPE: Mussels
and Sediment

CAT NO. 6335
REG. ID #: 90-5-051
ORDER NO. 85800-0-
6254

BOX CR
MISS. STATE, MS 39762
REPORT FORM
USDI/FWS

ORGANOCHLORINES

Date P.O. Recd 08/09/90
Date Spis Recd 10/23/90
Queue Date 12/20/90

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	ASH3-Sa	ASH3-Sb	ASH4-B	ASH4-Sa	ASH4-Sb	MILL	ASH5-Sa
LAB #	804155	804156	804157	804158	804159	804160	804161
MATRIX	Sediment	Sediment	Mussel	Sediment	Sediment	Mussel	Sediment
COMPOUND							
HCB	ND*	ND	ND	ND	ND	ND	ND
α-BHC	ND	ND	ND	ND	ND	ND	ND
γ-BHC	ND	ND	ND	ND	ND	ND	ND
β-BHC	ND	ND	ND	ND	ND	ND	ND
δ-BHC	ND	ND	ND	ND	ND	ND	ND
Oxychlorane	ND	ND	ND	ND	ND	ND	ND
Hept. Epox.	ND	ND	ND	ND	ND	ND	ND
p'-Chlordane	ND	ND	ND	ND	ND	ND	ND
t-Nonachlor	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND
PCB's (total)	ND	ND	ND	ND	ND	ND	ND
o, p'-DDE	ND	ND	ND	ND	ND	ND	ND
α-Chlordane	ND	ND	ND	ND	ND	ND	ND
p, p'-DDE	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND
o, p'-DDD	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
cis-nonachlor	ND	ND	ND	ND	ND	ND	ND
o, p'-DDT	ND	ND	ND	ND	ND	ND	ND
p, p'-DDD	ND	ND	ND	ND	ND	ND	ND
p, p'-DDT	ND	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND	ND
OTHER:							
WEIGHT (g)	457	286	151	569	293	173	283
MOISTURE (%)	14.6	28.2	93.0	30.0	26.0	92.0	71.0
LIPID (%)	-	-	0.320	-	-	0.380	-

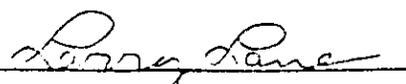
Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCB
For Water, LLD= 0.005 ppm for OCs, Tox , PCBs.

*ND = None Detected

**Spike = ppm for

***NS = Not Spiked

* = Confirmed by GC/Mass Spectrometry

Signature 

SAMPLE TYPE: Mussels
and Sediment

CAT NO. 6335
REG. ID #: 90-5-051
ORDER NO. 85800-0-
6254

BOX CR
MISS. STATE, MS 39762
REPORT FORM
USD1/FWS

ORGANOCHLORINES

Date P.O. Recd 08/09/
Date Spis Recd 10/23/
Queue Date 12/20/

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	ASH5-Sb	ASH6-B	ASH6-Sa	ASH6-Sb	ASH6-Sb	CT1-B	CT1-S
LAB #	804162	804163	804164	804165A	804165B	804166	804167
MATRIX	Sediment	Mussel	Sediment	Sediment	Duplicate Sediment	Mussel	Sediment
COMPOUND							
HCB	ND*	ND	ND	ND	ND	ND	ND
α-BHC	ND	ND	ND	ND	ND	ND	ND
γ-BHC	ND	ND	ND	ND	ND	ND	ND
β-BHC	ND	ND	ND	ND	ND	ND	ND
δ-BHC	ND	ND	ND	ND	ND	ND	ND
Oxychlorane	ND	ND	ND	ND	ND	ND	ND
Hept. Epox.	ND	ND	ND	ND	ND	ND	ND
γ-Chlordane	ND	ND	ND	ND	ND	ND	ND
t-Nonachlor	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND
PCB's (total)	ND	ND	ND	ND	ND	ND	ND
o, p'-DDE	ND	ND	ND	ND	ND	ND	ND
α-Chlordane	ND	ND	ND	ND	ND	ND	ND
p, p'-DDE	0.01	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND
o, p'-DDD	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
cis-nonachlor	ND	ND	ND	ND	ND	ND	ND
o, p'-DDT	ND	ND	ND	ND	ND	ND	ND
p, p'-DDD	ND	ND	ND	ND	ND	ND	ND
p, p'-DDT	ND	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND	ND
OTHER:							
WEIGHT (g)	474	178	587	276	276	155	404
MOISTURE (%)	37.6	93.0	30.8	36.0	34.8	92.0	44.6
LIPID (%)	-	0.260	-	-	-	0.440	-

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCBs
For Water, LLD= 0.005 ppm for OCs, Tox, PCBs.

*ND = None Detected

**Spike = ppm for

***NS = Not Spiked

* = Confirmed by GC/Mass Spectrometry

Larry Lane
Signature

SAMPLE TYPE: Mussels
and Sediment

CAT NO. 6335
REG. ID #: 90-5-051
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ORGANOCHLORINES

Date P.O. Recd 08/09/90
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PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	CT2-B	CT2-S	MIL1	Blank	Matrix Blank	Spike**	% Recovery
LAB #	804168	804169	804170	804171	for	804172	
MATRIX	Mussel	Sediment	Sediment	Reagent	Sediment	Sediment	
COMPOUND							
HCB	ND*	ND	ND	ND	ND	0.027	68
α-BHC	ND	ND	ND	ND	ND	NS***	
γ-BHC	ND	ND	ND	ND	ND	0.038	95
β-BHC	ND	ND	ND	ND	ND	0.040	100
δ-BHC	ND	ND	ND	ND	ND	NS	
Oxychlorthane	ND	ND	ND	ND	ND	0.040	100
Hept. Epox.	ND	ND	ND	ND	ND	0.041	103
γ-Chlordane	ND	ND	ND	ND	ND	NS	
t-Nonachlor	ND	ND	ND	ND	ND	0.038	95
Toxaphene	ND	ND	ND	ND	ND	NS	
PCB's (total)	ND	ND	ND	ND	ND	NS	
o, p'-DDE	ND	ND	ND	ND	ND	0.042	105
α-Chlordane	ND	ND	ND	ND	ND	0.039	98
p, p'-DDE	ND	ND	ND	ND	ND	0.040	100
Dieldrin	ND	ND	ND	ND	ND	0.038	95
o, p'-DDD	ND	ND	ND	ND	ND	NS	
Endrin	ND	ND	ND	ND	ND	0.041	103
cis-nonachlor	ND	ND	ND	ND	ND	0.041	103
o, p'-DDT	ND	ND	ND	ND	ND	0.040	100
p, p'-DDD	ND	ND	ND	ND	ND	0.039	98
p, p'-DDT	ND	ND	ND	ND	ND	0.038	95
Mirex	ND	ND	ND	ND	0.01	0.14	100
OTHER:							
WEIGHT (g)	165	479	444	-	-	-	
MOISTURE (%)	92.5	45.6	28.2	-	50.0	50.0	
LIPID (%)	0.460	-	-	-	-	-	

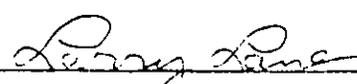
Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCBs
For Water, LLD= 0.005 ppm for OCs, Tox, PCBs.

*ND = None Detected

**Spike = 0.040 ppm for Sediment except

Mirex @ 0.14 ppm.

***NS = NOT Spiked

Signature 

SAMPLE TYPE: Mussels
and Sediment

CAT NO. 6335
REG. ID #: 90-5-051
ORDER NO. 85800-0-
6254

BOX CR
MISS. STATE, MS 39762
REPORT FORM
USD1/FWS

Date P.O. Recd 08/09/9
Date Spis Recd 10/23/9
Queue Date 12/20/9

ORGANOCHLORINES

PARTS PER MILLION AS RECEIVED (WET WT)

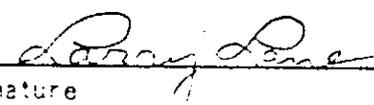
FWS #	Blank	Blank	Matrix Blank	Spike**	% Recovery		
LAB #	804173	804174	for	804175			
MATRIX	Reagent	Reagent	Fish	Fish			
COMPOUND							
HCB	ND*	ND	ND	0.066	66		
α-BHC	ND	ND	ND	NS***			
γ-BHC	ND	ND	ND	0.096	96		
β-BHC	ND	ND	ND	0.093	93		
δ-BHC	ND	ND	ND	NS			
Oxychlorane	ND	ND	ND	0.092	92		
Hept. Epox.	ND	ND	ND	0.10	100		
γ-Chlordane	ND	ND	ND	NS			
t-Nonachlor	ND	ND	ND	0.10	100		
Toxaphene	ND	ND	ND	NS			
PCB's (total)	ND	ND	ND	NS			
o, p'-DDE	ND	ND	ND	0.10	100		
α-Chlordane	ND	ND	0.01	0.078	78		
p, p'-DDE	ND	ND	0.02	0.095	95		
Dieldrin	ND	ND	0.01	0.081	81		
o, p'-DDD	ND	ND	ND	NS			
Endrin	ND	ND	ND	0.089	89		
cis-nonachlor	ND	ND	ND	0.097	97		
o, p'-DDT	ND	ND	ND	0.10	100		
p, p'-DDD	ND	ND	0.01	0.10	100		
p, p'-DDT	ND	ND	ND	0.10	100		
Mirex	ND	ND	ND	0.19	95		
OTHER:							
WEIGHT (g)	-	-	-	-			
MOISTURE (%)	-	-	71.0	68.0			
LIPID (%)	-	-	8.53	9.44			

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCBs
For Water, LLD= 0.005 ppm for OCs, Tox, PCBs.

*ND = None Detected

**Spike = 0.10 ppm for Fish except
Mirex @ 0.20 ppm.

***NS = Not Spiked

Signature 

SAMPLE TYPE: Mussels
and Sediment

CAT NO. 6335
REG. ID #: 90-5-051
ORDER NO. 85800-0-
6254

MISSISSIPPI STATE CHEMICAL LABORATORY
BOX CR
MISSISSIPPI STATE, MS 39762
REPORT FORM
USDI/FWS

Date P.O. Recd 08/09/90
Date Spis Recd 10/23/90
Queue Date 12/20/90

ORGANOCHLORINES (SUPPLEMENTAL)

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	ASH1-B	ASH1-Sa	ASH1-Sb	ASH2-B	ASH2-Sa	ASH2-Sb	ASH3-B
LAB #	804148	804149	804150	804151	804152	804153	804154
MATRIX	Mussel	Sediment	Sediment	Mussel	Sediment	Sediment	Mussel
COMPOUND							
Dicofol	ND*	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND	ND
8-Monohydromirex	ND	ND	ND	ND	ND	ND	ND
10-Monohydromire	ND	ND	ND	ND	ND	ND	ND
2,8-Dihydromirex	ND	ND	ND	ND	ND	ND	ND
(cis)5,10-Dihydromirex	ND	ND	ND	ND	ND	ND	ND
(trans)5,10-Dihydromirex	ND	ND	ND	ND	ND	ND	ND
OTHER:							
WEIGHT (g)	148	403	300	133	449	406	166
MOISTURE (%)	94.0	23.4	28.6	92.0	23.0	27.2	92.5
LIPID (%)	0.300	-	-	0.240	-	-	0.280

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCB
For Water, LLD= 0.005 ppm for OCs, Tox, PCBs.

**Spike = ppm for
= Confirmed by GC/Mass Spectrometry
*ND = None Detected
***NS = Not Spiked

Larry Lane
Signature

SAMPLE TYPE: Mussels
and Sediment

CAT NO. 6335
REG. ID #: 90-5-051
ORDER NO. 85800-0-
6254

BOX CR
MISSISSIPPI STATE, MS 39762
REPORT FORM
USDI/FWS

Date P.O. Recd 08/09,
Date Spis Recd 10/23,
Queue Date 12/20,

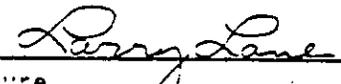
ORGANOCHLORINES (SUPPLEMENTAL)

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	ASH3-Sa	ASH3-Sb	ASH4-B	ASH4-Sa	ASH4-Sb	MILL	ASH5-
LAB #	804155	804156	804157	804158	804159	804160	804161
MATRIX	Sediment	Sediment	Mussel	Sediment	Sediment	Mussel	Sediment
COMPOUND							
Dicofol	ND*	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND	ND
8-Monohydromirex	ND	ND	ND	ND	ND	ND	ND
10-Monohydromirex	ND	ND	ND	ND	ND	ND	ND
2,8-Dihydromirex	ND	ND	ND	ND	ND	ND	ND
(cis)5,10-Dihydromirex	ND	ND	ND	ND	ND	ND	ND
(trans)5,10-Dihydromirex	ND	ND	ND	ND	ND	ND	ND
OTHER:							
WEIGHT (g)	457	286	151	569	293	173	283
MOISTURE (%)	14.6	28.2	93.0	30.0	26.0	92.0	71.0
LIPID (%)	-	-	0.320	-	-	0.380	-

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCBs.
For Water, LLD= 0.005 ppm for OCs, Tox, PCBs.

**Spike = ppm for
* = Confirmed by GC/Mass Spectrometry
*ND = None Detected
***NS = Not Spiked


Signature

SAMPLE TYPE: Mussels
and Sediment

CAT NO. 6335
REG. ID #: 90-5-051
ORDER NO. 85800-0-
6254

BOX CR
MISSISSIPPI STATE, MS 39762
REPORT FORM
USD1/FWS

Date P.O. Recd 08/09/90
Date Spis Recd 10/23/90
Queue Date 12/20/90

ORGANOCHLORINES (SUPPLEMENTAL)

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	ASH5-Sb	ASH6-B	ASH6-Sa	ASH6-Sb	ASH6-Sb	CT1-B	CT1-S
LAB #	804162	804163	804164	804165A	804165B	804166	804167
MATRIX	Sediment	Mussel	Sediment	Sediment	Duplicate Sediment	Mussel	Sediment
COMPOUND							
Dicofol	ND*	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND	ND
8-Monohydromirex	ND	ND	ND	ND	ND	ND	ND
10-Monohydromirex	ND	ND	ND	ND	ND	ND	ND
2,8-Dihydromirex	ND	ND	ND	ND	ND	ND	ND
(cis)5,10-Dihydromirex	ND	ND	ND	ND	ND	ND	ND
(trans)5,10-Dihydromirex	ND	ND	ND	ND	ND	ND	ND
OTHER:							
WEIGHT (g)	474	178	587	276	276	155	404
MOISTURE (%)	37.6	93.0	30.8	36.0	34.8	92.0	44.6
LIPID (%)	-	0.260	-	-	-	0.440	-

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCE
For Water, LLD= 0.005 ppm for OCs, Tox, PCBs.

**Spike = ppm for

* = Confirmed by GC/Mass Spectrometry

*ND = None Detected

***NS = Not Spiked

Larry Lane
Signature

SAMPLE TYPE: Mussels
and Sediment
CAT NO. 6335
REG.ID #: 90-5-051
ORDER NO. 85800-0-
6254

BOX CR
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REPORT FORM
USD1/FWS

Date P.O. Recd 08/09/90
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ORGANOCHLORINES (SUPPLEMENTAL)

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	CT2-B	CT2-S	MILL	Blank	Matrix Blank	Spike Level	Spike
LAB #	804168	804169	804170	804171	for		804172
MATRIX	Mussel	Sediment	Sediment	Reagent	Sediment	Sediment	Sediment
COMPOUND							
Dicofol	ND*	ND	ND	ND	ND	0.040	0.046
Endosulfan I	ND	ND	ND	ND	ND	0.010	0.010
Endosulfan II	ND	ND	ND	ND	ND	0.025	0.024
8-Monohydromirex	ND	ND	ND	ND	ND	0.10	0.10
10-Monohydromire	ND	ND	ND	ND	ND	0.10	0.10
2,8-Dihydromirex	ND	ND	ND	ND	ND	0.10	0.10
(cis)5,10-Dihydromirex	ND	ND	ND	ND	ND	0.10	0.10
(trans)5,10-Dihydromirex	ND	ND	ND	ND	ND	0.10	0.10
OTHER:							
WEIGHT (g)	165	479	444	-	-		-
MOISTURE (%)	92.5	45.6	28.2	-	50.0		50.0
LIPID (%)	0.460	-	-	-	-		-

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCS
For Water, LLD= 0.005 ppm for OCs, Tox, PCBs.
*ND = None Detected
***NS = Not Spiked

Larry Lane
Signature

SAMPLE TYPE: Mussels
and Sediment

CAT NO. 6335
REG. ID #: 90-5-051
ORDER NO. 85800-0-
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ORGANOCHLORINES (SUPPLEMENTAL)

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	% Recovery	Blank	Blank	Matrix Blank	Spike**	% Recovery	
LAB #		804173	804174	for	804175		
MATRIX		Reagent	Reagent	Fish	Fish		
COMPOUND							
Dicofol	115	ND*	ND	ND	0.095	95	
Endosulfan I	100	ND	ND	ND	0.038	95	
Endosulfan II	96	ND	ND	ND	0.10	100	
8-Monohydromirex	100	ND	ND	ND	0.10	100	
10-Monohydromirex	100	ND	ND	ND	0.10	100	
2,8-Dihydromirex	100	ND	ND	ND	0.098	98	
(cis)5,10-Dihydromirex	100	ND	ND	ND	0.091	91	
(trans)5,10-Dihydromirex	100	ND	ND	ND	0.11	110	
OTHER:							
WEIGHT (g)		-	-	-	-		
MOISTURE (%)		-	-	71.0	68.0		
LIPID (%)		-	-	8.53	9.44		

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCB
For Water, LLD= 0.005 ppm for OCs, Tox, PCBs.

*ND = None Detected

**Spike = 0.10 ppm for Fish except
Endo. I @ 0.04 ppm.

***NS = NOT Spiked

Larry Lane
Signature

Method 1. Analysis For Organochlorine Pesticides and PCBs In Animal and Plant Tissue.

Ten gram tissue samples are thoroughly mixed with anhydrous sodium sulfate and soxhlet extracted with hexane for seven hours. The extract is concentrated by rotary evaporation; transferred to a tared test tube, and further concentrated to dryness for lipid determination. The weighed lipid sample is dissolved in petroleum ether and extracted four times with acetonitrile saturated with petroleum ether. Residues are partitioned into petroleum ether which is washed, concentrated, and transferred to a glass chromatographic column containing 20 grams of Florisil. The column is eluted with 200 ml 6% diethyl ether/94% petroleum ether (Fraction I) followed by 200 ml 15% diethyl ether/85% petroleum ether (Fraction II). Fraction II is concentrated to appropriate volume for quantification of residues by packed or capillary column electron capture gas chromatography. Fraction I is concentrated and transferred to a Silicic acid chromatographic column for additional cleanup required for separation of PCBs from other organochlorines. Three fractions are eluted from the silicic acid column. Each is concentrated to appropriate volume for quantification of residues by packed or megabore column, electron capture gas chromatography. PCBs are found in Fraction II.

Method 2. Analysis For Organochlorine Pesticides and PCBs In Soil and Sediment.

Twenty-five gram soil or sediment samples are extracted with acetone followed by hexane, by allowing to soak one hour in each with intermittent shaking. The combined extracts are centrifuged and decanted into a separatory funnel containing sufficient water to facilitate partitioning of residues into hexane portion. The hexane is washed twice with water and concentrated to appropriate volume for transfer to a 1.6 gram Florisil mini-column topped with 1.6 grams sodium sulfate. Residues are eluted from the column in two elution fractions. Fraction I consists of 12 milliliters hexane followed by 12 milliliters of 1% methanol in hexane, and Fraction II consists of an additional 24 milliliters of 1% methanol in hexane. If additional cleanup is required to separate PCBs from other organochlorines in Fraction I, further chromatography on a Silicic acid column is performed. Quantification of residues in the two Florisil fractions and three Silicic acid fractions is by packed or megabore column, electron capture gas chromatography.

Elution Profiles for Florisil, Silica Gel and
Silicic Acid Column Separations

A. Florisil Column:

1. Fraction I (6% ethyl ether containing 2% ethanol, 94% petroleum ether)

HCB, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, oxychlordane, heptachlor epoxide, gamma-chlordane, trans-nonachlor, toxaphene, PCB's, o,p'-DDE, alpha-Chlordane, p,p'-DDE, p,p'-DDT, cis-nonachlor, o,p'-DDT, p,p'-DDD, p,p'-DDT, mirex, dicofol, endosulfan I (Split with FII).

2. Fraction II (15% ethyl ether containing 2% ethanol, 85% petroleum ether)

dieldrin, endrin, dacthal, endosulfan I (split with FI), endosulfan II (split with FIII), endosulfan sulfate (split with FIII).

3. Fraction III (50% ethyl ether containing 2% ethanol, 50% petroleum ether)

endosulfan II (split with FII), endosulfan sulfate (split with FII), malathion.

B. Florisil Mini-Column:

1. Fraction I (12 ml hexane followed by 12 ml 1% methanol in hexane)

HCB, gamma-BHC (25%), alpha-BHC (splits with FII), trans-nonachlor, o,p'-DDE, p,p'-DDE, o,p'-DDD, p,p'-DDD (splits with FII), o,p'-DDT, p,p'-DDT, mirex, cis-nonachlor, cis-chlordane, trans-chlordane, PCB's, Photomirex and derivatives.

2. Fraction II (24 ml 1% methanol in hexane)

gamma BHC (75%), beta-BHC, alpha-BHC (splits with FI), delta-BHC, oxychlordane, heptachlor epoxide, toxaphene, dicofol, dacthal, endosulfan I, endosulfan II, endosulfan sulfate, octachlorostyrene, Kepone (with additional 12mls 1% methanol in hexane).

C. Silica Gel:

1. SG Fraction I (100 ml petroleum ether)

n-dodecane, n-tridecane, n-tetradecane, cyclohexane, n-pentadecane, noncyclohexane, n-hexadecane, n-heptadecane, pristane, n-octadecane, phytane, n-nonadecane, n-eicosane.

2. SG Fraction II (100 ml 40% methylene chloride in petroleum ether followed by 50 ml methylene chloride)

napthalene, fluorene, phenanthrene, anthracene, fluoranthrene, pyrene, 1,2-benzanthracene, chrysene, benzo [b] fluoranthrene, benzo [k] fluoranthrene, benzo [e] pyrene, benzo [a] pyrene, 1,2:5,6-dibenzanthracene, benzo

[g,h,i] perylene.

D. Silicic Acid:

1. SA Fraction I (20 ml petroleum ether)
HCB, mirex
2. SA Fraction II (100ml petroleum ether)
PCB's, p,p'-DDE (splits with SA III)
3. SA Fraction III (20 ml mixed solvent: 1% acetonitrile,
80% methylene chloride, 19% hexane)
alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, oxychlordane,
heptachlor epoxide, gamma-chlordane, trans-chlordane,
toxaphene, o,p'-DDE, alpha-chlordane, p,p'-DDE (splits with
SAII), o,p'-DDT, cis-nonachlor, o,p'-DDT, p,p'-DDD,
p,p'-DDT, dicofol.

Appendix 2. Results of organophosphate and carbamate analyses of sediments and mussel tissue (*Elliptio complanata*) collected from the Ashuelot, Connecticut, and Mill Rivers in 1990.

U. S. FISH AND WILDLIFE SERVICE
PATUXENT WILDLIFE RESEARCH CENTER
ENVIRONMENTAL CONTAMINANTS RESEARCH BRANCH
QUALITY ASSURANCE REPORT

CATALOG: 6335

REGION: 5

REGIONAL ID: 90-5-051

These analyses were performed by the Patuxent Analytical Control Facility in conformance with the Environmental Contaminants Research Branch Quality Assurance Program.

The accuracy, as measured by spiked sample analyses was acceptable.

The precision, as measured by duplicate sample analyses, was acceptable for all analytes.

Clifford P. Rice 3-20-91
Quality Assurance Officer Date

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FISH & WILDLIFE SERVICE

MAR 25 1991

FISH & WILDLIFE ENHANCEMENT
CONCORD, N.H.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
PATUXENT WILDLIFE RESEARCH CENTER
LAUREL, MARYLAND 20708



Date 3-18-91

ANALYTICAL METHODOLOGY FOR ORGANOPHOSPHATE/CARBAMATE SCANNING

CN 6335

Matrix Tissue / Sediment

Sample Preparation Date 1-30-91

Summary: This method involves homogenization of the sample followed by mixing with acetone and methylene chloride to separate the pesticides from the tissue. The organic extract is filtered and adjusted to volume prior to gas chromatography using a flame photometric detector for organophosphate determinations and a nitrogen phosphorus detector for carbamate determinations. Megabore capillary columns are used for the GC separations.

Reference

Patuxent Wildlife Research Center, Analytical Chemistry Group SOP
Organophosphate/Carbamate Scanning Method (0-25.00). April 28, 1989.

ANALYST CERTIFICATION OF PROCESS

I certify that these analyses were performed according to the standard operating procedure as described by the method listed above.

There were no deviations _____.

Deviations were necessary .

Description and reasons for deviations: Due to large decrease in GC sensitivity for methomyl, it was deleted from report.

Craig J. Hulse
Analyst

Aquatic Wildlife Research Center
 Parent Analytical Control Facility
 Lab 11, Maryland 20706

ANALYTICAL REPORT

CAT #: 6335 GC column: 30m megabore: 7% cyanopropyl
 DATE: 03/18/91 7% phenyl polysiloxane for OPs:
 SUBMITTER: Kenneth Carr 5% phenyl methyl polysiloxane
 SUB I.D.#: 90-5-051 for carbamates

SAMPLE ID	SUBMITTER ID	IDENTIFICATION	Whole wt grams	Aliquot wt grams
1264	-	PROCEDURAL BLANK	-	-
1265	ASH1-B	MUSSEL TISSUE	-	10.28
1266	ASH2-B	MUSSEL TISSUE	-	10.01
1267	ASH3-B	MUSSEL TISSUE	-	10.23
1268	ASH4-B	MUSSEL TISSUE	-	10.75
1269	ASH5-B	MUSSEL TISSUE	-	10.51
1270	ASH5-B	DUPLICATE	-	10.18
1271	ASH6-B	MUSSEL TISSUE	-	10.06
1272	ASH6-B	OP/CARBAMATE SPIKE	-	10.00
1273	CT11-B	MUSSEL TISSUE	-	10.46
1274	CT12-B	MUSSEL TISSUE	-	10.06
1275	-	PROCEDURAL BLANK	-	-
1276	ASH1-Sa	SEDIMENT	-	10.07
1277	ASH1-Sb	SEDIMENT	-	10.09
1278	ASH2-Sa	SEDIMENT	-	10.07
1279	ASH2-Sa	DUPLICATE	-	10.07
1280	ASH2-Sb	SEDIMENT	-	10.36
1281	ASH3-Sa	SEDIMENT	-	10.13
1282	ASH3-Sa	OP/CARBAMATE SPIKE	-	10.25
1283	ASH3-Sb	SEDIMENT	-	10.13
1284	ASH4-Sa	SEDIMENT	-	10.04
1285	ASH4-Sb	SEDIMENT	-	10.03
1286	ASH5-Sa	SEDIMENT	-	10.14
1287	ASH5-Sb	SEDIMENT	-	10.26
1288	ASH6-Sa	SEDIMENT	-	10.15
1289	ASH6-Sb	SEDIMENT	-	10.13
1290	CT1-S	SEDIMENT	-	10.01
1291	CT2-S	SEDIMENT	-	10.08
1292	MIL1	SEDIMENT	-	10.10

CATALOG: 6732

ORGANOPHOSPHATE ANALYSES
(UG/G Wet Weight)

COMPOUND	1265	1266	1267	1268	1269	1271
Acephate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Azinphos-methyl	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos-dursban	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Coumaphos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Demeton	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorvos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dicrotophos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dimethoate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Disulfoton	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dursban	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
EPN	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethoprop	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Famphur	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fensulfothion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fenthion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Malathion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methamidophos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methyl Parathion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Mevinphos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Monocrotophos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phorate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Terbufos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorfon	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

CARBAMATE ANALYSES
(UG/G Wet Weight)

COMPOUND	1265	1266	1267	1268	1269	1271
Aldicarb	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbarvl	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbofuran	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Metidocarb	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Oxamyl	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Continued

CATALISE: 6838

ORGANOPHOSPHATE ANALYSES
(UG/G Wet Weight)

COMPOUND	1273	1274	1275	1277	1278	1280
Acetate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Azinphos-methyl	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos-dursban	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Coumaphos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Demeton	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorvos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dicrotophos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dimethoate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Disulfoton	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dursban	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
EPN	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethopros	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Famphur	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fensulfothion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fenthion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Malathion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methamidophos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methyl Parathion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Mevinphos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Monocrotophos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Paratnion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phorate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Terbufos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorfon	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

CARBAMATE ANALYSES
(UG/G Wet Weight)

COMPOUND	1273	1274	1275	1277	1278	1280
Aldicarb	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbaryl	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbofuran	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Metololant	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Oxamyl	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Continued

ORGANOPHOSPHATE ANALYSES

ORGANOPHOSPHATE ANALYSES
(UG/G Wet Weight)

COMPOUND	1281	1283	1284	1285	1286	1287
Acephate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Azinphos-methyl	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos-dursban	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Coumaphos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Demeton	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorvos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dicrotophos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dimethoate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Disulfoton	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dursban	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
EPN	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethoprop	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Famphur	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fensulfotion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fenthion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Malathion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methamidophos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methyl Parathion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Mevinphos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Monocrotophos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phorate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Terbufos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorfon	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

CARBAMATE ANALYSES
(UG/G Wet Weight)

COMPOUND	1281	1283	1284	1285	1286	1287
Aldicarb	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbarvl	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbofuran	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Methiocarb	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Oxamyl	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Continued

CATALOG: 8005

ORGANOPHOSPHATE ANALYSES
(UG/G Wet Weight)

COMPOUND	1288	1289	1290	1291	1292
Acephate	<0.5	<0.5	<0.5	<0.5	<0.5
Azinphos-methyl	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos-dursban	<0.5	<0.5	<0.5	<0.5	<0.5
Coumaphos	<0.5	<0.5	<0.5	<0.5	<0.5
Demeton	<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorvos	<0.5	<0.5	<0.5	<0.5	<0.5
Dicrotophos	<0.5	<0.5	<0.5	<0.5	<0.5
Dimethoate	<0.5	<0.5	<0.5	<0.5	<0.5
Disulfoton	<0.5	<0.5	<0.5	<0.5	<0.5
Dursban	<0.5	<0.5	<0.5	<0.5	<0.5
EPN	<0.5	<0.5	<0.5	<0.5	<0.5
Ethoprop	<0.5	<0.5	<0.5	<0.5	<0.5
Famphur	<0.5	<0.5	<0.5	<0.5	<0.5
Fensulfothion	<0.5	<0.5	<0.5	<0.5	<0.5
Fenthion	<0.5	<0.5	<0.5	<0.5	<0.5
Malathion	<0.5	<0.5	<0.5	<0.5	<0.5
Methamidophos	<0.5	<0.5	<0.5	<0.5	<0.5
Methyl Parathion	<0.5	<0.5	<0.5	<0.5	<0.5
Mevinphos	<0.5	<0.5	<0.5	<0.5	<0.5
Monocrotophos	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion	<0.5	<0.5	<0.5	<0.5	<0.5
Phorate	<0.5	<0.5	<0.5	<0.5	<0.5
Terbufos	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorfon	<0.5	<0.5	<0.5	<0.5	<0.5

CARBAMATE ANALYSES
(UG/G Wet Weight)

COMPOUND	1288	1289	1290	1291	1292
Aldicarb	<1.0	<1.0	<1.0	<1.0	<1.0
Carbaryl	<1.0	<1.0	<1.0	<1.0	<1.0
Carbofuran	<1.0	<1.0	<1.0	<1.0	<1.0
Methiocarb	<1.0	<1.0	<1.0	<1.0	<1.0
Oxamyl	<1.0	<1.0	<1.0	<1.0	<1.0

These analyses are qualitative: extraction parameters have not been optimized and recoveries have not been determined. Interpretation of data should be based on the qualitative presence of the compound(s) and not the reported concentrations. Compounds reported as "< detection limit" were not detected at that estimated limit, possibly due to poor method performance or major interferences with analyte in that sample matrix.

The nominal lower limit of reportable residue based on a 10 gram sample is 0.5 ppm wet weight for OPs and 1.0 ppm wet weight for carbamates.

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QUALITY ASSURANCE MONITORING
CARBAMATES

DATE: 03/18/91

CAT #: 6335

RECOVERIES

COMPOUND	Submit. #: ASHC-B Lab #: 1272			Submit. #: ASHC-Ea Lab #: 1282	
	Spike ug	Lab Value	% Recovery	Lab Value	% Recovery
Aldicarb	50.0	63.0	126.0	41.5	83.0
Carbarvl	50.0	45.0	90.0	42.0	84.0
Carbofuran	50.0	54.0	108.0	53.0	106.0
Methiocarb	50.0	49.0	98.0	53.0	106.0
Oxamyl	50.0	52.5	105.0	44.5	89.0

COMPOUND	DUPLICATES (UG/G Wet Weight)			BLANKS UG	
	1269 1270	1278 1279		1264	1275
Aldicarb	<1.0	<1.0		<10.0	<10.0
Carbarvl	<1.0	<1.0		<10.0	<10.0
Carbofuran	<1.0	<1.0		<10.0	<10.0
Methiocarb	<1.0	<1.0		<10.0	<10.0
Oxamyl	<1.0	<1.0		<10.0	<10.0

These analyses are qualitative; extraction parameters have not been optimized and recoveries have not been determined. Interpretation of data should be based on the qualitative presence of the compound(s) and not the reported concentrations. Compounds reported as "detection limit" were not detected at that estimated limit, possibly due to poor method performance or major interferences with analyte in that sample matrix.

The nominal lower limit of reportable residue is 0.5 ppm wet weight for OFs and 1.0 ppm wet weight for carbamates based on a 10 g sample.

Craig J. Harker
ANALYST

Craig J. Harker
CHIEF CHEMIST

